AMERICAN ASSOCIATION OF FELINE PRACTITIONERS

Anesthesia, Analgesia, & Surgery

American Association of FELINE PRACTITIONERS®

2021 CONFERENCE

PROCEEDINGS

September 30 – October 3, 2021

Phoenix Convention Center ▪ Phoenix, AZ

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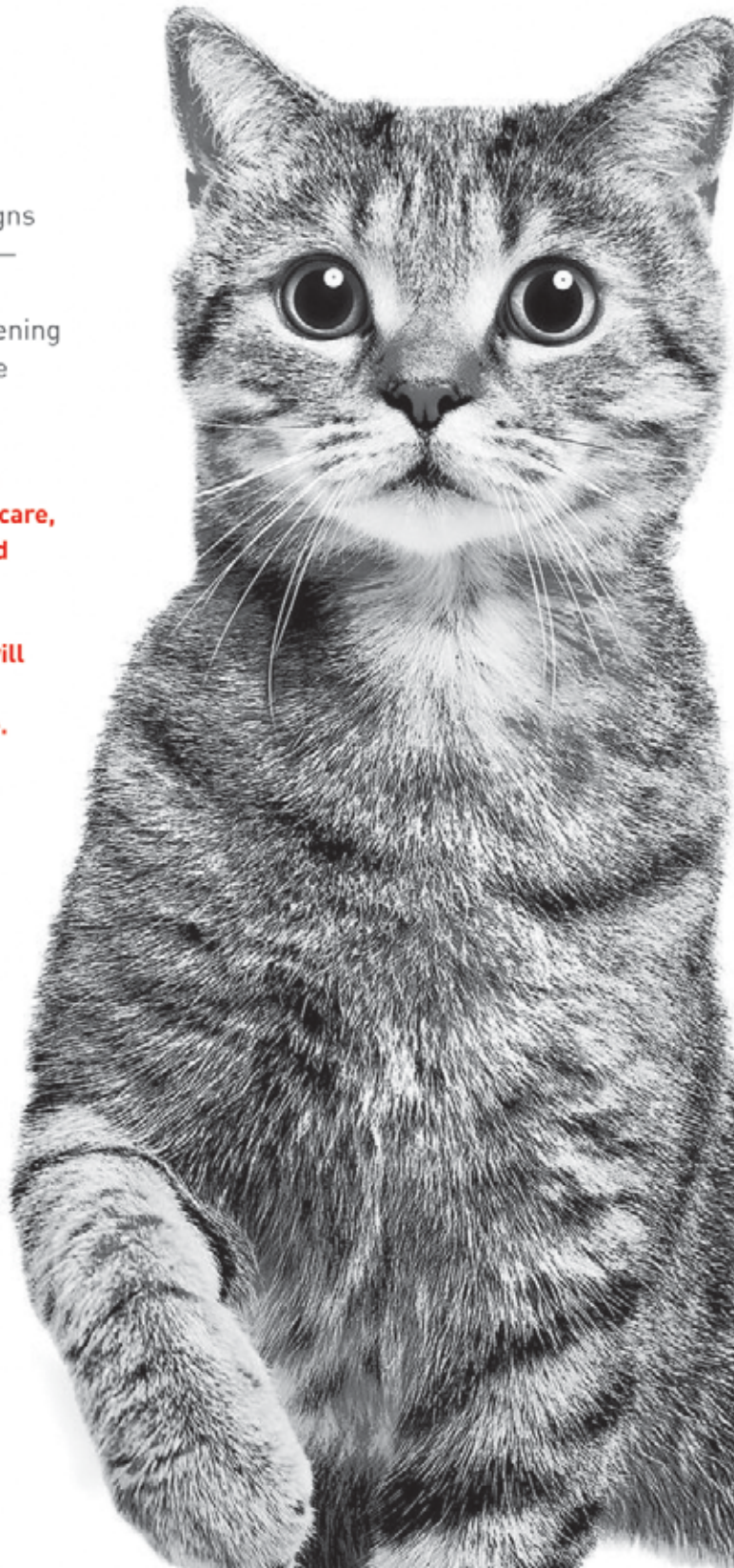

REFERENCE: 1. Forrester SD. 2004.

President's Welcome 2021

Welcome to the 2021 AAFP Annual Conference!

I am delighted to be able to welcome you in-person and virtually. Last year the AAFP and its members were exploring new territory in a fully virtual conference. With the amazing success of that virtual platform, and the ever-changing face of the pandemic (PIVOT!), we were able to plan and offer a hybrid event including both virtual and in-person options. We have put together the best of both worlds, something we probably never imagined possible in pre-pandemic days. That is pivoting at its finest, in my opinion!

This is my second annual conference as President of the AAFP, which is also an unprecedented event. This means that I have had a second opportunity to work with our wonderful Conference Task Force in the development of this year's conference, and that I get the pleasure of introducing the new President of the AAFP, Michelle Meyer.

Our conference theme this year is *Anesthesia, Analgesia & Surgery.* The Conference Task Force was very excited about this theme from the outset, and we had no shortage of enthusiasm and ideas. It turns out our biggest challenge was to fit so much great CE into a few days.

There is no question that the veterinary profession is becoming increasingly aware of feline pain and how to prevent, treat, and manage it. Our understanding of how pain negatively impacts the mental well-being of cats is unfolding. We are also advancing daily in the management of cats under anesthesia and enhancing our skills and abilities in feline surgery. This conference offers a one-stop shop for all of us to brush up on our knowledge, expand our understanding, and gain expertise in these critical areas.

Sessions on anesthesia and analgesia will include content such as peri-operative safety and pain management, local block techniques, orthopedic examination, identifying and managing osteoarthritis pain, maladaptive pain, anesthesia/analgesia for cats with endocrine comorbidities, beyond opioids and NSAIDs, euthanasia sedation protocols, and much more.

Surgical sessions will include anesthesia and surgery tips for common but sometimes tricky cases, visceral organ biopsy, wound management, perineal urethrostomy, managing feline ear polyps, and updates on feline chylothorax. Surgery of the gastrointestinal tract topics include surgery of the pancreas, liver and biliary system, subtotal colectomy, and colopexy.

As usual, we have a line-up of world class speakers who are ready to share this information with us. I am extremely pleased to have our opening speaker, Dr. Tamara Grubb, kick off our sessions with a discussion on 'The Intertwine of Fear and Pain: A Spinning Wheel with Implications for Cats and their Caregivers.' I can't think of a more suitable way to start this conference!

We also have our Pre-conference Day which will provide a myriad of additional feline topics such as feline behavioral needs, feline uroliths, Antimicrobial Use Guidelines, vaccination, diagnostics tests for infectious disease, and much more. For our in-person attendees, we hope you use this opportunity to connect with others passionate about feline medicine. And, don't forget, all attendees have access to live-streamed and on-demand CE until June 2022!

I would like to extend a huge thank you to the sponsors who have generously made this event - virtual and in person - a reality. Thank you to Royal Canin, Boehringer Ingelheim, Zoetis Petcare, Ceva, Elanco, Merck Animal Health, Idexx, Hill's Pet Nutrition, Purina Pro Plan Veterinary Diets, Dechra Veterinary Products, VetStem Biopharma, Sleepypod, and Morris Animal Foundation. A big thank you to our conference partners ABVP, EveryCAT, IAAHPC, IVAPM, and NAVTA.

We hope you will join us next year in Pittsburgh, PA from October 27 – 30, 2022 for our Annual Conference which is themed *Enriching Feline Care and the Veterinary Experience: Integrating and Improving Cat Friendly Techniques, Medicine, Environment, Interactions, Marketing, & Homes.*

Kelly A. St. Denis, MSc, DVM, ABVP (Feline)
2020-21 AAFP President

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American Association of Feline Practitioners
750 Route 202, Suite 200
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We would like to recognize and thank the following companies for their sponsorships.

Platinum Partnership Sponsor
Lunch & Learn with Speaker Dr. Jessica Markovich; Young Veterinarian Scholarship Program
Feline-Friendly Handling & Interactions: Evidence-based Techniques, Dr. Ilona Rodan

Platinum Partnership Sponsor
Welcome Reception; Two Lunch & Learns with Speakers Dr. Mark Acierno and Dr. Catharine Scott-Moncrieff; Conference Tote Bags and Giveaway

Diamond Partnership Sponsor
Exhibitor Happy Hour; Two Lunch & Learns with Speakers Dr. Eric Morissette and Dr. Elizabeth Colleran; Speaker Dr. Tamara Grubb; Speaker Dr. Duncan Lascelles; Speaker Dr. Kristin Shaw

Gold Partnership Sponsor
Pre-conference Day Early Morning Learning Sessions with Speakers Dr. Valarie Tynes and Dr. Natalie Marks
Feline-Friendly Handling & Interactions: Evidence-based Techniques, Dr. Ilona Rodan

Gold Partnership Sponsor
Offsite Event; Purrfecting Your Acute Pain Assessment Skills, Dr. Sheilah Robertson; Hotel Key Cards

Gold Partnership Sponsor
AAFP/ABVP Seminar and Social with Speaker Dr. Jane Sykes, Lunch & Learn with Speaker Dr. Robert Lavan; Conference Water Bottles

Gold Partnership Sponsor
Lunch & Learn with Speaker Dr. Guillermo Couto; Creating a Culture of Perioperative Safety in your Clinic, Drs. Sheilah Robertson & Bryden Stanley

Silver Partnership Sponsor
Food for Thought Luncheon with Speaker Dr. Jody Lulich; $5 Off Conference Discount Codes

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Lunch & Learn with Speaker Dr. Michael Lappin; Student Award Program

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Lunch & Learn with Speaker Dr. Brad Simon; Conference Wi-Fi in Convention Center; Notepad & Pen

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Lunch & Learn with Speaker Dr. Robert Harman

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Feline-Friendly Handling & Interactions: Evidence-based Techniques, Dr. Ilona Rodan

Conference Sponsor
Speaker Dr. Robin Downing

Conference Partners

THURSDAY, SEPTEMBER 30, 2021

Pre-conference Day

Schedule is in Mountain Standard Time (same as Pacific Daylight Time over these dates)

TIME	SESSION TITLE	SPEAKER	ROOM	SPONSOR/ PARTNER
PRE-CONFERENCE DAY*				
9:30 - 11:45 am	**Early Morning Learning Sessions**			
9:30 - 10:45 am	Providing for the Behavioral Needs of Each Cat LS	Dr. Valarie Tynes	North Ballroom AB	Ceva
10:50 - 11:45 am	The New Cat Parent: How to Exceed their Expectations for Feline Healthcare & Wellbeing LS	Dr. Natalie Marks	North Ballroom AB	Ceva
11:45 - 1:15 pm	**Food for Thought Luncheon**			
12:15 - 1:15 pm	To Cut or Not to Cut: Incorporating New Technologies & Avoiding the Pitfalls in the Treatment of Feline Uroliths LS	Dr. Jody Lulich	North Ballroom AB	Hills
1:30 - 5:30 pm	**ABVP/AAFP Seminar & Social**			MERCK Animal Health
1:30 - 2:20 pm	ISCAID Antimicrobial Use Guidelines: Which Antimicrobial, What Dose, & For How Long? LS	Dr. Jane Sykes	North Ballroom AB	ABVP
2:20 - 3:15 pm	Current Concepts in Feline Vaccination LS	Dr. Jane Sykes	North Ballroom AB	MERCK Animal Health, ABVP
3:15 - 3:45 pm	**Refreshment Break**		North Ballroom CD	
3:45 - 4:35 pm	Is a Positive Really Negative? Interpretation of Diagnostic Tests for Infectious Diseases LS	Dr. Jane Sykes	North Ballroom AB	MERCK Animal Health, ABVP
4:35 - 5:30 pm	Update on Feline Viral Infections: Pearls of Wisdom LS	Dr. Jane Sykes	North Ballroom AB	MERCK Animal Health, ABVP
5:30 - 7:00 pm	Welcome Reception *All attendees invited*		North Ballroom Foyer	Boehringer Ingelheim

*Pre-conference Day Registration Required. Additional fees apply.

Sessions and speakers are subject to change.

LS Live Streamed

FRIDAY, OCTOBER 1, 2021

Schedule is in Mountain Standard Time (same as Pacific Daylight Time over these dates)

TIME	SESSION TITLE	SPEAKER	ROOM	SPONSOR/ PARTNER
6:00 - 7:00 am	Early Riser Yoga Class*		Sheraton Hotel - Paradise Valley	
7:15 - 8:00 am	Continental Breakfast		North Ballroom Foyer	
8:00 - 8:15 am	President's Address LS	Dr. Kelly St. Denis	North Ballroom A - D	
8:15 - 9:15 am	The Intertwine of Fear & Pain: A Spinning Wheel with Implications for Cats & Their Caregivers LS	Dr. Tamara Grubb	North Ballroom A - D	ZOETIS PETCARE, IVAPM
9:15 - 10:45 am	Networking Refreshment Break		Exhibit Hall	
10:45 - 11:35 am	Purrfecting Your Acute Pain Assessment Skills LS	Dr. Sheilah Robertson	North Ballroom AB	Elanco
	Having the Nerve: Local Anesthetic Techniques You Should be Using - Part 1 LS	Dr. Mark Epstein	North Ballroom CD	Dechra, IVAPM
11:40 - 12:30 pm	A Pain Most Malicious: Understanding, Preventing, & Treating Maladaptive Pain LS	Dr. Tamara Grubb	North Ballroom AB	ZOETIS PETCARE, IVAPM
	Having the Nerve: Local Anesthetic Techniques You Should be Using - Part 2 LS	Dr. Mark Epstein	North Ballroom CD	Dechra, IVAPM
12:30 - 2:00 pm	Lunch		Exhibit Hall	
12:45 - 1:45 pm	*Lunch & Learn #1:** What the Guidelines Say on Identifying, Evaluating, & Managing Feline Hypertension	Dr. Mark Acierno	121A-C	Boehringer Ingelheim
12:45 - 1:45 pm	*Lunch & Learn #2:** What is Your Patient Telling You? Integrate All the Moving Parts	Dr. Guillermo Couto	122A-C	IDEXX
12:45 - 1:45 pm	*Lunch & Learn #3:** Don't Stress! Practical Management of Feline Lower Urinary Tract Disease	Dr. Jessica Markovich	124AB	ROYAL CANIN
12:45 - 1:45 pm	*Lunch & Learn #4:** Identifying & Treating Chronic OA Pain: Help is on the Way!	Dr. Elizabeth Colleran	126A-C	ZOETIS PETCARE
2:00 - 2:50 pm	I'm Old, Painful, & My Mouth Hurts: Dental & Other Protocols for Patients with Pre-existing Pain LS	Dr. Tamara Grubb	North Ballroom AB	ZOETIS PETCARE, IVAPM
	Feline Pain Management Beyond Opioids & NSAIDs: Part 1 LS	Dr. Mark Epstein	North Ballroom CD	IVAPM
2:55 - 3:45 pm	Anesthesia & Analgesia for Cats with Cardiac and/or Airway Comorbidities LS	Dr. Tamara Grubb	North Ballroom AB	ZOETIS PETCARE, IVAPM
	Feline Pain Management Beyond Opioids & NSAIDs: Part 2 LS	Dr. Mark Epstein	North Ballroom CD	IVAPM
3:45 - 4:40 pm	Networking Refreshment Break		Exhibit Hall	Elanco
4:40 - 5:30 pm	Anesthesia & Analgesia for Cats with Endocrine Comorbidities LS	Dr. Tamara Grubb	North Ballroom AB	ZOETIS PETCARE, IVAPM
	Is Your Anesthetized Patient in Trouble? LS	Dr. Sheilah Robertson	North Ballroom CD	
5:30 - 6:45 pm	Happy Hour Reception		Exhibit Hall	ZOETIS PETCARE

*Separate Registration Required. No fees associated.

LS Live Streamed

Anesthesia, Analgesia, & Surgery

Sept. 30 – Oct. 3, 2021
Phoenix Convention Center
Phoenix, AZ & Virtual

SATURDAY, OCTOBER 2, 2021

Schedule is in Mountain Standard Time (same as Pacific Daylight Time over these dates)

TIME	SESSION TITLE	SPEAKER	ROOM	SPONSOR/ PARTNER
6:00 - 7:00 am	Early Riser Yoga Class*		Sheraton Hotel - Paradise Valley	
7:00 - 8:00 am	Breakfast		Exhibit Hall	
8:00 - 9:00 am	The Whole Package: Anesthesia & Surgery Tips for Common but Sometimes Tricky Cases LS	Drs. Sheilah Robertson & Bryden Stanley	North Ballroom A - D	
9:05 - 10:00 am	Intestinal Anastomosis: Tips to Make it Easier LS NOD	Dr. Howard Seim	North Ballroom A - D	
10:00 - 11:00 am	Networking Refreshment Break		Exhibit Hall	
10:25 - 10:50 am	AAFP Membership Meeting LS		North Ballroom AB	
11:00 - 11:50 am	Making End of Life Decisions LS	Dr. Sheilah Robertson	North Ballroom AB	IAAHPC
	Visceral Organ Biopsy LS NOD	Dr. Howard Seim	North Ballroom CD	
11:55 - 12:45 pm	The Last Appointment: How to Navigate Smoothly Through Euthanasia Appointments LS	Dr. Sheilah Robertson	North Ballroom AB	IAAHPC
	Surgery of the Pancreas, Liver, & Biliary System LS NOD	Dr. Howard Seim	North Ballroom CD	
12:45 - 2:15 pm	Lunch		Exhibit Hall	
1:00 - 2:00 pm	*Lunch & Learn #1:** Monitoring the Difficult Diabetic Cat: Role of Continuous Glucose Monitoring	Dr. Catharine Scott-Moncrieff	121A-C	Boehringer Ingelheim
1:00 - 2:00 pm	*Lunch & Learn #2:** Enhancing Compliance & Reducing Stress: A Modern Perspective on Feline Parasite Protection	Dr. Robert Lavan	122A-C	MERCK Animal Health
1:00 - 2:00 pm	*Lunch & Learn #3:** Digital Cytopathology: Real-time Expert Help in Your Everyday Practice	Dr. Eric Morissette	124AB	ZOETIS PETCARE
2:15 - 3:05 pm	Creating a Culture of Perioperative Safety in your Clinic LS	Drs. Sheilah Robertson & Bryden Stanley	North Ballroom AB	IDEXX
2:15 - 2:40 pm	Wound Management Secrets LS NOD	Dr. Howard Seim	North Ballroom CD	
2:40 - 3:05 pm	Managing Feline Ear Polyps LS NOD	Dr. Howard Seim	North Ballroom CD	
3:10 - 4:00 pm	The Whole Package: Anesthesia & Surgery Tips for Common but Sometimes Tricky Cases in Kittens & Young Cats LS	Drs. Sheilah Robertson & Bryden Stanley	North Ballroom AB	
3:10 - 3:35 pm	Feline Subtotal Colectomy LS NOD	Dr. Howard Seim	North Ballroom CD	
3:35 - 4:00 pm	Colopexy for the Treatment of Recurrent Rectal Prolapse LS NOD	Dr. Howard Seim	North Ballroom CD	
4:05 - 4:25 pm	*Oral Abstract Session:* False Positive FeLV ELISA Results in Cats With Hemolytic Disease LS	Dr. Matthew Kornya	North Ballroom AB	
4:05 - 4:45 pm	Why Being a Cat Friendly Practice Matters		North Ballroom CD	Cat Friendly Practice
6:30 - 10:30 pm	A Feline Fete Offsite Event**			Elanco

*Separate Registration Required. No fees associated.
**Separate Registration Required. Additional fees apply.

Please Note: Dr. Seim's lectures will not be available on-demand after the in-person presentation or live-streaming for virtual attendees.

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NOD Not available On-demand

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References:

1. Data on file at Boehringer Ingelheim.
2. ProZinc® (protamine zinc recombinant human insulin) [Freedom of Information Summary]. Duluth, GA: Boehringer Ingelheim Animal Health USA, Inc.; 2019.
3. ProZinc® (protamine zinc recombinant human insulin) [Freedom of Information Summary]. St. Joseph, MO: Boehringer Ingelheim Vetmedica, Inc.; 2009.

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SUNDAY, OCTOBER 3, 2021

Schedule is in Mountain Standard Time (same as Pacific Daylight Time over these dates)

TIME	SESSION TITLE	SPEAKER	ROOM	SPONSOR / PARTNER
6:15 - 7:15 am	Early Riser Yoga Class*		Sheraton Hotel - Paradise Valley	
7:30 - 8:30 am	Breakfast		Exhibit Hall	
8:30 - 9:20 am	Detecting, Diagnosing, & Monitoring Feline OA Pain: A Practical Approach LS	Dr. Duncan Lascelles	North Ballroom A - D	ZOETIS PETCARE EveryCAT
9:25 - 10:15 am	NSAIDs for Chronic Pain Control in Cats: An Update LS	Dr. Duncan Lascelles	North Ballroom A - D	ZOETIS PETCARE IVAPM
10:15 - 10:45 am	Networking Refreshment Break		Exhibit Hall	
10:45 - 11:35 am	How to Perform a Successful Orthopedic Examination LS	Dr. Duncan Lascelles	North Ballroom AB	ZOETIS PETCARE IVAPM
	Perineal Urethrostomy & Other Options in Cats with FUS LS	Dr. Bryden Stanley	North Ballroom CD	
11:40 - 12:30 pm	Anti-NGF mAbs for Chronic Pain Control: The Science LS	Dr. Duncan Lascelles	North Ballroom AB	ZOETIS PETCARE IVAPM
	Revisiting Halsted's Principles (But Not His Habits!): Tips to Better Surgery LS	Dr. Bryden Stanley	North Ballroom CD	
12:30 - 1:45 pm	Lunch		Exhibit Hall	
12:40 - 1:40 pm	*Lunch & Learn #1:** Update on the Management of Stress Associated Illness in Cats	Dr. Michael Lappin	121A-C	Purina Pro Plan Veterinary Diets
12:40 - 1:40 pm	*Lunch & Learn #2:** Procedural Sedation & Analgesia in the Cat	Dr. Brad Simon	122A-C	Dechra
12:40 - 1:40 pm	*Lunch & Learn #3:** Stem Cell Therapy in the Domestic & Exotic Feline: Could This be the Answer to Your Difficult Cases?	Dr. Robert Harman	124AB	VetStem Biopharma
1:45 - 2:35 pm	Anti-NGF mAbs for Chronic Pain Control: The Evidence LS	Dr. Duncan Lascelles	North Ballroom AB	ZOETIS PETCARE IVAPM
	Chylothorax: An Update LS	Dr. Bryden Stanley	North Ballroom CD	
2:40 - 3:30 pm	Wearables for Diagnosis & Monitoring of Pain: Where Are We? LS	Dr. Duncan Lascelles	North Ballroom AB	ZOETIS PETCARE IVAPM
	Atypical Cutaneous Infections in Cats LS	Dr. Bryden Stanley	North Ballroom CD	
3:30 pm	End of Meeting			

*Separate Registration Required. No fees associated.

LS Live Streamed

The additional CE Sessions below will be available via on-demand access through the Virtual Platform. Both in-person and virtual attendees will have access to these CE Sessions.

On-demand Sessions

SESSION TITLE	SPEAKER	SPONSOR/PARTNER
Environmental Needs for Cats with DJD: Preserve Access to Promote Comfort	Dr. Margaret Gruen	IVAPM
Feline-Friendly Handling & Interactions: Evidence-based Techniques	Dr. Ilona Rodan	Ceva, Royal Canin, sleepypod
Hands-Free Radiology: Strategy, Training, & Implementation Ideas	Dr. Dennis Keith & Ms. Carolyn Spivock	
What About Cats? Rehabilitation Techniques for Feline Patients	Dr. Kristin Shaw	Zoetis Petcare
Cats Gotta Scratch: The Case Against Feline P3 Amputation	Dr. Robin Downing	IVAPM, Morris Animal Foundation
Managing Chronic Pain Following P3 Amputation	Dr. Robin Downing	IVAPM, Morris Animal Foundation
Oral Abstract - Feline Histoplasmosis: Serology as a Non-Invasive Diagnostic Alternative	Dr. Mariana Jardim	

On-demand Technician/Nurse Sessions

SESSION TITLE	SPEAKER	SPONSOR/PARTNER
Management of the Emergent Feline Patient	Mr. Harold Davis	NAVTA
Nursing Management of the Urinary Obstructed Cat	Mr. Harold Davis	NAVTA
Anesthetic Monitors: Understanding Their Use & Limitations	Ms. Heidi Reuss-Lamky	NAVTA
Who Needs an Anesthetic Plan? YOU DO!	Ms. Heidi Reuss-Lamky	NAVTA
Purr-fect Feline Anesthesia	Ms. Heidi Reuss-Lamky	NAVTA
Anesthesia Mistakes Awareness	Ms. Heidi Reuss-Lamky	NAVTA
Pain Scoring for Dummies	Ms. Heidi Reuss-Lamky	NAVTA
Detecting Feline Chronic Pain	Ms. Alison Gottlieb	NAVTA
Treatment of Chronic Pain	Ms. Alison Gottlieb	NAVTA
Feline Chronic Pain: Getting Cat Owners on Board	Ms. Alison Gottlieb	NAVTA
Feline Nursing Care for the Hospitalized Patient	Ms. Alison Gottlieb	NAVTA

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Mark Acierno, DVM, MBA, DACVIM

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Animal Health Institute at Midwestern University, Downers Grove, Illinois

Dr. Mark J. Acierno is a professor of small animal internal medicine at the Animal Health Institute at Midwestern University. He earned his veterinary degree at Mississippi State University and completed his internal medicine residency at Tufts University. He also holds an MBA from Pace University. Dr. Acierno is a Diplomate of the American College of Veterinary Internal Medicine in small animal internal medicine. His clinical interests include kidney disease, hypertension, interventional radiology, immunemediated disease, and dialysis medicine.

Elizabeth Colleran, DVM, MS, DABVP (Feline)

Sponsor ZOETIS PETCARE

Chico Hospital for Cats, Chico, California

Dr. Colleran is an author, keynote, and veterinary conference speaker, consultant, and feline specialist board-certified by the American Board of Veterinary Practitioners. She has successfully created and managed two feline medicine veterinary practices. Her practice in Portland, Oregon was the first feline-only practice in Portland and her current practice, the Chico Hospital for Cats, is celebrating its 22nd birthday this year. Dr. Colleran chairs the Cat Friendly Practice Committee for the AAFP. She has served on the AAFP board for several years including as President in 2011 and Treasurer from 2007-2009. She serves her profession as a volunteer for other veterinary organizations. Dr. Colleran is a published author and frequent contributor to several peer-reviewed publications. She has been a media spokesperson on a number of feline topics for communications campaigns and has proudly mentored many aspiring feline practitioners. Her next book for veterinarians, "The Senior Cat: Medicine and Management in the Golden Years" (working title) will be published in 2021. She loves teaching and believes it is one important way to improve health care and quality of life for felines.

C. Guillermo Couto, DVM, DACVIM

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Couto Veterinary Consultants, Hilliard, Ohio

Dr. Couto graduated from Buenos Aires University, Argentina in 1976. He spent 5 years as a private practice small animal practitioner in his home town, and then completed a Clinical Oncology Residency at the University of California-Davis. He is co-author of the textbook *Small Animal Internal Medicine* with Richard W. Nelson, and has over 350 peer-reviewed articles and book chapters in the areas of oncology, hematology, and Greyhound medicine. Dr. Couto served as Editor In Chief of the Journal of Veterinary Internal Medicine, and received numerous teaching and service awards while at the University. After 30 years in academia, he is now providing consultation and educational services through Couto Veterinary Consultants in Hilliard, Ohio.

Harold Davis, RVT, VTS (ECC) (Anesthesia/Analgesia)

Partner NAVTA

Davis Veterinary Practice Educational Consulting, Davis, California

Harold Davis is a veterinary practice educational consultant and the former Manager of the Emergency and Critical Care Service at the UC Davis William R Pritchard Veterinary Medical Teaching Hospital. He is a co-founder of the Academy of Veterinary Emergency and Critical Care Technicians and a charter member of Academy of Veterinary Technicians in Anesthesia and Analgesia. He is the past president of the Veterinary Emergency and Critical Care Society. Harold is the first non-veterinarian elected to this position of this 5000 plus member organization. He currently serves as President-elect on the Board of Directors for the North American Veterinary Community. In addition, he is a Treasurer of the Board of Directors for the National Association of Veterinary Technicians in America. Harold is the recipient of many awards and honors; most recently the 2020 Continuing Educator of the Year Award - Veterinary Technician at the Western Veterinary Conference in Las Vegas, Nevada. He is an international speaker haven spoken in 12 countries, and at least 8 times in Australia; four times for the VNCA Annual Conference. In addition, he has published several book chapters, journal articles, and is currently working on the second edition of his co-edited book entitled *Advanced Monitoring and Procedures for Small Animal Emergency and Critical Care.*

Robin Downing, DVM, MS, DAAPM, DACVSMR, CVPP, CCRP

Sponsor Morris Animal Foundation Partner IVAPM

The Downing Center for Animal Pain Management, LLC, Windsor, Colorado

Dr. Downing is Hospital Director of The Downing Center for Animal Pain Management. She has received many regional, national, and international awards, including the 2001 Excellence in Veterinary Medicine Award from the WSAVA, the 2016 Erwin Small Distinguished Alumni Award from the University of Illinois College of Veterinary Medicine, and most recently the 2020 Leo K. Bustad Companion Animal Veterinarian of the Year Award from the AVMA. Dr. Downing is a Diplomate of the ACVSMR, a Certified Veterinary Pain Practitioner, and was the third veterinarian in the world to earn the Diplomate credential in the American Academy of Pain Management. She was a founder of the International Veterinary Academy of Pain Management, and served as that organization's second President. She has served as President of the American Association of Human-Animal Bond Veterinarians (now called the Human-Animal Bond Association). Dr. Downing is an internationally sought-after speaker on a wide variety of topics including pain management, physical rehabilitation, physical medicine, hospice/end-of-life care, anesthesia related topics, and overcoming compliance obstacles/issues in veterinary medicine. In 2016 she completed her MS in Clinical Bioethics from the Icahn School of Medicine at Mount Sinai in NYC and Union Graduate College with the intention of translating the practices of clinical bioethics for application in veterinary medicine. This commitment includes framing the imperatives of the Fear Free movement, as well as comprehensive acute and chronic pain management, as obligations grounded in bioethical principles. She is now completing a Doctorate in Clinical Bioethics at Loyola University of Chicago. The Downing Center for Animal Pain Management was also the first Gold Cat Friendly Practice (CFP) in Colorado and Dr. Downing is a huge advocate for the CFP Program.

Mark Epstein, DVM, DABVP, CVPP

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TotalBond Veterinary Hospitals, PC, Gastonia, North Carolina

Dr. Epstein received his DVM from University of Georgia and is the Senior Partner and Medical Director of TotalBond Veterinary Hospitals and Carolinas Animal Pain Management, a small group of AAHA-accredited practices in the Charlotte and Gastonia, North Carolina area that received the Small Business of the Year Award from the Gaston Regional Chamber of Commerce in 2015. He is a Diplomate of the American Board of Veterinary Practitioners (Canine/Feline) and is a past-president of ABVP. He is certified by the Academy of Integrative Pain Management (AIPM), is recognized as a Certified Veterinary Pain Practitioner (CVPP) by the International Veterinary Academy of Pain Management, and is a past-president of IVAPM; he is currently President of the IVAPM Research & Scholarship Foundation. Dr. Epstein chaired the AAHA Senior Care Guidelines Task Force and co-chaired the 2015 AAHA/AAFP Pain Management Guidelines Task Force. He is published in journals and textbooks and is a national and international lecturer on the recognition, prevention, and treatment of pain in the veterinary clinical setting.

Alison Gottlieb, BS, CVT, VTS (ECC)

Partner NAVTA

CROWN Veterinary Specialist, Feasterville, Pennsylvania

Alison graduated from Towson State University with a bachelor's degree in Animal Behavior. She earned certification in emergency and critical care in 2000. Alison has served on the board of AVECCT as a member at large and on the application committee. Alison is the Co-founder/Owner of Four Paws Consulting LLC, an education based veterinary consultant. She is an active member of AAFP and ISFM. Over the years Alison has published many feline articles, frequently on pain; as well as authored a chapter on pain in the ICU. Alison has lectured extensively with Australia and New Zealand being amongst her favorites. Currently Ali is the Education Coordinator at CROWN in New Jersey and resides in Bucks County, Pennsylvania. Her favorite topics/areas are anything feline, osteoarthritis, analgesia, and low stress handling. In the clinic you can usually find Alison giving the patients cat nip and feeding cats. She spends most of her free time outside with her pit bull and her cats.

Tamara Grubb, DVM, PhD, DACVAA

Sponsor ZOETIS PETCARE Partner IVAPM

Washington State University, Uniontown, Washington

Dr. Grubb is a Diplomate of the American College of Veterinary Anesthesia & Analgesia with a strong focus in pain management. Dr. Grubb is a graduate of Texas A&M College of Veterinary Medicine. She is an Adjunct Professor of Veterinary Anesthesia & Analgesia at Washington State University and owns an anesthesia and pain management consulting and continuing education company, which serves both small and large animal practices. She is a member of the Board of Directors for the International Veterinary Academy of Pain Management, is a national/international educator and lecturer, and co-author of two books and over 100 articles. Dr. Grubb's favorite achievement is winning the Carl J. Norden Distinguished Teaching Award from students at both Oregon and Washington State Universities.

Margaret Gruen, DVM, MVPH, PhD, DACVB

Partner IVAPM

North Carolina State University College of Veterinary Medicine, Raleigh, North Carolina

Dr. Gruen completed her veterinary degree at the University of Illinois. She then went to North Carolina State University for an internship followed by a residency in veterinary behavior. She completed a Masters in Veterinary Public Health and became a board-certified veterinary behaviorist. After a few years on the faculty at NCSU, she decided to pursue a PhD with a focus on understanding the behaviors associated with pain in cats with naturally-occurring arthritis. She then spent two years at Duke University, where she co-directed the Canine Cognition Center, and has since returned to North Carolina State University as an Assistant Professor of Behavioral Medicine.

Robert Harman, DVM, MPVM

Sponsor VetStem BIOPHARMA

VetStem Biopharma, Poway, California

Dr. Harman founded and is the CEO of VetStem Biopharma, the first US-based commercial veterinary stem cell company. For 15 years prior to that, he was the CEO of HTI-Bio-Services, a preclinical research company for veterinary and human pharmaceutical development. He has authored more than 500 contract study reports for animal health companies throughout the world and for submission to the FDA and USDA in support of the development of new animal and human health products. In his current position, he is the CEO and Chief Scientific Officer of the programs at VetStem to bring stem cell therapy to veterinary medicine. He has been a frequent speaker at stem cell conferences in North America, Central America, Europe, and the Middle East. He has authored numerous peer-reviewed publications on stem cell therapy. Dr. Harman received his Doctor of Veterinary Medicine and Master's in Epidemiology from the University of California, Davis.

Dennis Keith, DVM, DACVR

VCA Inc., Mesa, Arizona

Dr. Keith is a graduate of the University of Arizona and Colorado State University. After time in private practice, he completed his radiology residency at the University of Pennsylvania. He then spent a year on faculty teaching small animal abdominal radiology during the core rotations, studying CT, and formulating the scan protocols for the implementation of a new scanner at the university, as well as a busy clinical caseload. He served as the Medical Director of VCA Animal Referral and Emergency Center of Arizona until 2017, where he included radioiodine therapy as an important part of his clinical practice. He has spoken internationally on the topics of Diagnostic Imaging in Emergencies, Clinical CT, and 3D Imaging Techniques. In 2017 Dr. Keith was asked to take on more responsibility and is now the VCA Regional Medical Director for Arizona, Utah, New Mexico, Nevada, and the San Diego region of California. Hands-free radiology is important in our industry for many reasons, including staff safety, patient safety, quality imaging, and minimizing patient anxiety and fear.

Michael Lappin, DVM, PhD, DACVIM

Sponsor PURINA PRO PLAN VETERINARY DIETS

Small Animal Clinical Veterinary Medicine, Colorado State University, Fort Collins, Colorado

Dr. Lappin graduated from Oklahoma State University and then completed an internship, internal medicine residency, and PhD program in Parasitology at the University of Georgia. Dr. Lappin is the Kenneth W. Smith Professor in Small Animal Clinical Veterinary Medicine at Colorado State University, is the director of the "Center for Companion Animal Studies" and he helps direct the shelter medicine program. He is the chair of the WSAVA One Health Committee. His principal areas of interest are prevention of infectious diseases, the upper respiratory disease complex, infectious causes of fever, infectious causes of diarrhea, and zoonoses. His research group has published over 300 primary papers or book chapters concerning small animal infectious diseases. Awards include the Norden Distinguished Teaching Award, NAVC Small Animal Speaker of the Year, the European Society of Feline Medicine International Award for Outstanding Contribution to Feline Medicine, the Winn Feline Research Award, the ACVIM Robert W. Kirk Award for Professional Excellence, the WSAVA Scientific Achievement Award, and the AVMA Clinical Research Award.

Duncan Lascelles, BSc, BVSc, CVA, PhD, FRCVS, DSAS(ST), DECVS, DACVS

Sponsor ZOETIS PETCARE Partners IVAPM EveryCAT HEALTH FOUNDATION

North Carolina State University, Raleigh, North Carolina

After graduating from the veterinary program at the University of Bristol, UK with honors in 1991, Dr. Lascelles completed a PhD in aspects of pre-emptive/perioperative analgesia at the University of Bristol. After an internship, he completed his surgical residency at the University of Cambridge, UK. He moved to Colorado for the Fellowship in Oncological Surgery at Colorado State University. He is currently Professor in Small Animal Surgery and Pain Management at North Carolina State University. He is board-certified in small animal surgery by the Royal College of Veterinary Surgeons, the European College of Veterinary Surgeons, and the American College of Veterinary Surgeons. He is director of the Comparative Pain Research and Education Centre (CPREC). His research program (Translational Research in Pain [TRiP]) is dedicated to answering critical questions about pain control and pain mechanisms through high quality, innovative research. His career has been focused on developing algometry methods (methods to measure pain) in spontaneous disease animal models (pets with naturally occurring disease), and probing tissues from well-phenotyped animals with spontaneous disease to understand the neurobiology, with a strong translational focus. The aim of his research is to improve pain control in companion animals, and facilitate analgesic development in human medicine. He has authored over 200 peer-reviewed research papers and reviews, 350 research abstracts, and over 30 book chapters. He is co-founder of AniV8, a company dedicated to developing innovative methods of measuring pain.

Robert Lavan, MS, MPVM, DVM, DACVPM

Sponsor MERCK Animal Health

Merck Animal Health, Perkasie, Pennsylvania

Bob Lavan is the Director of the Merck Animal Health Center for Observational and Real-World Evidence (CORE). He is a graduate of the State University of NY at Albany (BS, MS) and the School of Veterinary Medicine at the University of California at Davis (MPVM, DVM) and is an ACVPM Diplomate. With a focus in Outcomes Research across animal health, Bob looks for ways to understand the full value of current therapies for pets, pet owners, veterinarians, and their staff. Bob resides near Philadelphia with his wife (a small animal clinician), three adult children, two dogs, and two cats.

Jody Lulich, DVM, PhD, DACVIM

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University of Minnesota, Roseville, Minnesota

Dr. Lulich holds the academic rank of professor at the University of Minnesota. He is a Diplomate in the American College of Veterinary Internal Medicine. He is the director of the Minnesota Urolith Center and specializes in nephrology and urology. He has earned an international reputation as a clinical investigator and educator in this field. Research interests include the etiopathogenesis, epidemiology, genetic causes, comorbidities, and treatments of urolithiasis in animals. Among his contributions to veterinary medicine is the technique of voiding urohydropropulsion, a nonsurgical method to remove uroliths from the urinary bladder. In 2007, he was voted as Speaker of the Year at the North American Veterinary Conference held in Orlando, Florida. He was awarded the Norden-Pfizer-Zoetis Distinguished Teacher Award in 2001 & 2013. Dr. Lulich currently holds the endowed Hills/Osborne Chair in Nephrology and Urology at the University of Minnesota.

Jessica Markovich, DVM, DACVIM, DACVN

Sponsor ROYAL CANIN

VCA Valley Animal Hospital & Emergency Center, Tucson, Arizona

Dr. Markovich is a graduate of Ross University School of Veterinary Medicine, Class of 2008. After her rotating small animal internship, Dr. Markovich completed both a residency in small animal internal medicine and a residency in small animal clinical nutrition at the Tufts Cummings School of Veterinary Medicine. Dr. Markovich is board certified as a Diplomate of the American College of Veterinary Internal Medicine and as a Diplomate of the American College of Veterinary Nutrition. She is in clinical practice at VCA Valley Animal Hospital and Emergency Center in Tucson, Arizona. She enjoys working with pet owners to demystify decisions regarding the best diet for their pets with a variety of special dietary needs. Her special interests include feline medicine, infectious disease, interventional radiology, urinary disease, and nutritional management of chronic kidney disease.

Natalie Marks, DVM, CVJ

Sponsor Ceva

VCA Blum Animal Hospital, Chicago, Illinois

Dr. Marks obtained her bachelor's degree with High Honors in Animal Science from the University of Illinois in 1998, and then proceeded to obtain a Masters in Veterinary Medicine and Doctorate of Veterinary Medicine degree with High Honors from the University of Illinois College of Veterinary Medicine. She became a Certified Veterinary Journalist in 2018. She has been a veterinarian at Blum Animal Hospital since 2006, co-owner until 2018, and current Medical Director. Prior to 2006, Dr. Marks worked at a small animal practice just north of Atlanta, GA. Her media experience began in print when she created several monthly veterinary columns in multiple community magazines and was a frequent guest speaker for the German Shepherd and Bernese Mountain Dog clubs of Atlanta. Upon her return to Chicago, Dr. Marks became very active in the Chicago Veterinary Medical Association, serving on the executive board. She was also a past board member of the Illinois State Veterinary Medical Association and an active volunteer to the American Veterinary Medical Association and American Animal Hospital Association. Dr. Marks received the prestigious Dr. Erwin Small First Decade Award, presented to a veterinarian that has contributed the most to organized veterinary medicine in his or her first decade of practice. In 2012, Dr. Marks was awarded Petplan's nationally-recognized Veterinarian of the Year. In 2015, she was awarded America's Favorite Veterinarian by the American Veterinary Medical Foundation. And, most recently in 2017, she was awarded Nobivac's Veterinarian of the Year for her work on canine Influenza.

Eric Morissette, DVM, DACVP (Clinical)

Sponsor ZOETIS PETCARE

Zoetis, Fort Collins, Colorado

Dr. Morissette began his academic career at the University of Montreal, where he earned a Bachelor of Biology in 1994. After finishing this program, he continued at the University of Montreal and earned a Doctorate in Veterinary Medicine in 1998. In 2006, with his veterinary practice career in full swing, Dr. Morissette decided to further his education and training. He followed his passion and entered the Veterinary Clinical Pathology Program at the University of Florida, where he completed his residency and passed boards in 2009, granting him the title of Diplomate of the American College of Veterinary Pathologist (ACVP). After becoming a Board Certified Veterinary Clinical Pathologist, Dr. Morissette provided clinical pathology consultation services for Abaxis for 11 years and recently joined the Zoetis Global Diagnostics team. During that time, he has been involved in various research projects and teaching opportunities around the world.

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Heidi Reuss-Lamky, LVT, VTS (Anesthesia/Analgesia, Surgery), FFECP

Partner NAVTA

Oakland Veterinary Referral Services, Clinton Township, Michigan

Heidi Reuss-Lamky graduated from Michigan State University's Veterinary Technology Program in 1984. She has extensive experience in general practice, and since 1993 has devoted her technical expertise to the surgical department of specialty hospitals. She has been affiliated with Oakland Veterinary Referral Services in Bloomfield Hills, Michigan, since 2006. Heidi became certified through the Academy of Veterinary Technicians in Anesthesia and Analgesia in 2003, and sat on the credentials committee from 2005 to 2009. She served as president of the Michigan Association of Veterinary Technicians from 2007 to 2009. She was a member of the editorial review board for Today's Veterinary Nurse Journal from 2015 to 2020. She was also a charter member of the Academy of Veterinary Surgical Technicians, and currently sits on the executive board. She has a special interest in veterinary behavior medicine and achieved Fear Free Elite status in 2020. Heidi is an ardent advocate for the veterinary technology profession, and serves as a consultant for many allied veterinary industries. She is also a member of the National Association of Veterinary Technicians in America Committee on Veterinary Technician Specialties. Heidi is a prolific author and lecturer, presenting anesthesia, surgical nursing, surgical instrument sterilization, and Fear Free-related topics at veterinary meetings worldwide. She most recently published "Locoregional Anesthesia for Small Animal Patients" in Today's Veterinary Nurse Journal (formerly Today's Veterinary Technician Journal), (Summer 2020). She was also honored to receive the 2013 NAVC Dr. Jack L. Mara Memorial Lecturer award.

Sheilah Robertson, BVMS (Hons), PhD, DACVAA, DECVAA, DACAW, DECAWBM (WSEL)

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Lap of Love Veterinary Hospice, Gaineville, Florida

Dr. Robertson graduated from the University of Glasgow in Scotland. She spent time as a surgery intern followed by specialized training in anesthesia including a PhD at Bristol University (United Kingdom). She is board certified in anesthesia and in animal welfare in the USA and Europe and holds a certificate in small animal acupuncture. She has been a faculty member at the University of Saskatchewan, Michigan State University, and the University of Florida. She spent 2 years as an assistant director in the division of Animal Welfare at the American Veterinary Medical Association. In 2014 she completed her graduate certificate in Shelter Medicine at the University of Florida. In 2019 she received her certification as a Traditional Chinese Veterinary Medicine Palliative and End-of-Life practitioner by the Chi Institute of Chinese Medicine. She has published widely on the recognition and alleviation of acute pain in cats. Currently she is the senior medical director of Lap of Love Veterinary Hospice, a large network of veterinarians dedicated to end-of-life care and in-home euthanasia throughout the USA. Dr Robertson is also a courtesy Professor in the Department of Small Animal Clinical Sciences, University of Florida, Gainesville, Florida. She continues to volunteer at community cat clinics and High-Volume High Quality Spay and Neuter Programs.

Ilona Rodan, DVM, DABVP (Feline), CCBC, IABC

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Cat Behavior Solutions, LLC, Madison, Wisconsin

Dr. Rodan is ABVP certified in feline practice since 1995. Her passion is feline behavior and how to handle cats in veterinary practices to enhance feline welfare and human safety. She is the owner and director of Cat Behavior Consultations, LLC and the former medical director and owner of the Cat Care Clinic in Madison, Wisconsin from 1987-2015. Dr. Rodan is an active volunteer of the American Association of Feline Practitioners, a past-president, and former chair of the AAFP Cat Friendly Practice Program. She has also co-chaired several guidelines and welfare position statements, including the Feline-Friendly Handling, Feline Environmental Needs, and Pain Management Guidelines. She presents nationally and internationally on feline medicine and behavior, and leads workshops on feline-friendly handling. In 2005, she was awarded the AVMA Animal Welfare Award for her leadership and contributions to advancing feline medicine and behavior. Dr. Rodan has written journal articles and book chapters, and is a co-editor and co-author of the veterinary textbook, Feline Behavioral Health and Welfare, published in 2015.

Catharine Scott-Moncrieff, MA, VMB, MS, MRCVS, DACVIM, DECVIM, DSAM

Sponsor Boehringer Ingelheim

Purdue University, West Lafayette, Indiana

Catharine Scott-Moncrieff received her Veterinary Degree from the University of Cambridge in 1985. She completed an internship in small animal medicine and surgery at the University of Saskatchewan, Canada, and a residency and Master of Science degree in internal medicine at Purdue University. In 1989 she joined the faculty of Purdue University, where she is currently Professor of small animal internal medicine and head of the Department of Veterinary Clinical Sciences. She is a Diplomate of the American College of Veterinary Internal Medicine (small animal), the European College of Veterinary Internal Medicine (companion animal), and has a Diploma in Small Animal Medicine from the Royal College of Veterinary Surgeons. Her research and clinical interests are canine and feline endocrinology, and she is an author of more than 70 peer-reviewed publications in small animal endocrinology and internal medicine.

Howard Seim, DVM, DACVS

Colorado State University, Fort Collins, Colorado

Dr. Seim graduated from Washington State University, completed an internship in Saskatoon, Saskatchewan Canada, and a surgical residency at the Animal Medical Center in New York City. He obtained Diplomate status in the American College of Veterinary Surgeons in 1983. He is currently on the surgical staff at Colorado State University. He was a recipient of the Merck AGVET Award for Creative Teaching, the CSU Award for Instructional Innovation, and selected as the North American Veterinary Conference's Small Animal Speaker of the Year in 2009. Dr. Seim is founder of VideoVet a Veterinary Surgery Continuing Education video series - www.videovet.org.

Kristin Shaw, DVM, MS, PhD, DACVS, DACVSMR

Sponsor ZOETIS PETCARE

Zoetis, Parsippany, New Jersey

Dr. Shaw is a small animal surgeon and rehabilitation specialist whose career has focused on bridging the gap between these two disciplines. Dr. Shaw received her DVM, MS, and PhD, and completed a small animal surgical residency at the University of Florida. She is a Diplomate of the American College of Veterinary Surgeons and a Diplomate of the American College of Veterinary Sports Medicine and Rehabilitation. She spent 2 years as a clinical instructor at UF and 9 years in referral practice in Seattle, WA. Dr. Shaw is past-president of the American Association of Rehabilitation Veterinarians and has been a primary instructor for the Canine Rehabilitation Institute. In 2010 she was awarded the Outstanding Young Alumni Award by the University of Florida and in 2018 she was the recipient of the John J. Sherman Award for Excellence in Veterinary Rehabilitation. She is a frequent invited speaker at national and international veterinary conferences and has authored numerous journal articles and text book chapters related to veterinary surgery and rehabilitation. In 2019 Dr. Shaw founded CARE (www.caninearthritis.org), a website dedicated to providing practical, evidence-based resources and tools for her clients and veterinary colleagues caring for dogs (and cats) with osteoarthritis. In 2021 she joined Zoetis in order to have the greatest impact possible on the lives of dogs and cats suffering from OA and pain.

Bradley Simon, DVM, MS, DACVAA

Sponsor Dechra

Texas A&M College of Veterinary Medicine and Biomedical Sciences, College Station, Texas

Dr. Simon received his Doctor of Veterinary Medicine from Ross University School of Veterinary Medicine and completed a residency in anesthesia and analgesia at the University of Pennsylvania School of Veterinary Medicine. Following his residency, Dr. Simon received his Master of Science degree, with a focus on feline analgesia and opioid pharmacology. Currently, he is a board-certified veterinary anesthesiologist and an Assistant Professor of Anesthesiology at Texas A&M University College of Veterinary Medicine. He has written over 25 peer-reviewed publications and contributor to four books on feline anesthesia and analgesia. His most notable research focuses on the effects of aging and opioid-opioid combinations on feline analgesia. He has also published several impactful reviews on the present and future of opioid analgesics, the lack of analgesic use (oligoanalgesia) in small animal practice, and on feline procedural sedation and analgesia. Dr. Simon is an international lecturer and has presented at the International Conference on Opioids at Harvard University, South European Veterinary Conference, World Small Animal Veterinary Association Conference, World Congress of Veterinary Anesthesia, International Society of Feline Medicine Conference, and ACVS Surgery Summit to name a few. As an invited speaker, Dr. Simon hopes to continue his path of spreading knowledge about feline sedation, anesthesia, and analgesia to the veterinary profession and general public.

Carolyn Spivock, RVT

VCA, Inc., Baltimore, Maryland

Carolyn Spivock, RVT has been in the veterinary industry for over 20 years. She received her Bachelor's in Animal and Poultry Science from Virginia Tech and her Associate of Applied Science – Veterinary Technology from the Community College of Baltimore County. Over her career she has held roles in patient care, leadership, hospital management, and field and support office positions. She is currently the Director of Technician & Assistant Development in VCA's Medical Operations Department. Carolyn's passion is helping to create opportunities for continued growth in skills, knowledge, and leadership development for our Veterinary Technicians and Assistants with a special focus in patient and team safety.

Bryden Stanley, BVMS, MVetSc, MANZCVS, MRCVS, DACVS

Sponsor IDEXX

Michigan State University, College of Veterinary Medicine, Okemos, Michigan

Dr. Stanley is Emeritus Professor of Surgery at Michigan State University's College of Veterinary Medicine. She graduated in 1982 from Murdoch University, Australia. Following a short stint in private practice, she completed an internship at Murdoch and a surgical registrarship at the University of Sydney. From 1987 to 1990, Bryden completed an ACVS surgery residency and master's degree at the University of Saskatchewan, Canada. Dr. Stanley's first faculty appointment was at the University of Edinburgh in Scotland but she has been at Michigan State University since 1999, where she was Head of Surgery before retirement. Dr. Stanley's clinical interests are in all aspects of soft tissue surgery, particularly upper respiratory, wound management, and cutaneous reconstructive techniques. Dr. Stanley undertakes clinical research in upper respiratory diseases and wound healing. She publishes frequently, has received many teaching awards, and lectures widely at a national and international level.

Jane Sykes, BVSc (Hons), PhD, MBA, DACVIM (SAIM)

Sponsor MERCK Animal Health Partner ABVP

University of California-Davis, Davis, California

Jane Sykes is a Professor of Small Animal Medicine at the University of California, Davis School of Veterinary Medicine with a special interest in small animal infectious diseases. She obtained her veterinary degree and PhD in veterinary microbiology at the University of Melbourne in Australia, her residency in small animal internal medicine at the University of Minnesota, and an MBA degree from the University of Georgia. She is Board-Certified in the American College of Veterinary Internal Medicine, and joined the faculty at UC Davis in 2002. She has co-authored more than 100 peer-reviewed publications, is the editor of the Elsevier textbook "Canine and Feline Infectious Diseases," and the 130 chapter textbook "Greene's Infectious Diseases of the Dog and Cat." She co-founded the International Society of Companion Animal Infectious Diseases (ISCAID), was the first President of that Society, and is currently Secretary-Treasurer of ISCAID. She was President of the American College of Veterinary Internal Medicine (ACVIM) Specialty of Small Animal Internal Medicine from 2012-2015, was Associate Editor (Infectious Diseases) of the Journal of Veterinary Internal Medicine, and is currently President Elect of the ACVIM as a whole. Her research interests currently include antimicrobial drug resistant bacterial infections, blood-borne infectious diseases, and deep mycoses.

Valarie Tynes DVM, DACVB, DACAW

Sponsor ceva

Ceva Animal Health, Sweetwater, Texas

Dr. Valarie Tynes is a native Texan and received her DVM from Texas A&M University. She worked in private practice for 14 years before returning to academia to pursue a residency in clinical animal behavior at the University of California at Davis in 2000. She has been a Diplomate of the American College of Veterinary Behaviorists since 2003 and is also Board Certified in Animal Welfare. Her special interests are the behavior and welfare of pet pigs, exotic pets, and zoo animals. She has been actively involved in the Fear Free initiative since its inception and serves on the Fear Free Speakers Bureau. She is a frequent speaker at veterinary meetings around the world and author of numerous articles and textbook chapters. She joined Ceva Animal Health in October of 2014 as a veterinary services specialist but continues to provide consulting services to zoos.

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*Mottet J, Kowollik N: BSAVA Congress Proceedings. 2019. 424-425.

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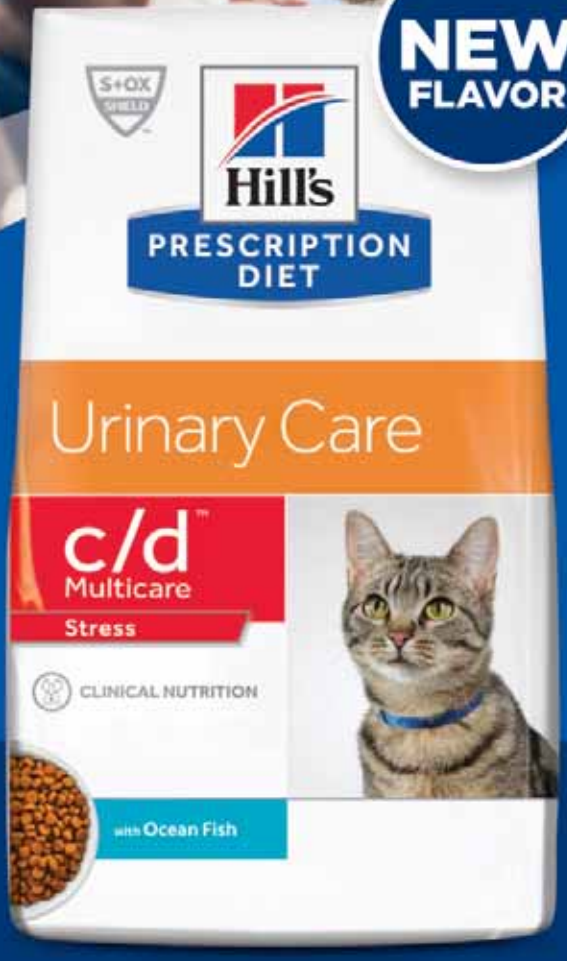

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Kruger JM, Lulich JP, MacLeay J, et al. Comparison of foods with differing nutritional profiles for long-term management of acute noninfectious idiopathic cystitis in cats. *J Am Vet Med Assoc.* 2015;247(5):508-517. [1]Lulich JP, Kruger JM, MacLeay JM, et al. Efficacy of two commercially available, low-magnesium, urine acidifying dry foods for the dissolution of struvite uroliths in cats. *J Am Vet Med Assoc.* 2011;243(3):1147-1153. Average 27 days in vivo study in urolith forming cats. [2]Pereira GG, Fragoso S, Pires E. Effect of dietary intake of L-tryptophan supplementation on multi-housed cats presenting stress related behaviours. In Proceedings. ISSAVA 2010. [3]Beata C, Beaumont-Graff E, Coirier et al. Effect of alpha-casozepine (Zylkene) on anxiety in cats. *J Vet Behav.* 2007;2(2):40-46.

Session Abstracts

Schedule is in Mountain Standard Time (same as Pacific Daylight Time over these dates)

KEY:
- C COMBINED TRACK
- A TRACK A
- B TRACK B
- LS LIVE STREAMED

THURSDAY, SEPTEMBER 30, 2021 – PRE-CONFERENCE DAY

9:30 – 10:45 am **Providing for the Behavioral Needs of Each Cat,** *Dr. Valarie Tynes*
Many behavior problems in cats develop due to our failure to provide them with their behavioral needs. This presentation will review the social structure of the cat and why multi-cat households can be so stressful. Recognizing these signs of stress and how to avoid their development will also be covered. In addition, a variety of tips for meeting the environmental and behavioral needs of the cat will be reviewed.

10:50 – 11:45 am **The New Cat Parent: How to Exceed their Expectations for Feline Healthcare & Wellbeing,** *Dr. Natalie Marks* LS
In this lecture, we will discuss and dissect a new feline pet parent's expectations (especially Millennials) for their journey with the veterinary team. This starts at home with the hospital's digital presence, the desire for communication and resources, and how to provide enrichment and emotional wellbeing. There will also be guidance on what preventive wellness strategies are (such as pet insurance and exam schedules) and how they should be given as resources. As we travel to the hospital, we will discuss how to remove stress and anxiety from both our patients AND their parents, and what the pet parent's expectation is for the exam itself.

12:15 – 1:15 pm **To Cut or Not to Cut: Incorporating New Technologies & Avoiding the Pitfalls in the Treatment of Feline Uroliths,** *Dr. Jody Lulich* LS
This seminar will reveal common mistakes in the diagnosis and prediction of urolith composition. We will introduce an app to help and provide the real significance of crystalluria. Then we will present simple steps to successful struvite dissolution. The seminar will end with a discussion of more nonsurgical methods to remove urocystoliths in cats.

1:30 – 2:20 pm **ISCAID Antimicrobial Use Guidelines: Which Antimicrobial, What Dose, & For How Long?,** *Dr. Jane Sykes* LS
This session will provide an update on antimicrobial use guidelines as they relate to cats. Judicious use of antibiotics, including drug, dose, and duration of treatment for common conditions of cats, will be covered. The ISCAID guidelines for respiratory disease and urinary tract disease will be reviewed, as well as rationale for recommendations. Practical approaches to cases will also be described.

2:20 – 3:15 pm **Current Concepts in Feline Vaccination,** *Dr. Jane Sykes* LS
Recently revised Guidelines for vaccination of cats were published by the AAFP/AAHA. This talk will review the recommendations in the Guidelines. Evidence to support the recommendations will also be discussed. Vaccine types, vaccination frequency, duration of immunity, and adverse effects as they relate to current vaccines will be covered, as well as vaccine selection based on lifestyle. Frequently asked questions as they relate to vaccination of cats will be reviewed.

3:45 – 4:35 pm **Is a Positive Really Negative? Interpretation of Diagnostic Tests for Infectious Diseases,** *Dr. Jane Sykes* LS
Recently there has been an expansion in the number and types of diagnostic tests for infectious diseases, and interpretation of these tests can be confusing for veterinary practitioners. This talk will provide a framework for proper selection and interpretation of diagnostic tests for better patient care. Advantages and disadvantages of different test types will be described, as well as how test methodology and sampling can influence test results.

4:35 – 5:30 pm **Update on Feline Viral Infections: Pearls of Wisdom,** *Dr. Jane Sykes* LS
This session is designed to update the practitioner on new knowledge about FeLV infections, FIV, FIP, feline respiratory viruses, and other emerging feline viruses including SARS-CoV-2. Important aspects of diagnosis, antiviral drug therapy, and prevention will be highlighted. Case material will be used to illustrate concepts.

FRIDAY, OCTOBER 1, 2021

8:15 – 9:15 am C ***The Intertwine of Fear & Pain: A Spinning Wheel with Implications for Cats & Their Caregivers,*** *Dr. Tamara Grubb* LS
Pain can cause fear, anxiety, and stress (FAS). Unfortunately, FAS can exacerbate pain. This combination of events can negatively impact the health, welfare, and behavior of the patient and can damage the human animal bond. In this session, attendees will explore the FAS/pain interaction. The attendees will leave this session with pharmacologic and nonpharmacologic options for prevention and treatment of FAS/pain and tips for owner education.

10:45 – 11:35 am A **Purrfecting Your Acute Pain Assessment Skills,** *Dr. Sheilah Robertson* LS
Our ability to assess acute pain in cats has improved greatly in recent years. By creating tools based on behaviors of non-painful and painful cats, careful validation and testing, we can be more objective. The Glasgow Composite Measure Pain Scale (GCMPS) uses observation and interaction to determine a pain score and provides a suggested intervention level. The Feline Grimace Scale involves scoring of 5 action units: four on the face plus the position of the head. It correlates well with the GCMPS, is a rapid screening tool, and can be used when interaction is not possible, for example with unsocialized cats. Attendees will learn how to use these tools through the use of images and videos.

B **Having the Nerve: Local Anesthetic Techniques You Should be Using - Part 1** *Dr. Mark Epstein* LS
During this lecture the audience will learn about the rationale and safest, highest, and wisest use of local anesthetics, with an emphasis on local and loco-regional techniques suitable for any clinician to master. Techniques in this session will include incisional, field, and cavity blocks, and methods to extend duration of local anesthetics. The learning objectives are to gain understanding of adjunctive LA mechanisms of action, learn potential toxicities and safe use of LA, and understand clinical use of various LA techniques for soft tissue and abdominal surgery.

FRIDAY, OCTOBER 1, 2021 continued

11:40 – 12:30 pm

A **A Pain Most Malicious: Understanding, Preventing, & Treating Maladaptive Pain,** *Dr. Tamara Grubb* LS
Physiologic or 'adaptive' pain is normal and important for survival as a protective mechanism. Maladaptive or 'pathologic' pain is not normal and serves no biologic purpose – it is pain beyond what is needed for protection. Maladaptive pain has a major negative impact on the patient's health, behavior, and welfare. The attendees will leave this session with a thorough understanding of maladaptive pain and knowledge of prevention/treatment strategies, including drug dosages and nonpharmacologic options, for patients with existing or developing maladaptive pain.

B **Having the Nerve: Local Anesthetic Techniques You Should be Using - Part 2,** *Dr. Mark Epstein* LS
During this lecture the audience will learn about the rationale and safest, highest, and wisest use of local anesthetics, with an emphasis on local and loco-regional techniques suitable for any clinician to master. Techniques in this session will include sacrococcygeal (caudal epidural), retrobulbar, orofacial and regional nerve blocks. The learning objectives are to understand clinical use of various LA techniques for limb/digit surgery, understand clinical use of retrobulbar regional blocks, understand clinical use of various LA techniques for orofacial surgery, and understand clinical use sacrococcygeal blocks for perineal or tail surgery.

12:45 – 1:45 pm

Lunch & Learn #1: What the Guidelines Say on Identifying, Evaluating, & Managing Feline Hypertension, *Dr. Mark Acierno*
Hypertension in cats tends to be caused by systemic disease or illness. This session will examine the epidemiology of hypertension in cats, review recommendations for evaluating suspected hypertensive patients, and show how to obtain the most clinically useful blood pressure measurements in practice. The interpretation, classification, and effects of hypertension, including target organ damage that the condition can cause, will be discussed, as will goals of therapy and feline-specific treatment protocols.

Lunch & Learn #2: What is Your Patient Telling You? Integrate All the Moving Parts, *Dr. Guillermo Couto*
A senior cat comes in for a second opinion; they are experiencing weight loss, anorexia, vomiting, diarrhea, or combinations thereof. As we all know, these clinical signs are shared by most of the diseases we see in cats of that age group, including hyperthyroidism, chronic kidney disease (CKD), inflammatory bowel disease (IBD), gastrointestinal lymphoma, pancreatitis, cholangiohepatitis, triaditis, etc. How do we collect, collate, and analyze this information? What is relevant and what is not? In this lecture, Dr. Couto will use cases to illustrate how to get to his destination integrating the clinical data with the results of the CBC, chemistry, and urinalysis, placing more emphasis on the hematologic changes. Basically, he will be thinking out loud as he evaluates each patient.

Lunch & Learn #3: Don't Stress! Practical Management of Feline Lower Urinary Tract Disease, *Dr. Jessica Markovich*
In this presentation, attendees will learn practical management techniques for feline patients with lower urinary tract disease with a special focus on nutritional strategies, and the role they play in a multimodal approach to disease management. Specifically, we will address nutritional supplements, methods to enhance water consumption, feline dietary preferences, and weight loss. We will end with practical options for owners to monitor for disease recurrence at home.

Lunch & Learn #4: Identifying & Treating Chronic OA Pain: Help is on the Way!, *Dr. Elizabeth Colleran*
Identifying and managing feline pain can be a challenge, to say the least! As we know, cats don't tend to be cooperative when we're looking to objectively measure chronic osteoarthritis pain. Even when we can diagnose OA, treatment options are wide-ranging, and getting them into the cat can be frustrating. This session will discuss new tools to help identify signs of chronic pain and review valid treatment options, including pharmaceutical and non-pharmaceutical methods.

2:00 – 2:50 pm

A **I'm Old, Painful, & My Mouth Hurts: Dental & Other Protocols for Patients with Pre-existing Pain,** *Dr. Tamara Grubb* LS
The potential presence of preexisting pain should be considered when designing protocols undergoing painful procedures like dental extractions. However, responses to drugs may be altered in senior patients with age-related changes. The attendees will leave this session with a thorough understanding of acute-on-chronic pain and the impact of aging on drug choices/doses. Specific anesthesia/analgesia protocols, including doses, will be provided.

B **Feline Pain Management Beyond Opiods & NSAIDs: Part 1,** *Dr. Mark Epstein* LS
During this lecture the audience will learn about non-NSAID, non-opioid pain modifying analgesic drugs (PMAD), and their use in cats. Examples include, but are not limited to, parenteral medications such as alpha-2 agonists, subanethetic ketamine CRI, maropitant, and anti-NGF Monoclonal Antibody. The learning objectives are to gain understanding of adjunctive PMAD mechanisms of action, learn patient populations that would most benefit – or not benefit – from various adjunctive PMADs, and understand clinical use of various PMADs.

2:55 – 3:45 pm

A **Anesthesia & Analgesia for Cats with Cardiac and/or Airway Comorbidities,** *Dr. Tamara Grubb* LS
Cats with cardiac and/or airway comorbidities can be challenging to safely anesthetize. The attendees will leave this session with anesthesia/analgesia techniques/tips and drug dosages for cats with hypertrophic cardiomyopathy, asthma, and other cardiac/respiratory comorbidities.

B **Feline Pain Management Beyond Opioids & NSAIDs: Part 2,** *Dr. Mark Epstein* LS
During this lecture the audience will learn about non-NSAID, non-opioid pain modifying analgesic drugs (PMAD) and their use in cats. Examples include but are not limited to oral medication such as tramadol, gabapentin, amitriptyline, SSNRIs, CBD, and non-pharmacologic intervention. The learning objectives are to gain understanding of adjunctive PMAD mechanisms of action, learn patient populations that would most benefit – or not benefit – from various adjunctive PMADs, and understand clinical use of various PMADs.

FRIDAY, OCTOBER 1, 2021 continued

4:40 – 5:30 pm

A **Anesthesia & Analgesia for Cats with Endocrine Comorbidities,** *Dr. Tamara Grubb* LS
Cats with some endocrine comorbidities can be challenging to safely anesthetize. The attendees will leave this session with anesthesia/analgesia techniques/tips and drug dosages for cats with thyroid, pancreatic, and other endocrine comorbidities.

B **Is your Anesthetized Patient in Trouble?,** *Dr. Sheilah Robertson* LS
An essential part of anesthesia is knowing which vital signs to monitor, how to monitor them, and knowing when and how to intervene if values stray from an acceptable range. Perioperative monitoring covers the time from admission to discharge. Using real cases, attendees will learn how to logically address hypotension, hypoventilation, changes in heart rate, inadequate depth of anesthesia, and prolonged or rough recovery from anesthesia. Most anesthetic deaths occur three hours after the end of anesthesia and tips for preventing problems during this critical period will be shared.

SATURDAY, OCTOBER 2, 2021

8:00 – 9:00 am

C ***The Whole Package: Anesthesia & Surgery Tips for Common but Sometimes Tricky Cases,*** *Drs. Sheilah Robertson & Bryden Stanley* LS
Feline urethral obstruction is frequently encountered in general and emergency practice. Dependent on the time of the obstruction to the time of presentation, clinical signs vary from mild to severe. Rapid triage is required to determine life-threatening issues due to severe electrolyte (hyperkalemia) and acid–base imbalances. Choosing the right drugs and techniques for sedation, analgesia, or anesthesia is important for a good outcome. Tips and tricks for relieving the obstruction will be shared, along with decision making about performing a cystotomy, or a perineal urethrostomy in repeat offenders.

9:05 – 10:00 am

C ***Intestinal Anastomosis: Tips to Make it Easier,*** *Dr. Howard Seim* LS
When performing an intestinal resection and anastomosis by yourself (i.e., no assistant to help), we will discuss several tips that may make the procedure easier for you. There are a number of alternative techniques that you can consider incorporating that will likely make this common procedure easier and more predictably successful. Video of clinical cases will be used to illustrate these techniques.

11:00 – 11:50 am

A **Making End of Life Decisions,** *Dr. Sheilah Robertson* LS
One of the most common questions we are asked is "when will I know it's time?" Despite wide usage, the term Quality of Life (QOL) with respect to animals does not have a universally consistent or accepted definition which has hampered our ability to measure it. Helpful working definitions which include physical and mental health will be discussed. Cats cannot self-report therefore we, and their owners, are their proxy. Attendees will learn about disease specific QOL tools and more generic tools that can be used for cats with comorbidities. Attendees will also learn about anticipatory grief and how to conduct a structured patient-centric conversation under difficult circumstances.

B **Visceral Organ Biopsy,** *Dr. Howard Seim* LS
This seminar will illustrate a variety of biopsy techniques of abdominal visceral organs. Discussion will include biopsy techniques used to acquire diagnostic samples of liver, pancreas, and small intestine. Video will be used to illustrate surgical techniques.

11:55 – 12:45 pm

A **The Last Appointment: How to Navigate Smoothly Through Euthanasia Appointments,** *Dr. Sheilah Robertson* LS
There are multiple steps involved in the euthanasia process and each one must be well coordinated. Communication within the team and between the team and owner is essential. Regardless of where the appointment takes place there are some simple tips to create the best possible environment for the cat, owner, and veterinary team. Pre-euthanasia sedation or anesthesia is strongly recommended, and attendees will learn which drugs, or drug combinations can be used, including non-injectable options. Attendees will learn about alternative routes for administration of euthanasia drugs if intravenous access is not possible.

B **Surgery of the Pancreas, Liver, & Biliary System,** *Dr. Howard Seim* LS
Occasionally patients require surgical management of pancreatic masses as well as disorders of the liver and biliary system. This session presents several cases with pancreatic and hepatobiliary disorders and describe in detail the surgical management used to treat each case. Video of clinical cases will be used to help illustrate surgical techniques used.

1:00 – 2:00 pm

Lunch & Learn #1: Monitoring the Difficult Diabetic Cat: Role of Continuous Glucose Monitoring,
Dr. Catharine Scott-Moncrieff
This lecture will discuss the best approach to monitoring glycemic control in cats with an emphasis on more challenging diabetic cases. The advantages and logistics of incorporating continuous glucose monitoring into case management will be discussed.

Lunch & Learn #2: Enhancing Compliance & Reducing Stress: A Modern Perspective on Feline Parasite Protection,
Dr. Robert Lavan
This course will examine consumer compliance and investigate the drivers behind cat owner product purchasing while demonstrating how extended duration products are beneficial to pets and pet owners. The session agenda will include why feline parasite protection is important, what professionals recommend, what pet owners are actually doing, enhancing compliance with convenience, how cat owners actually deliver medication doses (the gaps), and how to reduce stress for the cat AND the cat owner.

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Session Abstracts

Schedule is in Mountain Standard Time (same as Pacific Daylight Time over these dates)

KEY:
- A TRACK A
- B TRACK B
- O ORAL ABSTRACT
- LS LIVE STREAMED

SATURDAY, OCTOBER 2, 2021 continued

1:00 – 2:00 pm **Lunch & Learn #3: Digital Cytopathology: Real-time Expert Help in Your Everyday Practice,** *Dr. Eric Morissette*
Become familiar with recommended diagnostic modalities to be ulilized during routine wellness and sick animal examinations. Then test your chemistry, cytology, and hematology skills in this interactive case-based session. We will take a closer look at some common vs. oddball clinical scenarios, highlighting tips for interpretation of blood work, urine, and the utility of a point-of-care digital system that gives you real-time access to a board-certified veterinary clinical pathologist. You don't have to go it alone.

2:15 – 3:05 pm A **Creating a Culture of Perioperative Safety in Your Clinics,** *Drs. Sheilah Robertson & Bryden Stanley* LS
Improving morbidity and mortality statistics related to anesthesia and surgery is an essential part of our job. Assessing risks, adequate patient stabilization and preparation, and ensuring that equipment is available and functional are essential tasks. The data supporting the use of comprehensive checklists as a way to prevent accidents is robust and should be part of every clinic's culture. Attendees will learn how to create checklists that fit their caseload and how to initiate these and achieve "buy in" by everyone on the team. Real life data demonstrating the positive effect on adverse events before and after using checklists will be shared.

2:15 – 2:40 pm B **Wound Management Secrets,** *Dr. Howard Seim* LS
Can you force a wound to continue to contract…oh yes you can! Attendees will learn how to 'stretch' skin in order to close chronic non-healing wounds.

2:40 – 3:05 pm B **Managing Feline Ear Polyps,** *Dr. Howard Seim* LS
Polyps originating from the nasopharynx, ear canal, and middle ear of young cats is occasionally encountered in practice. This session will include techniques for removing polyps from the nasopharyngeal region, external ear canal, and middle ear. Video of clinical cases will be used to illustrate surgical technique.

3:10 – 4:00 pm A **The Whole Package: Anesthesia & Surgery Tips for Common but Sometimes Tricky Cases in Kittens & Young Cats,** *Drs. Sheilah Robertson & Bryden Stanley* LS
Kittens do not always land fully on their feet and may suffer from several congenital or trauma linked problems early in life. These include but are not restricted to rectovaginal fistulae, anal atresia, pectus excavatum, umbilical and body wall hernias, cleft palate, ruptured diaphragm, and fractures. Kittens have unique physiologic features that must be accounted for when creating an anesthesia, analgesia, and surgery plan. The attendees will "walk through" real cases with the presenters to learn tips and tricks to ensure a good outcome in our pediatric patients.

3:10 – 3:35 pm B **Feline Subtotal Colectomy,** *Dr. Howard Seim* LS
Subtotal colectomy for the treatment of megacolon in cats is no longer considered a salvage procedure. This session is designed to describe, in detail, the authors' preferred technique for subtotal colectomy. Video of a clinical case will be used to illustrate the authors' tricks on how to make the technique easier to perform and more predictably successful.

3:35 – 4:00 pm B **Colopexy for the Treatment of Recurrent Rectal Prolapse,** *Dr. Howard Seim* LS
Patients that present with chronic recurrent rectal prolapse can be difficult to medically manage. Permanent reduction of the rectal prolapse can be performed by suturing the colon to the body wall. This session will describe a technique that results in a permanent fibrous connective tissue scar between the colonic wall and body wall. Video of a clinical case will be used to illustrate the technique.

4:05 – 4:25 pm O **False Positive FeLV ELISA Results in Cats With Hemolytic Disease,** *Dr. Matthew Kornya* LS
Feline leukemia virus is a devastating, contagious disease that causes a wide variety of hematologic and neoplastic conditions. Diagnosis is much more complex than was previously believed even with the wide variety of tests at our disposal. This presentation will discuss a series of cats with hematologic disease demonstrating discordant results by two commonly available tests as well as possible implications and explanations.

4:05 – 4:45 pm **Why Being a Cat Friendly Practice Matters**
We will discuss the impact being a Cat Friendly Practice has on your practice, client relationships, and cats. We will be collecting your questions prior to the meeting and answering them during the presentation. We encourage anyone thinking about becoming a CFP, those who may be stuck in the process, and even current Cat Friendly Practices to attend the session. Many times we often have the same questions, so please join us to learn from your colleagues.

Session Abstracts

Schedule is in Mountain Standard Time (same as Pacific Daylight Time over these dates)

KEY: A TRACK A | B TRACK B | C COMBINED TRACK | LS LIVE STREAMED

SUNDAY, OCTOBER 3, 2021

8:30 – 9:20 am C ***Detecting, Diagnosing, & Monitoring Feline OA Pain: A Practical Approach,*** *Dr. Duncan Lascelles* LS

The steps involved in diagnosing DJD-associated pain in the feline patient can be summarized as owner education, facilitating a visit to the clinic, understanding the signalment of feline OA, observation, hands-on examination, radiography, and assessing impact of OA-pain. This presentation will discuss all of them except hands-on examination.

9:25 – 10:15 am C ***NSAIDs for Chronic Pain Control in Cats: An Update,*** *Dr. Duncan Lascelles* LS

Updates regarding the use of NSAIDs in cats for the control of long-standing musculoskeletal pain will be provided and discussed. Practical recommendations regarding the long-term use of NSAIDs in cats will be given.

10:45 – 11:35 am A **How to Perform a Successful Orthopedic Examination,** *Dr. Duncan Lascelles* LS

The steps involved in diagnosing DJD-associated pain in the feline patient can be summarized as owner education, facilitating a visit to the clinic, understanding the signalment of feline OA, observation, hands-on examination, radiography, and assessing impact of OA-pain. This presentation will discuss hands-on examination using a combination of videos and illustrations.

B **Perineal Urethrostomy & Other Options in Cats with FUS,** *Dr. Bryden Stanley* LS

Perineal urethrostomy (PU) in cats is a commonly performed procedure in feline practice, but the indications for the procedure must be clearly understood, and the procedure itself can carry significant complications. However, when performed correctly and meticulously, outcomes are excellent, with full continence. The slightly increased incidence of urinary tract infections seen following PU is likely not due to the procedure, but rather the underlying uropathy. Several suggestions and recommendations arising from experience and the literature are discussed to optimize outcomes when performing PUs, including some alternative techniques.

11:40 – 12:30 pm A **Anti-NGF mAbs for Chronic Pain Control: The Science,** *Dr. Duncan Lascelles* LS

This presentation will discuss the difference between the disease of osteoarthritis and the whole-body deterioration resulting from osteoarthritic pain, detail emerging treatment options for OA, present the science behind nerve growth factor (NGF) and its role in the control of pain resulting from osteoarthritis, and outline and discuss the evidence for anti-NGF monoclonal antibody strategies in the cat, and comparison to other species.

B **Revisiting Halsted's Principles (But Not His Habits!): Tips to Better Surgery,** *Dr. Bryden Stanley* LS

Following graduation, we climb a steep learning curve as we adjust to the demanding lifestyle of the practicing veterinarian. It is often a few years before we feel at ease with our career. Without doubt, mistakes will be made, and there will be stressful times. However, we strive to learn from our mistakes, and as our career specializes into a specific discipline or interest (such as feline medicine and surgery), and our experience grows, we develop a personal set of standards and protocols. Starting with Halsted's Principles of Surgery, I present a list of tips that I have learnt over many years that will minimize complications, maximize your competence, decrease panic, and enhance confidence in the surgical arena.

12:40 – 1:40 pm **Lunch & Learn #1: Update on the Management of Stress Associated Illness in Cats,** *Dr. Michael Lappin*

A variety of clinical problems are exacerbated by stress in cats. Notable examples include recurrent respiratory or ocular disease from FHV-1, diarrhea, and feline interstitial cystitis. Both syndromes can be difficult to manage and can result in relinquishment of the cat. In this lecture, Dr. Lappin will update the audience on recent studies using stress relief to aid in the management of common clinical problems associated with stress in cats. Emphasis will be placed on a new study documenting use of a probiotic that lessened stress in FHV-1 infected cats, resulting in decreased clinical signs of reactivated infection compared to the placebo group.

Lunch & Learn #2: Procedural Sedation & Analgesia in the Cat, *Dr. Brad Simon*

Procedural sedation and analgesia (PSA) describes the process of depressing a patient's conscious state to perform unpleasant, minimally invasive procedures (e.g. ultrasound, phlebotomy, or bandage changes), and is often part of the daily routine in feline practices. Decision-making with respect to drug choice and dosage regimen, taking into consideration the cat's health status, behavior, co-morbidities, and the need for pain management, can be complicated and represents an everyday challenge in feline practice. While PSA is commonly perceived to be uneventful, complications can occur and on occasion may be life-threatening. An overview of, and rationale for, building a PSA protocol, and the advantages and disadvantages of different classes of sedatives and anesthetics, is presented in a clinical context supported by an evidence-based approach and clinical experience.

Lunch & Learn #3: Stem Cell Therapy in the Domestic & Exotic Feline: Could This be the Answer to Your Difficult Cases?, *Dr. Robert Harman*

This presentation is designed to cover the basics about adipose-derived, autologous stem cell therapy in veterinary medicine and how it may be applied to feline medicine. The objectives of this course are to discuss the potential mechanisms of action, efficacy, safety, and present guidelines on how to use stem cell therapy for the treatment of some of the most complex feline ailments such as chronic kidney disease, gingivostomatitis, and inflammatory bowel disease. Dr. Harman will cover the VetStem process from tissue collection to stem cell injection as well as treatment protocols for multiple feline disease processes. Referencing clinical findings, Dr. Harman will explore the many uses of adipose-derived stem cell therapy in domestic and exotic felines.

SUNDAY, OCTOBER 3, 2021 continued

1:45 – 2:35 pm

A **Anti-GGF mAbs for Chronic Pain Control: The Evidence,** *Dr. Duncan Lascelles* LS
This presentation will outline and discuss the evidence for anti-NGF monoclonal antibody strategies in the cat, and comparison to other species.

B **Chylothorax: An Update,** *Dr. Bryden Stanley* LS
"Idiopathic"chylothorax in both cats and other species is a serious condition for which the underlying etiology and even pathophysiology is still poorly understood. Although further research is indicated to fully characterize the condition, a number of recent therapeutic interventions and management options have clearly improved outcomes. Various lymphangiographic procedures can outline the highly variable anatomy of the cisterna chyli and thoracic duct. We now have the ability to identify collateral vessels and also have improved means to not only obliteral the pathway into the pleural cavity, but also to provide long-term, minimally-invasive drainage.

2:40 – 3:30 pm

A **Wearables for Diagnosis & Monitoring of Pain: Where Are We?,** *Dr. Duncan Lascelles* LS
The future of improved diagnosis and monitoring will be the integration of varied and rich data sets in real-time. Wearable and implantable sensors have been garnering more attention as they offer opportunities to access such continuous, real-time data across multiple varied dimensions. However, with the high-frequency longitudinal data generated comes the challenge of managing this data, and interpreting the biological meaning. While some simple summary values may be of use in certain circumstances, the future lies in analyzing and interpreting patterns. As an example of the challenges and opportunities, the measurement of pain in cats via monitoring activity will be discussed. The presentation will focus on two aspects: 1) understanding activity of cats in health and disease; 2) the handling, analysis, and interpretation of data to generate biologically useful information.

B **Atypical Cutaneous Infections in Cats,** *Dr. Bryden Stanley* LS
Veterinarians do not see the large number of chronic, non-healing wounds that our human counterparts attend to, largely due to the lack of comorbidities such as obesity, alcoholism, chronic diabetes, and cardiac disease. Cat wounds often heal without complication. Their skin also has a laxity that allows contraction to play a larger role in healing than in species with a tighter skin. However, there are occasions when a wound does not seem to be healing as expected. In such cases, the cat may have a mycobacterial infection, which may go unrecognized for months. These chronic infections of the subcutis and panniculus layer can be persistent and challenging to diagnose. Macerated tissue culture (rather than surface swab) is indicated, and specific request for mycobacterial culture requested (aerobic, anaerobic, fungal cultures, and histopathology can also be performed). Mycobacterial wounds generally respond to resection and long-term, appropriate systemic antibiotic therapy.

On-demand Session Abstracts

Miscellaneous

Cats Gotta Scratch: The Case Against Feline P3 Amputation, *Dr. Robin Downing*
Cats' paws and toes play a critical role in their lives. They use them to communicate, for exercise, for escape, and for defense when needed. This session will help practitioners understand the reasons to reject amputating P3 in cats by understanding the pathogenesis of the chronic maladaptive and neuropathic pain that results, by understanding the pathologic changes in bioemechanics that lead to other musculoskeletal issues, and by understanding the bioethical violations involved.

Managing Chronic Pain Following P3 Amputation, *Dr. Robin Downing*
Cats' paws and toes play a critical role in their lives. Sometimes, however, we see cats in our practices who have had their P3s amputated. These cats, no matter how carefully their surgeries were performed, are subjected to the same nervous system aberrations that occur in humans post-amputation, which can result in chronic maladaptive, neuropathic pain in up to 80% of patients. This session will explore ways to "unwind" the peripheral and central sensitization that occurs in the wake of P3 amputation, both in the feet, and downstream from altered biomechanics.

Environmental Needs for Cats with DJD: Preserve Access to Promote Comfort, *Dr. Margaret Gruen*
In this presentation, we will discuss the environmental conditions that promote quality of life in cats. We will work through the natural history of cats, and how that affects their need for access to safe areas and 3-D space. We will also identify the accommodations that need to be made for cats with painful degenerative joint disease both at home and in the clinic.

Feline-Friendly Handling & Interactions: Evidence-based Techniques, *Dr. Ilona Rodan*
Benefits of feline-friendly handling and interactions include human safety, efficiency, better medicine, client loyalty, and preventing patient distress. Although veterinary care positively impacts quality and length of life, almost half of cats do not receive annual care, mainly due to stress surrounding the veterinary visit. Preparing the client and cat for veterinary visits reduces owner anxiety and feline negative emotions. How cats are handled can also impair their welfare, perhaps long-term. Fortunately, several studies help us recognize feline handling techniques and other methods to improve feline visits. The bonus is that these evidence-based techniques also increase human safety.

Hands-Free Radiology: Strategy, Training, & Implementation Ideas, *Dr. Dennis Keith & Ms. Carolyn Spivock*
Safely obtaining diagnostic quality radiographs is of paramount importance for your patient and for your hospital team. Capturing properly positioned radiographs, while minimizing exposure to radiation and reducing stress for our patients and team is the goal every time we enter the radiology suite. During the "Hands-Free Radiology: Strategy, Training and Implementation Ideas" session, we will discuss implementation ideas, as well as tools and resources, that can help you achieve this goal through an overall hospital team approach.

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Miscellaneous

What About Cats? Rehabilitation Techniques for Feline Patients, *Dr. Kristin Shaw*
Prior to implementing a rehabilitation plan, a rehabilitation diagnosis must be established. This presentation will discuss the importance of performing a Feline Friendly examination in the context of the rehabilitation exam and review methods of minimizing stress during the clinic visit, particularly if the cat will be returning frequently for ongoing therapy. This presentation will then review the primary components of physical rehabilitation, including therapeutic exercise, hydrotherapy, acupuncture, manual therapy, and therapeutic modalities such as photobiomodulation ("laser therapy") and pulsed electromagnetic field therapy. We will also discuss how these techniques can be practically applied for feline patients. Several case examples will be presented, including post-surgical and nonsurgical patients.

Feline Histoplasmosis: Serology as a Non-Invasive Diagnostic Alternative, *Dr. Mariana Jardim*
The objective of this study is to analyze the antigenic enzyme assay in urine and serum of domestic cats with a previous diagnosis of histoplasmosis.

Technician

Management of the Emergent Feline Patient, *Mr. Harold Davis*
The management of the emergent feline patient can be a challenging endeavor primarily because of the nature of the "beast." Aside from the obvious acute traumatic injury the cat is adept at hiding signs of illness. This discussion will cover the initial management of the emergent feline patient.

Nurse Management of the Urinary Obstructed Cat, *Mr. Harold Davis*
This discussion will provide an overview of the patient with urinary obstruction. Having a basic understanding of the pathophysiologic and compensatory mechanism of this disease process will aid the veterinary technician in meeting therapeutic and monitoring goals.

Anesthetic Monitors: Understanding Their Use & Limitations, *Ms. Heidi Reuss-Lamky*
Technicians interpret data from anesthetic monitors on a routine basis. This presentation covers various monitoring modalities used in assessing the anesthetized cat, as well as common pitfalls and precautions that should be taken while interpreting the data. Monitoring modalities discussed include ECG, blood pressure (including Doppler), pulse oximetry, capnography, and temperature. The learning objectives are to explain physiologic process associated with each type of monitoring modality and identify various ways to measure them. (e.g., understand carbon dioxide physiology as relevant to measuring ETCO2; discuss various monitoring methods for ETCO2), develop skills to troubleshoot equipment, identify malfunction and avoid misinterpretation of the data, specifically, as how they impact monitoring anesthetized cats, and recognize normal physiologic parameters for anesthetized felines and identify minimum acceptable values for ECG, blood pressure, pulse oximetry, capnography, and temperature for anesthetized feline patients.

Who Needs an Anesthetic Plan? YOU DO!, *Ms. Heidi Reuss-Lamky*
Every cat that enters your hospital is a unique biologic unit. Do you know how to develop an anesthetic plan that ensures their safe passage throughout the anesthetic episode? Careful pre-anesthetic assessments are essential to identify physiological, pathological, or drug-related factors that may complicate a feline patient's anesthetic management. Learn the components of developing an anesthetic plan and the steps necessary to optimize the surgical procedure and expected outcome for each and every patient. The learning objectives are to determine how organ function and feline specific diseases impact anesthetic protocols, pharmacologic interactions awareness with anesthetic drugs and the unique features of feline metabolism, and how to develop a feline friendly anesthetic plan.

Purr-fect Feline Anesthesia, *Ms. Heidi Reuss-Lamky*
Anesthetizing felines can pose unique challenges for the veterinary technician. In addition to the fact that cats can be difficult to monitor under anesthesia, their small size, interesting metabolism, variable temperament, and propensity towards particular health problems can also prove problematic. During this presentation learn how to successfully address these challenges while avoiding the many pitfalls associated with anesthetizing felines. Feline handling techniques will also be discussed.

Anesthesia Mistakes Awareness, *Ms. Heidi Reuss-Lamky*
The pressures facing anesthetists today are great; the anesthetist must fully understand physiology, pathophysiology, pharmacology, anesthesia equipment, and monitoring devices as well as recognize their limitations. Although the goal is to assure a successful surgical or procedural outcome while ensuring our feline patient receives the finest possible anesthetic care, mistakes can and do happen. Discover the most common causes of feline anesthesia-related errors as well as some insight on how to prevent them. The learning objectives are to enhance awareness of the most common sources of anesthesia mistakes unique to cats, identify characteristics of a great anesthetist, and develop ways to avoid or minimize anesthetic related errors surrounding feline patients.

Pain Scoring for Dummies, *Ms. Heidi Reuss-Lamky*
Identifying the symptoms of pain in cats is an important but often times difficult part of a veterinary technician's job. Furthermore, differentiating acute pain signs from fear, anxiety, and stress (FAS) can be perplexing to even the most astute feline observers. We'll explore the pros and cons of a variety of pain scoring tools for both acute and chronic pain in cats. Interpreting feline body language as it relates to pain versus FAS will also be discussed. The learning objectives are to differentiate the body language of FAS vs. pain in cats, describe the limitations associated with pain scoring methods in cats, and describe the value of a validated pain scoring method for both acute and chronic feline pain.

Detecting Feline Chronic Pain, *Ms. Alison Gottlieb*
Feline chronic pain is a multi-layer obstacle course, each hurdle difficult but possible with practice and determination. The first hurdle is admitting it exists; however, we cannot stop there. Detecting chronic pain is a team sport, requiring all cat caregivers to be aligned and educated. This session will focus on tools and techniques for detecting feline chronic pain.

Treatment of Chronic Pain, *Ms. Alison Gottlieb*
Once feline chronic pain has been identified treatment can begin. This is a delicate balance of compromise, patience, and creativity. Our plan needs to be long-term, approved by the cat, and feasible for the owner as well. This session will focus on treatment options for all members of the cat care team.

Feline Chronic Pain: Getting Cat Owners on Board, *Ms. Alison Gottlieb*
We have certainly come a long way, and followed the trajectory of recognition and treatment for these painful cats. However, all our education and discussion is mute if the primary caretaker is not educated as well. Cat owners are vital in every facet of alleviating chronic pain, and arguably the most important participant in the recognition and treatment process. Educating cat owners is truly a gift, providing them with information, resources, and support will be the focus.

Feline Nursing Care for the Hospitalized Patient, *Ms. Alison Gottlieb*
We can all agree, the hospital is not an ideal place for cats. We can often compromise with them for a visit, however hospitalization is occasionally warranted. As cat advocates and caretakers, we can significantly improve this experience. Feline friendly handling, pharmacologic intervention, and creativity decrease stress, improve healing and appetite, and often shorten the length of hospitalization. We will discuss these tips and tricks for any hospitalized cat.

Package Insert for Cats

ProZinc®
(protamine zinc recombinant human insulin)

40 IU/mL

Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian.

Description: PROZINC® is a sterile aqueous protamine zinc suspension of recombinant human insulin.

Each mL contains:

recombinant human insulin	40 International Units (IU)
protamine sulfate	0.466 mg
zinc oxide	0.088 mg
glycerin	16.00 mg
dibasic sodium phosphate, heptahydrate	3.78 mg
phenol (added as preservative)	2.50 mg
hydrochloric acid	1.63 mg
water for injection (maximum)	1005 mg

pH is adjusted with hydrochloric acid and/or sodium hydroxide.

Indication: PROZINC (protamine zinc recombinant human insulin) is indicated for the reduction of hyperglycemia and hyperglycemia-associated clinical signs in cats with diabetes mellitus.

Dosage and Administration: USE OF A SYRINGE OTHER THAN A U-40 SYRINGE WILL RESULT IN INCORRECT DOSING.

FOR SUBCUTANEOUS INJECTION ONLY.

DO NOT SHAKE OR AGITATE THE VIAL.

PROZINC should be mixed by gently rolling the vial prior to withdrawing each dose from the vial. Once mixed, PROZINC suspension has a white, cloudy appearance. Clumps or visible white particles can form in insulin suspensions: do not use the product if clumps or visible white particles persist after gently rolling the vial.

Using a U-40 insulin syringe, the injection should be administered subcutaneously on the back of the neck or on the side of the cat.

Always provide the Client Information Sheet with each prescription.

The initial recommended PROZINC dose is 0.1 – 0.3 IU insulin/pound of body weight (0.2 – 0.7 IU/kg) every 12 hours. The dose should be given concurrently with or right after a meal. The veterinarian should re-evaluate the cat at appropriate intervals and adjust the dose based on both clinical signs and glucose nadirs until adequate glycemic control has been attained. In the effectiveness field study, glycemic control was considered adequate if the glucose nadir from a 9-hour blood glucose curve was between 80 and 150 mg/dL and clinical signs of hyperglycemia such as polyuria, polydipsia, and weight loss were improved.

Further adjustments in the dosage may be necessary with changes in the cat's diet, body weight, or concomitant medication, or if the cat develops concurrent infection, inflammation, neoplasia, or an additional endocrine or other medical disorder.

Contraindications: PROZINC is contraindicated in cats sensitive to protamine zinc recombinant human insulin or any other ingredients in PROZINC. PROZINC is contraindicated during episodes of hypoglycemia.

Warnings: User Safety: For use in cats and dogs only. Keep out of the reach of children. Avoid contact with eyes. In case of contact, immediately flush eyes with running water for at least 15 minutes. Accidental injection may cause hypoglycemia. In case of accidental injection, seek medical attention immediately. Exposure to product may induce a local or systemic allergic reaction in sensitized individuals.

Animal Safety: Owners should be advised to observe for signs of hypoglycemia (see Client Information Sheet). Use of this product, even at established doses, has been associated with hypoglycemia. A cat with signs of hypoglycemia should be treated immediately. Glucose should be given orally or intravenously as dictated by clinical signs. Insulin should be temporarily withheld and, if indicated, the dosage adjusted.

Any change in insulin should be made cautiously and only under a veterinarian's supervision. Changes in insulin strength, manufacturer, type, species (human, animal) or method of manufacture (rDNA versus animal-source insulin) may result in the need for a change in dosage.

Appropriate diagnostic tests should be performed to rule out other endocrinopathies in diabetic cats that are difficult to regulate.

Precautions: Cats presenting with severe ketoacidosis, anorexia, lethargy, and/or vomiting should be stabilized with short-acting insulin and appropriate supportive therapy until their condition is stabilized. As with all insulin products, careful patient monitoring for hypoglycemia and hyperglycemia is essential to attain and maintain adequate glycemic control and to prevent associated complications. Overdose can result in profound hypoglycemia and death.

Glucocorticoids, progestogens, and certain endocrinopathies can have an antagonistic effect on insulin activity. Glucocorticoid and progestogen use should be avoided.

The safety and effectiveness of PROZINC in breeding, pregnant, and lactating cats has not been evaluated.

The safety and effectiveness of PROZINC in kittens has not been evaluated.

Adverse Reactions: Effectiveness Field Study

In a 45-day effectiveness field study, 176 cats received PROZINC. Hypoglycemia (defined as a blood glucose value of < 50 mg/dL) occurred in 71 of the cats at various times throughout the study. Clinical signs of hypoglycemia were generally mild in nature (described as lethargic, sluggish, weak, trembling, uncoordinated, groggy, glassy-eyed or dazed). In 17 cases, the veterinarian provided oral glucose supplementation or food as treatment. Most cases were not associated with clinical signs and received no treatment. One cat had a serious hypoglycemic event associated with stupor, lateral recumbency, hypothermia and seizures.

All cases of hypoglycemia resolved with appropriate therapy and if needed, a dose reduction.

Three cats had injection site reactions which were described as either small, punctate, red lesions; lesions on neck; or palpable subcutaneous thickening. All injection site reactions resolved without cessation of therapy.

Four cats developed diabetic neuropathy during the study as evidenced by plantigrade stance. Three cats entered the study with plantigrade stance, one of which resolved by Day 45. Four cats were diagnosed with diabetic ketoacidosis during the study. Two were euthanized due to poor response to treatment. Five other cats were euthanized during the study, one of which had hypoglycemia. Four cats had received PROZINC for less than a week and were euthanized due to worsening concurrent medical conditions.

The following additional clinical observations or diagnoses were reported in cats during the effectiveness field study: vomiting, lethargy, diarrhea, cystitis/hematuria, upper respiratory infection, dry coat, hair loss, ocular discharge, abnormal vocalization, black stool, and rapid breathing.

Extended Use Field Study

Cats that completed the effectiveness study were enrolled into an extended use field study. In this study, 145 cats received PROZINC for up to an additional 136 days. Adverse reactions were similar to those reported during the 45-day effectiveness study and are listed in order of decreasing frequency: vomiting, hypoglycemia, anorexia/poor appetite, diarrhea, lethargy, cystitis/hematuria, and weakness. Twenty cats had signs consistent with hypoglycemia described as: sluggish, lethargic, unsteady, wobbly, seizures, trembling, or dazed. Most of these were treated by the owner or veterinarian with oral glucose supplementation or food; others received intravenous glucose. One cat had a serious hypoglycemic event associated with seizures and blindness. The cat fully recovered after supportive therapy and finished the study. All cases of hypoglycemia resolved with appropriate therapy and if needed, a dose reduction.

Fourteen cats died or were euthanized during the extended use study. In two cases, continued use of insulin despite anorexia and signs of hypoglycemia contributed to the deaths. In one case, the owner decided not to continue therapy after a presumed episode of hypoglycemia. The rest were due to concurrent medical conditions or worsening of the diabetes mellitus.

To report suspected adverse drug events, for technical assistance or to obtain a copy of the Safety Data Sheet (SDS), contact Boehringer Ingelheim at 1-888-637-4251.

For additional information about adverse drug experience reporting for animal drugs, contact FDA at 1-888-FDA-VETS or online at http://www.fda.gov/reportanimalae.

Information for Cat Owners: Please refer to the Client Information Sheet for Cats for more information about PROZINC. PROZINC, like other insulin products, is not free from adverse reactions. Owners should be advised of the potential for adverse reactions and be informed of the associated clinical signs. Potential adverse reactions include: hypoglycemia, insulin antagonism/resistance, rapid insulin metabolism, insulin-induced hyperglycemia (Somogyi Effect), and local or systemic reactions. The most common adverse reaction observed is hypoglycemia. Signs may include: weakness, depression, behavioral changes, muscle twitching, and anxiety. In severe cases of hypoglycemia, seizures and coma can occur. Hypoglycemia can be fatal if an affected cat does not receive prompt treatment. Appropriate veterinary monitoring of blood glucose, adjustment of insulin dose and regimen as needed, and stabilization of diet and activity help minimize the risk of hypoglycemic episodes. The attending veterinarian should evaluate other adverse reactions on a case-by-case basis to determine if an adjustment in therapy is appropriate, or if alternative therapy should be considered.

Effectiveness: A total of 187 client-owned cats were enrolled in a 45-day field study, with 176 receiving PROZINC. One hundred and fifty-one cats were included in the effectiveness analysis. The patients included various purebred and mixed breed cats ranging in age from 3 to 19 years and in weight from 4.6 to 20.8 pounds. Of the cats included in the effectiveness analysis, 101 were castrated males, 49 were spayed females, and 1 was an intact female.

Cats were started on PROZINC at a dose of 0.1-0.3 IU/lb (0.2-0.7 IU/kg) twice daily. Cats were evaluated at 7, 14, 30, and 45 days after initiation of therapy and the dose was adjusted based on clinical signs and results of 9-hour blood glucose curves on Days 7, 14, and 30.

Effectiveness was based on successful control of diabetes which was defined as improvement in at least one blood glucose variable (glucose curve mean, nadir, or fructosamine) and at least one clinical sign (polyuria, polydipsia, or body weight). Based on this definition, 115 of 151 cases (76.2%) were considered successful. Blood glucose curve means decreased from 415.3 mg/dL on Day 0 to 203.2 mg/dL by Day 45 and the mean blood glucose nadir decreased from 407.9 mg/dL on Day 0 to 142.4 mg/dL on Day 45. Mean fructosamine values decreased from 505.9 µmol/L on Day 0 to 380.7 µmol/L on Day 45.

Cats that completed the effectiveness study were enrolled in an extended use field study. The mean fructosamine value was 342.0 µmol/L after a total of 181 days of PROZINC therapy.

How Supplied: PROZINC is supplied as a sterile injectable suspension in 10 mL and 20 mL multi-dose vials. Each mL of PROZINC contains 40 IU recombinant human insulin.

Storage Conditions: Store in an upright position under refrigeration at 36-46°F (2-8°C). Do not freeze. Protect from light. **Use the 10 mL vial within 60 days of first puncture. Use the 20 mL vial within 80 days of first puncture.**

Approved by FDA under NADA # 141-297

Marketed by:
Boehringer Ingelheim Animal Health USA Inc.
Duluth, GA 30096

Revised 08/2019

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Boehringer Ingelheim

Package Insert for Dogs

ProZinc®
(protamine zinc recombinant human insulin)

40 IU/mL

Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian.

Description: PROZINC® is a sterile aqueous protamine zinc suspension of recombinant human insulin.

Each mL contains:

recombinant human insulin	40 International Units (IU)
protamine sulfate	0.466 mg
zinc oxide	0.088 mg
glycerin	16.00 mg
dibasic sodium phosphate, heptahydrate	3.78 mg
phenol (added as preservative)	2.50 mg
hydrochloric acid	1.63 mg
water for injection (maximum)	1005 mg

pH is adjusted with hydrochloric acid and/or sodium hydroxide.

Indication: PROZINC (protamine zinc recombinant human insulin) is indicated for the reduction of hyperglycemia and hyperglycemia-associated clinical signs in dogs with diabetes mellitus.

Dosage and Administration: USE OF A SYRINGE OTHER THAN A U-40 SYRINGE WILL RESULT IN INCORRECT DOSING.

FOR SUBCUTANEOUS INJECTION ONLY.

DO NOT SHAKE OR AGITATE THE VIAL.

PROZINC should be mixed by gently rolling the vial prior to withdrawing each dose from the vial. Once mixed, PROZINC suspension has a white, cloudy appearance. Clumps or visible white particles can form in insulin suspensions: do not use the product if clumps or visible white particles persist after gently rolling the vial.

Using a U-40 insulin syringe, the injection should be administered subcutaneously on the back of the neck or on the side of the dog.

Always provide the Client Information Sheet with each prescription.

Starting dose: The recommended starting dose for PROZINC is 0.2-0.5 IU insulin/pound of body weight (0.5-1.0 IU/kg) **once daily**. The recommended starting dose for naïve dogs is the lower end of the dose range. The recommended starting dose for dogs with poorly controlled diabetes mellitus and transitioning from another insulin product is the mid to higher end of the dose range based on the veterinarian's experience with the dog's medical history and previous insulin dose. When transitioning from another insulin, the dog's blood glucose and general condition should be closely monitored. **When transitioning from another insulin, PROZINC should be started once daily, regardless of the frequency of prior insulin use.**

The dose should be given concurrently with or right after a meal. The veterinarian should re-evaluate the dog at appropriate intervals and adjust the dose and frequency based on both clinical signs and laboratory test results (the blood glucose curve values and shape, nadir, and fructosamine) until adequate glycemic control has been attained. In the effectiveness field study, glycemic control was considered adequate if the glucose nadir from a 9-hour blood glucose curve was between 80 and 125 mg/dL, the maximum blood glucose was ≤ 300 mg/dL, and clinical signs of hyperglycemia such as polyuria, polydipsia, or weight loss were improved.

Changing to twice daily dosing: Twice daily dosing should be considered if the duration of insulin action is determined to be inadequate with once daily dosing. Use caution when adjusting from once daily to twice daily dosing because PROZINC may have prolonged duration of action in some dogs (see Clinical Pharmacology). The veterinarian should closely monitor the duration of action using blood glucose curves to avoid the increased risk of hypoglycemia. If twice daily dosing is initiated, the two doses should each be approximately 25% less than the once daily dose required to attain an acceptable glucose nadir. For example, if a dog receiving 10 units of PROZINC once daily has an acceptable nadir but inadequate duration of activity, the dose should be changed to 7 units twice daily (round down to the nearest whole unit).

Further adjustments in the dosage may be necessary with changes in the dog's diet, body weight, or concomitant medication, or if the dog develops concurrent infection, inflammation, neoplasia, or an additional endocrine or other medical disorder.

Contraindications: PROZINC is contraindicated in dogs sensitive to protamine zinc recombinant human insulin or any other ingredients in PROZINC. PROZINC is contraindicated during episodes of hypoglycemia.

Warnings:
User Safety: For use in dogs and cats. Keep out of the reach of children. Avoid contact with eyes. In case of contact, immediately flush eyes with running water for at least 15 minutes. Accidental injection may cause hypoglycemia. In case of accidental injection, seek medical attention immediately. Exposure to product may induce a local or systemic allergic reaction in sensitized individuals.

Animal Safety: Owners should be advised to observe for signs of hypoglycemia (see Client Information Sheet). Use of this product, even at established doses, has been associated with hypoglycemia. A dog with signs of hypoglycemia should be treated immediately. Glucose should be given orally or intravenously as dictated by clinical signs. Insulin should be temporarily withheld and, if indicated, the dosage adjusted.

Any change in insulin should be made cautiously and only under a veterinarian's supervision. Changes in insulin strength, manufacturer, type, species (human, animal) or method of manufacture (rDNA versus animal-source insulin) may result in the need for a change in dosage.

Appropriate diagnostic tests should be performed to rule out other endocrinopathies in diabetic dogs that are difficult to regulate.

Precautions: Dogs presenting with severe ketoacidosis, anorexia, lethargy, and/or vomiting should be stabilized with short-acting insulin and appropriate supportive therapy until their condition is stabilized. As with all insulin products, careful patient monitoring for hypoglycemia and hyperglycemia is essential to attain and maintain adequate glycemic control and to prevent associated complications. Overdose can result in profound hypoglycemia and death.

Glucocorticoids, progestogens, and certain endocrinopathies can have an antagonistic effect on insulin activity. Glucocorticoid and progestogen use should be avoided.

The safety and effectiveness of PROZINC in breeding, pregnant, and lactating dogs has not been evaluated.

The safety and effectiveness of PROZINC in puppies has not been evaluated.

Adverse Reactions: In a 182-day field study, 276 dogs received PROZINC. The most common adverse reactions were lethargy, anorexia, hypoglycemia, vomiting, seizures, shaking, diarrhea, and ataxia.

Table 1 summarizes the adverse reactions reported in the study. Clinical signs of hypoglycemia varied and included seizure, collapse, ataxia, staggering, trembling, twitching, shaking, disorientation, lethargy, weakness, and vocalization. In Table 1, the individual clinical signs that were observed during the episodes of hypoglycemia are captured as separate adverse reactions and a single dog may have experienced more than one clinical sign of hypoglycemia.

Table 1. Adverse reactions seen in the safety population (276 dogs)

Adverse Reaction	Number and Percentage
Lethargy (lethargy, depression, listless, and tiredness)	45 (16.3%)
Anorexia (anorexia, decreased appetite, inappetence, and not eating)	28 (10.1%)
Hypoglycemia with clinical signs	24 (8.9%)
Vomiting	21 (7.6%)
Seizures	16 (5.8%)
Shaking/trembling/twitching	13 (4.7%)
Ataxia (ataxia, balance problem, stumbling gait)	11 (4.0%)
Diarrhea (includes bloody diarrhea)	9 (3.3%)
Disorientation/confusion	9 (3.3%)
Weakness	8 (2.9%)
Restlessness/anxiety/agitation	6 (2.2%)
Cataract	6 (2.2%)
Panting (panting and tachypnea)	6 (2.2%)
Hematuria	4 (1.5%)

Clinical pathology: The only change seen in complete blood count, serum chemistry, and urinalysis results was an elevation in mean cholesterol at Day 182 (432.6 mg/dL, normal range 131-345 mg/dL) compared to Day -1 (333.7 mg/dL).)

Injection site reactions: Seven dogs had injection site reactions, including observations of thickened skin, swelling, bumps at the injection site, and redness. All injection site reactions resolved without cessation of PROZINC therapy. Reaction to the injection, including vocalization, was observed in four dogs.

Hypoglycemia: There were 80 hypoglycemic episodes recorded during the study with some dogs experiencing more than one episode; 37 episodes were associated with clinical signs in 24 dogs, 40 episodes were without clinical signs in 27 dogs, and 3 were with unknown signs in 2 dogs. Clinical signs of hypoglycemia varied and included seizure, collapse, ataxia, staggering, trembling, twitching, shaking, disorientation, lethargy, weakness, and vocalization. Some dogs required hospitalization and intravenous dextrose while most recovered after receiving oral supplementation with a meal and/or oral glucose such as syrup. Two dogs were euthanized when the hypoglycemia did not resolve with supportive care. Hypoglycemia without clinical signs was defined as two consecutive blood glucose curve values < 60 mg/dL unaccompanied by clinical signs.

Diabetic ketoacidosis and pancreatitis: Eleven dogs were diagnosed with diabetic ketoacidosis. Four of these 11 dogs died or were euthanized, one after one dose of PROZINC. Twenty-one dogs were diagnosed with pancreatitis. Seven of these 21 dogs died or were euthanized due to complications of pancreatitis. Four dogs had concurrent diabetic ketoacidosis and pancreatitis, three of which died or were euthanized. Not all the deaths were considered related to PROZINC.

Deaths: Thirty-six (36) dogs died or were euthanized, six of which were possibly related to PROZINC. One dog died from recurrent episodes of pancreatitis, and one died after developing severe vomiting and diarrhea followed by a seizure. Four dogs were euthanized: one developed severe pancreatitis and azotemia, one had recurrent episodes of pancreatitis and diabetic ketoacidosis, and two for lack of effectiveness.

To report suspected adverse drug events, for technical assistance or to obtain a copy of the Safety Data Sheet (SDS), contact Boehringer Ingelheim at 1-888-637-4251.

For additional information about adverse drug experience reporting for animal drugs, contact FDA at 1-888-FDA-VETS or online at http://www.fda.gov/reportanimalae.

Clinical Pharmacology: PROZINC was administered subcutaneously to 10 healthy Beagles using an incomplete crossover design at doses of 0.5 IU/kg (5 dogs), 0.8 IU/kg at a single site (10 dogs), or 0.8 IU/kg at three separate sites (6 dogs). Insulin and glucose concentrations were measured over 24 hours. The shapes of insulin and glucose curves were variable among dogs; and the relationship between insulin dose, concentration, and glucose-lowering effect was nonlinear (Table 2).

Table 2. Pharmacodynamics of three dosing groups

Dose group	Onset of Action	Time to nadir	Duration of Action
0.5 IU/kg at a single site	1 to 14 hours	6 to 16 hours	16 to >24 hours
0.8 IU/kg at a single site	0.5 to 10 hours	5 to >24 hours	16 to >24 hours
0.8 IU/kg divided at three sites	1 to 10 hours	8 to 20 hours	18 to >24 hours

Information for Dog Owners: Please refer to the Client Information Sheet for Dogs for more information about PROZINC. PROZINC, like other insulin products, is not free from adverse reactions. Owners should be advised of the potential for adverse reactions and be informed of the associated clinical signs. Potential adverse reactions include hypoglycemia, insulin antagonism/resistance, rapid insulin metabolism, insulin-induced hyperglycemia (Somogyi Effect), and local or systemic reactions. The most common adverse reaction observed is hypoglycemia. Signs may include weakness, depression, behavioral changes, muscle twitching, and anxiety. In severe cases of hypoglycemia, seizures and coma can occur. Hypoglycemia can be fatal if an affected dog does not receive prompt treatment. Appropriate veterinary monitoring of blood glucose, adjustment of insulin dose and regimen as needed, and stabilization of diet and activity help minimize the risk of hypoglycemic episodes. The attending veterinarian should evaluate other adverse reactions on a case-by-case basis to determine if an adjustment in therapy is appropriate, or if alternative therapy should be considered.

Effectiveness: A total of 276 client-owned dogs were enrolled in an 84-day field study followed by a 98-day extended-use phase with 276 dogs receiving PROZINC. The dogs included various purebred and mixed breed dogs ranging in age from 2 to 16 years and in weight from 3.3 to 123 pounds. There were 128 neutered males, 8 intact males, 134 spayed females and 6 intact females. Two hundred twenty-four dogs (224) were included in the effectiveness analysis. Dogs were started on PROZINC at a dose of 0.2-0.5 IU/lb (0.5-1.0 IU/kg) once daily. Dogs were evaluated at 7, 14, 21, 28, 42, 63 and 84 days after initiation of therapy. The dose was adjusted based on clinical signs and results of 9-hour blood glucose curves on Days 7, 14, 21, 28, 42, 63 and 84.

Effectiveness was based on successful control of diabetes which was defined as improvement in at least one laboratory variable (blood glucose curve mean, blood glucose curve nadir, or fructosamine) and at least one clinical sign (polyuria, polydipsia, or weight loss). Based on this definition, 162 of 224 cases (72%) were considered successful.

How Supplied: PROZINC is supplied as a sterile injectable suspension in 10 mL and 20 mL multi-dose vials. Each mL of PROZINC contains 40 IU recombinant human insulin.

Storage Conditions: Store in an upright position under refrigeration at 36-46°F (2-8°C). Do not freeze. Protect from light. **Use the 10 mL vial within 60 days of first puncture. Use the 20 mL vial within 80 days of first puncture.**

Approved by FDA under NADA # 141-297

Marketed by:
Boehringer Ingelheim Animal Health USA Inc. Duluth, GA 30096

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Boehringer Ingelheim

Anesthesia, Analgesia, & Surgery

2021 CONFERENCE

Sept. 30 – Oct. 3, 2021
Phoenix Convention Center
Phoenix, AZ & Virtual

THURSDAY, SEPTEMBER 30, 2021

Pre-conference Day

Schedule is in Mountain Standard Time (same as Pacific Daylight Time over these dates)

TIME	SESSION TITLE	SPEAKER	ROOM	SPONSOR/ PARTNER
PRE-CONFERENCE DAY*				
9:30 - 11:45 am	**Early Morning Learning Sessions**			
9:30 - 10:45 am	Providing for the Behavioral Needs of Each Cat LS	Dr. Valarie Tynes	North Ballroom AB	Ceva
10:50 - 11:45 am	The New Cat Parent: How to Exceed their Expectations for Feline Healthcare & Wellbeing LS	Dr. Natalie Marks	North Ballroom AB	Ceva
11:45 - 1:15 pm	**Food for Thought Luncheon**			
12:15 - 1:15 pm	To Cut or Not to Cut: Incorporating New Technologies & Avoiding the Pitfalls in the Treatment of Feline Uroliths LS	Dr. Jody Lulich	North Ballroom AB	Hill's
1:30 - 5:30 pm	**ABVP/AAFP Seminar & Social**			MERCK Animal Health
1:30 - 2:20 pm	ISCAID Antimicrobial Use Guidelines: Which Antimicrobial, What Dose, & For How Long? LS	Dr. Jane Sykes	North Ballroom AB	ABVP
2:20 - 3:15 pm	Current Concepts in Feline Vaccination LS	Dr. Jane Sykes	North Ballroom AB	MERCK Animal Health, ABVP
3:15 - 3:45 pm	**Refreshment Break**		North Ballroom CD	
3:45 - 4:35 pm	Is a Positive Really Negative? Interpretation of Diagnostic Tests for Infectious Diseases LS	Dr. Jane Sykes	North Ballroom AB	MERCK Animal Health, ABVP
4:35 - 5:30 pm	Update on Feline Viral Infections: Pearls of Wisdom LS	Dr. Jane Sykes	North Ballroom AB	MERCK Animal Health, ABVP
5:30 - 7:00 pm	Welcome Reception *All attendees invited*		North Ballroom Foyer	Boehringer Ingelheim

*Pre-conference Day Registration Required. Additional fees apply.

Sessions and speakers are subject to change.

LS Live Streamed

Providing for the Behavioral Needs of Each Cat

Valarie Tynes, DVM, DACVB, DACAW

Introduction

Studies support the fact that behavior problems can damage the human animal bond[1] and a weakened bond can result in relinquishment.[2] Being able to provide appropriately for a cat's behavioral needs should decrease the incidence of problem behaviors but limited, and sometimes conflicting, research exists on how to best provide for a cat's behavioral needs. Recognizing that our domestic cat has some very particular behavior needs that are inconsistent with the typical lifestyle of today's cat owner, and then educating cat owners is critical to the welfare of pet cats. A recent study reported that owners with a better understanding of normal cat behavior reported fewer behavior problems with their cats.[3]

Description of the Problem

Feline behavior problems often reported by owners include aggression to humans and other household pets, house soiling, destructive behavior and anxiety or fear. It should be of concern to those committed to improving feline welfare that in one study more than 50 % of cat owners said they sprayed the cat with water when it performed an unwanted behavior and almost 30% agreed with the statement that "cats often misbehave to get back at their owners for doing something the cat did not like".[3] In addition, there was a strong negative correlation between the bond people had with their cats and their belief in these statements, demonstrating the importance of owner education in order to improve cats wellbeing.

Behavioral Needs

Many of the problem behaviors seen in cats appear to stem from inattention to their behavioral needs. The domestic cat has undergone much less artificial selection since domestication than has the dog and they have retained many of their ancestral behaviors. The fact that their ancestor was a solitary, nocturnal, desert dwelling predator is too often forgotten. Being confined to the indoors and forced to live in close contact with unrelated cats is just one factor that results in the cat being unable to express many of its species typical behaviors. Inadequate access to resources results in the cat being unable to avoid interactions with individuals that it may prefer to avoid. The unpredictable and ever-changing lifestyle of their owner can further contribute to inescapable stress for pet cats. This demonstrates that in order to provide for the cats' behavioral needs, attention must be given to their social environment as well as their physical environment.

Social Environment

Cats are capable of living sociably when adequate resources are present in their environment. There is also a great deal of variation in individual cat's temperaments and experience that can determine how sociable they are likely to be with another cat. Cats that do not have adequate experiences with other cats while they are still a kitten may be unable to interact appropriately with another cat when they are adults due to their lack of knowledge and experience interacting with conspecifics. When attempting to introduce unfamiliar cats, it is likely that introductions via olfactory and visual contact without actual physical contact for a period of time can help decrease agonistic behavior when physical contact does occur. Nevertheless, once cats are able to live together peacefully, they may or may not be come preferred associates. Some will simply be able to live together in a shared space while using mutual avoidance to maintain the peace. Some poorly socialized cats may never be able to adjust to sharing a home with another cat

Cats in a group are unlikely to exhibit strict dominance hierarchies but hierarchical relationships may exist and can become a problem if resources are inadequate and/or one of the cats exhibits "bullying type behaviors." In a stable group of cats, the higher-ranking cats typically communicate clearly with the lower- ranking cats using visual cues that alleviate the need for overt aggression. But cats that exhibit "bullying" behavior, may threaten other individuals frequently and possibly even prevent their access to certain resources. This type of behavior, if ongoing, can result in a great deal of stress amongst a group of cats living together so having an understanding of the hierarchical relationships amongst a group of cats sharing a home can be critical to preventing and solving problems when they develop.

Interactions with humans are also important to the cat's well-being. The cat needs positive, consistent and predictable interactions with humans. This can be problematic when children are in the home depending upon the individual cat's temperament. Being pursued regularly by a child or any human may result in chronic stress for some cats especially if unable to escape. Children too young to learn to leave a cat alone when it is resting or appears uninterested in interactions, or how to pet or hold a cat appropriately, must be supervised around cats for both child safety and cat welfare.

Physical Environment
Following the Five Pillars framework for providing an optimum feline environment [4], the features of an ideal physical feline environment include having a safe place to escape perceived threats, multiple and separated resources required for health and well-being, e.g., food, water, toileting areas, scratching areas, play areas and resting/hiding locations, as well as opportunity to exhibit play and predatory behavior. Finally, it is important that the cat's sense of smell be respected. The amazing sense of smell that the cat possesses is a factor that is often overlooked in considering the cats behavioral needs. The cat uses olfactory cues as a means of "time sharing" and olfactory cues are an important part of their social behavior. In addition, they will likely find many of the smells that we find pleasant, completely, offensive. For this reason, strong smelling cleanser, air fresheners and other perfumed items should be avoided in the home especially when cleaning the cats litter pans or other items used by the cat. New items should also be added to the home very cautiously. Making an attempt to quickly add a familiar smell to the item of furniture can be helpful. For example, placing a blanket over a new chair or sofa can help to give it a familiar smell and possibly prevent it from appearing quite so alien to the cat.

Pheromone Therapy
Pheromones are chemicals that evolved as a signal between individuals of a species and they elicit a particular reaction from the receiver.[5] Copies of these naturally occurring chemicals have been available for many years and are popular tools for aiding behavioral therapy in companion animals. Previous research on all of these different pheromones has resulted in deciphering of the composition of major feline pheromones. The specific mix and concentration of all of the components that produce certain messages in cats have been identified. Advances in technology have allowed these pheromone components to be used in the assembly of new pheromone complexes, created with the intention of sending enhanced messages to cats. FELIWAY *Optimum* is the first feline pheromone complex to be commercially available and research demonstrates that it provides an enhanced message of social confidence and safety in the environment for the cat. Efficacy data demonstrates that FELIWAY *Optimum* relieves more signs of anxiety in even more situations including urine marking, hiding, inter-cat conflict and vertical scratching.[6]

Behavior Modification
The role that behavior modification can play in providing for the cats' behavioral needs is often overlooked. Many people think of this as just "training" and believe that "training" is somehow demeaning to the cat or deprives it of choice by forcing it do engage in training. Nothing could be further from the truth. When used appropriately, behavior modification in the form of classical conditioning or operant conditioning can be highly effective and, in many cases, provide a means for improving human animal relationships as well as providing for mental stimulation and exercise. Behavior modification for this purpose should be limited mostly to positive reinforcement type training in which the cat can choose to participate or not. If the cat participates it receives something highly valuable such as tiny morsel of food or play, brushing or petting, depending upon what motivates the cat. If the cat does not want to participate, then it simply doesn't receive the reinforcement at this time.

Classical conditioning alone can be used to help decrease some fears. For example, if a cat is afraid of visitors to the home, it can be tossed tiny pieces of food (or engaged in brief play with a toy) every time it appears when a visitor is present. The cat eventually will begin to associate the appearance of visits with something good happening. Again, in this example, the cat has the choice to engage or not. It can stay hidden if that is what it prefers to do.

Opportunities to Thrive
The concept of "Opportunities to Thrive" was developed for internal use by the San Diego Global Zoo and is based on, but expands upon, the concept of the Five Freedoms.[7] While these concepts are typically applied to captive wild animals and/or farm animals, their application to providing for the behavioral needs of the domestic cat are quite appropriate. The "Five Opportunities" include the opportunity for a well-balanced diet, opportunity to self-maintain, opportunity for optimal health, opportunities to express species typical behaviors and opportunities for choice and control. While there is some overlap between the "Opportunities" and the Five Pillars framework, the Five Opportunities includes something that is rarely mentioned in companion animal health; opportunities for choice and control.

When it comes to the mental health of most any living creature, one of the most crucial needs is the need for choice and control in one's life. This is an opportunity that most domestic animals are deprived of from the moment they are brought into our homes. In the natural setting, when cats reach social maturity at 2-4 years of age, they can choose to stay in their natal group or leave and live a more solitary lifestyle. The pet cat does not have this opportunity. It is often forced into very artificial social settings without any means of escape. Thus, the cats' need for choice and control can be partially met when we can give them safe opportunities to go outside and return when they wish. Provision of cat flaps for this purpose can be invaluable. Providing the *multiple* elevated resting spaces and places to

hide that are mentioned in the “Five Pillars” will also be critical in order for the cat to be able to choose to escape form children or other cats.

This issue of choice and control has been missed in many of our discussions regarding the multi cat household. While it is often said that “more behavior problems” occur in multi cat homes or cats in multi cat homes are “more stressed”, the research does not consistently support this contention.[8] While this may have occurred simply due to different methodologies used for these different studies, it is also possible that we are not necessarily asking the right questions; the factors that determine why or how cats in a multi-cat home co-exist peacefully are possibly more numerous than we have even begun to imagine. Factors such as combinations of cats and their different temperaments, as well as population density probably affect the outcome. Numbers of resources, as well as how they are spaced about the home all probably affect the outcome. These things can be very hard to quantify but that knowledge should only cause us to work harder to try to provide cats with their behavioral needs so as to ensure their best welfare.

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The New Cat Parent: How to Exceed Their Expectations for Feline Healthcare & Wellbeing

Natalie L. Marks, DVM, CVJ

Disclaimer: This presentation is sponsored by CEVA.

It's been quite a year, for both people and pets! When we look at the positives that came out of the COVID-19 pandemic, one bright shining light was the record number of pet adoptions that happened, many of these to FIRST time pet parents. These furry family members very quickly wore many hats – companion, co-worker, confidant, best friend and many in between. But what didn't immediately happen with these adoptions is immediate trust and reliance on the veterinary industry. How do we change that? How do we help these felines stay as healthy and happy as possible, these clients feel supported and as if they are doing everything they can, while at the same time not adding to our compassion fatigue and burnout in an overstressed and understaffed industry!

This is the basis for the goals of this presentation:

- Learning about who the first-time cat parent is
- How to elevate your veterinary digital presence
- What the hospital "journey" should look like, including vaccine verbiage
- The last impression
- The internet of medical things

The First-Time Pandemic Cat Parent

Many people talk about how many pets were adopted during the pandemic, but were these adoption rates really that big? According to Rover.com who surveyed over 1000 new pet parents, 53% adopted a dog, ***32% adopted a cat*** and ***14% of pet parents adopted BOTH***. (Rover.com, 2021) Within these groups, the same study indicated that 64% of these pets were adopted (40% from rescue groups, 24% from other family members) while 26% purchased a pet from a breeder[1]. And, as mentioned before, there were many inciting reasons behind adoptions, but one of the biggest groups (41%) adopted for emotional support and happiness and 54% of adoptees even adjusted their budget during a pandemic to afford a pet.

Within this group, the largest demographic, as supported by a large TD Ameritrade study, are Millennials. In fact, 67% of Millennials call their pet 'fur babies'. (Lintz, 2018) The American Pet Products Association Pet Owners Survey from 2017-2018 reported that 55% of cat owners say that their pet is 'like a child' to them, and 44% of them adopted a pet to prepare for human children. In fact, Dr. Jean Twenge, psychology professor at San Diego State University, is not surprised by this trend stating, "Pets are becoming a replacement for children. They're less expensive. You can get one even if you're not ready to live with someone or get married, and they can still provide companionship."

Being the largest group of pet parents, it's incredibly important for us as veterinary teams to understand that these clients are NOT the clients of 5, 10 or 20 years ago. Millennials tend to want a wider range of products and services offered to them, are particular in the 'what', 'how' and why', are incredibly active on social media platforms, and truly value quality over price. While this group often gets called 'frugal', the same TD Ameritrade study showed that Millennial cat owners spend an average of $915/year and $33.5 billion/year as a group.[2]

Does that mean that we need to change our practices to cater ONLY to the Millennial client? Of course not. In fact, a M/A/R/C research study just recently reported in a DVM 360 Webinar June 2021, these pandemic pet parents were further categorized. Of the first-time pet parents, these were typically male, younger (18-34 years of age), single, had a higher income, higher education, worked full-time and were slightly more likely to have adopted a dog. However, the pet parents who adopted during the pandemic who already had pets tended to be female, over 50 years of age, had a lower income and education than the first-time pet parent group, were typically retired or a homemaker, and ***were slightly more likely to have adopted a cat***.

Veterinary Digital Presence

Now that we know a little more about these pandemic clients, let's talk about their first impression of us – our digital presence. Think of the first places they will find you and focus here first – your website and social media platforms.

[1] Rover.com/blog/pandemic-pet-adoption-boom/

[2] https://www.petbusiness.com/archives/how-millennials-spend-on-their-pets/article_a05c7fcf-6343-560d-bf5b-05ba5fecdcb3.html

Practice websites are incredibly powerful, and if you're not feeling comfortable or satisfied with what you have, don't hesitate to outsource this. We can't, and aren't expected, to do it ALL! Your website needs to be very functional – have the capability to email team members, request appointments, contain chat features, be easy to understand, and most importantly, tell YOUR story. Have original content and original pictures that allow your current and future clients to connect with you authentically.

I do recommend these feline specific or associated links on your website for clients to easily hyperlink to when surfing:

AAFP	https://catvets.com/
ASPCA	https://www.aspca.org/
OSU Indoor Cat Initiative	https://indoorpet.osu.edu/cats
International Cat Care	https://icatcare.org
Cornell Feline Health Center	https://www.vet.cornell.edu/deparments-centers-and-institutes/cornell-feline-health-center

Outside of these reference links, what else do our feline clients want to see before choosing us?

The most recent Bayer Veterinary Care Usage Study suggests many things:

- Knowledge in cat-specific diseases
- Social media content (i.e., Caturdays)
- Certifications (Cat-Friendly Practice, etc.)
- Ultrasound
- Cat client "champion"
- Discounts/promotions
- Monthly payment/wellness plans

These are all worth noting, targeting, and achieving, but understandably, many of our first-time cat parents don't know what they don't know. I would argue, as would many of my colleagues, that we need to almost get back to the basics and really focus on other areas, especially built out on our website:

- Potential home toxins
- How to "catproof' a home
- Preparing other pets
- Nutrition 101
- The ABCs of litterbox husbandry
- Enrichment
- House-training
- Pet health insurance – what?

Once a client selects our practice and schedules that first appointment, there are a few tips that helps a client feel confident in their choice and helps our team be more efficient. Utilize digital signature platforms before the appointment (those like Snout ID, JotForm or DocuSign) to capture release forms and other important records. Label parking spots and include appropriate signage as described to the client in an email for easier arrival. And, whether you want to or not, EMBRACE TEXTING. Yes, I said it, but this isn't just my opinion. In fact, according to a 2019 study, texts have a 99% open rate and 95% of them are read in the first 3 minutes of receipt.[3]

And, finally, one part of this first interaction that we must improve upon, individually and as an industry, is stopping the "phone fix". When a first-time cat parent calls and says her cat hasn't eaten well for a few days, instead of just suggesting tuna and monitoring, instead acknowledge how great of a mom she is for noticing this, explain that this is hyporexia and encourage an exam. The same holds true for cats that aren't grooming well, aren't jumping well, having intermittent gastrointestinal signs and behavior changes.

The Hospital Journey

Remember, many of our pandemic parents, especially first-time moms and dads, have never had the pleasure of being in your practice or seeing what an exam looks like. Let's make sure to show them how a visit does NOT need to be stressful. This starts with us looking at a cat's sensory experience in your hospital. Remember, cats have an extremely strong sense of smell, in fact it's 14 times better than humans! When we use bleach to disinfect, we can cause temporary destruction of the olfactory cells, creating nose blindness for up to a week. This is also why warming foods, especially for pediatric and geriatric patients, is helpful in stimulation of this sense. Cats also have

[3] Burke K, 107 texting statistics that answer all of your questions (Burke, 2019)

an incredible sense of hearing as they can rotate their ears 180 degrees. Make sure you can keep cats separate from barking dogs to help avoid these 'nuisance noises', and instead, add calming music (classical and reggae) or even white noise machines to the exam rooms.

On the contrary, cats have a weak sense of sight as compared to other species. This means that we, as veterinary team members, should make sure to use slow movements and low stress handling consistently with our patients to accommodate this. Also, cats have a very weak sense of taste with only 473 taste buds! How does this compare to humans? We have ~ 10,000!

Besides senses, we also need to acknowledge, understand and be respectful of feline body language. This helps our patients and clients relax, allows us to obtain more accurate diagnostics and significantly improves our stress level! Remember, relaxed cats tend to have soft faces, forward-facing ears, almond-shaped pupils, keep their tail away from the body and a relaxed musculature. However, stressed cats from fear or anxiety tend to be hissing, have drawn back lips, hold ears out to the side, dilated round pupils, keep their tail tucked around the body, keep their body crouched and their back arched. Utilizing these skills, along with warm towels impregnated with pheromones like Feliway and high reward treats like tuna, will create a relaxed and comfortable setting for everyone in the exam room.

The NEW Vaccine Verbiage

SO many of these first-time pet parents have also never been witness to their cat receiving an injection or a vaccine! I suggest we rethink the vaccine "conversation" to ensure we are asking the right history questions and providing the right knowledge to our new pet parents about where their cats are exposed to infectious diseases. Forget the "indoor" vs. "outdoor" category breakdown! Many indoor cats have exposure to the outside world, especially in if there are other pets (i.e., dogs) in the household that go outside. We also can't forget about a hot new trend in cat ownership – the "catio". These outdoor experiences for indoor cats provide tremendous mental stimulation and exercise, but also risk factors to the once predominantly indoor only cat.

When your team is talking to these pet parents, think about these updated history questions as supported by the AAHA Task Force for feline vaccination:

- What is your cat's typical day life?
- How does your cat encounter the outside world?
- Can you describe the environment your cat explores outside?
- What type of supervision is on your cat's adventures?
- What other locations does your cat visit?
- Can you describe your cat's relationship with other pets and animals inside and outside your home?

These directed questions help individualize your patient's vaccine recommendations and help the pet parent think about risk factors that they were unaware of previously. The other key component of this vaccine verbiage is the need to communicate this recommendation with vaccine empathy. I sense many of my colleagues may be grimacing their face or be acting bewildered at the thought of this need with something we do 15-30 times a day sometimes, but research suggests our new pet parents want this. I do think, however, that learning the technique to communicate empathy is one that can be used repeatedly in all settings with clients. There are four steps: listen to the client, actively hear their concerns, imagine their position, and give verbal AND nonverbal cues showing empathy and compassion.

The wellness exam doesn't just include vaccinations, and we certainly want to communicate better to our pet parents that one of the strongest reasons for this visit is the physical exam and/or screening tests we can provide. These pet parents want to know the risks ahead, especially related to breed. A perfect case study for this is the discussion around chronic kidney disease. We need to communicate that 1 in 3 cats are likely to develop kidney disease during their lifetime (Marino CL, 2014). That means that 60% of senior cats over the age of 10 and 80% of geriatric cats ages 15-20 years of age will be afflicted, and the average pet parent managing a kidney patient will spend $650/year. These are all important to share, but even more of a priority is sharing the risk factors known for the development of chronic kidney disease so pet parents can try to avoid or prevent (Green, 2014):

- Thin body condition
- >9 years of age
- Prior periodontal disease
- Prior cystitis
- Anesthesia/documented dehydration in the last year
- Neutered male
- Any region of the US OUTSIDE of the northeast

- Loss of appetite

This leads me to anticipate a possible pet parent's next question about "loss of appetite" – this is really tied to the measurable metric of weight. Our cats should be weighed at EVERY visit and ideally consistently at home. Weight loss can be detected up to 3 years before a diagnosis of chronic kidney disease, and if it continues, accelerates disease progression after diagnosis. (Freeman LM, 2016) Let's not wait for weight loss! Median weight loss was detected 6-12 months prior to a chronic kidney disease diagnosis in 10.8% of chronic kidney cats as compared to 2.1% in non-kidney cats. This is where appetite stimulants shine! There are currently two FDA-approved medications. Mirataz, a topical, is approved in cats for up to 14 days. The newer stimulant, Elura, is approved for chronic long-term use in cats with chronic kidney disease. And finally, don't forget about newer screening tools that help predict development of this disease. Renaltech, a screening test from Antech labs, uses artificial intelligence to predict which cats will develop chronic kidney disease in the following two years with >95% accuracy. The median age was 15 years for predicted cats as compared to 9 years of age for non-predicted cats.

Also included in education for our pet parents alongside screening tests are breed risks and tendencies. In 2018, CNBC reported average costs of caring for certain breeds of cats and they ranged from $1000-$25,000 for Bengals to $200-$3000 for Sphynx's (Turner, 2018), Our information seeking Millennials will have interest in these values. What do these breeds have in common with some other purebreds? They all have inherent risk of hypertrophic cardiomyopathy (HCM). Unfortunately, this disease is one that usually starts at 4-8 years of age but can begin as early as 3 months of age. (Arnold Plotnick, 2019) Hence, these discussions should occur as close to first visits as possible to create awareness ahead of any disease process.

The Internet of Medical Things

The initial digital introduction has passed, the physical exam and is over, but that doesn't mean our recommendations and touchpoints must end! Therefore, I bring up the "Internet of Medical Things". These are medical devices and applications created to connect patients to care providers. (Cox, 2021) They do require a telemedicine application and internet to function, but the newer generations also include AI, or artificial intelligence.

When would we bring this concept up to our pet parents? There are so many cases that would benefit from these types of home "monitoring": detecting scratching, food, and water consumption monitoring, licking associated with joint pain, sleep disturbances, body weight trending and even biometric data.

Many colleagues have asked what the internet of medical things looks like to us and the consumer. Here are a few examples. The Sure Petcare Feeder is a device that monitors how much, how often and when a cat or cats eat. It connects to an app via a hub in the home and weighs the pet food placed into the device through integrated scales. This is a fabulous option for those multi-cat families where one cat is obese, and one can't keep weight on, or one cat is on prescriptive diets and the others only need maintenance diets. A newer offering from the same company is the Felaqua, a device that delivers fresh water with the same app connection. (https://www.surepetcare.com/en-gb/felaqua-connect/felaqua-connect) Similar to the feeding device, it monitors individual cat drinking patterns and can help really track hydration and/or home monitoring for diabetes mellitus, chronic kidney disease and other metabolic diseases. One that is featured as an up-and-coming smart litterbox is the Space Kotty. With a built-in UV lamp, it tracks the frequency of urination and defecation and weighs the cat(s) every time of use. (Hearn, 2020) Finally, don't forget the wearables! Consumers spent over one billion dollars in 2016 worldwide, 80% of them being Millennials.

The Last Impression

It's time for check-out and it's our last few minutes with our pet parents and feline patients. What is the best way to spend this time? The first thing to do is ***forward schedule.*** Remember, we don't want our pet parents to think the only time they bring in their cats for wellness exams is when a vaccine is due. Stress the importance of the physical exam as the core reason for the visit. There are NEW AAFP Feline Senior Care Guidelines for exams, recommending every 6 months for cats 10-15 years of age and every 4 months for >15 years of age. (2021 AAFP Feline Senior Care Guidelines, 2021)

Does that exam need to be in person? Well, in a recent research study by M/A/R/C research presented on DVM360, 48% of pet parents felt they would "probably" to "definitely" use telehealth in the future for their pets. Pet owners find telehealth faster and a more convenient alternative to in person exams. Talk to your team and figure out your telehealth strategy – what cases apply, what platform works best, what you will charge and how you will communicate this to clients.

Finally, the same study revealed that 57% of new pet owners were surprised by the costs of care and found it to be higher than expected. That's a very important statistic to acknowledge. In fact, the AVMA has not only

acknowledged this, but unveiled recommendations on what consumers want post-pandemic in a recent June 14th, 2021, blog. These included keeping curbside stays an option for those that prefer it, make online order a focus, send out your own client survey for preferred communication and desired services at your practice, and most importantly, offer creative care/financing options, including payment plans, deferred payment, and credit options. This helps show clients we care and recognize that pet parent desires to do the best for their cat have not changed although their financial status may have due to the pandemic.

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To Cut or Not to Cut: Incorporating New Technologies & Avoiding the Pitfalls in the Treatment of Feline Uroliths

Jody Lulich, DVM, PhD, DACVIM

Optimal patient care depends on an accurate diagnostic assessment of clinical information and thoughtful analysis of the trade-offs between the benefits and risks of further diagnostic testing and treatment. Sometime this results in us falling into traps and clinical dogmas that are not true.

Medical Pitfalls

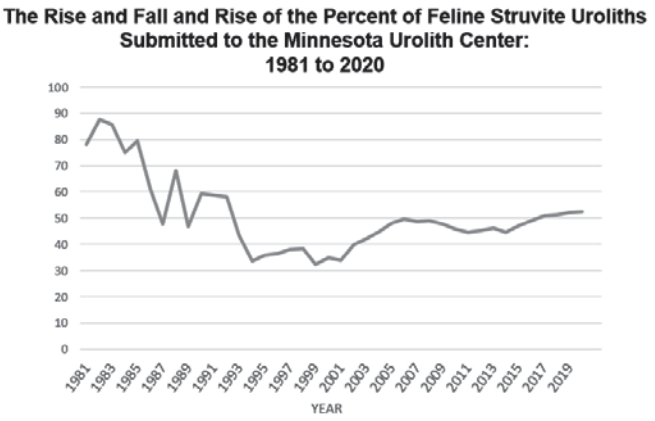
Definition:

Medical Pitfalls are beliefs that are exaggerated and generally not true. Falling into one of these traps prevents veterinarians from providing their best care to patients. Below are common diagnostic pitfalls and solutions for feline urolithiasis.

Pitfall	Evidence and Rationale	Solution
Predicting urolith composition prior to surgery is not helpful, just remove stones surgically	Predicting the composition allows options for more compassionate care (e.g. medical dissolution). Uroliths are not a disease but a marker for disease (hypercalcemia, portosystemic shunt, urinary tract infections, genetic variants, etc.). Correcting the disease before or at the time of stone removal will minimize stone recurrence and maximize efficiency.	Use radiographs and the Minnesota Urolith Center App to guide stone prediction and management. (https://vetmed.umn.edu/centers-programs/minnesota-urolith-center/urolith-analysis/urolith-center-app)
Crystal type is a reliable predictor of stone composition	Over 75% of cats with stones do not have crystalluria. When crystals are present 10% do not match stone composition.[1]	
Ultrasound is superior to radiographs for stone diagnosis	Ultrasounds can better identify small uroliths and non-radiopaque uroliths, but can miss stones in the urethra and ureters. Ultrasound lacks information about stone characteristics that can aid prediction of composition. Ultrasound and radiographs are not mutually exclusive but complimentary.[2]	

Feline Struvite Dissolution is the Standard of Care.

Struvite dissolution has never been easier, safer, and faster in the history of veterinary medicine. Yet it is underutilized. The chart below shows the rise and fall and rise of feline struvite. a phenomenon likely occurring because more struvite stones are removed surgically than dissolved nutritionally.



To Improve Struvite Dissolution Outcomes, Consider These Strategies

1. Strengthen your accuracy of stone prediction (CALCulate, Radiograph, UA)
2. Consider a urine culture in cats likely to have an infection (e.g. cats with a perineal urethrosotomy)
3. Avoid dissolution of urethral stones
4. Recheck radiographs in 2 weeks to assess therapeutic efficacy
5. Check in with clients often to enhance compliance

Current Dogmas (Catmas) That May Incorrectly Have You Think Negatively About Struvite Dissolution

False Dogma	Evidence countering the dogma
Male cats are likely to obstruct during dissolution	Of over 120 cats that participated in dissolution studies, only 1 obstructed (<1%)
I want to give my cats immediate relief	The pain associated with surgery is likely greater and longer than the discomfort associated with stone dissolution [3]
Surgery is always effective	Studies show that surgeons experience incomplete stone removal in 20% of cystotomies.4
Most cats will not eat canned food	Studies proved that dry struvitolytic foods dissolve stones as quickly as canned struvitolytic foods.[1]
I do not know how to identify struvite stones in cats	The Minnesota urolith center app can help identify struvite using your smart phone. Download the app.
I like doing surgery	I like during surgery also, but my patients will not benefit from my expertise unless I can provide them with expert therapeutic options that are compassionate and economically feasible.
A gradual diet transition will delay stone dissolution	You are correct, but most cats who are good eaters will not need a gradual transition to a new diet. Finicky cats may need a gradual food transition.

Small Stones Can be Removed Non-Surgically by Voiding Urohydropropulsion

Voiding Urohydropropulsion:

Twenty years ago at the University of Minnesota, I developed an innovative technique to remove urocystoliths, called voiding urohydropropulsion.[5] By taking advantage of the effect of gravity on urolith position in the urinary bladder and dilation of the urethral lumen during the voiding phase of micturition, this simple technique allows uroliths to be rapidly flushed out of the urinary bladder. This procedure is idea for eliminating recurrent stones in patients that are routinely monitored. This is because detecting recurrent stones early prior to them causing clinical signs usually indicates that they are small enough to easily void and that the bladder wall is sufficiently healthy to easily accommodate forceful manual expression.

Below is a list of important considerations to insure successful urolith removal.

1. Choose the right patient. Voiding urohydropropulsion works well in female cats with small urocystoliths (<4mm). The urethral in male cats is too narrow to accommodate passage of the uroliths once the diagnosis is made.
2. Don't assume that a light plane of anaesthesia is sufficient to relax the urethra; full anaesthesia beyond the depth necessary to perform an abdominal celiotomy should be utilized.
3. Avoid anesthetizing with dexmedetomidine. This drug works by activating the sympathetic nervous system. Although dexmedetomidine primarily activates alpha 2 receptors and the urethra has primarily alpha 1 receptors, experimental studies in rats indicate that dexmedetomidine is not completely selective and also activates alpha 1 receptors causing increased urethral tone. This will make voiding more difficult.
4. Voiding urohydropropulsion is not suitable for managing urethral stones. Therefore, using only ultrasound to diagnosis uroliths may be inadequate to since it does not always detect all urethral stones.
5. Voiding urohydropropulsion is not suitable for managing patients with urethral obstruction or recent bladder surgery; the integrity of the bladder wall has been compromised and may not accommodate safe bladder expression.
6. Select cats based on stone size and your level skill. If you have never performed voiding urohydropropulsion, select cats with smaller (<3mm), smooth uroliths, and prepare for cystotomy in case of an adverse event. You should not be concerned about stones becoming stuck in the urethra. If stones could become lodged in the urethra during bladder expression, they are easily flushed back into the urinary bladder to be removed surgically.[6]

Performing Voiding Urohydropropulsion

1. Anesthetize the patient	The type of anaesthesia selected may vary based on patient considerations. A common mistake is assuming that only a minimal depth of anaesthesia is needed. In our experience, the depth of anaesthesia needed to perform voiding urohydropropulsion is greater than that needed for routine abdominal surgery. Consider the addition of short acting anaesthetics (e.g. Propofol, 0.5-1mg/kg IV) 30 seconds prior to bladder expression, or lumbar epidural anaesthesia (0.1–0.2 mL/kg of 2% lidocaine without epinephrine) to facilitate urethral

	relaxation. Avoid anaesthetic drugs likely to increase urethral tone (e.g. dexmedetomidine and other adrenergic receptor agonists).
2. Attach a 3-way stopcock to the end of an 8 *Fr* urinary catheter and insert the catheter into the urethra	The 3-way stopcock facilitates control of the volume of fluid entering the bladder and containment of fluid once the bladder is filled.
3. Fill the urinary bladder	Sterile physiologic solutions (LRS, normal saline) are injected through a transurethral catheter to distend the bladder. If fluid is expelled prematurely around the catheter prior to adequate bladder filling, the vulva and/or urethra can be gently occluded using your thumb and first finger. Placement of additional fluid may not be needed.
4. Position the patient such that the spine is approximately vertical	Repositioning the patient allows uroliths to accumulate at the neck of the bladder facilitating their expulsion. Anatomically, the urethra does not become vertical until the caudal spine is 20 to 25 degrees anterior of vertical, but this may not be clinically important to completely void stones.
5. Oscillate the bladder	Gently oscillate the urinary bladder left and right to dislodge uroliths that may be loosely adhered to the bladder mucosa.
6. Remove the urinary catheter	
7. Express the urinary bladder	Apply steady digital pressure to the urinary bladder to induce micturition. Once voiding begins, the bladder is more vigorously compressed. When compressing the urinary bladder lift it cranially (toward the back and head of the patient). Compressing the urinary bladder caudally toward the pelvis may cause the urethra to kink preventing maximal urethral dilation.
8. Repeat steps 2 through 7	The bladder is flushed repeatedly until no uroliths are expelled. You may notice the urine become pink (blood tinged). This is not an indication to stop voiding but may indicate that the depth of anaesthesia needs to be deepened. Visible hematuria usually resolves within 24 hours.
9. Medical Imaging	Imaging provides an appropriate method of assessing successful expulsion of uroliths. To enhance detection of remaining small uroliths consider a double-contrast cystography (only the lateral view is needed).

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ISCAID Antimicrobial Use Guidelines: Which Antimicrobial, What Dose, & For How Long?

Jane Sykes, BVSc (Hons), PhD, MBA, DACVIM (SAIM)

The International Society for Companion Animal Infectious Diseases (ISCAID) Antimicrobial Guidelines Working Group was formed to develop guidelines for antimicrobial drug use in dogs and cats, because of concerns that antimicrobial drug resistance has dramatically increased in prevalence among isolates from dogs and cats in the last decade. The guidelines are to be published in open access format so that they are widely available. The members of the ISCAID Working Group are Scott Weese, Joseph Blondeau, Dawn Boothe, Edward Breitschwerdt, Luca Guardabassi, Andrew Hillier, Michael Lappin, David Lloyd, Mark Papich, Shelley Rankin, Jane Sykes, and John Turnidge. Input has also been obtained from panels of Diplomates of relevant specialty groups. It should be noted that members of the working group receive support from a variety of industry groups that provide funding for honoraria and research (listed at www.iscaid.org).

Guidelines for treatment of urinary tract disease in dogs and cats (updated), respiratory infections in dogs and cats, and superficial pyoderma in dogs have been published (www.iscaid.org).[1-3] During the course of guideline development, it became clear that there is a significant lack of objective, published information. Accordingly, recommendations are based on available data, whenever present, along with expert opinion, considering principles of infectious diseases, antimicrobial treatment, antimicrobial resistance, pharmacology, and internal medicine. Funding for studies on antimicrobial resistance in companion animals is badly needed. Clinical trials that evaluate antimicrobial drug regimes for bacterial infections in dogs and cats are encouraged.

Because of the increased prevalence of antimicrobial drug resistance, the need to properly document the presence of an infection before initiating antimicrobial drug treatment is more important than ever. In veterinary medicine, this may be at odds with client financial resources. However, inappropriate use of antimicrobial drugs is wasteful of client resources when an infection is not present or a multidrug resistant pathogen is present, and risks selection for antimicrobial resistant bacteria that may be harmful to the pet, other animals, and also humans that are in contact with the animal. Clinicians should choose laboratories for culture and susceptibility (C&S) testing that follow protocols and use breakpoints published by the Clinical and Laboratory Standards Institute (CLSI), EUCAST or other internationally recognized institutions. The Working Group hopes that veterinarians will re-think the empiric use of antimicrobial drugs, especially when the underlying condition is not immediately life-threatening. An emphasis on rational antimicrobial treatment needs to be made to pet owners, as has been made in human medicine. The guidelines do not provide specific recommendations for hygiene and disinfection, but posters describing appropriate measures and guideline documents are available from veterinary associations in North America and in Europe and these should be followed.

Some of the basic recommendations within the urinary and respiratory guidelines that relate to cats are summarized below. Doses of specific antimicrobial drugs are listed in the guidelines themselves.[1,2]

Recommendations for Urinary Tract Disease

Sporadic Cystitis

Definition: Sporadic bacterial infection of the bladder (< 3 UTIs per year).

- The presence of urinary tract infection implies the presence of dysuria, pollakiuria, and/or stranguria. However, diagnosis of UTI cannot be made on the basis of clinical signs alone.
- Sediment analysis alone is not adequate for diagnosis because of the variable quality of interpretation.
- Complete urinalysis and quantitative aerobic C&S testing should be performed for all cases in cats. Free-catch samples should not be used.
- For cystocentesis specimens, counts ≥ 10^3 CFU/mL indicate UTI. For catheterized specimens, counts ≥ 10^4 in males and ≥ 10^5 CFU/mL in females are significant.
- Bacterial isolation should only be attempted in clinics with appropriate laboratory facilities, proper biosafety containment and waste management, and adequately trained individuals. A recent study showed that in-house “urine paddles” may be useful to rule out the presence of infection but these do not reliably identify bacteria and can generate false negative results.[3]
- Treatment is indicated to relieve patient discomfort while awaiting C&S test results. Recommendations for initial treatment are amoxicillin (11 – 15 mg/kg PO q12h) or trimethoprim-sulfonamide (15 mg/kg PO q12h).
- Veterinarians are encouraged to document and monitor resistance patterns among isolates from their hospital.
- If C&S testing reveals a resistant isolate and there is a lack of clinical response, treatment should be changed to an appropriate antimicrobial drug.

- Although treatment has been recommended in the past for 7 to 14 days, recent research suggests 3-5 days may be more appropriate.[4,5]
- There is no evidence that intra- or post-treatment urinalysis or urine culture is indicated in the absence of ongoing clinical signs of UTI.

Recurrent UTI
Definition: the presence of 3 or more episodes of UTI during a 12-month period.
- The same general principles as for sporadic cystitis apply
- Efforts should be made to identify the underlying cause; consider referral
- Treatment should be based on the results of C&S testing
- Although 4 weeks has been recommended for treatment, shorter durations are recommended, with a focus on clinical cure rather than microbiological cure.
- There is insufficient evidence to recommend "pulse" or chronic low-dose treatment, urinary antiseptics, and nutritional supplements such as cranberry juice extract for prevention of UTIs.

Subclinical Bacteriuria
Definition: presence of bacteria in the urine as determined by positive bacterial culture, in the absence of clinical signs of UTI.
- Treatment may not be necessary, but could be considered if there is a high risk of ascending or systemic infection (eg. patients with underlying renal disease)
- Diagnosis and management of the underlying cause is critical

Urinary Catheters
- Clinical signs of UTI absent: no culture or treatment indicated.
- Removal of urinary catheters: urine culture is reasonable if the risk and implications of a UTI are high, but in general it is not recommended. There is no indication for routine use of prophylactic antimicrobials.
- Clinical signs of UTI present: perform a culture after replacement of the urinary catheter with a new catheter. Several mL of urine should be removed to clear the catheter before a specimen is obtained for culture. Alternatively, remove the catheter and perform a cystocentesis. Culture from the collection bag, and culture of the catheter tip after removal are not recommended. Treatment should follow the guidelines for complicated and uncomplicated UTIs, and is more likely to be successful after catheter removal.

Pyelonephritis
- C&S testing should always be performed.
- Treatment should be initiated while awaiting culture results, using antimicrobials effective against Gram-negative *Enterobacterales*. A fluoroquinolone is a reasonable first choice, after which treatment should be based on C&S results. If combination treatment was used initially and C&S results indicate that both drugs are not required, the spectrum should be narrowed.
- Treatment for 4 to 6 weeks is recommended until further information becomes available.
- Culture is recommended 1 week after starting treatment and 1 week after treatment is discontinued.

Recommendations for Respiratory Disease

Acute Upper Respiratory Tract Disease (URTD)
- Consider an observation period of up to 10 days without antimicrobial treatment for cats with acute URTD. Antimicrobial therapy should be considered if a mucopurulent nasal discharge is accompanied by fever, lethargy or anorexia. In the latter case, appropriate empiric therapy would be doxycycline (first choice) followed by amoxicillin (the latter is not active against *Mycoplasma* spp.). The duration should be 7-10 days.
- Avoid performing C&S on nasal discharge from cats with acute URTD
- If empiric antimicrobial therapy is ineffective, a diagnostic work-up is indicated.

Chronic Upper Respiratory Tract Disease
- A diagnostic work-up is recommended. If treatable causes of nasal discharge are not identified, then nasal lavage or brushings could be submitted for C&S testing, and a nasal biopsy could be submitted for histopathology. Treatment should be based on these results.
- Should nasal discharge recur, the previously effective antimicrobial drug should be used for a minimum of 48 hours; if this is ineffective, only then a switch to a different class should be considered, provided a diagnostic work-up to rule out other causes of nasal discharge (tumors, fungal infection, foreign bodies etc) has been performed.

Bacterial Bronchitis

- Airway lavage with cytologic examination and C&S testing is indicated if bacterial bronchitis is suspected
- While awaiting results of the above tests, empiric treatment is recommended with doxycycline for 7 to 10 days. If this results in clinical improvement, treatment should be continued for 1 week past resolution of clinical signs.

Pneumonia

- Antimicrobial therapy for pneumonia should be initiated as soon as possible and within 1-2 hours if signs of sepsis exist
- Antimicrobial therapy should be parenteral while patients with pneumonia are hospitalized
- If there is no evidence of systemic sepsis, parenteral administration of a beta-lactam is recommended for empiric therapy; if signs of sepsis are present, then a combination of a fluoroquinolone and a drug that targets gram-positive bacteria and anaerobes (e.g., ampicillin or clindamycin) is recommended pending the results of C&S if possible. Animals should be re-evaluated for possible discontinuation of antimicrobials no later than 10 to 14 days after starting treatment.

Pyothorax

- Pyothorax should be treated with IV fluids and drainage of pus after placement of chest tubes. Surgical debridement may be required for some animals.
- Empiric antimicrobial therapy pending the results of C&S should be with a parenteral combination of a fluoroquinolone and a penicillin or clindamycin
- It has been recommended that treatment continue for at least 3 weeks and ideally 4-6 weeks, but the optimum duration is unknown. Cats should be re-evaluated 10 to 14 days after starting treatment.

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Current Concepts in Feline Vaccination

Jane Sykes, BVSc (Hons), PhD, MBA, DACVIM (SAIM)

Introduction

Feline injection-associated sarcomas continue to be a concern in cats, and vaccination protocols in cats are designed to minimize their impact. Annual reassessment of risk to guide vaccine selection is recommended. In 2020, the AAFP/AAHA published updated guidance for vaccination of cats. The update introduced new concepts for consideration, with particular emphasis on administration of the booster that is normally timed for 1 year at 6 months, as suggested by the World Small Animal Veterinary Association. The guidelines are complemented by an online resource center at aaha.org/felinevaccination and supplemental materials at catvets.com/vaccination.

Some common FAQs are presented here.

What vaccines are cCore' and what are 'noncore'?
The AAHA/AAFP vaccination guidelines taskforce recommended vaccines for FHV-1, FCV, FPV, rabies, and FeLV (cats younger than 1 year old) as core vaccines; optional or non-core vaccines for cats include FeLV (for cats older than 1 year), *Chlamydia felis*, and *Bordetella bronchiseptica* vaccines.

At what age should the last kitten vaccine in the series be administered?
For parenteral attenuated live (MLV) feline herpesvirus 1 (FHV), calicivirus (FCV), and panleukopenia (FPV) virus vaccines (FVRCP), the author recommends vaccination at 6-8 weeks, 10-12 weeks and 16-20 weeks of age. In breeding catteries, it is suggested that the final vaccine be administered at 20 weeks. These are *not* booster vaccinations – they are given in a series order to 'catch' the point at which the maternal antibody titer declines enough so that it no longer interferes with vaccination. In the absence of maternal antibody, and provided the vaccine is properly stored and administered, a single vaccination with an MLV FPV vaccine is sufficient to provide long-lasting protection against infection. Some kittens may not be protected against FPV infection using these standard kitten protocols, and that consideration should be given to administering the booster after 6 months *instead of* 12 months.[1] *In the 2020 AAFP/AAHA vaccination guidelines update, this Task Force adopted the same recommendation of revaccination against FPV, feline herpesvirus type 1 (FHV-1), and feline calicivirus (FCV) at 6 months of age to potentially reduce the window of susceptibility in kittens with MDA toward the end of the kitten series (16–18 weeks).* The Task Force recognized that this means an additional visit will still be necessary for administration of the annual feline leukemia virus (FeLV) and rabies vaccinations in young cats.

In shelter environments, revaccination of kittens less than 20 weeks of age should be performed every 2 weeks.

Should a booster be given 2-4 weeks after the first vaccine in cats that first present for vaccination after 16 weeks of age?
Theoretically, a single attenuated live vaccine dose should provide protection to cats that lack maternal antibody. However, a second dose 2-4 weeks later could be considered for cats that reside in high-risk environments. The second dose should be given 2 weeks later to cats in shelter environments.

Do FPV vaccines protect cats against infection with CPV variants?
Antibodies against FPV provide cross-protection against CPV variants. However, the neutralizing activity of serum from cats vaccinated with FPV is reduced when tested against CPV-2 variants, which may have implications for duration of protection in kittens that receive maternal antibody.

When should inactivated FVRCP vaccines be used?
Although in some studies, similar serologic responses can be achieved with inactivated FVRCP vaccines when compared with MLV vaccines,[2] MLV vaccines tend to be more effective at producing protective antibody titers against FPV and probably also FCV,[3] and so MLV vaccines should be used in most circumstances. Inactivated FVRCP vaccines have been recommended for administration to retrovirus-infected cats and pregnant cats, but the extent to which MLV vaccines cause vaccine-associated disease in this group is not well understood. Cats treated with high-dose (24 mg/kg) cyclosporine had equivalent immune responses to booster MLV FVRCP vaccines without evidence of vaccine-associated disease, but their response to initial vaccination with an inactivated FIV vaccine was reduced when compared with untreated cats.[4] Dual strain FCV vaccines may have the potential to provide broader cross-protection against FCV variants that single-strain vaccines,[5] and currently these are only available as inactivated vaccines. If inactivated vaccines are used, two doses of vaccine 2-4 weeks apart are recommended for cats that first present for vaccination after 16 weeks of age.

When should intranasal vaccines be used?
Intranasal (IN) vaccines for FHV1 may produce rapid onset of immunity (within 4 days) when a cat is introduced to a contaminated environment.[6] Administration of an IN vaccine may also have the potential to stimulate a nonspecific immune response and lead to reduction in disease caused by other pathogens, specifically *Bordetella bronchiseptica*.[7] In a study of experimentally infected cats, concomitant administration of an IN FHV1/FCV vaccine and an MLV parenteral FVRCP vaccine led to improved protection against challenge with FHV1 as compared with administration of the parenteral vaccine alone.[8] However, during the 7 days after vaccination but before challenge, more cats receiving the IN vaccine had clinical signs of vaccine-associated sneezing and cough. IN vaccines containing FPV do not provide adequate protection against FPV.

How efficacious is the feline leukemia virus (FeLV) vaccine, when is it indicated and how often should booster vaccines be given?
FeLV vaccines effectively protect kittens from FeLV infection. Nonadjuvanted vaccines may be less likely to be associated with injection site sarcomas,[9] although there remains insufficient evidence to recommend a single vaccine type. All kittens should receive a vaccine for FeLV, after which booster vaccination should be performed at one year and every 2-3 years thereafter for cats at risk of infection for cats with the potential for periodic exposure to FeLV. Annual revaccination is recommended for cats that engage in high-risk activities (fighting, predominantly outdoor lifestyle). The AAFP/AAHA task force continued to recommend that FeLV vaccines be given as distally as possible on the left pelvic limb to facilitate tumor removal with clean margins should a sarcoma arise.

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Is a Positive Really Negative? Interpretation of Diagnostic Tests for Infectious Diseases

Jane Sykes, BVSc (Hons), PhD, MBA, DACVIM (SAIM)

Diagnostic tests for infectious diseases should be broadly considered as either *organism detection tests* or *antibody detection tests.* Examples of organism detection tests are bacterial culture, tests that detect the antigen of a potential pathogen, or molecular tests that detect the nucleic acid of a pathogen (such as NAAT; nucleic acid amplification tests). The detection of an organism implies the presence of the pathogen itself, whereas the pathogen may no longer be present when antibodies are detectable. When considering diagnostic tests for an infectious disease, veterinarians should decide whether an organism detection test or an antibody detection test, or both, are most appropriate. This decision must be based on a knowledge of whether organisms are predicted to be present in high numbers or low numbers, and the *laboratory* sensitivity and specificity of the tests available.

Factors that influence whether organisms are present in high or low numbers include:
a) the most likely stage of disease (peracute, acute, subacute, chronic). Early in the course of disease, an organism detection test is often more appropriate than an antibody detection test, because insufficient time has elapsed to allow an antibody response to develop. However, in peracute disease states, organisms may not be detectable using some assays as well. Typically, in chronic disease syndromes, organisms are present in very low numbers and antibody tests are more sensitive than organism tests. However, the possibility of recovery from previous exposure must be considered. For chronic, persistent infections, such as FIV infection, a positive antibody result equates to infection, provided the animal has not been previously vaccinated. A combination of both organism-detection and antibody-detection tests may be needed to maximize sensitivity and specificity for some infectious diseases.
b) Host immune competence. Organisms tend to be present in high numbers in immunosuppressed animals, and sometimes these animals fail to mount an antibody response, so antibody tests are generally less useful.
c) The anatomic site to be sampled. Clinicians must be aware of organism shedding patterns for an infectious disease, and anatomic sites where the largest number of organisms are shed.

Veterinarians must also consider the value of a positive test result from different assays. Detection of an organism, either by antigen testing, nucleic acid testing, or culture, does not imply that it is the cause of the disease (known as the *etiologic predictive value*). The presence of an organism may be an incidental finding, especially when subclinical infection or colonization is widespread. For some infectious disease and diagnostic test combinations, positive test results may occur as a result of recent vaccination, so vaccination history is important for test interpretation. This is true for any antibody test where attenuated live or inactivated vaccination has occurred in the past (unless discriminatory or DIVA tests are available), and organism-detection tests where attenuated live vaccination has occurred in the past. Vaccination with inactivated vaccines does not generally result in false positive organism-detection tests.

Interpreting negative test results is just as important as interpreting positive test results. Too often, clinicians 'rule out' an infectious disease because a test result is reported as negative. Organisms may be present at undetectable levels, the sample size may be too small, or for PCR assays, assay design may limit the detection of certain strains of a pathogen. It is also possible that organisms are not being shed from the specimen collection site. As noted above, antibody tests are commonly negative early in the course of acute infectious diseases, or in very immunosuppressed animals.

Positive infectious disease test results in very low prevalence situations must be interpreted carefully because more often represent false positive test results than when positive test results occur in high prevalence situations (referred to as *positive predictive value*). This is particularly a problem when unsuspected positive test results appear when an infectious disease 'panel' is requested, including for pathogens that the veterinarian was not initially suspecting.

In many situations, the use of multiple different types of infectious disease diagnostic tests in combination is required, which should be interpreted in light of the time course of illness and the clinical findings. The results of antibody-detection tests often complement the results of organism-detection tests.

Veterinarians should be particularly careful when only large panels for multiple infectious agents are available (such as PCR panels). It is recommended that clinicians return to a differential diagnosis list, select the diagnostic test that is focused on the most likely infectious agent, and interpret the results of unsuspected positive test results with great caution. Communication with the laboratory is also encouraged if there is unfamiliarity with diagnostic tests available. The laboratory should be able to provide information on analytical sensitivity and specificity (how sensitive and specific the assay is in laboratory conditions eg. the lowest amount of antigen that can be detected), and the

veterinarian should also be familiar with the *clinical* sensitivity and specificity of a test (how the test performs when applied to a group of animals with the disease in question), because clinical sensitivity and specificity does not equate to laboratory sensitivity and specificity.

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Update on Feline Viral Infections: Pearls of Wisdom

Jane Sykes, BVSc (Hons), PhD, MBA, DACVIM (SAIM)

Feline Retrovirus Infections

Feline immunodeficiency virus (FIV) and feline leukemia virus (FeLV) are retroviruses that belong to the genera *Lentivirus* and *Gammaretrovirus*, respectively. They remain important causes of mortality in cats through their ability to cause immunosuppression and neoplasia. Screening for retrovirus infections continues to be underperformed by veterinarians, but there are also many recently recognized challenges with test interpretation. Cats infected by both viruses may live long periods of time with good health, and so a positive test result should not alone be a reason for euthanasia.

Feline Immunodeficiency Virus Infection

FIV establishes a chronic, persistent infection that, in some cats, can culminate in immunodeficiency and/or tumor formation. There are at least 6 different subtypes of FIV, designated A through F. The existence of many strains of the virus has complicated the design of molecular diagnostic tests and vaccines for FIV. FIV is shed in high concentrations in saliva, and the major mode of transmission is through bites. Studies worldwide have consistently shown that seropositivity (which is equivalent to infection) is associated with a history of bite wounds, older age, male sex, illness, and outdoor access. Indoor housing decreases transmission of FIV but does not eliminate it. Worldwide, the seroprevalence of FIV in domestic pet cats currently ranges from around 1 to 12%. Higher prevalences are found in feral and free-ranging cats and sick cats.

The main cellular target for FIV is the CD4+ T cell. However, FIV also infects CD8+ T cells, B cells, macrophages, and dendritic cells, microglia and astrocytes. Three phases of disease have been delineated, *acute (primary), subclinical,* and *terminal*. Knowledge of these phases can help practitioners understand diagnostic test results for FIV. After inoculation, the virus replicates in lymphoid tissues, and virus can be detected in the blood in high concentrations 2 weeks after infection. A peak of viremia occurs 8 to 12 weeks after infection. There is a decline in CD4+ and CD8+ T cells in peripheral blood, and this may be associated with transient illness, which lasts 3 to 6 months and is often unrecognized by cat owners. Some cats may show signs of lethargy, fever, anorexia, diarrhea, stomatitis, weight loss and lymphadenopathy during this phase. Most cats survive the acute phase of infection.

In the subclinical phase, the numbers of CD4+ T cells rebound, and the virus load in the plasma declines to very low levels that can be difficult to detect even with PCR assays. Cats remain subclinically infected, often for years or even for life. There is a slow and progressive decline in the number of CD4+ T cells, reduction in the CD4+:CD8+ T cell ratio, and in some cats, hyperglobulinemia, which results from B cell hyperactivation. The rate of progression of this subclinical phase depends on factors such as the virus strain, environmental factors such as co-infections with other agents that activate virus transcription, and host immunity.

Ultimately, in some cats, these changes lead to the terminal phase of disease, which is characterized by the appearance of clinical manifestations of opportunistic infections, neoplastic disease, myelosuppression, and neurologic disease. However, many infected cats never develop FIV-related clinical signs, even when CD4+ T cell counts are low, and instead die from other causes. Lymphomas are the most commonly reported FIV-associated tumor. Immune dysregulation and increased circulating immune complexes can also lead to immune-mediated disorders. Myelodysplasia may develop in some cats. Neurovirulent strains of FIV can cause progressive behavioral changes, tremors, sleep disturbances, anisocoria, delayed reflexes, abnormal cranial nerve function, urinary and fecal incontinence, and seizures. The extent to which chronic FIV infection contributes to disease of other organs, such as the heart muscle and the kidneys, is not well understood, because the prevalence of cardiomyopathy and interstitial nephritis in geriatric cats not infected with FIV is high.

The initial assay of choice for diagnosis of, and screening for, FIV infection is an ELISA assay that detects antibody to FIV. Provided there has not been any history of vaccination for FIV and the tested cat is less than 6 months of age, positive antibody test results equal infection, because the virus establishes a life-long, persistent infection. Point-of-care, lateral flow ELISA assays and diagnostic laboratory-based ELISA assays have rapid turnaround times and high sensitivities and specificities in cats. Positive test results in the absence of antibody to FIV may occur as a result of operator error or non-specific reactivity against tissue culture components after vaccination. Confirmation of positive screening test results has been recommended because of the low prevalence of infection in healthy cats and the higher possibility that false positive test results may occur. It is especially important to confirm positive test results if they are likely to result in euthanasia or rehoming for disease control purposes. Confirmation can be done using a test from a different manufacturer or Western blotting.

False positive test results for infection can occur in cats vaccinated for FIV or kittens less than 6 months of age that possess maternal antibody, the latter either as a result of infection or vaccination of the queen. Kittens that test positive should be retested after 4 to 6 months of age. Cats with a history of vaccination with the inactivated FIV vaccine, even years previously, develop false positive test results that can persist for more than 4 years. Infection can occur in the face of vaccination, so positive test results in a vaccinated cat may represent infection or historical vaccination. Currently, molecular testing with PCR assays is required to identify infection in these cats, but some infected cats may test PCR-negative because of the low levels of virus present.

False negative serological test results can occur early in the course of illness, because some cats take up to 60 days to develop an antibody response to the virus. Thus, when recent exposure is possible, a second serological test should be performed a minimum of 2 months after the initial test. False negative test results can also occur in cats in the terminal phase of disease, as a result of impaired antibody production, or in kittens with rapidly progressive infections. These cats often have high plasma viral loads. Thus, if FIV infection is suspected on the basis of clinical signs, negative antibody test results should always be followed by virus detection using molecular methods. However, negative serology when serology is used as a *screening* test is considered to be highly reliable because of the high sensitivity of the test and the low prevalence of infection in most populations of healthy cats.

A variety of PCR assays have been developed for diagnosis of FIV infection. Assays may detect viral RNA (RT-PCR), proviral DNA, or both RNA and proviral DNA. Compared with serology, PCR can be insensitive (sensitivity < 80%), because viral loads in healthy cats are often low, and some strains may not be detected because of variability in the sequence of the viral genome among FIV isolates. Sensitivity may be higher in cats in the acute and terminal phase of disease when viral loads are expected to be higher. Regardless of the assay used, given the limitations of its interpretation, PCR should never be performed in the absence of concurrent serological testing. PCR-positive, seronegative cats may reflect a false positive PCR result or the terminal phase of disease with failure to produce antibody.

Cats in the terminal phase of FIV infection may require supportive treatments with fluids, nutritional support, regular dental prophylaxis, dilute chlorhexidine-based mouth washes or oral gels, and dental extractions for severe stomatitis. Some cats with advanced neurologic signs show clinical improvement after treatment with glucocorticoids. Opportunistic infections may respond to appropriate antimicrobial treatment, but more prolonged or life-long antimicrobial treatment may be required.

Cats that test positive for FIV should be housed indoors and the feeding of raw foods and hunting behavior should be avoided. FIV-positive cats should be rechecked on a 6-monthly basis in order to monitor body weight, assess for periodontal disease, and discuss the need for routine laboratory testing and vaccination with core vaccines. A complete physical examination, CBC, serum biochemistry panel, and urinalysis should be recommended on an annual basis. Because vaccination with core vaccines has the potential to activate viral transcription, vaccination should only be performed for FIV-positive cats that are likely to be exposed to other cats, especially those that have access to the outdoors. When hospitalized, FIV-infected cats should be kept in separate cages *away from* isolation, where there may be other cats with transmissible infectious diseases such as viral respiratory diseases.

A limited number of studies have shown no significant difference in lifespan between cats infected with FIV and uninfected cats. In 1 study, the median survival times of these 2 groups after testing for FIV infection were 3.9 and 5.9 years, respectively. The progression and severity of disease is related to virus strain and host immunity. Because the lifespan of FIV-infected cats may not be considerably different from that of uninfected cats, no cat should be euthanized on the basis of a positive FIV test alone. Once terminal FIV-related disease occurs, lifespans are typically less than 1 year.

Feline Leukemia Virus Infection

Feline leukemia virus (FeLV) belongs to the genus *Gammaretrovirus* of the family *Retroviridae*. Despite a reduction in the prevalence of infection in recent years, FeLV remains an important cause of mortality in cats as a result of its ability to cause immune suppression, bone marrow disorders and hematopoietic neoplasia.

FeLV infection progresses more rapidly than FIV infection and is more pathogenic, so virtually all cats that have progressive, productive infections ultimately die of FeLV-related disease. However, in contrast to FIV infection, many cats infected with FeLV regress to a permanent state of viral latency. Thus, a positive test result for FeLV in an apparently healthy cat does not always imply that FeLV-related disease and mortality will occur.

There are 4 different subtypes of FeLV: FeLV-A, FeLV-B, FeLV-C, and FeLV-T. Each subtype uses a different receptor to enter cells. All cats infected with FeLV-B, FeLV-C, and FeLV-T are co-infected with FeLV-A, and only

FeLV-A is transmitted between animals. The other subtypes, which are more pathogenic, arise from FeLV-A. The FeLV subtype influences the clinical expression of disease. For example, FeLV-T, a T-cell tropic variant, is associated with immunodeficiency in cats, whereas FeLV-C is associated with non-regenerative anemia.

Transmission of FeLV-A primarily occurs as a result of prolonged, close contact with salivary secretions, such as through licking, mutual grooming, and shared food and water dishes. The prevalence of infection has declined over the last 2 decades with more extensive testing and immunization for the infection. Currently, the overall prevalence of infection in mixed populations of cats is approximately 1 to 6%. The median age of cats infected with FeLV is 3 years. This reflects the phenomenon of age-related resistance to FeLV.

The outcome of FeLV infection depends strongly on the virus strain involved and factors that influence host immune function. The virus replicates in oral lymphoid tissue and then circulates in a few monocytes and lymphocytes within peripheral blood. Some cats may develop systemic signs, such as fever, lethargy and lymphadenopathy during this period. A small number of infected lymphocytes then travel to the bone marrow, where the virus infects rapidly dividing precursor cells and subsequently lymphoid and epithelial cells throughout the body. Infection of the bone marrow is a critical step in the pathogenesis of FeLV infection. Once infection of epithelial cells within the intestinal crypts and salivary glands occurs, the virus is shed in massive quantities in the saliva and feces; it can also be shed in urine.

There are several possible outcomes of infection with FeLV. The immune system of some infected cats is able to suppress productive viral infection within a few weeks after infection, before significant infection of the marrow occurs. These cats develop a *regressive infection* whereby proviral DNA is present in the host cell genome but production and shedding of virus no longer occurs. Regressive infection usually occurs for life, but it may be reactivated with immunosuppression. Transfusion of blood from cats with regressive infections to naïve cats has the potential to be followed by reactivation of FeLV in the transfused cat. Cats develop *progressive infection* once involvement of the marrow is established and persistent viremia and progressive FeLV-related disease results.

Progressive FeLV infection leads to opportunistic infections, neoplasia, anemia, immune-mediated disease, neurological disorders, enteritis, and reproductive disease. The most common types of neoplasia in cats infected with FeLV are lymphoma and leukemia. Anemia in cats infected with FeLV may occur as a result of multiple different mechanisms, including decreased RBC production and increased RBC destruction.

Infection with FeLV is often diagnosed during screening efforts. Screening should be performed with ELISA assays for FeLV antigen. The retrovirus status of all cats should be known regardless of the presence of absence of illness.

Even though some cats that test positive for FeLV antigen have no clinical signs or physical examination abnormalities, a CBC, chemistry panel and urinalysis should be obtained from these cats (and at a minimum, a complete CBC with blood smear evaluation) to assess for underlying abnormalities that may signal the presence of FeLV-related disorders.

The initial assay of choice for diagnosis of FeLV infection is an ELISA that detects soluble p27 capsid protein antigen in blood. When virus isolation in culture was used as the gold standard, the sensitivity of 7 different assays ranged from 92.1 to 96.8%, and the specificity ranged from 95.4 to 99.2%.

When ELISA assays are used as screening tests, confirmation of positive test results is recommended because of the low prevalence of infection in healthy cats and the higher possibility that false positive test results may occur. Positive test results in the absence of FeLV antigen occur rarely as a result of operator error or non-specific reactivity. There are several options to confirm a positive test result:

- Perform another ELISA antigen test using an assay from a different manufacturer. However, it should be remembered that in contrast to FIV infection, cats that test truly positive for FeLV antigenemia early in the course of infection may ultimately still control the infection.
- Perform an IFA assay on peripheral blood smears, because cats with positive IFA results have infection of the bone marrow and are almost always progressively infected. However, IFA is an insensitive diagnostic test.
- Retest with ELISA 1 month later. If the antigen test remains positive, progressive infection is likely. Because in some cats, antigenemia may persist for 4 months before regressive infection occurs, the test should be repeated 3 months later or monthly if client finances permit so long as the cat remains healthy.
- Perform a full CBC. If hematological abnormalities exist, progressive infection is likely.

False negative ELISA assay results can occur in the first month after exposure, before sufficient virus can be detected in the peripheral blood. Cats that test negative within 30 days of possible exposure to the virus should be retested 1 to 2 months later.

IFA assays can be performed on fresh peripheral blood smears or bone marrow. IFA is less sensitive than ELISA and, depending on the laboratory, is more prone to false negative and positive results and so is not recommended for screening purposes. False negative test results can occur in cats with progressive infection when there are inadequate blood cells in the periphery, such as in neutropenic cats. Performance of IFA on bone marrow rather than peripheral blood may help to overcome this problem.

Several different PCR assays have been developed for detection of FeLV. Currently the major clinical indications for PCR are 1) to screen potential blood donors in association with antigen testing, 2) to help understand fluctuating ELISA assay results. PCR assays may detect viral RNA (RT-PCR), proviral DNA, or both RNA and proviral DNA. At the current time, PCR should *never* be used in the absence of antigen testing in order to screen for or diagnose FeLV infection. In addition, it is important that the clinician understand if the laboratory assay used detects proviral DNA, viral RNA (RT-PCR), or both, because the clinical significance of a positive viral RNA assay may differ from that of a positive proviral DNA assay. Recently, quantification of viral load has been correlated to prognosis, and this may become available to practitioners in the future.

The clinical outcome for cats with a positive proviral PCR test result but negative soluble antigen test, which in 1 study represented about 10% of cats with negative antigen test results, is currently unclear. The sensitivity and specificity of commercially available PCR assays is likely to vary depending on assay design, and assays offered commercially have not been well validated or their use has not been well published, so caution is always warranted when interpreting the results of PCR assays for FeLV infection.

Cats with opportunistic infections and lymphoma can be successfully treated using medications and supportive treatments used for cats that test negative for FeLV. Antiviral agents and immunomodulators have shown limited benefit for treatment of cats with FeLV infections.

Cats infected with FeLV should be housed indoors to prevent spread of infection to other cats and minimize exposure of infected cats to other opportunistic pathogens, and raw food diets should not be fed. Survival may be prolonged in low stress environments, so provision of space, adequate litter boxes, management of co-infections and a proper diet is important. Some cats infected with FeLV may not respond to vaccination.

Survival times vary depending on the stage of infection, host immunity, and the strain of FeLV involved. Nevertheless, virtually all cats that are progressively infected with FeLV die as a result of FeLV-related disease within 5 years of diagnosis. Many progressively infected cats, especially adult cats, may live for several years with a good quality of life, and so euthanasia is not recommended on the basis of a positive FeLV test alone.

Several vaccines are available for prevention of FeLV infection. No vaccine provides 100% protection against FeLV infection, and even when protection against progressive infection occurs, regressive infections still occur after challenge. However, vaccination can protect cats from progressive FeLV infection, and so it is indicated for all cats that are at risk of infection. Two doses are given 3 to 4 weeks apart from 8 to 9 weeks of age, followed by a booster at 1 year and then every 1 to 3 years thereafter. Testing for FeLV should be performed before each booster if exposure to FeLV was likely before booster immunization was required (which would be true for most cats vaccinated for FeLV).

Feline Coronavirus Infections

Coronaviruses are large, enveloped, single-stranded RNA viruses. FCoVs cause enteric disease in cats worldwide as well as feline infectious peritonitis (FIP). FIP remains an important cause of death in young and young adult cats, especially those from multi-cat environments such as purebred catteries and shelters. The vast majority of domestic cats that develop FIP are 3 months to 3 years of age. However, FIP can occur at any age, and geriatric cats (> 10 years of age) are also often affected. Although the disease can occur in any breed, purebred cats are more susceptible.

In multiple cat household situations, cats are repeatedly infected, shed virus, and recover, but some cats remain persistently infected and chronically shed FCoV in the absence of clinical signs. More than half, and as many as 100%, of cats in multi-cat environments (> 6 cats) become infected with FCoVs. However, even though the prevalence of infection in multi-cat households is high, less than 10% of cats from large, multi-cat households develop FIP. The most widely accepted theory (the ‘internal mutation hypothesis”) is that cats are infected with a low-pathogenicity coronavirus after oronasal exposure, which results either in no signs, or mild signs of enteric disease. This low-pathogenicity virus has been referred to as *feline enteric coronavirus* by some, in order to distinguish it from virulent FIP virus. However, the use of this name has been controversial, because although the virus is mostly confined to the gastrointestinal tract (especially colonic epithelial cells), FCoV RNA can also be found in blood and

tissue macrophages of cats that do not have FIP. Within some infected cats, the low-pathogenicity virus is then thought to mutate to a virulent virus that has the ability to multiply unhindered within macrophages, and incite pyogranulomatous vasculitis. The mutation may occur shortly after initial infection, or years later. Virulent strains do not seem to be able to replicate effectively in the gut, which may explain why cat-to-cat transmission of FIP does not occur.

Factors that contribute to immunosuppression, such as concurrent viral infection, stress due to overcrowding, surgery or transport, and especially genetic factors may allow viral replication and mutation to proceed unchecked. There is still no distinct mutation that allows avirulent FCoV strains to be differentiated from virulent strains. Therefore, no diagnostic test distinguishes FIP virus from benign FCoV strains. However, mutations in the spike protein gene, membrane protein gene, and the non-structural *3c* and *7b* genes may play a role in different circumstances. In particular, the *3c* gene appears to be disrupted in most (but not all) virulent FCoV strains. Mutations at a spike protein furin cleavage site (S1/S2) appears to correlate with systemic spread of the virus but not necessarily FIP.

The other, less popular hypothesis to explain the pathogenesis of FIP is that distinct circulating virulent and avirulent FCoV strains exist, and the combination of infection with a virulent FCoV and an individual cat's genetic and environmental predispositions leads to FIP. It has also been suggested that both hypotheses may play a role.

Currently, definitive diagnosis of FIP can only be made by immunohistochemical staining for coronavirus antigen within lesions characterized by the presence of pyogranulomatous or granulomatous vasculitis. Because it may be difficult or impossible to obtain biopsy specimens from cats with FIP, antemortem diagnosis can often only be suspected on the basis of history, signalment, clinical and laboratory findings, and by ruling out other causes of disease. Because the presence of the characteristic effusion is most helpful for antemortem diagnosis, efforts should be always made to identify and analyze any fluid that is present in body cavities. When owner funds are limited, laboratory analysis of effusion, rather than blood, may be the most economic diagnostic approach.

Detection of antibodies to FCoV can be performed using IFA, ELISA, or virus neutralization. The methods used, as well as the titers themselves, can vary considerably between laboratories. Use of a reliable laboratory that reports quantitative titers (to the endpoint dilution, as well down to 1:100) is critical. Even when performed correctly, a positive FCoV antibody titer is not diagnostic for FIP, because cats that have been exposed to avirulent FCoV strains or even other related coronaviruses such as canine enteric coronavirus are also seropositive. Therefore, serology should be referred to as a "coronavirus antibody test" rather than an "FIP test". Occasionally (up to 10% of the time), cats with advanced disease may be seronegative, due to failure of antibody production with severe immunosuppression, or the formation of antibody complexes with the large quantities of virus present. In ONE study, titers ≥ 1:1600 were highly suggestive (94% chance) of FIP *in the presence of compatible clinical signs*. In addition, strong positive titers in cats with consistent signs and laboratory abnormalities are especially suggestive of the diagnosis if a cat resides in a household that contains only 1 or 2 cats, because cats often become seronegative within a few months once they are removed from households that contain large numbers of cats.

Real-time RT-PCR assays have been developed for detection of FCoV, including strains with virulence mutations, but these tests do not consistently differentiate between virulent and avirulent strains. In addition, avirulent strains can be detected in the blood and tissues of cats that do not have FIP, so the finding of viral RNA in locations other than the gastrointestinal tract is not helpful for diagnosis. False negative test results can occur when there are low quantities of virus present. Some assays may not detect all strains of FCoV. Positive RT-PCR results for FIP-like viruses in blood or effusion fluid of cats that have other clinical abnormalities that suggest FIP indicate the presence of a coronavirus, and, in that respect, may help to support the diagnosis made provided the limitations of the test are recognized.

FCoV antigen can be detected in macrophages with immunocytochemistry or immunohistochemistry. When the test is performed properly, it appears that only cats with FIP have positive test results. False negative results can occur when there are insufficient numbers of infected cells, when very low quantities of virus are present, or when antigen is unavailable for detection because of complexing by antibody.

Currently, no approved drug treatments for FIP exist; it remains a progressive, fatal disease. The goal of treatment is to prolong lifespan and improve quality of life through reduction of the inflammatory response and supportive care. Administration of prednisolone can result in temporary remissions in some cats. A variety of immunomodulators have been tried, but none have convincingly shown benefit in vivo. The greatest advances in FIP research recently have come in the area of antiviral drugs. Prolonged remissions have been documented in some experimentally- and naturally-infected cats using 3C-protease inhibitors, and especially the remdesivir-like drug GS-441524, and remdesivir. Unfortunately, at this time, illegal manufacturing of these drugs in countries where patents and approval

processes are not honored is occurring. Owners and their veterinarians that are desperately seeking treatments are going increasingly to this black market.

In households that contain only one or a few cats, young cats that develop FIP likely become infected with FCoV before they are acquired; they may or may not have FIP at the time of acquisition. When a cat from a single-cat household dies from FIP, it has been recommended that the owner wait at least 2 months before a new cat is obtained, so that any virus in the environment becomes inactivated. Selection of a new cat from a different genetic background than the previous cat should be considered. If a low number of other cats remain in the household, they may or may not continue to shed virus. These cats usually have a positive antibody titer, but this in no way predicts that they will develop FIP. Before a new cat is introduced, the antibody status of existing and new cats should be established, and factors that could reduce stress and overcrowding should be identified and addressed.

The risk of transmission and disease can be reduced through attention to hygiene, prevention of overcrowding, maintenance of a larger ratio of adult to juvenile cats, and ensuring that cats are in stable groups of 3 or less per room and have sufficient, regularly cleaned litter trays located in a different area to where they are fed. In shelter situations, the disease may be reduced when overcrowding and prolonged stays are minimized, especially during kitten season.

Further understanding of genetic factors that contribute to FIP is required such that selective breeding might be performed in order to reduce risk of the disease. In the meantime, breeding of cats that produce litters that succumb to FIP should be avoided. This is especially true for male cats, because a single male cat can have an effect on far more kittens and litters than a queen.

Novel Feline Viral Infections

Over the last few years, three new viruses have been discovered that have the potential to impact our approach to diagnosis and treatment of common feline diseases. The first is *Felis catus* gammaherpesvirus 1 (FcaGHV1), a gammaherpesvirus that resembles Epstein Barr virus. FCaGHV1 was discovered in 2014. The prevalence of FcaGHV1 infection as determined using PCR on blood has been identified as 9.6%–23.6% in cats from Australia, USA, Europe, Singapore and Brazil. The true prevalence of infection is likely to be higher. Risk factors include being a male cat, being over 2 years of age, infection with FIV, and infection with hemoplasmas. It is suspected that transmission occurs through aggressive interactions among cats. Currently, it is unknown whether this virus is pathogenic, but accumulating evidence suggests the possibility that it may be associated with lymphoma in some cats.

In 2018, a hepadnavirus was discovered in an FIV-infected cat with lymphoma using a metagenomics approach. Hepadnaviruses can cause liver cancers in other host species. Currently there is research examining whether this *domestic cat hepadnavirus* (DCH) might be associated with liver tumors in cats.

The third virus of interest is feline morbillivirus (FeMV), which is a virus related to canine distemper virus and measles virus. Morbilliviruses are highly transmissible viruses that infect lymphocytes and cause immunosuppression. A feline morbillivirus was first detected using molecular methods in feline urine and isolated from cats in 2012. The virus was detected in cats with chronic interstitial nephritis, but a causative association has still not been proven. Cats can be chronically infected over several years with FeMV, and successful experimental infections of research cats with FeMV have now been performed.

References and Suggested Readings

1. Little S, Levy J, Hartmann K, et al. 2020 AAFP feline retrovirus testing and management guidelines. J Feline Med Surg 2020;22:5-30.
2. Beall MJ, Buch J, Clark G, et al. Feline Leukemia Virus p27 Antigen Concentration and Proviral DNA Load Are Associated with Survival in Naturally Infected Cats. Viruses 2021;13.
3. Beatty JA, Sharp CR, Duprex WP, et al. Novel feline viruses: Emerging significance of gammaherpesvirus and morbillivirus infections. Journal of Feline Medicine and Surgery 2019; 21 (1): 5-11.
4. De Luca E, Sautto GA, Crisi PE, Lorusso A. Feline Morbillivirus Infection in Domestic Cats: What Have We Learned So Far? Viruses 2021;13(4):683
5. Lanave G, Capozza P, Diakoudi G et al. Identification of hepadnavirus in the sera of cats. Scientific Reports 2019; 9 (1).

NOTES:

Anesthesia, Analgesia, & Surgery

2021 CONFERENCE

Sept. 30 – Oct. 3, 2021
Phoenix Convention Center
Phoenix, AZ & Virtual

FRIDAY, OCTOBER 1, 2021

Schedule is in Mountain Standard Time (same as Pacific Daylight Time over these dates)

TIME	SESSION TITLE	SPEAKER	ROOM	SPONSOR/ PARTNER
6:00 - 7:00 am	Early Riser Yoga Class*		Sheraton Hotel - Paradise Valley	
7:15 - 8:00 am	Continental Breakfast		North Ballroom Foyer	
8:00 - 8:15 am	President's Address LS	Dr. Kelly St. Denis	North Ballroom A - D	
8:15 - 9:15 am	The Intertwine of Fear & Pain: A Spinning Wheel with Implications for Cats & Their Caregivers LS	Dr. Tamara Grubb	North Ballroom A - D	ZOETIS PETCARE, IVAPM
9:15 - 10:45 am	Networking Refreshment Break		Exhibit Hall	
10:45 - 11:35 am	Purrfecting Your Acute Pain Assessment Skills LS	Dr. Sheilah Robertson	North Ballroom AB	Elanco
	Having the Nerve: Local Anesthetic Techniques You Should be Using - Part 1 LS	Dr. Mark Epstein	North Ballroom CD	Dechra, IVAPM
11:40 - 12:30 pm	A Pain Most Malicious: Understanding, Preventing, & Treating Maladaptive Pain LS	Dr. Tamara Grubb	North Ballroom AB	ZOETIS PETCARE, IVAPM
	Having the Nerve: Local Anesthetic Techniques You Should be Using - Part 2 LS	Dr. Mark Epstein	North Ballroom CD	Dechra, IVAPM
12:30 - 2:00 pm	Lunch		Exhibit Hall	
12:45 - 1:45 pm	*Lunch & Learn #1:** What the Guidelines Say on Identifying, Evaluating, & Managing Feline Hypertension	Dr. Mark Acierno	121A-C	Boehringer Ingelheim
12:45 - 1:45 pm	*Lunch & Learn #2:** What is Your Patient Telling You? Integrate All the Moving Parts	Dr. Guillermo Couto	122A-C	IDEXX
12:45 - 1:45 pm	*Lunch & Learn #3:** Don't Stress! Practical Management of Feline Lower Urinary Tract Disease	Dr. Jessica Markovich	124AB	ROYAL CANIN
12:45 - 1:45 pm	*Lunch & Learn #4:** Identifying & Treating Chronic OA Pain: Help is on the Way!	Dr. Elizabeth Colleran	126A-C	ZOETIS PETCARE
2:00 - 2:50 pm	I'm Old, Painful, & My Mouth Hurts: Dental & Other Protocols for Patients with Pre-existing Pain LS	Dr. Tamara Grubb	North Ballroom AB	ZOETIS PETCARE, IVAPM
	Feline Pain Management Beyond Opioids & NSAIDs: Part 1 LS	Dr. Mark Epstein	North Ballroom CD	IVAPM
2:55 - 3:45 pm	Anesthesia & Analgesia for Cats with Cardiac and/or Airway Comorbidities LS	Dr. Tamara Grubb	North Ballroom AB	ZOETIS PETCARE, IVAPM
	Feline Pain Management Beyond Opioids & NSAIDs: Part 2 LS	Dr. Mark Epstein	North Ballroom CD	IVAPM
3:45 - 4:40 pm	Networking Refreshment Break		Exhibit Hall	Elanco
4:40 - 5:30 pm	Anesthesia & Analgesia for Cats with Endocrine Comorbidities LS	Dr. Tamara Grubb	North Ballroom AB	ZOETIS PETCARE, IVAPM
	Is Your Anesthetized Patient in Trouble? LS	Dr. Sheilah Robertson	North Ballroom CD	
5:30 - 6:45 pm	Happy Hour Reception		Exhibit Hall	ZOETIS PETCARE

*Separate Registration Required. No fees associated.

LS Live Streamed

The Intertwine of Fear & Pain: A Spinning Wheel with Implications for Cats & Their Caregivers

Tamara Grubb, DVM, PhD, DACVAA

Introduction

Pain can be a powerful and unrelenting amplifier – or trigger – of fear, anxiety and stress (FAS). This is probably obvious if you have ever delayed a dental appointment because of fear of procedural pain or felt anxious that your knee pain would keep you from completing your favorite outdoor activity, like a long hike or a round of golf. What might not be so obvious is that FAS can also exacerbate pain. This is well-documented in human medicine and is often called 'anxiety-induced hyperalgesia'. The examples are numerous, here are a few: Patients with pain of osteoarthritis (OA) and higher anxiety scores had significantly lower pressure pain detection thresholds at sites local to - and distant from - the initiating pain source and high anxiety scores predicted increased risk of pain onset.[1] Children and adolescents with higher level of perioperative anxiety had a higher level of postoperative pain.[2] Children with chronic pain and high anxiety had greater pain-related functional impairment and were less improved with interdisciplinary rehabilitation, both at the time of admission to rehab and at a one-month recheck, compared to children with lower anxiety.[3] In the same study, decreased anxiety improved functional outcome. [3] Patients with more 'anxiety-like states' had higher pain scores on a numerical rating system (visual analog scale).[4] And the list goes on!

One theory on the patho-physiologic development of anxiety-induced hyperalgesia is based on the Gray-McNaugton theory, which states that, in situations that create conflict, the hippocampus amplifies the neural representation of the aversive conflict-causing event.[5] If pain is the aversive event, that pain could be amplified to a 'worst case scenario' as a survival mechanism that drives the cat to avoid the cause of the pain, but which also creates FAS regarding the cause of the pain, even if the pain was seemingly minor.[6] This is a crucial concept for the individual (person or animal) that is experiencing pain because pain is not **what** you feel, it is **how it makes** you feel and even presumably mild pain can have a large negative effect on the individual. These concepts are largely based on humans since humans can self-report both their pain and FAS levels. Treatment of both pain AND anxiety is fairly common in human medicine.

What Does This Have to Do with Cats?

Simple physiology – and science. The pain pathway is well-preserved across mammalian species so for a scientific certainty, if a stimulus is painful to a human, it is painful to a cat. We also know that, like humans, animals suffer from fear/anxiety/stress (FAS). So the assumption that FAS could exacerbate pain in animals, and vice-versa, is scientifically valid. Potential evidence in veterinary species includes the fact that dogs with chronic musculoskeletal pain are more likely to experience fear-related noise sensitivity.[7] Stress suffered by cats with idiopathic cystitis[8] likely are likely to have worsening pain as a component of the stress, as has been reported in women with the same condition.[9] As occurs in human medicine, there are likely numerous examples of the pain/fear intertwine in cats – it is just a matter of identifying them, which can be difficult in species that don't self-report their pain/FAS levels. However, in absence of identified examples, cats with pain – especially those that have behavioral changes associated with that pain – are likely to need both analgesics and anxiolytics, at least in the early stage of treatment (ie, until the pain is controlled) or intermittently when stress-triggers occur (eg, extra humans in the house).

What Is the Impact on the Cat?

Untreated or under-treated pain causes a myriad of wide-ranging adverse effects. For instance, pain-induced neuroendocrine changes can include increased cortisol and catecholamine release along with catabolism and immunosuppression. Numerous sympathoadrenal adverse effects can occur, including tachycardia, hypertension, renin/angiotensin release, etc. Neuroplasticity and immunomodulatory changes can lead to peripheral and central sensitization (or 'plasticity'), which can greatly amplify the pain level. And central processing changes can cause a negative impact on welfare/quality of life (eg, anorexia, insomnia) and on behavior, with the potential for FAS, aggression (which is generally extreme FAS), etc.

What Is the Impact on the Cat Owner?

The ideal scenario is that the cat's pain is diagnosed during an annual physical exam, treatment is initiated, and the pain is easily controlled with minimal to no impact on the owner. Unfortunately, pain is often missed by both the owner and the veterinarian when it is mild, especially in cats who can be more difficult to examine and often in a brief, routine annual exam with no indication that pain might be an issue. There is a lot to squeeze into an annual exam! For example, of 90 geriatric cats identified with radiographic changes of degenerative joint disease (DJD), only 4 cats had potential pain conditions mentioned in their medical records.[10] Although radiographic changes do not consistently predict the presence of pain, there is some correlation[11] and it could be predicted that more than 4 of 90 cats were painful. Educating veterinarians to ask pain-focused questions and educating the owners to recognize

changes that might indicate pain and ask about them would allow earlier diagnosis/treatment of pain. When pain is expected, asking owners to submit videos of their cat's activity at home can be very helpful for pain assessment. Without diagnosis, as the untreated pain continues to worsen from ongoing disease and potential initiation of peripheral and central sensitization, the impact on the cat also continues to worsen and the pain itself - and the fear of pain – will likely cause the cat to withdraw from any potentially painful situations, like what the owner perceives to be a light pat on the head. The cat withdraws to a hiding place, or worse, bites or scratches its owner. This leads to an impaired, or even fractured, human animal bond, which, of course can have a major negative impact on both the cat (doesn't get interaction, pain even less likely to be noticed) and the cat-owner (negative impact on emotional well-being and often even health). In addition, as the pain worsens, it becomes more difficult to treat and will require multimodal therapy, which can require more restraint (depending on the route of administration and acceptance by the cat) and more frequent and/or varied drug administration, which adds to the owner burden and the ever-decreasing human-animal bond.

How Can the Intertwine of FAS/Pain be Minimized?

Prevention of pain would be ideal, but this isn't always possible since the pain initiator isn't always known. An example of this is development of osteoarthritis (OA), and its associated pain, in cats. OA often has a known initiator in dogs (developmental joint disease, trauma, etc.) but is primarily idiopathic in cats. If not prevention, then early recognition and treatment of pain should be achieved so that the cat can have a longer span of less FAS and pain. Thus, using tools for veterinarians (pain-focused checklists provided to owners,[12] telemedicine and videos to view the cat in its normal environment, pain-focused physical exams[12]) and tools for owners (checklists sent from the veterinarian,[12] pain-focused websites,[12-14] etc.) are critical for prevention/slowing of the pain/FAS intertwine. Once stress and pain are diagnosed, TREAT BOTH PAIN AND STRESS. Treating one might control the other if both pain and stress are mild but at least intermittent treatment of stress will likely be needed for control of more advanced pain. Consider what the owner can do and what forcing a cat to take medication can do to the human/animal bond. Make a plan that includes environmental modification (it is both stressful and painful if a cat can no longer jump up into its favorite sunny spot) and treatment modalities that don't require restraint or administering something the cat doesn't like (if possible). Get appropriate drugs compounded in special flavors and experiment with the cat to see what it likes. Utilize drugs that are absorbed transmucosally. A recent study showed that gabapentin may be among those drugs.[15] Whenever possible, include nonpharmacologic therapy – especially therapy that the owners can do at home like light massage and pulsed electromagnetic field therapy. For cats with severe pain, consider a daily visit to the hospital for Simbadol injections (off-label use), or a ketamine infusion (off-label use), to accelerate the reduction in pain intensity. With the European-approved (but not yet in the US) anti-nerve growth factor monoclonal antibody, m of the owner administration of drugs will be eliminated as one injection will last approximately 4-6 months.[16]

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Purrfecting Your Acute Pain Assessment Skills

Sheilah Robertson, BVMS (Hons), PhD, DACVAA, DECVAA, DACAW, DECAWBM (WSEL)

Introduction

In feline medicine we always try to practice based on evidence and this includes determining outcome measures to track our success when treating our patients. Historically, we have administered analgesics to cats perioperative or after trauma and either thought our "job was done" or made subjective assessments of how they responded to treatment. Pain is a conscious emotion and always aversive; it has a sensory and affective component.

If pain is not alleviated adequately serious adverse consequences ensue, including but not limited to; tachycardia, vasoconstriction, increased myocardia workload, tachypnea, ileus, release of catabolic hormones and impaired healing. Defensive behaviors are a consequence of untreated pain and inhibit good nursing care. Oligoanalgesia (defined as failure to recognize acute pain and provide adequate analgesia) is still prevalent in feline practice. We can make things better for cats by improving education on pain management in the veterinary curriculum, providing continuing education and implementing pain scales.[1] The four major approaches to successful pain management are:

1. Recognition of pain
2. Assessment of pain
3. Implementation of pharmacologic and non-pharmacological treatments
4. Reassessment

Assessment of Acute Pain

How We Began

The British philosopher Jeremy Bentham (1747-1832) asked "The question is not, Can they *reason*? nor, Can they *talk*? but, Can they *suffer*?" in the context of a discussion of animals and infants and their rights. It seems like it has taken a long time for people to believe that animals are sentient beings, feel pain, deserve the treatment we would wish for ourselves and that pain in never good. However, let's look to the positive effect that embracing feline pain management has done for the cats who are our patients.

There is no doubt that when we started trying to ask cats "how do you feel, how badly does it hurt?", we tried many techniques, often following what was being done for new-born and pediatric patients. We started with the simplest of scales which were unidimensional; for example, a visual analogue scale or a numerical rating scale. It was a start, and it raised awareness, but we soon found these tools could not capture the complexities and multidimensional aspects of pain and because they were subjective, inter-observer agreement was poor, meaning that in a busy clinical setting treatment protocols were not consistent between clinicians. These tools also missed the affective component of pain, or as what Dr Jacky Reid describes as "how it makes the animal feel". With perseverance by clinical researchers, we realized that we needed to understand feline behaviors better, and specifically what changed when they were painful and what behaviors were consistently seen related to acute pain.

Where We are Now

It is now accepted that quantitative measurement of behavior is the most reliable method for assessing pain in animals. These tools look at many features of the cat, including posture, facial expressions and behaviors and are referred to as *composite* or *multidimensional* scales. There has been and continues to be a lot of activity directed at developing more objective assessment tools for cats. There are two validated multidimensional scales; 1. UNESP-Botucatu Multidimensional Composite Pain Scale (UNESP-Botucatu MCPS) and 2. The Glasgow Composite Measure Pain Scale-Feline (Glasgow CMPS-Feline). The UNESP-Botucatu MCPS was developed by Brondani and colleagues by observing cats that underwent ovariohysterectomy.[2, 3] This tool is currently difficult to use in a busy setting because of its length. A shorter more clinically applicable version of this tool is being developed and will be validated in cats with a wide variety of acute pain, including medical causes and will be available in multiple languages (expected in 2021). The original Glasgow CMPS-Feline has been updated to include facial expressions of pain.[4-6] This tool was developed using cats undergoing different types of surgery or with medically related pain.

Facial Expression of Emotions

In 1872, Charles Darwin described facial pain expressions in humas as including features such as "the mouth may be closely compressed, or more commonly, the lips are retracted, with the teeth clenched or ground together".[7] It was a long time before using facial expressions to access internal states of animals or people who could not self-report (e.g., newborn babies and cognitively impaired adults) was explored in depth. However, it soon became clear that there was a so-called "primal face of pain"[8] and that this was a way to look at animal welfare in multiple species.[9]

Even in animals that are preyed upon and therefore hiding pain is essential to survival, facial expressions of pain are spontaneous and cannot be suppressed.[10]

The Feline Grimace Scale

The facial expressions of pain in cats include changes in ear position and tension in the muzzle.[6] A validated Feline Grimace Scale (FGS) is now available and shows excellent inter-rater reliability.[11,12, 13] There is a dedicated website (see Resources) which was launched in July 2020 and regularly updated, where you can download the training manual and read about how the scale was developed and there will be a section where you can practice your own assessment skills. The FGS asks us to score 5 "action units" as shown below, and each is scored 0, 1, or 2. (Figure 1).

Figure 1. The 5 action units and scoring system for the Feline Grimace Scale.

The Feline Grimace Scale

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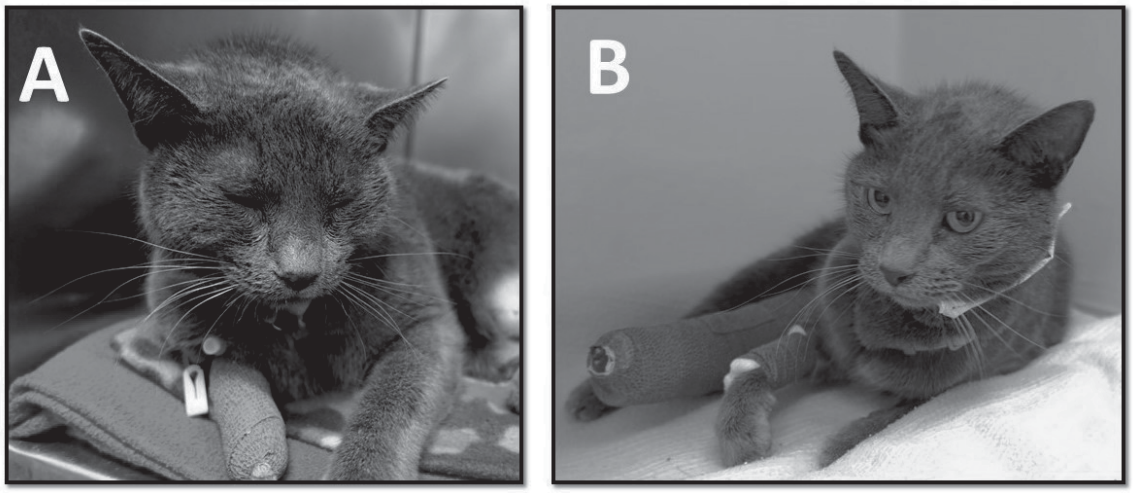
ACTION UNITS	SCORE 0	1	2
Ears	Up	Apart	Flat
Eyes	Open	Partially open	Squinted
Muzzle	Relaxed	Mildly tense	Tense
Whiskers	Loose	Curved	Straight
Head position in relation to shoulders	Above	Level	Below

Since "a picture is worth a thousand words" the images below show the facial expressions of a painful cat Figure 2(A) and after rescue analgesia Figure 2(B). In the image labelled "A", lowered ears, "squinted eyes", tension in his muzzle, straight whiskers and a slightly lowered head all suggest this cat is experiencing pain. In image "B" you see a very different facial expression.

Figure 2A, B. Images of a cat before and after analgesic intervention showing the changes in facial expression.



Outliers?

Assessing acute pain in cats is still a combination of art and science and also putting the scenario in context. We also need to use common sense and look for changes before and after surgery and with treatment. Even prior to an elective procedure in a healthy cat, the baseline score on the FGS may not be zero; consider the at shown below in Figure 3.

Figure 3. The normal facial features of the Scottish Fold cat.

The Role of Anxiety and Stress in Pain

Some of the body postures and facial expressions (e.g., ear position) related to fear and anxiety are similar to those seen with pain and we must differentiate between these but treat both. There have been initiatives in veterinary medicine to enhance the experience of cats during clinic visits and during hospitalization; these include low stress handling, and feline friendly handling. However, the direct impact of these on pain management is often overlooked. Historically, stress induced analgesia has been well documented, but stress induced hyperalgesia also occurs.[14] The affective components of physical and psychological pain share many of the same neural networks and areas of the brain.[15, 16] Addressing perioperative fear and anxiety in cats is part of an integrative or holistic approach to pain management.

What the Future of Pain Assessment May Look Like

Artificial intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems. Specific applications of AI include facial recognition, and this is a big step forward from computer based automatic assessment. To this end, an Artificial Intelligence company based in Canada (sylverter.ai) are developing AI tools based on the FGS. One application is called the Tably which can be downloaded as a beta version to iOS based smart phones.

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Resources – acute pain tools for download

- The UNESP-Botucatu Multidimensional Composite Pain Scale: Animal Pain - English http://www.animalpain.com.br/en-us/avaliacao-da-dor-em-gatos.php
- The Glasgow Composite Measure Pain Scale-Feline: NewMetrica » Acute Pain Measurement https://www.newmetrica.com/acute-pain-measurement/
- The Feline Grimace Scale: Pain assessment in cats | Feline Grimace Scale https://www.felinegrimacescale.com/

Suggested Reading

- Bradley T. Simon; Update on Clinical Acute Pain Assessment in Cats. Today's Veterinary Practice; Update on Clinical Acute Pain Assessment in Cats | Today's Veterinary Practice (todaysveterinarypractice.com)
- Darwin: Darwin, C. R. 1872. The expression of the emotions in man and animals. London: John Murray. First edition. (darwin-online.org.uk)

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A Pain Most Malicious: Understanding, Preventing, & Treating Maladaptive Pain

Tamara Grubb, DVM, PhD, DACVAA

Introduction

NOTE: A thorough review of this topic, including a very informative diagram, is available from Adrian, et al.[1]
Although there may be individuals who still believe the myth that 'animals don't feel pain', this is in fact scientifically impossible. The processes involved in the initiation, propagation and sensation of pain are highly conserved, meaning very similar, across mammalian (and other) species.[2,3] This means that a stimulus causing pain in a human is scientifically evidenced to cause pain in an animal. Thus, veterinary patients should receive analgesics for the same painful conditions that are treated in humans. Failure to control pain is both an ethical and medical issue, causing a myriad of negative effects on the patient's health, welfare/quality of life and behavior.

Of course, not all pain is bad. Pain is defined by the International Association for the Study of Pain as 'an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage'.[4] This rather awkward-sounding definition is actually useful because it describes the value of pain in protection from injury. A cat's paw placed on a sharp object causes activation of the pain pathway, the paw is reflexively withdrawn and tissue damage is prevented, or at least reduced. Thus, pain can be a normal physiologic response which is termed 'physiologic', 'adaptive' or 'protective' pain and is primarily, at least initially, derived from tissue inflammation. This adaptive pain can continue over time as part of the healing process since, as long as the tissue sending the pain impulse is indeed healing, the pain can be protective from further injury. However, the intensity and duration of even protective pain can be in excess of that needed for protection and, if not treated, could lead to maladaptive pain.

'Maladaptive' or 'pathologic' pain is an abnormal response of the nervous system resulting in a state of intense and/or prolonged pain that is not protective from tissue damage, or serves 'no biologic purpose'.[1,5,6] Maladaptive pain can occur due to a variety of reasons, including severe tissue trauma, prolonged inflammation, direct damage to the nervous system (eg, nerve root tumors, herniated intervertebral disc, etc…), and untreated or under-treated pain, especially if the pain is moderate to severe. There are two main types of maladaptive pain, neuropathic pain, which is the pain caused by damage to the nervous system – including damage caused by peripheral neuropathies in diseases like osteoarthritis, and functional pain, which has no identifiable lesions and is driven solely by dysfunctional pain pathway changes.[1] However, there can be a great deal of cross-over in types of pain in maladaptive pain and patients can have more than one type of pain and numerous pain-pathway changes.[1] In general, chronic pain is maladaptive pain because most causes of chronic pain, including the most common cause of chronic pain - osteoarthritis (OA), is not considered protective since OA is not a curable disease that is occurring in healing tissues. Also, pain from OA may be partially, but not wholly, driven by inflammation, but instead by other components of the pathway. For all forms of maladaptive pain, the pain is disease and should be treated as a disease, regardless of the inciting or underlying cause.

Identification of Pain in Cats

Ideally, pain would be readily identifiable, and identification would lead to immediate treatment and improved health/welfare/behavior for the cat. Unfortunately, as is well-known, identification of pain, including maladaptive pain, can be very difficult in animals, especially cats. This difficulty can be due to a number of reasons. Evolutionarily, cats are both predators and prey. As prey, their natural instinct is to hide any vulnerability that could increase predation, including pain. This unfortunately commonly leads to under-recognition with subsequent under-treatment of pain in cats. However, the impact of pain on the cat's lifestyle and quality of life can be discerned if cat owners are educated on pain manifestation. As with acute pain, change in behavior is the most common sign that the cat might have chronic pain. Identification of pain in cats is covered in detail elsewhere.[7,8]

Treatment of Maladaptive Pain in Cats

Because of the major negative impact on the patient, along with difficulty in identification, maladaptive pain should be prevented whenever possible. Aggressive multimodal analgesia (Figure) at the time of acute pain can be useful. Acute pain management should include opioids, local blocks, anti-inflammatory drugs and ketamine infusions, especially if pain is moderate to severe. Other pharmaceutical and nonpharmaceutical modalities should be included, depending on the source of pain.

Once pain has become maladaptive, the cause of pain may not be the initial cause but rather a change in the pain pathway and traditional analgesics may have reduced, or no, efficacy. For instance, there may be a minimal or no inflammatory component to the pain, rendering NSAIDs only minimally effective at best. Changes in the spinal cord

can cause a downregulation of opioid receptors, making this class also minimally effective aa best. Opioids may be affective for acute break-through pain as might be the situation (as an example) in patients with cancer pain. Thus, treatment is focused on 'nontraditional' choices that have select mechanisms in the pain pathway. Most of these treatments are not effective alone and must be used as part of multimodal therapy (Figure).[9] In addition to pharmaceuticals, non-pharmacologic options like acupuncture can be useful.

Drugs that may play a specific role in multimodal analgesic therapy for maladaptive pain include amantadine, ketamine, gabapentin, pregabalin and anti-nerve growth factor monoclonal antibodies. Amitriptyline and tramadol, and some other drugs, may play a role as norepinephrine and/or serotonin reuptake inhibitors in the descending limb of the pain pathway. CBD also has potential. Few studies are available for the use of the drugs listed below in veterinary medicine, and almost no studies in cats, but all of these drugs have been used clinically to treat chronic maladaptive pain in cats. A more in-depth review of the drugs is available.[1]

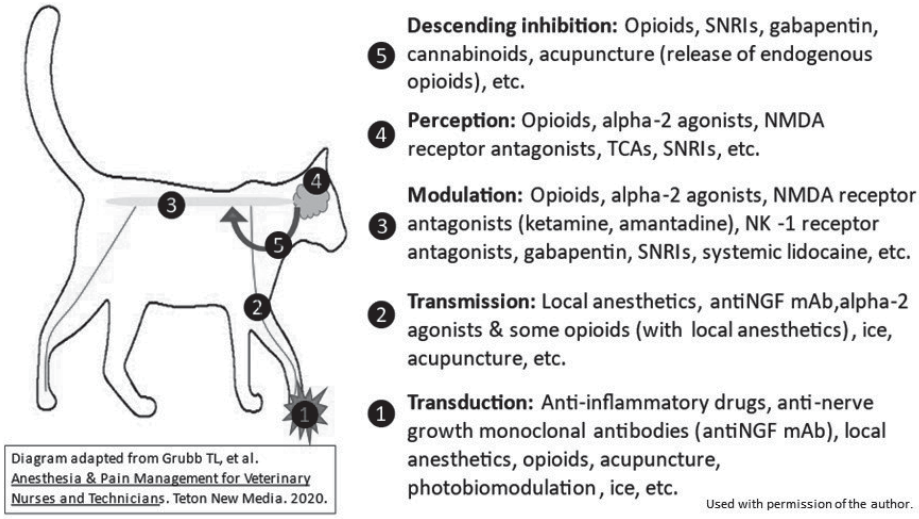

Figure: Pain pathway location of action of various analgesic drugs/treatments.[9]

TABLE: Pros/cons/dosages of the drugs potentially useful for maladaptive pain in cats, including osteoarthritis (OA) pain. NSAIDs and opioids have been omitted because of minimal efficacy with maladaptive pain. (*JS=personal communication with Dr. Jen Slovak, DVM, MS, DACVIM)

Drug (class)	Dose, route, frequency	Pros	Cons	Comments
Amantadine (NMDA-receptor antagonist)	3-5 mg/kg PO, BID JS*: 5 mg/kg SID-BID	Minimal adverse effects, potential of significant pain relief because of MOA	Oral BID Efficacy can be difficult to determine.	Dosing is based on one dog study and may be inadequate but neither pharmacokinetics or pharmacodynamics have been studied in the cat.
Amitriptyline (tricyclic anti-depressant)	3-4 mg/kg PO, BID	Minimal adverse effects	Oral BID Cats don't like the taste	Serotonin-reuptake inhibition may provide analgesia through the descending inhibitory limb of the pain pathway.
Anti-nerve growth factor monoclonal antibody[10-12]	1-2.8 mg/kg SQ, once q4-6+ weeks (basically 'as needed'	Minimal-no adverse effects, long duration,	TBD	Not yet available in US, released in EU/UK in 2021[13] Injectable route of administration by veterinarian = decreased owner work
Gabapentin (calcium channel blocker) Pregabalin (in comments	3-20 mg/kg PO, BID-QID JS*: 5 mg/kg if ANY evidence of CKD, 10 mg/kg BID-TID	Minimal adverse effects, one study indicates efficacy for treatment of OA pain in cats[14]	Oral BID-TID Can cause sedation, +/- controlled drug	Proven effective for calming prior to transport to the veterinary hospital, which may also decrease pain since pain causes anxiety and anxiety exacerbates pain. **Pregabalin** 1-2 mg/kg[15] may be more effective but there are no studies to date
Ketamine (NMDA receptor antagonist)	IV infusion of 2-10+ micg/kg/min following 0.5	Minimal adverse effects, potential of significant pain relief	Patient must be hospitalized for infusion. Repeat	Proven effective in other species, especially in patients with pain of central sensitization. Most effective dose and infusion duration are unknown and are likely highly individual.

	mg/kg loading dose	because of MOA	infusions may be necessary.	
Maropitant? (NK-1 receptor antagonist)	1 mg/kg IV or SQ 1-2 mg/kg PO SID	Minimal to no adverse effects, potential for pain relief via unique MOA	Oral SID administration	May be useful especially for chronic GI pain. JS*: can dose significantly longer than 5 days if necessary
Tramadol?	1-2 mg/kg PO, BID JS*: 2-4 mg/kg BID, **ONLY if E-tube in place due to taste	Two studies indicate efficacy for treatment of OA pain in cats[16,17]	Tastes bad, oral BID-TID dosing, can cause sedation or dysphoria, controlled drug	Adverse effects like dysphoria, sedation and diarrhea are **common** at the effective dose

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I'm Old, Painful, & My Mouth Hurts: Dental & Other Protocols for Patients with Pre-existing Pain

Tamara Grubb, DVM, PhD, DACVAA

Introduction

As with aging humans, aging cats can be healthy, with no heightened concern for anesthesia, or can have physical, physiologic and/or cognitive changes that can impact – or be impacted by – anesthesia, potentially increasing the risk for anesthesia-related adverse events. Management of anesthesia, including choice of drugs, in healthy aging cats is generally not different from anesthesia in young adults since the pharmacokinetics/pharmacodynamics of drugs is likely unaltered,[1] although lower dosages may be effective. The adage 'age is not a disease' is just as true for cats as other species and it is not the number of years the cat has lived that increases anesthetic risk but the presence of comorbidities and declining physiologic reserve. Rather than an exact age that defines the term 'geriatric', a more scientific description is the age 'generally considered to be the last 20% to 25% of the animal's normal expected life span'.[2] The definition of geriatric in the amazing 2021 AAHA/AAFP Feline Life Stage Guidelines is the most appropriate and helpful: ' 'geriatric' is more a statement of health status, and has no specifically associated age'.[3] All that being said, comorbidities occur more commonly in aging patients and cats ≥12 years are reported to be twice as likely as young adult cats (0.5–5 yrs) to have an anesthesia-related death.[4] In addition to comorbidities, 'frailty' occurs and is defined by the AAFP as, 'a syndrome, more common with advancing age, in which the patient has a decreased functional reserve that leads to a decline in physiologic and cognitive performance and a greater vulnerability to adverse medical outcomes'. A brief review of potential physiologic changes that occur with frailty and their effects on anesthesia is presented in the **table** at the end of the notes.

Physiologic and Pharmacokinetic-Pharmacodynamic Considerations:

The decreased functional reserve that occurs with frailty can cause a decreased ability to respond to a physiological challenge or change and increased 'sensitivity' to anesthetic drugs that manifests as exaggerated or prolonged effects after the administration of drug dosages that are appropriate for young adult patients. In addition, many comorbidities alter the pharmacokinetics of drugs, which may also alter the pharmacodynamics of those drugs. Drug choice/dose is dictated not only by the comorbidity itself, but also by the impact of the comorbidity. For example, cardiac disease may cause decreased blood flow to other organs, like the liver and kidney. This could result in decreased hepatic and/or renal function, thereby potentially slowing clearance of drugs that depend on metabolism/clearance by those organs for termination of drug effect. This is another mechanism that could lead to an exaggerated response to anesthetic drugs, or other concurrently administered drugs. Cognitive dysfunction, which is a fairly common comorbidity in aging cats, can produce an exaggerated dysphoric response after sedation or during recovery from general anesthesia.

Pre-existing Pain

Pain is a common comorbidity in aged cats. Preexisting pain can be acute and obvious, like a wound, a fracture or an intestinal foreign body, or can be chronic and undiscovered. Chronic pain sources include osteoarthritis (the most common), periodontal disease, cancer, musculoskeletal injury and a variety of other medical conditions like pancreatitis. Pain is a tremendous stressor and, like other comorbidities, can cause a myriad of health, welfare and behavior effects. Pain also impacts the safety of anesthesia since the presence of pre-existing pain, in addition to the acute pain associated with the procedure requiring anesthesia ('acute-on-chronic pain'), commonly results in central sensitization (or central 'plasticity') with the resultant amplification of pain intensity. Unless managed appropriately with robust multimodal analgesic protocols, central sensitization results in the need for increased inhalant dosages, which will contribute to hypotension and hypoventilation. Preexisting pain, if not managed, also increases the intensity of pain and need for analgesia during the recovery and discharge phases of anesthesia.[5] Thus, preexisting pain should be managed prior to anesthesia whenever possible and should be addressed when developing analgesic protocols used in the anesthetized patient. Preexisting pain occurs more commonly than is realized. For instance, **90%** (90 out of 100 cats studied!) of cats >12 years of age had radiographic signs of degenerative joint disease.[6] And 92% of 100 cats between 6 months and 15 years of age had radiographic evidence of OA/DJD, with the presence/severity of the disease increasing by 13.6% for each year of age.[7]

Periodontal Disease

Periodontal disease is yet another comorbidity whose frequency increases with age and the disease is common in aged cats. Periodontal disease results in a myriad of health issues and the underlying pain can exacerbate those issues and cause other issues, like behavior changes. Periodontal disease is one of the, if not the, most common cause of acute-on-chronic pain in aged patients. The oral/facial area is highly innervated, the patient may have profound chronic pain with inflammation and tissue damage, and the acute pain caused by further inflammation and tissue damage during probing, extractions, etc. is almost guaranteed to result in central sensitization. As stated, if not

controlled, this will result in the need for increased inhalant dosages in patients that are more likely to experience dose-dependent inhalant-mediated hypotension and hypoventilation. Thus, analgesia is critical for anesthetic safety. Multimodal analgesia should include drugs with different mechanisms of action that target different sites in the pain pathway. Anti-inflammatory drugs are not contraindicated because of age and should be included if at all possible since inflammation is a powerful pain generator and propagator. Local blocks are a critical component of the analgesic protocol and can make a major impact on intraoperative analgesia (and, thus, on anesthetic safety), postoperative analgesia and potentially long-term pain prevention. Low-dose ketamine infusions (10 micg/kg/min) will also have a major impact as the drug's mechanism of action (N-methyl-D-aspartate antagonist) is specific for control of pain of central sensitization. Other drugs to consider are listed in the pain pathway figure in the companion proceedings on maladaptive pain.

Anesthesia Plan for Geriatrics with Frailty

For healthy geriatrics, most of the currently used sedative and anesthetic drugs are appropriate, but drug dosages may be lower than those used for young and middle-aged adults. In compromised patients, drug selection may be more critical and drug *dosage* can be extremely critical. Detailed and very helpful information on anesthesia in cats is available.[8]

Preanesthesia: Patient Preparation/Stabilization

Identification of underlying disease/insufficiency with subsequent stabilization significantly increases anesthetic safety. A thorough health history and physical examination is important for all patients, regardless of age. A minimum geriatric data base should also include full serum chemistry panel and total T4, CBC with cytology, urinalysis, arterial blood pressure and ECG (if the cat will tolerate ECG clips). More advanced diagnostics should be done based on expected comorbidities (eg, specific biochemistry tests, imaging, etc.). Hydration status should be critically evaluated. Frail geriatrics adapt poorly to hypovolemia, preoperative fluid therapy may be necessary. However, because protein may be low and renal clearance may be compromised, overhydration can occur if fluid needs are not carefully calculated. As stated, pre-existing pain should be identified and treatment begun prior to anesthesia. The physical exam should include an orthopedic exam and excellent videos detailing an orthopedic exam in cats are available.[9] Use short fasting time (4-6 hours) and assess which medications (if there are any) should be continued and which should be discontinued prior to anesthesia but don't discontinue all drugs without consideration.[10] For instance, enalapril is often discontinued for one dose as its presence can make hypotension more difficult to treat, whereas anxiolytics, like gabapentin, should NOT be discontinued.

Preanesthesia: Premedication

Opioids are an extremely safe class of drugs in all patients including geriatric cats and the effects of opioids are reversible, adding to their safety. Midazolam and alfaxalone are absorbed after IM administration and can be added to the opioid in calmer cats. The alpha-2 agonists (eg, medetomidine, dexmedetomidine) are not contraindicated because of age and can be considered for geriatric patients that need moderate to profound sedation. The effects of the alpha-2 agonists are reversible. Acepromazine might be used in some cases but the duration of action can be prolonged and acepromazine-mediated vasodilation may contribute to hypotension in patients with minimal vascular and baroreceptor control.

Induction

Preoxygenate for 3 minutes! DOSE DRUGS 'TO EFFECT'. Any of the injectable induction drugs are appropriate in healthy patients. Because of the multiple routes of elimination, propofol and/or alfaxalone are often most appropriate in frail patients since compromised metabolic and clearance mechanisms won't affect elimination of the drug. Ventilatory and circulatory support may be required to compensate for the cardiovascular and respiratory depression caused by these drugs. Ketamine and tiletamine/zolazepam are not contraindicated but are cleared at least in part by the kidney and could lead to prolonged recoveries in patients with renal disease. Mask or chamber induction is contraindicated – the required inhalant dose is too high and the stress of restraint or being in the chamber can cause or exacerbate negative effects of comorbidities.

Maintenance

Isoflurane and sevoflurane are appropriate choices for maintenance of anesthesia. As with other patients – but critical in frail patients, inhalant anesthetic concentrations during maintenance of anesthesia should be kept to a minimum since inhalant anesthetics are major contributors to hypotension, hypoventilation and hypothermia. Analgesia: As mentioned, effective analgesia can allow a significant decrease in the dose of inhalant anesthetic drugs necessary for anesthesia. *Analgesia is imperative and absolutely should not be withheld because fear of adverse effects of analgesic drugs.* Pain itself can cause tachycardia, hypertension, decreased renal blood flow, and myriad other effects that may not be well tolerated in frail patients with minimal physiologic reserve. Of course, choose drugs and dosages appropriate for the patient's health status. Local anesthetic drugs and opioids can be used in any patient. Low-dose constant rate infusions (CRIs) of opioids and/or ketamine are also appropriate.

Monitoring & support: This is the most critical component of the entire anesthetic event since the limited physiological reserves in frail patients increase the possibility of anesthetic complications. Safe anesthesia in geriatrics is dependent on rapid identification of and rapid response to physiologic abnormalities. Again, because of the limited physiologic reserve, minor decreases in blood pressure or ventilation that might be transient and inconsequential in a healthy middle-aged adult, can be prolonged and consequential in a frail geriatric. Correct physiologic abnormalities quickly – there will likely be no physiologic compensation so correction is in the hands of the anesthetist. A staff member should be dedicated to careful monitoring of the patient throughout the entire procedure. Monitoring should include basics like HR, RR, pulse strength, mucous membrane color and capillary refill time, and electronic-based monitoring like oxygen-hemoglobin saturation (SpO_2), blood pressure, end-tidal CO_2 and ECG analysis. Body temperature should be continuously – or frequently - monitored as geriatric patients often have decreased thermoregulatory control. Shivering in the recovery phase of anesthesia greatly increases oxygen consumption (up to 200%) and can contribute to hypoxia. Thus, every attempt should be made to avoid hypothermia. Other monitoring could include serial biochemical tests, as with glucose in diabetics or serum potassium in cats with urethral obstruction.

Recovery

Unfortunately, most anesthetic deaths occur in recovery and many of these deaths are preventable with appropriate monitoring and support,[4] which can be critical for the frail geriatric patient. Oxygen and fluid therapy should continue until the patient into recovery and the duration of support depends on the age/health status of the individual patient. Active warming is generally necessary. Blood glucose concentrations may need to be checked, especially in any patient that is having a prolonged recovery. Cog dysfunction, as mentioned, can result in dysphoria and supplemental sedation and patient support (eg, holding the patient instead of placing it in a cage) may be necessary. Pain can add to the dysphoria and an effective analgesic protocol should be instituted. TIP: The more robust the intra-anesthesia analgesia protocol, the lower the pain level in recovery. Discharge the patient with analgesic drugs. Consider administration of long duration drugs like Simbadol (consider dosing at 0.12-0.18 mg/kg in frail patients) and NOCITA in the hospitalized patient to minimize the number of drugs that the owner must administer at home. As stated, NSAIDs are not contraindicated by age so dispense if appropriate for health status. Oral transmucosal buprenorphine is an option, the dose may need to be increased over the injectable dose because of low bioavailability by this route. Gabapentin and/or amantadine should be considered as part of a multimodal protocol in patients with central sensitization.

TABLE: Physiologic characteristics of geriatric patients that may affect anesthesia (NOTE: the changes listed below are general changes associated with age but may not be present in all geriatric patients.)

Potential Geriatric Physiologic Characteristic	**Effect on Anesthesia**
General Characteristics Hypoalbuminemia Neuronal degeneration Decrease in neurons & neurotransmitters Decrease in skeletal muscle Increase in body fat Impaired thermoregulatory system	Exaggerated effect from standard drug dosage for young adult patients, decreased dosage required; decreased tolerance to fluid load, don't over hydrate; Fat may act as drug reservoir and contribute to delayed recovery; Hypothermia contributes to delayed recovery, keep warm.
Renal / Urinary System Decreased RBF, GFR & tubular function Decreased filtration rate & excretory capacity	Prolonged duration of action of renally cleared drugs, may prolong recovery time; decreased tolerance to fluid load - don't over hydrate
Hepatic System Decreased hepatic mass & hepatic blood flow	Prolonged duration of action of hepatically cleared drugs, may prolong recovery time
Respiratory System Loss of strength of muscles of ventilation Thorax becomes rigid, lungs lose elasticity Increased closing volume Reduction in arterial oxygen	Decreased respiratory reserve, both oxygen and ventilatory support are required for most patients
Cardiovascular System Myocardial atrophy; Fibrosis of the endocardium; Decreased myocardial contractility; Loss of vascular distensibility; Maximum heart rate decreases, cardiac output is SV dependent; SNS less responsive to stress; Decreased vasoconstrictor & baroreceptor responses	Decreased cardiac reserve, cardiovascular system must be supported with IV fluids & some patients may need chronotropic or inotropic support; anticipate need for dopamine or dobutamine

RBF - renal blood flow; GFR - glomerular filtration rate; SV - stroke volume; SNS - sympathetic nervous system

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NOTES:

Anesthesia & Analgesia for Cats with Cardiac and/or Airway Comorbidities

Tamara Grubb, DVM, PhD, DACVAA

Introduction

The anesthesia plan for cats with comorbidities will depend on the patient's American Society of Anesthesiologists (ASA) status. Cats are at higher risk than dogs for anesthesia-related deaths (risk factor of 0.11% vs 0.05%, respectively, in healthy patients and 1.4% vs 1.33%, respectively, in sick patients).[1] Stabilization, with subsequent decrease in ASA status, will significantly decrease the risk of anesthesia-related morbidity/mortality. ASA IV and V patients should not be anesthetized unless anesthesia is required for a life-saving procedure. ASA III and higher cats require very diligent monitoring and support during anesthesia and in the recovery period. Analgesia and decreased fear/anxiety/stress (FAS) can be a component of stabilization in patients with pre-existing pain and/or FAS.

ASA Status	American Society of Anesthesiologists (ASA) Description	Patient Example
1	Normal healthy patient	Healthy cat
2	Patient with mild systemic disease	Cat with CKD, IRIS stage 1
3	Patient with moderate systemic disease	Cat with controlled CKD, IRIS stage 2-3 or mild, controlled HCM
4	Patient with severe systemic disease that is a constant threat to life	Cat with urethral obstruction who is obtunded and moderately hyperkalemic
5	Moribund patient who is not expected to survive without the procedure requiring anesthesia	Hypotensive, hypothermic, obtunded cat with septic abdomen

Adapted from 2020 AAHA Anesthesia & Monitoring Guidelines in Dogs & Cats[2]

General Anesthetic Goals

In all patients, the main goal of the anesthetist is to support oxygen delivery to the organs/tissues. This is done through diligent monitoring and support of the cardiovascular and respiratory systems. Enhanced monitoring and support are often necessary in patients with cardiovascular and/or respiratory disease. Using anxiolytic and analgesic drugs will generally result in decreased stress and a lower dose of sedative/anesthetic drugs, which increases anesthetic safety since adverse effects of these drugs are primarily dose-dependent. Analgesia will also decrease the sympathoadrenal response to pain, which, if not controlled, can cause stress-related complications and exacerbate the adverse effects of underlying disease. Analgesia also promotes a smoother recovery, again decreasing a pain-mediated stress response. Maintenance of normothermia is also important as hypothermia causes a number of pathologies, including hypoventilation, decreased cardiac contractility, arrhythmias, clotting dysfunction, immune system compromise, and many others.

Disease/Condition: Asthma

Concerns/Goals/Plan

Successful anesthesia for cats with asthma depends more on patient management than on drug choice. Management goals for anesthesia include stress minimization, airway reactivity prevention/alleviation, bronchoconstriction identification and treatment (if necessary) and maintenance of normal oxygenation and blood flow to optimize tissue/organ oxygen delivery.

Drug Contraindications: None. However, some drugs may have benefit. See below.

Stabilization Plan: Cats with asthma should be stabilized before anaesthesia, generally long-term using steroids, bronchodilators, etc… or short-term (if need for anesthesia is urgent) using bronchodilators, and oxygen supplementation +/- steroids. Even if stable, asthmatic cats may have an acute broncho-constrictive response to anaesthesia and/or airway procedures (eg, bronchoalveolar lavage [BAL]) so bronchodilators should be available.

Anesthetic Plan

Preanesthesia/premedication: Have owners administer anxiolytics (generally gabapentin or trazodone) at home do decrease stress of transport and hospitalization. Once in the hospital, immediately take the cat to the anesthesia area and sedate before the cat gets more stressed. Although an opioid alone is generally inadequate, sedation options include butorphanol (or other opioid) alone or (better) combined with midazolam or alfaxalone if the cat is sick/obtunded or an alpha-2 agonist if the cat is healthy and/or stressed. Acepromazine is also an option for combination with opioids. Don't not place a catheter until the patient is sedated. The goal is to avoid stress.

Induction: Preoxygenate for 3 minutes! The choice of anaesthetic induction drug is not as critical as achieving an appropriate depth of anaesthesia before rapid intubation since laryngeal stimulation may increase airway reactivity

and cause bronchospasm in a patient that is too lightly anesthetized. Lidocaine should be applied to the arytenoids before endotracheal intubation. Propofol or alfaxalone are often first choices because of their rapid onset of action. Ketamine, combined with a benzodiazepine, although a bit slower onset, is also a good choice because of its bronchodilatory effects. Mask or chamber induction with any inhalant agent is slow and not appropriate for patients with airway disease – or any other patient.

Maintenance: Inhalants unless the procedure precludes inhalant administration (eg, bronchiolar lavage [BAL]). In that setting, propofol or alfaxalone infusions can be utilized. If the procedure is <15-20 minutes, one dose of ketamine + midazolam or diazepam may be sufficient.

Monitoring & Support: Standard monitoring with a focus on SpO_2 and $ETCO_2$. Bronchoconstriction can occur and can be identified by a sudden onset of dyspnea, resistance being felt to lung expansion during manual ventilation (ie, 'squeezing the reservoir bag'), desaturation (SpO_2 <90%) and a capnograph typical of airway constriction (see below). Deepening the plane of anaesthesia may be sufficient to relax bronchoconstriction, but a specific bronchodilator drug such as terbutaline or albuterol is a better choice since it will have a more rapid effect and won't contribute to hypotension. Increasing the inhalant dose will almost always lead to hypotension. A 'puff' of albuterol can be delivered from a standard inhaler: connect the inhaler to the end of the endotracheal tube (ETT), one press on the inhaler activation tab delivers the drug at an appropriate dose into the ETT. The inhaler should then be immediately removed to prevent impaired ventilation via increased resistance to breathing.

Analgesia: Use analgesics appropriate for the procedure. Analgesia provided in maintenance will contribute to lower inhalant dosages and a smoother recovery, which is critical for normal ventilation.

Recovery: Asthmatic patients should be extubated before return of the gag reflex (ie, before they swallow) to prevent increased airway reactivity and bronchoconstriction. Prevent stress from hypothermia, pain, dysphoria, etc… Use sedatives and analgesics as needed.

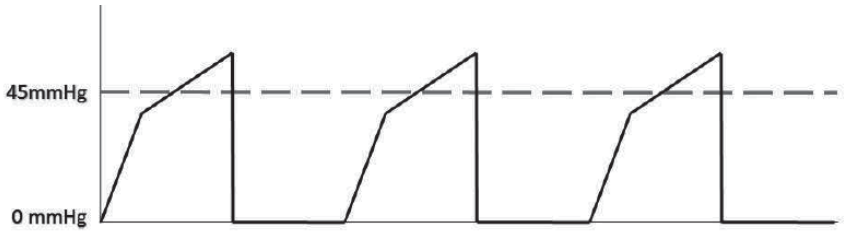

FIGURE: A capnograph with 'shark fins' in the alveolar plateau phase of the tracing is typical of bronchoconstriction or airway occlusion causing resistance during exhalation. (From Grubb et al., Anesthesia and Pain Management for Veterinary Technicians and Nurses. Teton New Media 2020; used by permission of the author).[3]

Disease/Condition: **Hypertrophic Cardiomyopathy (HCM)**
Up to 15% of cats may have some degree of HCM and the disease is often occult.[4] Thus, it is likely that cats with mild HCM are routinely anesthetized using standard anesthetic protocols with no negative impact. However, on the other end of the spectrum, the disease can be life-threatening and difficult to manage in the anesthetized patient. Pre-anesthesia screening is recommended for cats with high likelihood for HCM (eg, Main Coon and Persian cats).

Concerns/Goals/Plan
There are numerous anesthetic concerns. Of primary concern is the hypertrophy and fibrosis of the left ventricle which causes left ventricular diastolic dysfunction. End-diastolic ventricular volume (EDVV) is reduced, which in-turn limits stroke volume and cardiac output. Myocardial vascularization and perfusion do not increase as the ventricle hypertrophies, leaving the potential for myocardial ischemia and subsequent myocardial dysfunction and/or arrhythmias, especially if cardiac work and subsequent oxygen demand are increased. Left ventricular dynamic outflow obstruction (LVOTO) can occur due to anterior movement of the mitral valve leaflets during systole and/or to the myocardial hypertrophy. High left ventricular diastolic pressure can lead to left atrial enlargement, mitral regurgitation, venous congestion, pulmonary edema and/or effusion and potentially left sided congestive heart failure. Left atrial clots can form and can cause arterial thromboembolism, which often results in the presenting complaint in cats with HCM (eg, feline aortic thromboembolism).

With dilated cardiomyopathy and degenerative mitral valve disease a slightly high heart rate and reduced afterload (or systemic vascular resistance; SVR) are desired. With HCM a slightly low heart rate and slightly increased SVR are desired. The low heart rate provides more time for cardiac filling during diastole, decreases myocardial work and oxygen consumption, and increases time for myocardial perfusion. The increased SVR minimizes LVOTO which minimizes further decreases in stroke volume. Hypovolemia contributes to the reduced ventricular volume and should

be avoided - but volume overload can cause cardiac decompensation. Thus, IV fluids should be administered, but in judicious volumes.

Goals of anesthesia include maintenance of low heart rate and avoidance of 1) high heart rate, 2) increased cardiac work (accomplished by minimizing sympathetic activation), 3) hypovolemia, 4) volume overload and 5) decreased SVR. The ultimate goal is to maintain normal blood flow and oxygenation to optimize oxygen delivery to the organs/tissues.

Drug Contraindications: Anticholinergics should not be administered. Ketamine and tiletamine may increase heart rate and contractility via their sympathomimetic effects, thus both are best avoided at anesthetic dosages in moderate-severe disease. A low-dose ketamine infusion as part of a pain management protocol is safe. Low dose (1-3 microg/kg) dexmedetomidine (or 2-6 microg/kg medetomidine) may be beneficial in some patients with HCM +/- LVOTO. Dexmedetomidine agonist decreases stress, produces bradycardia (which increases left ventricular filling time), increases SVR and decreases LVOTO.[5] In addition, the effects of the drug can be reversed, if necessary. Dexmedetomidine is useful in patients with mild disease, especially those that are very anxious or fractious. However, profound bradycardia can increase preload and could lead to CHF so the drug should be avoided in patients with severe disease. Fortunately, these patients are unlikely to require the profound sedation provided by the alpha-2 agonists. A very low dose of acepromazine (0.005-0.01 mg/kg) is often added to protocols for DCM to decrease afterload secondary to vasodilation but use in HCM is not recommended since normal or slightly increased afterload is desired.

Stabilization Plan
In cats with clinical disease, stabilization over several weeks to months with ace-inhibitors (eg, enalapril, benazepril), calcium channel blockers (eg, diltiazem), +/- antithrombotics (eg, aspirin, clopidrogrel) and +/- furosemide should occur prior to anesthesia (see cardiology texts/articles for treatment recommendations). If present, dyspnea should be resolved prior to anesthesia.

Anesthetic Plan
Preanesthesia/premedication: Have owners administer anxiolytics (generally gabapentin or trazodone) at home do decrease stress of transport and hospitalization. Discontinue calcium channel blockers (CCB) for the one dose prior to anesthesia to decrease the impact of the CCB on intraoperative blood pressure. Preoxygenate! Start monitoring NOW as arrhythmias and hypertension can occur. Administer an opioid appropriate for the level of procedural pain + midazolam or alfaxalone IM. Remember that stress should be avoided so administer the premeds prior to restraint for catherization (unless the patient has severe disease). An opioid used alone may not provide adequate sedation, except in patients with severe disease.

Induction: A benzodiazepine + etomidate may be necessary for cats with severe disease but a benzodiazepine + low dose propofol or alfaxalone is acceptable in most cats with mild-moderate disease.

Maintenance: The lowest dose of inhalants possible. Use a very robust multimodal analgesic protocol to keep inhalant concentrations low. High dose inhalants will cause vasodilation, thus reducing SVR and preload, which is not desirable.

Monitoring & Support: Standard monitoring with high vigilance on blood pressure. Minimal IV fluids (1-2 ml/kg/hr unless ongoing losses require higher rates) to avoid pulmonary edema and/or effusion and potential cardiac decompensation due to volume overload. In general, vasopressors like phenylephrine (0.25-0.5 microg/kg/min) have been recommended to improve blood pressure (if necessary) since inotropes increase contractility and may increase myocardial oxygen consumption. However, dopamine and phenylephrine administered to cats with HCM induced dose-dependent increases in systemic blood pressure without increased oxygen consumption. Only dopamine resulted in increased cardiac output.[6] A dose of 2-5 microg/kg/min dopamine is commonly used to improve blood pressure in cats with HCM, especially if phenylephrine is not available.

Analgesia: Appropriate for procedure. Be aggressive to decrease pain-mediated stress with resultant increased heart rate. Local/regional blocks! Analgesic infusions of opioids and/or ketamine are appropriate.

Recovery: Continue monitoring and support as needed, potentially for several hours. Keep warm!! Hypothermia can cause decreased cardiac contractility and arrhythmias along with a profound stress response. Shivering greatly increases tissue oxygen consumption which in turn increases cardiac work.

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Anesthesia & Analgesia for Cats with Endocrine Comorbidities

Tamara Grubb, DVM, PhD, DACVAA

Introduction

In all patients, anesthesia, surgery, trauma and **pain** produce an endocrine stress response which includes activation of the sympathetic nervous system and secretion of pituitary hormones. Cardiovascular manifestations of the endocrine stress response include hypertension and tachycardia while respiratory manifestations include hypoxemia, hypercarbia and acid-base imbalance. The release of cortisol, vasopressin and glucagon can lead to catabolism and hyperglycemia. The magnitude of the stress response depends on the degree of existing disease and the duration and extent of the surgical procedure. Other stressors like inflammation and infection can intensify the adverse stress response. These stress-related changes can further exacerbate the pathology of preexisting endocrine disease. Both appropriate drug selection and appropriate patient management are important for optimal patient outcome and both surgical and anesthetic techniques that minimize the magnitude of the stress response can maximize the chance for a successful outcome. Patients should be stabilized prior to surgery and anesthetic protocols chosen based on the patient's American Society of Anesthesiologists (ASA) status (see companion proceedings in the session on anesthesia for cats with cardiovascular/respiratory disease). Surgical technique should be as minimally invasive and as short as possible. Anesthetic protocols should include the use of anxiolytics (in anxious/fearful patients), sedatives (eg, alpha-2 agonists), opioids and local anesthetic drugs. The use of opioids plus local-regional blockade has been shown to dramatically decrease the stress response. Because of the negative impact of inflammation, non-steroidal anti-inflammatory drugs should be utilized. The benefit of these drugs will be short-lived if appropriate treatment is not continued into recovery and after discharge. The endocrine disorders encountered most commonly encountered in cats include diabetes mellitus and hyperthyroidism.

Diabetes Mellitus

Concern/Goals/Plan

Safe anesthesia for diabetic cats depends more on patient management than on drug choice. The main peri-anesthetic management goal for anesthesia is minimal disruption of food intake with return to eating as soon as possible postoperatively in order to maintain glycemic control. The main intra-anesthesia goal is maintenance of intraoperative glucose around 150 mg/dL (range 120-200 mg/dL), along with appropriate fluid therapy to counteract hyperglycemia-induced osmotic diuresis and minimization of patient stress to decrease the likelihood of disruption of glycemic control. Patient stress can be minimized by utilization of anxiolytics at home, limiting the time in the hospital, keeping the patient calm in the hospital and utilizing effective analgesic techniques.

Even with stable glycemic control, diabetic patients may be dehydrated (because of osmotic diuresis caused by the hyperglycemia) and are likely to suffer swings in their serum glucose concentrations. Hypoglycemia can obviously be dangerous. Diabetics may also be more prone to infection than non-diabetic patients. Thin patients (as some diabetic patients may be) are more likely to get hypothermic and may get painful areas or burns over boney points if they are placed on hard surfaces with inadequate padding or placed directly on heating pads with no cover (which should never happen in ANY patient). Fat patients (as some diabetics may be) may have difficulty breathing due to abdominal fat pressing on the diaphragm and may need ventilatory support. Hypertension is less likely to occur in cats than in dogs but blood pressure assessment should be considered as part of the preoperative physical exam. Hypertension can lead to a variety of pathologies including cardiomyopathy and renal failure.

Preexisting pain from diabetic neuropathy, which is more prevalent in cats than dogs (potentially approximately 10% of cats), may be present and should be considered when making an analgesic plan. Underlying pancreatitis may be present and can also be painful. If not controlled, pain can cause CNS stimulation during anesthesia, necessitating increased anesthetic drug dosages to keep the patient asleep. Adverse events from anesthetic drugs are primarily dose-dependent so failure to address pain will decrease anesthetic safety.

Cats with diabetic ketoacidosis (DKA) should not be anesthetized unless anesthesia is required for a life-saving procedure.

Drug Contraindications: No drug contraindications but drugs with short duration of action and/or reversible effects are preferred so that the patient recovers quickly and resumes normal meal consumption as soon as possible. Drugs that might delay recovery and prolong time to eating (e.g., acepromazine, high dosages of ketamine, tiletamine) are not ideal. Ketamine and tiletamine are also somewhat controversial because these drugs cause sympathetic nervous system (SNS) stimulation which could cause increased serum glucose. However, both drugs at appropriate clinical doses can be safely used for anesthesia in patients with controlled diabetes. Low-dose ketamine as used in a constant rate infusion is not controversial and is an excellent choice for control of neuropathic pain. Alpha-2 agonists

are considered controversial by some because they cause transient hyperglycemia secondary to an alpha-2 receptor mediated reduction in endogenous insulin secretion. However, this effect is transient and, during anesthesia, hyperglycemia is not as potentially dangerous as hypoglycemia. In rats, dexmedetomidine has been shown to reduce pain from diabetic neuropathy.[1]

Anesthetic Plan
Preanesthesia preparation/stabilization: Stabilize glucose levels prior to anesthesia with appropriate insulin therapy and diet. If possible, anesthesia should be delayed until ketonuria has resolved. However, a key point of diabetic stabilization is the fact that some diseases, especially inflammatory diseases like dental disease, can make glycemic control difficult. For these patients, a degree of stabilization should be obtained but surgery/dentistry should not be delayed longer than necessary.

Preanesthesia/premedication: Stress hormones have an 'anti-insulin' effect which leads to alterations in glucose homeostasis and hyperglycemia, thus the stress response to surgery should be minimized with the use of preoperative anxiolytics and sedatives and perioperative analgesic drugs. Consider gabapentin or trazodone (or other anxiolytic) administered at home to minimize stress. Fast the patient only briefly (2-4 hours) and don't remove water (not from this patient or any other patient). Consider maropitant administered orally at home the morning of the procedure or administered IV or SQ in-hospital one hour prior to premedication. Dogs receiving maropitant preoperatively return to normal feeding postoperatively more quickly than dogs not receiving maropitant.[2] Although not yet studied, this is potentially also true for cats and, if so, is a major benefit to diabetic cats (and others of course!).

Assess hydration, serum glucose and electrolytes prior to anesthesia. Some patients may need IV fluids +/- specific electrolytes for 1-2 hours prior to anesthesia. If a DKA patient must be anesthetized it should receive IV fluids, potassium and insulin prior to anesthesia. Surgery should be done first thing in the morning so that ample time is available for serum glucose monitoring, full recovery from anesthesia and return to eating prior to discharge. Administer ½ the regular dose of insulin on the morning of the procedure. Premedicate with the opioid of choice based on the pain of the procedure. For sedation, add dexmedetomidine if the cat is fairly healthy and active or midazolam or alfaxalone in sicker cats.

Induction: Preoxygenate for 3 minutes! Any induction drug will be appropriate but propofol and alfaxalone would be the least likely to contribute to prolonged recovery. Gastric emptying is delayed in some diabetic patients so patients should be intubated in sternal recovery, rapidly intubated and the endotracheal tube cuff inflated to the appropriate pressure prior to placing the patient in lateral recumbency. This should be the standard protocol for most patients.

Maintenance: LOW DOSE inhalant. The deeper the patient is during the maintenance phase of anesthesia the longer recovery will take, which will delay return to eating.

Monitoring & Support: Standard anesthetic monitoring PLUS glucose. Check the glucose prior to anesthesia, once per hour (or 30 minutes after making changes in glucose/insulin administration) throughout the surgery and in recovery. Administer 2.5-5% dextrose IV fluids if the blood glucose drops below 120-150 mg/dL. If glucose can't be measured practice, administer 2.5-5% dextrose solution throughout the procedure. Ensure that body temperature is monitored and supported as hypothermia can delay recovery. Position the patient carefully and pad well. Be sure to use aseptic technique where required to decrease the chance of infection.

Analgesia: Local anesthetic blocks and opioids will blunt the stress response and allow a lower inhalant concentration which should allow a faster recovery. In patients with diabetic neuropathy, vasoconstrictors should not be added to the local anesthetic as decreased blood flow could exacerbate the neuropathy.

Recovery: Keep the patient warm with blankets and external heating sources, may need to continue to monitor glucose if the patient had low glucose during anesthesia. If recovery is unexpectedly prolonged, definitely check glucose. Feed a small amount (1-2 tablespoons) of moist food when the patient is awake enough to swallow normally. Start NSAIDs if appropriate. Uncontrolled diabetics could develop DKA and should be closely monitored.

Hyperthyroidism
Hyperthyroidism is a multisystemic disease with varied and wide-ranging effects. Organ systems affected include the cardiovascular, respiratory, urinary and hepatic systems, although almost any organ system can be involved. Thyroid hormones are involved in regulation of heat production and metabolism of carbohydrates, proteins and lipids. They also interact with the nervous system, increasing overall sympathetic drive. Clinical signs are numerous and varied and usually include weight loss (despite an increased appetite), pu/pd, and hyperactivity and/or aggression. Hyperthyroidism increases minute oxygen consumption (up to 100% above normal) in all tissues except the brain. Thus, any organ can be affected by the disease if oxygen delivery is increased. Elevations in hepatic enzymes, BUN

and creatinine are common in hyperthyroid cats. Serum electrolyte concentrations, especially potassium and calcium, are often abnormal. Cardiac function is often normal in the early stages of the disease, but sinus tachycardia, arrhythmias, and myocardial changes occur as the disease progresses and some hyperthyroid patients will present in congestive heart failure. Death in untreated patients is most often related to a cardiac event. 'Thyroid storms', which are fortunately rare, are life-threatening events that occur secondary to stress-induced exacerbation of hyperthyroidism and present as acute tachycardia, tachypnea, hyperthermia, and alterations in consciousness. Thyroid storms are rare. Intraoperative or immediate postoperative deaths in untreated hyperthyroid cats may be as high as 10%-14%. Thus, elective procedures should be postponed until the patient can be made euthyroid with appropriate medical therapy. Stress and excitement exacerbate thyrotoxicosis and appropriate sedation and analgesia should be used perioperatively.

Effect of excess thyroid hormone	**Impact on anesthesia**
Increased sympathetic nervous system tone (SNS) = increased cardiac output to meet increased metabolic demand, which can lead to cardiomyopathy.	Increased oxygen demand, decreased cardiac function and eventual decrease in cardiac output, arrhythmias; high cardiac output can mask renal failure
Tachycardia, other arrhythmias	Increased oxygen demand, potential for fatal arrhythmias (eg, ventricular fibrillation)
Increased basal metabolic rate	Increased oxygen consumption
Panting tachypnea, dyspnea	Impaired gas exchange
Compression of trachea by tumor	Upper airway dyspnea
Weight loss, cachexia	Prone to hypothermia, need extra padding over boney prominences to prevent pressure sores when recumbent
Hyperactivity/aggression	Can be difficult to handle, require sedation
Diarrhea/vomiting	Dehydration, hypovolemia
Hypertension	Can cause a variety of pathologies including cardiomyopathy and renal failure
Hyperthermia	Highly likely to be HYPOthermic during anesthesia

The main **goals** for anesthesia include pre-anesthesia attainment of a euthyroid status (if possible), avoidance of stress with subsequent increased sympathetic nervous system stimulation (so use adequate sedation and don't wrestle with the cat!) and maintenance of tissue oxygen delivery.

Drug contraindications: No anesthetic drug contraindications but drugs that might cause further SNS stimulation (eg, ketamine, tiletamine) are not ideal. However, low-dose ketamine infusions for analgesia are not contraindicated and can be beneficial for pain control. Anticholinergics should not be administered.

Anesthetic Plan

Preanesthesia preparation/stabilization: Because hyperthyroidism can negatively impact a number of organ systems that can result in anesthetic complications, the patient should not be anesthetized until the disease is controlled if possible. At a minimum, beta-adrenergic agonists (eg, propranolol, esmolol, atenolol) should be administered for 48 hours prior to anesthesia (again, if possible). Also assess cardiac function since arrhythmias and cardiomyopathy can be present. Assess renal function as the high chemistry as the high cardiac output caused by hyperthyroidism can mask renal failure.

Preanesthesia/premedication*:* Discontinue calcium channel blockers for one dose prior to anesthesia; if methimazole is being administered, do not discontinue. Gabapentin or trazodone should be administered at home in cats that are agitated, stressed, fearful or fractious. This technique can make a major contribution to safe anesthesia since calmer patients require lower doses of sedative/anesthetic drugs and the adverse effects of these drugs, like most drugs, is dose-dependent. Some cats will require doses the night before as well as the morning of the procedure. Opioids alone may suffice for sedation in some cats but in most cats will need to be combined with midazolam or alfaxalone. In highly excited/fractious cats a low dose of dexmedetomidine (3-8 microg/kg) should be added to the opioid. Low-dose acepromazine is also an option for most cats.

Induction: Preoxygenate for 3 minutes! Low dose propofol or alfaxalone + a benzodiazepine titrated to effect. If the patient has cardiomyopathy, etomidate would be ideal, but not critical

Maintenance*:* LOW DOSE inhalants.

Monitoring & Support: Standard – very diligent – monitoring. Watch for the development of arrhythmias, hypotension, hypothermia and hypoxemia.

Analgesia: Be aggressive with analgesia as pain will cause SNS stimulation and exacerbate negative effects of hyperthyroidism. Opioids – infusions are best to prevent breakthrough pain as analgesia from boluses wear off. Local/regional blocks!

Recovery*:* Continued observation can be critical, depending on the severity of the disease. Keep warm and readdress need for analgesics. If anesthetized for a procedure other than removal of the thyroid glands, the glands can potentially compress the upper airway after extubation. If anesthetized for removal of thyroid glands, swelling and potential blood clots at the surgery site can potentially compress the upper airway after extubation. Either way, be prepared to reintubate if respiratory compromise occurs. If the thyroid glands were removed, serum calcium should be assessed postoperatively as the parathyroid glands may also have been inadvertently removed. If low, 0.5-1.0 ml/kg 10% calcium gluconate can be administered slowly IV over 20-30 minutes with constant ECG evaluation. If arrhythmias, most commonly bradycardia, occur, calcium administration should be stopped. Other complications that can occur with gland removal include laryngeal nerve damage with respiratory compromise in recovery due to laryngeal paralysis and iatrogenic respiratory compromise in recovery from excessively tight bandages at the surgery site. Renal function should be re-assessed postoperatively.

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NOTES:

Having the Nerve: Local Anesthetic Techniques You Should be Using - Part 1

Mark Epstein, DVM, DABVP, CVPP

Introduction

Local anesthetics were once a mainstay of pain management in veterinary medicine, and may now be one of the most under-utilized modalities despite its advantages, safety, ease of use, lack of expense, and that it is a ubiquitous tool in human surgery. In 2015, the AAHA/AAFP Pain Management Guidelines directed that local anesthetics should be used, insofar as possible with every surgical procedure.

Background

Local anesthetics were once a mainstay of pain management in veterinary medicine, and may now be one of the most under-utilized modalities. There are many reasons to combine general and local anesthetic for surgical pain relief.[1] Local anesthetic drugs are extremely effective, inexpensive and easy to use. When local anesthetic drugs are administered, pain impulses originating in the periphery are blocked and prevented from reaching the central nervous system. This blockade has several positive consequences:

- The sensation of pain is alleviated or even eliminated for the duration of the block. Local anesthetic drugs work by blocking sodium channels in nerve membranes. Decreased permeability to sodium slows the rate of depolarization so that the threshold potential is not achieved and an action potential is not propagated, thus the pain impulse is not propagated. Local anesthetics bind more readily to 'open' channels, thus rapidly firing nerves are more susceptible to blockade.
- The likelihood that 'wind-up' or hypersensitization will occur in the dorsal horn of the spinal cord is greatly decreased because the portion of the pain pathway called 'transmission' is blocked; this results in a lower incidence of exaggerated, sustained (i.e. maladaptive, neuropathic) pain states.
- The analgesia allows the patient to be maintained under a lighter plane of anesthesia and this makes the anesthetic episode safer for the patient. In fact, local anesthetic drugs decrease the minimum alveolar concentration (MAC) of all anesthetic gases and propofol.
- Creates a sparing effect of other analgesic medications, especially opioids and their attendant adverse effects
- Local anesthetics are recognized to have many beneficial effects beyond blocking nerve conduction; broad anti-inflammatory effects (reduced production of eicosanoids, thromboxane, leukotriene, histamine, and inflammatory cytokines; and scavenging of oxygen free radicals) and even antimicrobial, antifungal and antiviral effects.[2].[3]
- A limitation of LA is their generally short-duration of activity. However, the duration of activity can reportedly be doubled with small amounts of an opioid, either morphine (0.075 mg/kg) or buprenorphine (0.003 mg/kg added to buprenorphine in a canine study extended duration to 24-72H)[4] or alternatively dexmedetomidine (0.002 mg/kg) which provided 24 hours of analgesia in 2/3 of dogs receiving peripheral nerve blockade.[5] Alternatively, buprenorphine and possibly dexmedetomidine did not increase anti-nociception of femoral and pelvic nerve blockade in cats.[6]
- New in 2016: Nocita®, a liposome-encapsulate bupivacaine product that provides up to 3 days of post-operative analgesia at the application site (canine label for cruciate repair closure). The pharmacokinetics of this product has been established in cats,[7] and efficacy for 72 H in an onychectomy model.[8]

Furthermore, local anesthetic blocks are extremely cost effective and can increase profits to the clinic.

Commonly Used Local Anesthetic Drugs in Veterinary Medicine Include

Lidocaine

- Onset of action: rapid (less than 5 minutes), duration of action: 60-120 minutes
- 'Toxic dose' in cats reported as 6-10 mg/kg
- The general recommendation for clinical use is ≤ 3-4 mg/kg in the cat.

Bupivacaine

- Onset of action: approximately 5-10 minutes after injection (up to 20 minutes), duration of action: 4 to 6 hours
- Cardiotoxic when administered IV
- Data is mostly anecdotal in the cat but the general feeling is that 3 mg/kg is the maximum dose.
- The general recommendation for clinical use in cats is 1 mg/kg in the cat.

Ropivacaine

- Onset to max effect 10-20 min, duration 3-6 hours
- Less cardiotoxic than bupivacaine

- Generally recommended infiltrative dose in cats 1 mg/kg
- "Toxic dose" reported in cats 3mg/kg

Mepivacaine

- General characteristics similar to lidocaine
- But stings less than other LA

Adverse Events Caused by Local Anesthetic Drugs: extremely rare but can include any of the following:

- Local tissue effects – swelling, bleeding, inflammation, dysthesias ('tingling'? unknown if this occurs in animals). A commonly held misconception is that local anesthetics impair wound healing – although they can powerfully inhibit the inflammatory component of cellular tissue influx, there is no evidence to support a clinical effect of impaired wound healing. Both bupivacaine and ropivacaine have been implicated in myotoxicity when injected IM, although this has not been listed as a complication in most human studies where these drugs were infused for 24 – 36 hours postoperatively into a wound bed. Anaphylaxis – rare, more common with esters (but still rare)
- Central nervous system – muscle tremors, seizure, coma. At lower concentrations, depression of inhibitory neurons occurs and can cause cerebral excitation, which may lead to seizures. At higher concentrations, profound CNS depression with subsequent coma, respiratory arrest and death can occur. This AE is more likely following IV boluses of large doses of lidocaine.
- Cardiovascular system – the myocardial conduction system is sensitive to local anesthetics and IV boluses can result in cardiovascular collapse. ONLY LIDOCAINE CAN BE ADMINISTERED IV (and never with epinephrine).
- Methemoglobinemia – rare, but can occur in cats. especially with esters e.g. Cetacaine® when sprayed on vocal cords to facilitate intubation, (the same AE not observed with a drop of lidocaine on arytenoid cartilages).
- Motor and autonomic nerves are also blocked by local anesthetics, and so motor weakness and vasodilation may occur with certain techniques. Blockade of essential nerve function, like that of phrenic nerve, or high epidural blocks, should be avoided. Motor weakness or paralysis of limbs, from spinal or major nerve trunk blockade is transient and as long as the patient is protected from injury and undue stress, should not be of consequence.

Locoregional Applications: The locality of administration is often limited only by the clinician's ability to learn various utilities and anatomic landmarks; few are outside the scope of any clinician to master. For many of the blocks listed below, a suggested volume of drug is listed based on the amount of drug that can physically be injected into the site. However, with all blocks, the total dose that the patient can receive should be calculated and the cumulative dose (add up the dose or volume injected for each block) should not exceed this total dose.

1. **Transdermal/cutaneous**
    a. Commercial transdermal products are extremely useful in facilitating catheter placement and for minor procedures involving the dermis and epidermis. A lidocaine/prilocaine ointment formulation (EMLA®, also comes as a generic) is placed on a shaved area and covered with a non-porous wrap (foil or cellophane). In humans it is recommended to have the product in place for 45 minutes to achieve full affect, but in the author's experience 15-20 minutes appears sufficient in dogs and cats. Penetration depth of analgesia has been reported to be time dependent and from 2-6 mm.[9]
    b. Commercial 5% lidocaine patches (Lidoderm®) provides post-operative wound paraincisional analgesia.[10] However, Lidoderm® patches in fact are manufactured and labeled for post-herpetic neuralgia (Shingles), a very common form of chronic, neuropathic pain in humans. The pharmacokinetics of this product has been investigated in dogs and cats, with minimal systemic absorption noted.[11],[12] The adhesive patches can be cut formed to the desired size and shape, for example on either side of an incision. Safety in cats wearing a whole patch Mefor 5 days has been demonstrated.[13] One cautionary note is that an entire patch contains 700 mg of lidocaine, obviously a dose that would be toxic if ingested; therefore adequate precautions need to be taken to ensure the patient is unable to access the patch.
    c. Studies in humans with moderate-severe stifle osteoarthritis reveal significant reduction in pain intensity after 2-week use of Lidoderm® patches [14], and pain relief similar to that achieved by oral NSAID.[15] Their potential for use in animals for chronic pain conditions (e.g. osteoarthritis, osteomyelitis, osteosarcoma) remains plausible but no applications are described in the veterinary literature.
2. **Incisional and 'Field' Block**
    a. Local anesthetic drugs can be administered around the incision or directly into the incision site. It is not true that lidocaine in an incision causes a delay in healing.
    b. In humans the overall preponderance of data including several systematic reviews supports the ability of incisional blocks to improve a number of outcome measures including patient comfort, reduction in use of opioids, earlier discharge, and diminished chronic pain states. Several veterinary

studies demonstrate clinical efficacy of incisional local anesthetic.[16],[17] In cats specifically, preoperative incisional block with only lidocaine or combined with bupivacaine seems to produce a similar intraoperative analgesia in cats undergoing OHE; the combination of lidocaine and bupivacaine reduced the required doses, and had a faster onset of action and prolonged effect.[18] .

3. **Intra-cavitary**
    a. Intraperitoneal (IP) bupivacaine has demonstrated safety and a positive effect in cats[19],[20] at 2.0 mg/kg undergoing Ovariohysterectomy (OHE). Safety of IP bupivacaine with addition of epinephrine or dexmedetomidine has also been established in cats.[21] This is supported by multiple studies of similar techniques in humans having laparotomy, and IP (and even intra-pleural) infusions of bupivacaine are used to alleviate pain from pancreatitis.[22]
    b. The bupivacaine can be injected directly into abdomen or diluted in saline and left in as a final abdominal lavage. In a closed cavity (chest[23] or abdomen), the bupivacaine can be injected through a catheter.

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NOTES:

Having the Nerve: Local Anesthetic Techniques You Should be Using - Part 2

Mark Epstein, DVM, DABVP, CVPP

Continuation of Notes from Part 1

3. **Mesovarium Block**
    a. Efficacy demonstrated in cats with 0.1-0.2 ml 0.5% bupivacaine into suspensory ligaments and uterine body.[i]
4. **Indwelling Diffusion/Wound Catheter Block (Sort of a Long Term Field Block)**
    a. Implantation of a catheter into the surgical wound site prior to closure allows repeated or continuous infusion of local anesthetics into the affected area over several days. Indwelling, or 'diffusion', catheters should be considered for large wounds or incisions e.g. amputation, mastectomies, wide-excision lumpectomies, etc.
        i. Exit sites are separate from incision or penrose drains and secured with finger-trap suture.
        ii. Local anesthetic drugs can be infused via a pump or administered by intermittent injection (e.g., q 6-8 hour injections of bupivacaine 1-2 mg/kg +/- mixed with opioid to extend duration).
        iii. The catheter is generally removed in 48-96 hours.
    b. In humans, relatively costly FDA approved catheters[a] are used. For veterinary use, two moderately priced types are commercially available[b,c]. A recent review of wound incision catheters for surgery in humans, concluded that the overall: "Continuous wound catheters consistently demonstrated analgesic efficacy in terms of reduced pain scores or opioid use for all surgical subgroups, despite heterogeneity in type of surgical procedure, location of wound catheter, mode of delivery of local anesthetic, dose of local anesthetic, and analgesic mixture."[ii] Veterinary clinical studies report positive outcomes (including cats) with few complications.[iii],[iv]

Oro-Facial Blocks (Figure 1): *Not just for dentistry;* these blocks desensitize tooth roots, bone, and soft tissue rostrally ipsilateral side to midline and can be used for any oro-facial surgery. The degree of post-procedure pain has been strongly correlated to degree of calculus and gingival disease, # of missing teeth, and # of extractions; severe oral disease requires long-term (up to 6 days) post-procedure analgesia.[v]

5. **Maxillary or Infraorbital Nerve Block:** efficacy (and value) in cats has been described.[vi]
    a. cranial approach
        i. The infraorbital nerve exits the infraorbital foramen, which can be palpated as a depression in the buccal mucosa dorsal to the distal root of the maxillary 3rd premolar (just cranial to the root of the 4th premolar or carnassial tooth in the area where the gingiva on the maxillary bone and the gingiva on the lip join together).
        ii. Block the nerve by injecting local anesthetic under the gingiva just rostral to the foramen and hold a finger at the site to promote caudal diffusion, there will be caudal migration of the local anesthetic into the canal sufficient to block the branches innervating the molars cranially.
        iii. A vessel runs with this nerve so aspirate, then slowly infuse drug (0.1 ml). Intra- and post-operative efficacy of this block has been established in the cat.

6. **Mandibular Nerve Block**
        i. The mandibular foramen or the mandibular nerve can often be palpated on the lingual side of the mandible just rostral to the angle of the mandible and just caudal to the last molar in approximately the middle 1/3rd of the mandible (as measured from top to bottom).
        ii. Regardless of whether or not the nerve or foramen can be palpated (often difficult to palpate in very small patients), the landmarks described above will be utilized for deposition of local anesthetic drug.
        iii. The nerve ENTERS the mandible at the mandibular foramen and cannot be blocked between the mandibular foramen and the mental foramen. **Extraoral technique:** approach is from the outside, through the skin at the angle of the mandible. This technique is easier than the intraoral technique in cats and in some small dogs.

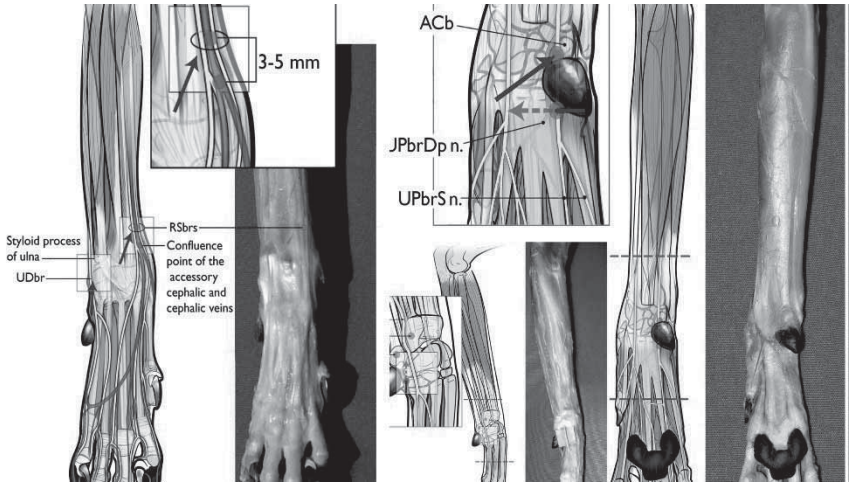
1. Pass the needle through the skin along the medial aspect of the mandible with the needle perpendicular to the mandibular cortical bone, to the level of the foramen (again, aiming for a site just caudal to the last molar on the lingual side of the mandible).

2. With a finger in the oral cavity the needle can be felt under the gingiva.

3. When the site near the mandibular foramen is reached, aspirate and inject the local anesthetic drug (0.2mls).

7. **Testicular Block** – in cats IT lidocaine efficacy similar to IV methadone and sacrococcygeal epidural[vii]
    a. Isolate body of testicles; insert needle to cranial pole and give extended aspiration to make sure not in vessel. Inject lidocaine or bupivacaine into the body of the testicle until you feel 'pressure'.
        i. Drug will migrate up spermatic cord; takes approx. 10-15 min for max. effect.
    b. Generally <0.5 per testicle in cats will cause it to become turgid.
    c. For incision directly over testicle, continue infiltrating as the needle exits the testicular body to block the skin and subcutaneous tissue.
    d. Safety of lidocaine 5 mg/kg of combination laryngeal splash + intratesticular block has been established in cats.[viii]

8. **Digit or Paw Block (Figure 2)**
    a. Three point (or four point)[ix]
        i. Locate the carpus and the accessory carpal pad and inject 0.1-0.3 mls subcutaneously at three sites:
            1. medial to the accessory carpal pad (blocks median nerve and palmar branch of the ulnar nerve);
            2. lateral and proximal to the accessory carpal pad (blocks dorsal branch of the ulnar nerve); and
            3. on the dorsal-medial portion of the carpus (blocks superficial branches of the radial nerve).
            4. The feline forelimb innervation anatomy has been more thoroughly described for the most precise placement.[x]



    b. IV Regional Anesthesia (IVRA, "Bier block")[xi]
        i. Blood exsanguinated from cephalic vein by distal → proximal occlusion
        ii. Tourniquet is placed on cephalic vein firm enough to occlude venous but not arterial flow
        iii. Lidocaine 2 mg/kg (no epi!) is injected IV (some use catheter, some not); has been demonstrated safe in cats as well.[xii]
        iv. Will take approx. 10-15 min for full effect, will block distal limb; max time for tourniquet 90 min.; do not remove tourniquet any earlier than 20 min. post injection to avoid IV bolus.

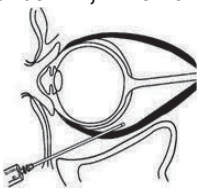
9. **Intercostal Block**[xiii]
    a. Indicated for rib fractures, chest tubes, thoracotomy

b. Inject local anesthetic in the tissues caudal to the proximal portion of the ribs. Inject local anesthetic in 2-3 rib spaces in front of and 2-3 rib spaces behind the area that needs to be desensitized.

10. Sacro-coccygeal Block[xiv]

a. Indicated for perineal, tail procedures including: relief of urinary obstruction, perineal urethrostomy, anal sacculectomy, peri-anal mass removal, tail amputation, orchiectomy. Utility for orchiectomy alone[xv] and in combination with intratesticular lidocaine has been demonstrated in cats.[xvi]
b. Patient is placed in sternal recumbency, palpate the space between the sacrum and the 1st coccygeal vertebra while dorsoflexing tail (between Cx 1-2 also acceptable)
c. Clip & prep, Use a 25ga 1" needle to penetrate the skin at midline
d. Direct the needle at a 30 to 45 degree angle and continue through the interarcuate ligament
e. There may be a palpable "pop" when the ligament is penetrated; as the needle is advanced, there is no resistance upon entering the epidural space
f. If bone is encountered, keep the needle in the skin and slightly angle the needle cranially or caudally off the bone until the space is entered
g. The needle feels more firmly seated once the ligament is penetrated than it does in the subcutaneous tissues
h. Inject 0.5 ml of 2% lidocaine or 0.5% bupivacaine; there should be no resistance

11. Retrobulbar[xvii],[xviii] and Other Ophthalmic Blocks

a. 
b. Retrobulbar, peribulbar eyelid and conjunctival infiltration, intracameral (globe) injection, splash block intraorbital absorbable gelatin LA sponge reported to be effective and are recommended for use as part of the anesthetic regimen and pain management in animals. However, the veterinary literature is still lacking controlled clinical trials and adverse events reports; very little evidence for choosing one technique over another.[xix] Orbital injections of bupivacaine 2 mg/kg elicited peak plasma concentrations approximately half that reported to cause arrhythmias or convulsive electroencephalogram (EEG) activity in cats, and about 1/6 of that required to produce hypotension.[xx]

12. **Regional Electronerve-Location and US-Guided Blocks** are now extensively described in cats, although requiring specialized equipment and training. They include:
    a. Transversus abdominal plane[xxi]
    b. The innervation of[xxii], and utility of, peripheral nerve blocks of the pelvic limb in cats have also been established[xxiii] (anti-nociception between 1-8 hours, most between 2-4H; motor function impaired for 1-2H[xxiv]).
    c. Similarly, innervation of[xxv] and regional nerve block techniques for the pelvic limb in cats have been established.[xxvi]

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Feline Pain Management Beyond Opioids & NSAIDs: Part 1

Mark E. Epstein, DVM, DABVP, CVPP

Introduction

Outside the realm of NSAID and opioid exist a broad range of medications that exert an analgesic effect, or otherwise modify and protect against pain, by manipulating various targets along the nociceptive pathway. This session will focus on those medications administered by the parenteral and oral routes.

Alpha-2 Agonist

Medetomidine and dexmedetomidine binds opioid-like receptors on C- and A-delta fibers, especially in the central nervous system. Binding pre-synaptically, NE production is reduced and sedation occurs; binding post-synaptically, analgesia is produced, and is profoundly synergistic with opioids. It also blocks NE receptors on blood vessels, resulting in vasoconstriction; the resulting hypertension parasympathetically induces bradycardia, which is extended by a subsequent direct decrease in sympathetic tone. However, central perfusion is maintained (including in cats[1]) and wide use can be made for these alpha-2 agonists in acute and peri-operative setting, especially at lower-than label doses in combination with opioids +/- ketamine. One particularly novel and user-friendly utility is IV micro-doses intra- and post-operatively, 0.25 – 1.0 mcg/kg. Dosing of cats and small dogs presents a challenge since doses with the standard dexmedetomidine 0.5 mg/ml; a more dilute 0.1 mg/ml formulation is also available. Microdoses are especially useful in the immediate post-op patient experiencing unusual pain, dysphoria, or emergence delirium; or intra-op in the patient that becomes anesthetically light or experiences sympathetic reactions during painful maneuvers e.g. pulling on the mesovarium or other viscera). Be mindful that theses lower doses will shorten the duration of the drug (microdoses = 5-10 min), and the analgesic effects may wane prior to the sedative effects.

One small study of cats with HCM revealed medetomidine to actually increase the ventricular outflow.[2] A popular use of alpha 2 agonists is to combine with ketamine and an opioid, and administered intramuscularly. This so called "Kitty Magic," for which many formulations abound, provides for dose-dependent sedation, analgesia, immobilization, and in some cases, a surgical plane. One study revealed that out of 10 cats sedated with dexmedetomidine 25 mg/kg, ketamine 3 mg/kg, and buprenorphine 30 mcg/kg IM, 7 were able to proceed with orchiectomy without the need for supplemental gas anesthesia (1, and none, required no supplemental anesthesia with butorphanol 0.2 mg/kg, and hydromorphone 0.05 mg/kg, respectively).[3]

The utility of OTM dexmedetomidine, combined with buprenorphine, has been evaluated in in healthy adult cats. Although pharmacokinetics are inferior to IM administration[4], and the OTM route elicited salivation, there were comparable levels of sedation and antinociception to IM dosing.[5]

The safety and pain modifying effect of dexmedetomidine constant rate infusions have been described.[6],[7] in cats? A loading microdose is recommended, followed by the CRI.

A customary formula adds 1.0 ml of dexmedetomidine 0.5 mg/ml (500 mcg/ml) per ***liter***, which elicits a concentration of 500mcg or 0.5 mg per liter; this solution is then administered at a customary maintenance rate of 2 ml/kg/hr, delivering 1.0 mcg/kg/hr of dexmedetomidine. Volumes of dexmedetomidine can be decreased by 50% and 75% when using 500ml or 250ml bags of maintenance fluids, respectively.

Note: For medetomidine (1.0 mg/ml), the equivalent volume to add to 1 liter of fluids is 2.0 ml (1000 mcg or 1.0 mg) which elicits a concentration of 1000 mcg or 1.0 mg/L of medetomidine; this solution is then administered at a customary maintenance rate of 2 ml/kg/hr, delivering 2.0 mcg/kg/hr.[8]

The reader is referred to a thorough description of the use of alpha-2 agonists in dogs and cats, including intra-articular, epidural and intra-thecal, oral transmucosal, and local anesthetic adjunctive uses. (VCNA ref Valverde)

Sub-Anesthetic Ketamine CRI

A phencyclidine dissociative anesthetic, the evidence is building for its pre-emptive and preventive effects when given at subanesthetic doses in an intravenous constant rate infusion. Ketamine binds to a phencyclidine receptor inside the NMDA receptor, i.e. the calcium channel would already have to be open and active for ketamine to exert its effect. However, once bound, it decreases the channel's opening time and frequency, thus reducing Ca+ ion influx and dampening secondary intracellular signaling cascades. Hence it is unlikely (and has not been shown) to be truly analgesic in nature. Rather, it appears to be protective against hyperalgesia and central hypersensitization

in the post-operative setting,[9] including in the dog.[10] One study in the cat revealed ketamine CRI to raise both thermal and mechanical thresholds.[11]

Consensus Guidelines in humans advocate the use of ketamine CRI in patient populations where the degree of post-surgical pain would be expected to be severe, and generally as an opioid-sparing modality.[12] The International Veterinary Academy of Pain Management and the 2015 American Animal Hospital Association – American Association of Feline Practitioners Pain Management Guidelines have both adopted a position that the pain-modifying effects and safety warrant the consideration of subanesthetic ketamine as part of a multi-modal approach to transoperative pain management, especially in patients with risk factors that may dispose them to exaggerated or maladaptive pain states. Such conditions include, but are not limited to:

- Any nerve or neuron injury
- Severe trauma (pre-existing and/or intra-operative)
- Pre-existing long-standing inflammation (e.g. osteoarthritis)
- Use of neurotoxic agents (e.g. certain chemotherapeutics e.g. vincristine)

To achieve sub-anesthetic CRI, 60 mg (0.6 ml of 100 mg/ml) ketamine can be added to 1 L of fluids. Administering the fluids at customary intra-operative rates of 5-10 ml/kg/hr will deliver 5-10 mcg/kg/min of ketamine; and slowing to a customary maintenance rate of 2 ml/kg/hr will deliver 2 mcg/kg/min of ketamine. A loading dose of 0.5-1.0 mg/kg IV is advised to rapidly achieve plasma levels that the CRI would then sustain. Utilizing most any of the dexmedetomidine/ketamine/opioid protocols, or Inducing with ketamine/valium IV (or alternatively, likely Telazol®) will provide the loading dose. Alternatively, a combination ketamine (2 mg/kg) / propofol (2 mg/kg) IV induction protocol was described in cats[13] which also (more than) provides the loading dose for continuing ketamine CRI.

Consensus Guidelines in humans also suggest a role for ketamine CRI in the case of patients with chronic maladaptive, neuropathic pain syndromes, although without a unifying dosing or administration schedule recommendation.[14]

Maropitant

Maropitant (Cerenia®) inhibits binding of Substance P to the NK-1 receptor. Acting in the Vomiting Center of the brain, it serves as an anti-emetic, but in the spinal cord a pain-modifying effect is hypothesized. The true pain-modifying effect in dogs and cats remains uncertain, and no published data in cats are available. One study in dogs revealing an anesthetic-sparing effect[15] but utilized a very high-dose IV infusion of maropitant, and another a non-inferior effect to morphine in an ovariohysterectomy model.[16] Whether the patients were more comfortable because they were less painful, or experience less nausea, is unknown. A more recent canine OHE-model administered maropitant or morphine SC pre-anesthetically; no significant differences between the two groups were noted although maropitant-treated dogs were more likely to eat at 3 hours.[17] Maropitant performed poorly in development as pain-modifying agent in humans and was withdrawn as a study target. Anecdotal long-term oral use has been reported in the cat, especially IBD; whether these cats appear to be better because of an anti-emetic or pain-modifying effect or both is unknown. A recent meta-analysis and systematic review of the anti-inflammatory and analgesic properties of maroptiant in various species revealed that it to be anesthetic-sparing (significantly reduced the minimum alveolar concentrations for isoflurane and sevoflurane for many different surgical procedures) but it had no clearly proven effect on inflammation and pain.[18]

Polysulfated Glycosaminoglycans

Parenterally-administered PSGAG products have regulatory approval as safe and effective chondroprotectants, supported by independent studies.[19],[20],[21] Although not an analgesic drug per se, a clinical effect can be said to be conferred by minimizing the release of pro-inflammatory cytokines (e.g. IL1, PGE2) and degradative enzymes (e.g. metalleoproteinases). Adequan™ (American Regent) is labeled in dogs for 4.4 mg/kg IM twice weekly for 4 weeks. However, extra-label long-term use is commonly employed, generally administered once monthly and adjusting frequency according to patient needs. Extra-label use also includes administering subcutaneously instead of IM; bioavailability is thought to be similar, which is supported by a study of radio-labeled SC administration in cats Heidrich 2008 VOS[22]. Use in cats with DJD is also extra-label but anecdotally appears effective in this species as well.

Pentosan polysulphate is labeled in the U.K., Canada (Catrophen-Vet®), and Australia (Arthropen-Vet®) as an injectable chondroprotectant, 3 mg/kg SC once weekly for 4 weeks. Extralabel uses would be in the U.S., in cats, and chronically.

Anti-NGF Monoclonal Antibody

Nerve Growth Factor (NGF) is produced and utilized by many cell types including epithelium, endothelium, immunoreactive cells, and CNS glia. It is found in abundance during neonatal development and infancy, then

gradually decreases over time.[23] However it is upregulated with chronic inflammation (including OA) in both peripheral tissue and the spinal cord.

NGF binding to Trk-A receptors elicits several aberrations of pain processing, including an increase in nociceptor excitability, degranulation of mast cells and release of pro-inflammatory and proalgesic mediators, as well as sprouting of terminal nerve endings (promoting nociceptor and non-nociceptor neuronal "cross-talk"). These sensitization effects contribute to hyperalgesia and expanded field of pain.

Multiple investigations are being pursued in humans, dogs, and cats for an anti-NGF product for treatment of OA pain. A veterinary therapeutic anti-NGF monoclonal antibody (MAb) product has been "felinized"[24] from a murine protein (frunevetmab) with favorable PK in cats: Tmax 3 days (range1.9-4.3), plasma half-life 9 days (range 7-15) with plasma concentrations still detected at 42 days. Safety was also established at up to 14 X the therapeutic dose.[25] In a subsequent pilot study, efficacy of frunevetmab was demonstrated in cats from 2 to 6 weeks following a single subcutaneous (SC) injection with greater improvement than observed with meloxicam during the first 3 weeks.[26] Notably, for the first time in published literature, owners were able to differentiate treatment from placebo in a parallel group design. Data from an unpublished randomized placebo-controlled blinded pilot field study supports efficacy and safety of frunevetmab for 6 weeks following IV and SC administration, and a pivotal trial utilizing 3 monthly SC injections is currently under review by the FDA for the treatment of pain associated with the OA in cats. If approved, veterinarians will have to radically accept the novel mechanisms involved: it targets peripheral sensitization rather than inflammation directly.

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Feline Pain Management Beyond Opioids & NSAIDs: Part 2

Mark E. Epstein, DVM, DABVP, CVPP

Introduction

Outside the realm of NSAID and opioid exist a broad range of medications that exert an analgesic effect, or otherwise modify and protect against pain, by manipulating various targets along the nociceptive pathway. This session will focus on those medications administered by the parenteral and oral routes.

Tramadol

Tramadol is a (now) Schedule IV drug that in humans has opioid and serotonin- and norepinephrine (inhibitory neurotransmitters) agonism. In contradistinction to the dog, the cat displays favorable pharmacokinetics and pharmacodynamics. This species does make the M1 (opioid) metabolite,[1] and the oral form has been shown to increase thermal thresholds[2,3] as well as demonstrate a pain-modifying effect in an ovariohysterectomy model[4] and in osteoarthritis[5] including in geriatric cats (2 mg/kg PO BID; AE's include behavior changes and GI signs).[6] Case series have been published utilizing oral tramadol peri-operatively.[7] It is a bitter drug that cats may not readily accept, but compounded palatable formulations have been reported.[8] It is important to note that we have no veterinary dose-titration, reliable safety or toxicity data in cats (or dogs), cats may be more sensitive to tramadol's extrapyramidal effects and toxicities are reported.[9]

Tramadol should be used only very cautiously with other serotoninergic or monoamine-enhancing medications such as tricyclic antidepressants, selegiline (deprenyl), and amtiraz. Customary doses for tramadol in the cat are in the 3 mg/kg range.

Tapentadol acts similarly to tramadol with the parent compound rather than metabolites having the opioid, serotoninergic and noradrenergic effects. In cats, one study revealed high (>90%) bioavailibilty of tapentadol when delivered parenteral routes, and a T1/2 of 2-3H[10]. More studies are needed to evaluate the PK, PD, and clinical utility of tapentadol in dogs and cats especially via the oral route.

Gabapentin

Gabapentin is labeled for use as an anti-convulsant drug but is in widespread human use for its analgesic properties, purported to be mostly through interaction with the alpha-2-delta subunit of the voltage gated calcium channel.[11] There is good kinetic data on dogs and cats, suggesting a TID dosing schedule.[12,13,14,15] Rodent studies demonstrating a pain-modifying effect in OA.[16] There are case reports describing using long-term gabapentin for musculoskeletal and back pain,[17,18] in the treatment of Feline Orofacial Pain Syndrome,[19] and one trial demonstrated an anti-hyperalgesic effect in feline OA.[20] Anecdotal experience is favorable as an adjunct medication for DJD along with NSAID and remains one of its most popular utilities. The primary adverse effect of somnolescence can be mitigated by starting off at quite low doses and tapering upwards, e.g. beginning at 3-5 mg/kg and tapering upwards every 1-2 weeks to a target dose of 15-20 mg/kg BID (and sometimes higher). Gabapentin has been used in the acute, peri-surgical setting and multiple meta-analyses and systematic reviews in humans support this utility, in addition to other outcome measures such as decreased opioid consumption and time to discharge.[21,22,23,24,25,26] The dose utilized in these studies is generally in the 15 mg/kg range, given pre-op and several (somewhat lower) doses TID post-op.[27] In cats, gabapentin was not MAC-sparing[28] nor did it increase thermal thresholds.[29] However, there is a case report of using it in cases of acute injury in 2 cats[30] and anecdotal experience may be favorable. Additionally, gabapentin has been utilized at a high dose for its sedating effect (it may not be anxiolytic since stress markers such as cortisol, glucose do not decrease[31]) to facilitate travel to the veterinarian's office; customary it is a100 mg (20 mg/kg for a 12-lb cat) whose contents are mixed with food (and a flavor enhancer such as Fortiflora or Zyklene) 2CD (it. Similarly, gabapentin has demonstrated utility in humans to reduce preoperative anxiety and pain catastrophizing in highly anxious patients prior to major surgery.[32,33]

Suggested dosing modifications in cats with CKD (decreased GFR slows clearance of the drug)

IRIS Stage	Creatinine		Gabapentin dose, frequency
	mg/dL	µmol/L	
IRIS 1	<1.6	<141	5 mg/kg BID
IRIS 2	1.6-2.8	142-247	3 mg/kg BID
IRIS 3	2.8-5.0	248-442	2 mg/kg SID
IRIS 4	>5.0	>442	1 mg/kg SID-EOD

In humans, gabapentin has been shown to potentiate opioid euphoria, and as physicians have increased its prescribing in the face of the opioid epidemic, suicide ideation (and actual suicide) dramatically increased on patients taking the medication. Therefore many states (and the UK) have made gabapentin a scheduled drug.

Amantadine

Amantadine exerts a pain-modifying effect as an NMDA receptor antagonist[34] and remains an interest in humans with chronic and neuropathic pain (but not specifically osteoarthritis) in humans, with mixed results.[35],[36] One study at 3 mg/kg once daily does demonstrate utility as an adjunct to NSAID in dogs with refractory osteoarthritis within 3 weeks,[37] and there is one case report of using amantadine to treat neuropathic pain in a dog.[38] The pharmacokinetics of amantadine in cats has been established,[39] with a high oral bioavailability and favorable plasma T ½ (5-6 hours). More recent pharmacokinetic studies suggest that 3-5 mg/kg every 12 hours may be more appropriate.[40] Clinical utility in cats is strictly anecdotal at this time. Toxicity and kinetic studies have been performed in humans,[41] and in dogs, anecdotal reports of amantadine-induced ADE's include agitation and other behavioral changes, and GI signs especially diarrhea. In humans QT-syndrome is reported, and in dogs a recent study demonstrated a moderate risk of arrhythmia and decreased cardiac output in halothane-anesthetized dogs receiving IV amantadine.[42] The clinical significance of these findings in cats is unknown. A recent study of amantadine found that it significantly decreased activity, but improved owner-identified impaired mobility and owner-perceived quality of life in cats with osteoarthritis.[43]

Tricyclic Anti-Depressants

TCA's exert their analgesic activity by enhancing synaptic norepinephrine and serotonin (inhibitory transmitters) in the dorsal horn of the spinal cord, although it has other effects including anti-histamine, anti-cholinergic, NMDA receptor antagonism, and sodium channel blockade. It has a balanced NE and serotonin effect, and thus is among the more sedating, anti-cholinergic, and effective of various TCA's.[44] As a class, TCA's are the most effective medications for neuropathic pain in humans.[45] However in cats the literature is restricted to idiopathic cystitis[46] (also now termed "Pandora Syndrome" for its description as a somatic pain syndrome). In humans TCA's can have an unfavorable side effect profile which limit their use for neuropathic pain despite their efficacy (dry mouth, sedation, PU/PD, urine retention, blurred vision, hypotension, weight gain, agitation, seizures, cardiac arrhythmia, BM dyscrasia). Customary doses of amitriptyline are 1-2 mg/kg BID in the cat, but a recent review article suggests 3-4 mg/kg based on its PK profile in these species[47] and anecdotally appears to be well-tolerated. The transdermal route in cats is poor.[48]

SS(N)RI's

These compounds exert their effect by increasing serotonin +/- norepinephrine in the synaptic cleft. At least one popular SSNRI, duloxetine, has a chronic pain label in humans (including osteoarthritis and low back pain, in addition to fibromyalgia and diabetic neuropathy). There are conflicting data about bioavailability and other pharmacokinetics in dogs[49],[50] and no data at all in cats. There are PK data of another SSNRI in dogs, venlafaxine (which has evidence for efficacy in human OA;[51] bioavailability approaching 50% of that of humans and T ½ of 3 hours with a suggested dose of 4 mg/kg PO Q 8-12H),[52] but not in cats. Evidence of a clinical pain-modifying effect for either molecule is currently lacking in animals, and there are no dosed-titration data for either drug.

SNRI's appear to be a safe class of drug in cats. In one case series of toxicities,[53] only ¼ of cats w/ known ingestion became symptomatic with the most common AE sedation (75%) followed by GI signs (50%); CNS stimulation and CV signs 13%. There was 100% survival with general supportive care.

Note: many drugs and compounds enhance monoamines and/or serotonin and caution should be undertaken when or if used in combination. Examples include: tramadol, TCA's including amitriptyline and clomipramine, SS(N)RI's, amantadine, metoclopramide, selegiline, amitraz, mirtazapine.

Diet, Nutraceuticals, and Other Oral Supplements

A study of OA cats receiving an EPA- and DHA-fortified diet revealed owners to perceive some aspects of behavior and locomotion to improve. Although these results are encouraging, the outcome measures were not validated for OA-related pain in cats.[54]

Cannabinoids

The cannabinoid system is now well-established to facilitate pain modulation, although the exact mechanism remains an area of intense study.[55],[56] Several different CB receptors are described but of special interest for pain modification are the CB1 and CB2 sub-types on pre-synaptic neurons in the central nervous system, although a number of other receptors may also be in play. They are G-protein coupled (as are opioid PGE2 receptors) and generally speaking when activated decreases the release of neurotransmitters (glutamate, acetylcholine, dopamine)

into the synaptic cleft, which hyperpolarizes the post-synaptic neuron. CB1 (predominantly located in the brain and spinal cord, but also viscera and adipose tissue) also modulates opioid, NMDA, and GABA receptors on the post-synaptic side; CB2 receptors are found in highest concentrations on immunoregulatory cells, including microglia. CB1 and CB2 are generally down-regulated in a healthy state, but become up-regulated in both neurons and microglia with injury or inflammation.[57] Pharmacologically, the goal is to selectively enhance this aspect of the cannabinoid system without activation of central adverse effects including psychotropic activity. Targets include developing selective synthetic CB agonists to achieve this effect, antagonizing degradative enzymes of endogenous cannabinoids anandamide (AEA) and 2-arachidonoylglycerol (2-AG), and inhibiting the re-uptake of AEA and 2-AG. A complete review of the recent human literature regarding cannabinoids in pain management is available,[58] and a recent systematic review made variable recommendations regarding the use of cannabinoids in human neuropathic pain depending on the specific condition and type of cannabinoid utilized.[59] Safety and tolerability of escalating cannabinoid doses in healthy cats was recently published.[60] However in humans, a recent position statement by the International Association for the Study of Pain states: "Due to the lack of high-quality clinical evidence, the IASP does not currently endorse general use of cannabis and cannabinoids for pain relief."[61]

Non-Pharmacologic Modalities

Low-Stress, Fear-Free Handling

The *AAFP/ISFM Feline-Friendly Handling Guidelines* (Rodan I, Sundahl E 2011) is an excellent place to begin, and the manuscript is accompanied by video demonstrations: http://www.catvets.com/guidelines/practice-guidelines/handling-guidelines. Dr. Sophia Yin's body of work is probably the most comprehensive dedicated to this subject are, in particular: *Low Stress Handling, Restraint and Behavior Modification of Dogs and Cats: Techniques for Developing Patients Who Love Their Visits* and website, www.drsophiayin.com. AAHA is partnering with the Fear Free program of training and certification: www.fearfreepets.com. Facial pheromones (e.g. Feliway®) are increasingly recognized for their integral role in diminishing stress, perhaps especially in cats and part of low-stress and fear-free handling.

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Is Your Anesthetized Patient in Trouble?

Sheilah Robertson, BVMS (Hons), PhD, DACVAA, DECVAA, DACAW, DECAWBM (WSEL)

Introduction

Complications frequently occur during feline anesthesia, ranging from minor to severe. Anesthesia is a state of reversible unconsciousness and many potent drugs with potential unwanted side effects are used in the process therefore trouble should not be unexpected. This session will discuss the most common problems, why they occur and how to predict, plan for and treat them. Cats are unique and contributing factors to anesthetic complications include their small size and how they metabolise drugs, underlying cardiac disease (e.g., hypertrophic cardiomyopathy), fluid overload, airway trauma, hypothermia, and susceptibility to stress.

In a large prospective study poor health status, increasing age, extremes of weight, emergency or complex surgery, endotracheal intubation and fluid therapy were associated with increased risk of mortality.[1] Of note is that 60% of feline deaths occur in the post-anesthetic period, especially in the first three hours.[1]

Adverse events are more difficult to document because there are no universal definitions nor mandatory reporting in veterinary medicine. Adverse events occur in approximately 35% of feline anesthetics.[2] These include but are not limited to arousal, hypoventilation, desaturation, hypotension, hypertension, arrhythmias, hyperthermia, hypothermia, airway complications, and excitation during recovery.

There is no doubt that prevention is better than cure; many complications can be prevented or at least made manageable if procedure-related problems are anticipated and careful preparation made before induction of anesthesia. It is now well established that the preoperative check list prevents complications resulting from human error and a simple system adapted for each clinic should be used (this will be covered in the session on creating a culture of perioperative safety in your clinic). Thereafter constant observation throughout the course of anesthesia and recovery has been shown to reduce the risk of mortality. For example, the presence of a person dedicated solely to anesthesia reduces mortality[3] and monitoring (the pulse and using pulse oximetry) decreased the risk.[1]

Preventing complications

Boxes 1 and 2 show the key points and top priorities of anesthesia and surgery planning and successful execution.

Box 1. Prevention is always better than intervention

- Assign risk
- Use check lists
- Monitor during anesthesia
- Monitor until at least sitting in sternal recumbency, and ideally for 3 hours after the end of the procedure

Allocation of a degree of risk (American Society of Anesthesiologists ASA) is not just an academic exercise. It alerts the team to the likelihood of complications developing and focuses the preparation for a specific procedure onto the most appropriate anesthetic and analgesic protocols, supportive equipment and expertise required. Since the evidence shows that high risk cats are more likely to die or to develop serious complications than healthy cats, they warrant particularly careful pre-anesthetic preparation and perianesthetic monitoring. This includes the very thin or fat, very young or old, cats with comorbidities (e.g., hyperthyroidism or diabetes mellitus) as well as the sick cat. How to allocate an ASA status is described in the 2018 American Association of Feline Practitioners Anesthesia Guidelines[4]:
(Anesthesia Guidelines | American Association of Feline Practitioners (catvets.com); https://catvets.com/guidelines/practice-guidelines/anesthesia-guidelines).

Box 2. Top priorities for preventing complications

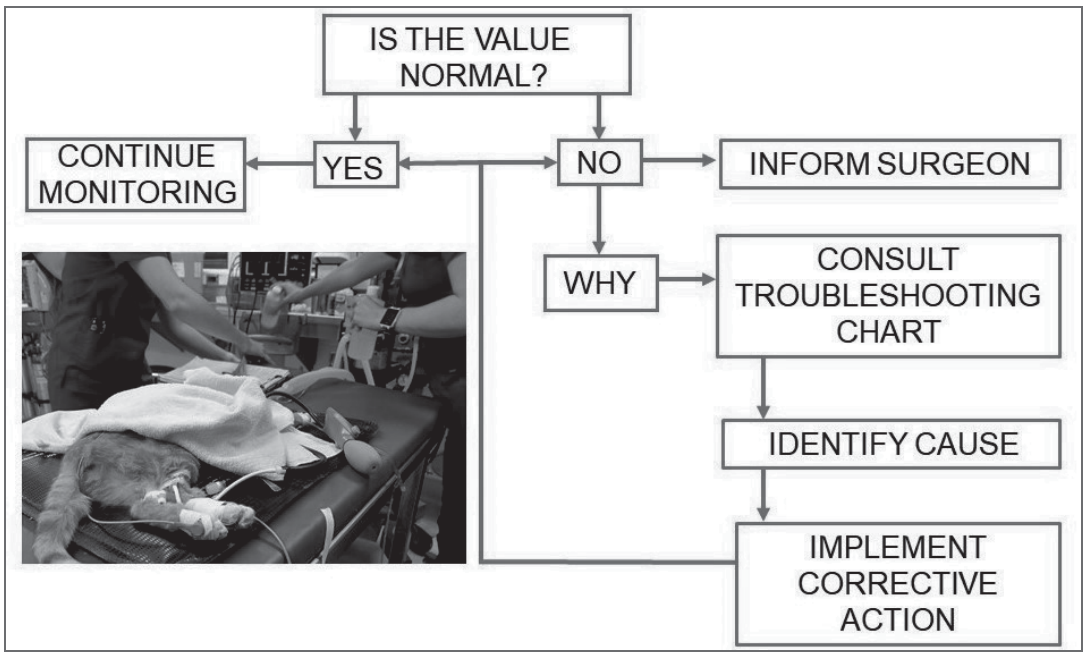
Check:

- Airway
- Breathing
- Circulation
- Temperature
- Equipment

Monitoring
"You see only what you look for, you recognize only what you know"**;** *Merrill Sosman*
Key points about monitoring include:

- *A MONITOR* – is a device used for observing, checking or keeping a continuous record
- *TO MONITOR (verb)* – to observe and check the progress or quality of something over time
- Monitors warn about an adverse event
- Intervention and response are a vital function of the anesthetist to prevent harm to the patient
- The anesthetists must understand what the monitors are telling them
    - What is normal, what is abnormal?
    - When is intervention needed and how do decide what to do?

The following figure depicts the steps related to monitoring that keep cats safe under anesthesia.



When writing the 2018 American Association of Feline Practitioners Anesthesia Guidelines, the committee put together a comprehensive section about anesthetic complications along with a set of troubleshooting algorithms to assist in rapid recognition and intervention steps to follow when cats are in trouble during a procedure.[4] The complications that are featured are common and some are life threatening if not fixed quickly. The guidelines committee members recommend that these algorithms are printed off, laminated, and attached to every anesthesia machine and that all team members are trained to use them. Some, but not all of these complications will be covered in these notes and the associated session at the AAFP 2021 meeting.

Clinical monitoring requires the use of the physical senses and equipment. The senses of sight, sound, and touch are invaluable in monitoring. They often provide the first indication of physiological changes or equipment malfunction. For example, Doppler ultrasound provides audible objective information about arterial blood pressure but also continuous indication of changes in frequency or volume of the signal, indicating changes in heart rate and blood flow that should be further investigated. Similarly, if a monitor (e.g., a pulse oximeter) gives an unexpected reading (e.g., peripheral capillary oxygen saturation; SpO_2 < 90%), "hands-on" assessment of the patient will often help rule out equipment malfunction (e.g., assess mucus membrane color, respiratory pattern and oxygen supply). A proficient anesthetist integrates the information provided by physiological monitors, clinical monitoring and a knowledge of physiology, and pharmacology to provide safe, efficient perioperative care.

Depth of anesthesia
Monitoring depth of anesthesia is one of the most important functions of the anesthetist. All anesthetic drugs produce dose dependent respiratory and cardiovascular depression, but none more than inhalant anesthetics. The aim is to maintain a suitable depth of anesthesia for the procedure to be performed – not too deep, but not too light that arousal can occur. an appropriate depth of anesthesia will vary depending on the nature of stimulation.This requires frequent assessment and adjustment of vaporizer setting and / or drug infusions. The box below illustrates how to recognize the different depths of anesthesia.

Clinical sign	Depth of anesthesia		
	Light	**Appropriate***	**Deep**
Palpebral reflex	Present	Absent	Absent
Eye position	Central	Ventromedial rotation	Central
Pupil diameter	Variable (drug dependent)	Variable (drug dependent)	Dilated
Jaw tone	Present	Absent	Absent
Withdrawal response to toe pinch	Present	Absent	Absent
Heart rate[1]	Possibly increased, (depending on drugs given)	Steady	Possibly decreased, (depending on drugs given)
Respiratory rate[1]	Possibly increased, (depending on drugs given)	Steady	Possibly decreased, (depending on drugs given)
Cardiopulmonary response noxious stimulation	Yes	Variable[2]	No

*****Note, an appropriate depth of anesthesia will vary depending on the nature of stimulation. For example, the anesthetic depth required for diagnostic imaging will be less than for surgery.
[1]Heart and respiratory rates are often affected by drugs (e.g., bradycardia and decreased respiratory rate associated with dexmedetomidine). Single observations are unreliable. It is more informative to evaluate changes in heart and respiratory rates following stimulation or over time.
[2]There should be no more than a minimal response (< 10-15% of pre-stimulation values) when the anesthetic depth is appropriate for the degree of noxious stimulation. The depth of anesthesia should be increased, or analgesics should be administered if a marked response to surgery occurs.

Hypoxemia
Pulse oximeters are valuable monitors because they provide a continuous visual and audible indication of pulse rate and identify SpO_2 (hemoglobin saturation with oxygen) which correlates to PaO_2 (partial pressure of arterial oxygen). Note that a pulse oximeter does not give information on the adequacy of ventilation; adequacy of ventilation is assessed by measuring end-tidal or arterial carbon dioxide. During anesthesia, when high inspired concentrations of oxygen are provided, the SpO_2 should be greater than 95%. A SpO_2 reading of less than 90% indicates hypoxemia, a physiologic state which cannot be sustained for long before brainstem hypoxia and cardiovascular collapse occur. The 5 causes of hypoxemia are:

1. Hypoventilation (unlikely when 100% oxygen is inspired, but can be a cause if the cat is breathing room air)
2. Low inspired oxygen
3. Shunt
4. Ventilation/perfusion mismatch
5. Diffusion impairment

When a low pulse oximeter reading is noted the first thing to do is check the patient – NOT the monitor! The first thing is to check for a pulse (palpable, or if a Doppler is in place, can you hear the pulse?). If the answer is no proceed to CPR. If there is a pulse, give a manual breath and listed with a stethoscope for air movement? If you cannot give a manual breath troubleshoot for an airway obstruction e.g., a kinked endotracheal tube. If the respiratory system is Ok, verify of the patient is getting oxygen: is the cat disconnected from the breathing circuit, has the endotracheal tube slipped out? If the oxygen supply is OK, then you check the pulse oximeter probe. Pulse oximeter probes can compress tissue and decrease capillary blood flow and operating room lights and fluorescent lights can cause interference. One of the best ways to use a pulse oximeter is to wrap the tongue with a moist single layer of gauze then place the probe and cover it with another piece of gauze.

Blood pressure
In most cases, blood pressure will be measured indirectly using a Doppler or oscillometric monitor. When troubleshooting blood pressure problems, it is important to remember how it related to cardiac output and perfusion – the two key things we are interested in but cannot easily monitor. Cardiac Output (CO) is a product of Heart Rate (HR) and Stroke Volume (SV). Blood pressure (BP) is = CO x Systemic Vascular Resistance (SVR). The key point here is that BP can be 'good' when CO is low and SVR is high. Therefore, a BP reading is not taken is isolation but combined with information gathered about perfusion (color of mucus membranes, and how warm the periphery (e.g., paws) feel.

Hypotension is the most common BP issue and has been reported to occur in up to 33% of healthy cats during anesthesia.[5] Hypotension is usually defined as a Mean Arterial Pressure (MAP) < 60 mmHg, below a MAP of 60 mmHg, there is a risk of inadequate tissue perfusion because organs are unable to regulate local blood flow to match metabolic requirements. MAP can be measure with an oscillometric monitor but if a Doppler is used, the only measurement obtained is the systolic blood pressure (SAP) and this should be > 90 mmHg. Noting the development of hypotension should prompt investigation of the cause, such as anesthetic overdose or hypovolemia, to guide treatment. Reduction in the inspired volatile agent concentration at this stage will often prevent a major crisis. Similarly, appropriate IV therapy is most effective if started before hypotension becomes severe. Please refer to the AAFP feline anesthesia guidelines for an algorithm to help you through treating a hypotensive crisis.

Prolonged recovery
If a feline patient is not beginning to show signs or waking up 15 to 30 minutes after the vaporizer has been turned off this is a concern. The number one cause of a prolonged recovery is hypothermia.[6]

Patient temperatures should be checked before, during and after procedures and all efforts made to maintain normothermia. In addition to prolonged recovery, hypothermia has far reaching negative effects including reduced anesthetic requirements, reduced drug metabolism, respiratory depression, increased bleeding, impaired immune function, increased postoperative wound infection, bradycardia, decreased cardiac output, dysrhythmias and post-operative shivering and discomfort.

Check the anesthetic record for drugs that can be reversed (Table 1) as their metabolism will be significantly slowed by low body temperatures and decreased hepatic perfusion. It is difficult to give exact doses of reversal agents as the dose will vary based on the original dose and how long ago that was given. This author prefers to dilute reversal agents such as flumazenil and titrate them intravenously and to effect. Atipamezole should only be intravenously in an emergency – for delayed recoveries it is given intramuscularly. Recommended doses are 50–100 µg/kg, or atipamezole volume equal to 25–50% of administered dexmedetomidine volume (if a concentration of 500 µg/ml was used) or 5–10% of administered dexmedetomidine volume (if a concentration of 100 µg/ml was used).[4]

Table 1: reversible anesthetic drugs

DRUG	REVERSAL AGENT
Dexmedetomidine	Atipamezole
Medetomidine	Atipamezole
Diazepam	Flumazenil
Midazolam	Flumazenil

Dysphoria and rough recoveries
The recovery phase of anesthesia is a critical part of the anesthesia experience and if it is abrupt and violent both the patient and personnel may be injured. These types of reactions cannot always be anticipated but a plan should be in place if they do occur. The behaviors associated with pain, anxiety, fear, and dysphoria can be similar making it difficult to determine the exact cause in each patient. For an excellent discussion on 'Rough Anesthetic Recoveries" see the article listed in suggested reading. Therefore, in some cases re-anesthetising the patient, or heavily sedating them may be the best thing to do until you can troubleshoot and try waking them again; for this reason, intravenous catheters should be kept in place until the critical period of recovery is over (first 3 hours).

Performing anesthesia on cats is both a science and an art; attention to detail, careful preparation, anticipating events, using checklists, and troubleshooting algorithms, close monitoring with the physical senses and equipment and working as a team will keep you patients out of trouble.

Suggested reading

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What the Guidelines Say on Identifying, Evaluating, & Managing Feline Hypertension

Mark Acierno, DVM, MBA, DACVIM

Hypertension may be the most under-diagnosed systemic illness affecting companion animals.
Blood pressure elevations are commonly divided into idiopathic, secondary and situational hypertension. Idiopathic (primary) hypertension is the result of an imbalance in the relationship between cardiac output and systemic vascular resistance. Although more than ninety percent of all human hypertension cases are idiopathic, the exact cause of this imbalance is not well understood. Idiopathic hypertension is thought to account for relatively few cases of canine hypertension; however, it may account for as many as 20% of feline cases. Secondary hypertension is an increase in blood pressure that occurs because of another illness or drug. While relatively uncommon in humans, secondary hypertension is believed to account for as many as 80% feline hypertension cases. This is important, since it allows us to focus our screening efforts on a specific group of patients who are at high risk of hypertension. (Table 1). Situational hypertension is an elevation in blood pressure that is the consequence of the in-clinic experience in an otherwise normotensive animal. It is caused by autonomic nervous system alterations that arise from the effects of excitement or anxiety. It's important to identify patients who suffer from situational hypertension so as to avoid unnecessary treatments.

Definition: The definition of "normal" blood pressure has recently undergone revision. Blood pressure is now categorized on the basis of how likely a range of pressures is to cause target organ damage (TOD). In addition, studies suggest that cats whose blood pressure falls in the range of 140-159 mm Hg are likely to develop clinically relevant hypertension in the future. This has given rise to a new category: Prehypertensive.

- **Normotensive (minimal TOD risk) SBP <140 mm Hg**
- **Prehypertensive (low TOD risk) SBP 140-159 mm Hg**
- **Hypertensive (moderate TOD risk) SBP 160-179 mm Hg**
- **Severely hypertensive (high TOD risk) SBP ≥180 mm Hg**

Consequences: Patients with mild increases in blood pressure may not have any signs directly attributable to the hypertension. As the hypertension worsens, specific organs become damaged (TOD):

- Kidney - Glomerular and tubular damage.
- Eye - Retinopathy and choroidopathy (retinal edema, tortuous vessels, hemorrhage and retinal detachment).
- Heart - Cardiac hypertrophy (murmur, arrhythmia, and gallop sound).
- Brain - Hypertensive encephalopathy (ataxia, depression, and seizures).

Measurement
Clinically, we rely on indirect estimations of blood pressure using Doppler and oscillometric devices. The Doppler flow detector is a commonly used blood pressure measuring device. The only equipment needed is the Doppler flow detector, a sphygmomanometer and a selection of different sized cuffs. Although systolic pressure is easily obtained, determining diastolic pressure can be challenging or impossible. As oscillometric blood pressure devices are automated and can determine systolic pressure, diastolic pressure, mean arterial pressure and heart rate, these units are quite popular. Recently, a number of oscillometric units that claim to be optimized in companion animals have been developed; however, studies have produced contradictory information as to whether these units can actually produce accurate measurements. As of today, no device has met all ACVIM standards for accurate measurements; nevertheless, studies suggest that some of these devices can provide clinically useful information.

Important Concepts
Regardless of which blood pressure measuring technology is used, there are four principles that help ensure accurate measurements: Proper cuff selection, consistency of personnel, acclimation of the patient, and repeatability of results. One of the most important factors in attaining accurate and repeatable blood pressure measurements is the selection of a correctly sized cuff. Some veterinary-specific oscillometric units have specially designed cuffs, however for Doppler and many oscillometric units, the width of the cuff should be 30%-40% of the circumference of the extremity. A cuff that is too narrow may overestimate blood pressure while a cuff that is too wide can artificially decrease values. Stress associated with the office visit can cause profound increases in blood pressure; these effects can be minimized by measuring blood pressure in a quiet area, away from other animals, before other procedures, and only after patients have acclimated to their surroundings. The owner should always be present, and restraint should be kept to a minimum. Pressure measurement should be repeated at least 5 times with the first measurement discarded, and the remaining measurements compared. If there is a significant variation, (>10%) readings should be discarded and the process repeated. Some cats will demonstrate a decrescendo affect whereby

the blood pressure readings continue to slowly decrease as the measurement process continues. In these animals, pressure measurements should continue until measurements plateau. It is important to record the limb used, body position, cuff size, all measurements and the staff involved so that all measurement parameters are consistent.

Treatment
Since most feline hypertension is secondary to an underlying process, the first step should be to diagnose and treat any underlying condition. Although blood pressure may return to normal for some animals, most will not. Therefore, treatment for hypertension should not be delayed.

Angiotensin converting enzyme inhibitors (ACEi). ACEi exert their effect by competitively inhibiting the conversion of angiotensin I to angiotensin II. Since angiotensin II is a potent vasoconstrictor, systemic vasodilatation occurs when its synthesis is inhibited. Angiotensin II also stimulates the release of aldosterone, which leads to sodium and water retention and thus, an increased blood volume. Lastly, angiotensin II directly stimulates the kidney to retain sodium, which results in an increased blood volume. There are 2 commonly used ACEi in veterinary medicine: enalapril and benazepril. Many cats do not respond to enalapril. In addition, enalapril is cleared exclusively by the kidneys while benazepril is cleared by the liver and kidney. For this reason, benazepril is preferred in the treatment of hypertension in kidney disease patients.

While ACEi are generally considered to be the initial drug of choice in treating canine hypertension (Table 2), they are significantly less effective in cats. Historically, calcium channel blockers have been the drug of choice in controlling feline hypertension. These drugs work by interfering with the influx of calcium needed for smooth muscle contraction and vascular constriction. Due to its once-a-day dosing, gradual rate of effect and relative low cost, amlodipine besylate is widely used as anti-hypertensive medication for cats. Current treatment recommendations in cats with an initial SBP <200mm Hg is 0.625 mg/cat PO Q24. For patients with an initial SBP > 200 mm Hg the recommended dose is 1.25mg/cat PO Q24 (Table 2).

Angiotensin receptor blockers (ARBs) are an exciting new class of drug that exerts their effect by directly blocking the angiotensin II type 1 receptor. There are currently several published studies looking at the use of ARBs on hypertensive cats. In one study of 294 hypertensive cats, there was an average decrease of 25 mmHg in blood pressure at day 28 of treatment with telmisartan. In a second study of 221 hypertensive cats (142 treated and 79 placebo controls) treated with telmisartan experienced a median blood pressure reduction of 23.9 mmHg. In a third study, telmisartan was potentially more effective than ACEi in reducing proteinuria. On the basis of these and other studies, the FDA has approved telmisartan (Semintra) for the treatment of feline hypertension. Theoretical benefits of ARBs over calcium channel blockers include: Decreased aldosterone release, decreased target organ cell proliferation and inflammation, and decreased proteinuria. Much of the benefit can be traced to ARBs preferential blockade of the of angiotensin II type 1 receptor, leaving the type 2 receptor unobstructed.

Beta-blockers may useful adjunctive therapy in cats when the initial anti-hypertensive agent has failed to produce the desired decrease in blood pressure (Table 1). Beta-adrenergic receptors are found in both the heart (B1) and lungs (B2). Blockade of the B1 receptors will slow the heart and lower blood pressure; blockade of the B2 receptors can cause an undesirable bronchial constriction. Therefore, selection of a Beta-blocker should be limited to a B1-selective antagonist such as atenolol.

Drugs that antagonize aldosterone may protect the heart, brain and kidneys from the harmful effects of hypertension. Although inhibition of aldosterone causes only a mild decrease in blood pressure, it may protect against hypertension-induced damage of these target organs. While this information is preliminary, hypertensive patients may benefit from the use of spironolactone as an adjunctive treatment (Table 2).

Goals
The goal of treating hypertensive patients is to gradually lower systolic pressure to less than 140 mmHg. Since proteinuria is common in hypertensive patients and proteinuria has been shown to be a negative prognostic indicator, decreasing proteinuria should be a secondary goal of therapy. Reductions in proteinuria can be achieved using a combination of ACEi and ARBs.

In the initial stages of treatment, monitor the patient regularly but avoid large adjustments in medications. Changes in dose and drugs should only be made every two weeks unless the patient's condition deteriorates. Once the patient's systolic pressure has been regulated, it should be rechecked every three months, and complete blood count and serum chemistry should be checked twice a year.

Table 1. Conditions that are commonly associated with hypertension

- Hyperadrenocorticism
- Kidney disease
- Thyroid disease
- Diabetes mellitus (dogs)
- Hepatic disease (dogs)
- Drugs: erythropoietin, phenylpropanolamine, others
- Uncommon conditions: Polycythemia, pheochromocytoma, hyperaldosteronism, chronic anemia

Table 2. Commonly used antihypertensive medications and their dosages

Drug	Class	Feline Dose
Telmisartan (Semintra)	ARB	See package insert
Enalapril (Enacard, Merck)	ACE inhibitor	0.25-0.5 mg/kg q12–24h, PO
Benazepril (Lotensin, Novartis)	ACE inhibitor	0.25-0.5 mg/kg q12-24h, PO
Amlodipine (Norvasc, Pfizer)	Ca++ channel blocker	0.625–1.25 mg/cat q24h, PO
Atenolol (Tenormin, AstraZeneca)	Beta Blocker	6.25-12.5 mg/cat q12-24h, PO
Metoprolol (Lopressor, Novartis)	Beta Blocker	2.0 – 15.0 mg/cat q8h, PO
Spironolactone (Aldactone, Serle)	Aldosterone inhibitors	1.0 mg/kg q 12, PO

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What is Your Patient Telling You? Integrate All the Moving Parts

Guillermo Couto, DVM, DACVIM

This is the typical situation for me, an internist and oncologist: a cat comes in for a second opinion; the owners pull out a 3-ring binder or a pen drive with the medical history, lab reports, radiograph and ultrasound printouts, and plenty of information downloaded from “Dr. Google”. They are seeking an answer in what has been a frustrating situation. Now, we have 2 options: a) to pull our hair out and run out the door, or b) to integrate all the clinical information and try to arrive at a definitive diagnosis. Most of the times, although tempted to go for a), we will choose b).

For you, a primary care clinician, more likely the family will bring in the cat because he/she is “not doing well”; in the US we even have an official name for this: “ADR” (ain’t doing right). Let’s face it, a lot of our feline patients, particularly senior and geriatric ones, come to us with very similar clinical signs: weight loss, anorexia, vomiting, diarrhea or combinations thereof. As we all know, these clinical signs are shared by most of the diseases we see in cats of that age group, including hyperthyroidism, chronic kidney disease (CKD), inflammatory bowel disease (IBD), gastrointestinal lymphoma, pancreatitis, cholangiohepatitis, triaditis, etc.

In most countries, we use **problem-oriented medicine** (POM) to reach a working diagnosis. I typically generate a problem list in my head integrating the history, physical examination findings, hematology, chemistry, urinalysis, imaging, etc; for beginners, the best approach is to list problems in a piece of paper in several columns (first column with PALLOR, second column with SPENOMEGALY, etc). I only use clinically relevant problems to simplify this approach, but I keep in the back of my mind the problems that do not appear relevant, just in case they eventually become so.

Inevitably, clinicians start listing differential diagnoses as soon as the patient comes into the exam room! The diagnostic method is an inverted pyramid; the top is wide (all the differential diagnoses) and the bottom pointed (the actual diagnosis). Once we eliminate most other differential diagnoses (based on the signalment, history, physical exam, hematology, chemistry, urinalysis, etc), we are left with the “bottom tip”, our working diagnosis (that will likely become our final diagnosis).

Here is how I do it. First, I ask the owners my first open-ended question: “Please tell me what’s happening with Snowball”. I guide the owner with pointed questions so they can stay focused. Once I do that and organize my thoughts, I collate the information they provided. Then, I do the physical exam.

If the patient does not have well defined clinical signs, or if the clinical signs are shared by several diseases (see above), the POM approach rarely works well. In those cases, my best approach is to use the minimum database (MDB). In my mind, the MDB consists of a complete blood count (CBC), chemistry profile, urinalysis, and an FeLV/FIV/heartworm SNAP test. After I evaluate these results, I decide what additional tests I have to run, based on my presumptive diagnosis or on the diseases I excluded based on the normal/abnormal previous results (see below). Because I have an interest in hematology, I look at the CBC report/s first; if there are several, I organize them chronologically and start from the first one available. Some reference laboratories provide the ability to present chronological data in columns, and they allow us to evaluate trending graphs; this saves me a lot of time! Don’t forget that a previous CBC/chemistry profile/UA in our patient, when they were healthy, is way better as for comparison than generic reference intervals!

In referred patients, after I evaluate the CBCs and let them “tell me a story”, I now devote my attention to the chemistry profiles and urinalyses (plus any other test result/report) and do the same; as a general rule, the “story” these results tell me will be very similar to the one told by the owners (and by the patient!). I now focus on the images (ultrasound, radiographs, CT scan, etc).

After I generate my problem list, I assign “common diseases/disorders” to each column. Obviously, in order to do this successfully, you must know the prevalence of different diseases/disorders in his/her area. For example, if you see a cat with regenerative anemia in the Northern hemisphere during the winter months, it is less likely to be due to a hemoparasite and more likely to be immune-mediated. I then “cross reference” all the columns, and the disease/disorder that appears in all columns becomes my “working diagnosis”.

In the example I mentioned above, a cat with “ADR” that is found to have pale mucous membranes and diffuse splenomegaly in the physical exam, I will generate a list of common causes of ANEMIA (the most common, yet not the only cause of PALLOR) and a list with the common causes of diffuse splenomegaly (see below):

ANEMIA*	**SPLENOMEGALY**
Regenerative anemias	Lymphoreticular hyperplasia
Hemolysis	Splenitis
Blood loss	Neoplasia
Non-Regenerative anemias	
Inflammatory disease	
Chronic renal disease	
Bone marrow disease	
*Iron deficiency anemia is UNCOMMON in cats so I will not list causes	

As I mentioned above, the signalment and history may be useful; for example, if this cat is young and lives outdoors (or indoors/outdoors), has fleas, and strongly regenerative anemia, hemolytic anemia due to *Mycoplasma* that is causing splenic lymphoreticular hyperplasia and thus, diffuse splenomegaly moves up high in the list. If the cat is FeLV positive and has nonregenerative anemia, bone marrow pathology (neoplasia) with splenic infiltration (lymphoma or leukemia) now moves up the list. Evaluation of the numerical values, graphics, and/or blood smears allows me to get information about the leukogram. For example, with some flow cytometry hematology analyzers (LaserCyte Dx, ProCyte Dx) neoplastic circulating cells (lymphoma, leukemia, systemic mast cell disease) can be commonly identified in the graphics (dotplots).
Obviously, once I have a working (or preliminary) diagnosis, I need to perform the appropriate test/s that will allow me to confirm or rule out this diagnosis. I see a cat that was just hit by a car and I suspect a humeral fracture: what diagnostic test do I use to confirm it: humeral radiographs or a CBC? Although this is a blatantly obvious situation, it is not always that clear in cats with complex medical issues. So, I always ask myself: “If Snowball has disease A, what tests do I need to request to confirm/exclude it?”. Tests should be selected on the basis of their sensitivity and specificity, and of their cost and invasiveness (or lack thereof).
In other words, for me, “connecting the dots” and arriving at a final diagnosis that allow me to successfully treat my patient is the most exciting part of medicine. In this session, I will present clinical cases that illustrate this approach.

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Don't Stress! Practical Management of Feline Lower Urinary Tract Disease

Jessica Markovich, DVM, DACVIM, DACVN

Introduction

Inappropriate urination is one of the most common cause for relinquishing cats to animal shelters in the United States. Older studies have established the incidence of feline lower urinary tract disease (FLUTD) in the US to be estimated from 0.85% to 1.7% to up to 10% of veterinary clinic admissions of cats.[1] Feline idiopathic cystitis (FIC) is the most common cause of FLUTD in cats, accounting for approximately 65% of cases of non-obstructive feline lower urinary tract disease; however, other potential causes of lower urinary tract signs include urolithiasis, bacterial cystitis, anatomical defects, or neoplasia. Diagnosis of FIC is accomplished by exclusion of the aforementioned differentials and confirmed with a clinical presentation and no documented causation. If feline idiopathic cystitis (FIC), recurrence of clinical signs is usually self-limiting & typically persists for 5-7 days in up to 92% of cats with non-obstructive idiopathic lower urinary tract disease. Cats with FIC have been found to have a biologically different stress response system and multi-modal enrichment and modification therapy provides a varied method of addressing this disease, in combination with dietary and pharmacologic options.[2]

Clinical Presentation and Risk Factors

Cats with FIC typically present at an earlier age than the cats with similar clinical signs due to bacterial cystitis or urolithiasis, although there can certainly be overlap. Overweight indoor only cats are overrepresented, and some studies have suggested a predisposition in long-haired cats.[3] Clinical signs can include hematuria, dysuria, pollakiuria, and/or periuria. Described environmental risk factors include a primarily indoor lifestyle, a dry dietary history, multi-cat household, and/or a lack of environmental enrichment.[1,3,4] Male cats are over-reported due to their anatomic propensity to develop urethral obstruction, but this disease also affects females.

Nutritional Options and Data

A few studies have evaluated a variety of nutritional strategies in groups of cats with FIC. One small study in cats with non-obstructive urinary disease fed a veterinary therapeutic diet designed for urolith and cystitis prevention found that the cats that were eating this diet did appear to have improvement and significant reduced incidence rate of lower urinary tract signs, but not resolution of their clinical signs. When evaluating this study, the authors postulated that the improvement in clinical signs may be associated with the addition of higher concentrations of antioxidants and omega-3 fatty acids.[5]

Because the stress response system is theorized to play a role in the etiopathogenesis of this disease, there have been studies with specific dietary supplements added in different amounts to veterinary therapeutic diets and then evaluated in cats with known anxiety and/or lower urinary tract signs. These studies have found that feeding a diet supplemented with L-tryptophan and α-casozepine does reduce urinary cortisol concentrations but did not decrease serum cortisol concentrations under acute stress conditions (a visit to the veterinarian). Another small case controlled prospective urinary diet trial formulated with the addition of l-tryptophan and α-casozepine found that similar to the above urinary diet trial, participants that ate the supplemented urinary diet demonstrated less recurrence of lower urinary tract signs than those who ate the typical commercial diets.[6]

Although several dietary strategies have been considered, water remains the single most important nutrient of concern based on several studies. Increased water consumption is thought to benefit the urinary bladder by decreasing the concentration of irritating substances and/or minerals (in the case of urolithiasis).[7] The ways to increase water consumption have been varied and inconsistently successful. Water delivery options include typical open water containers, free falling water fountains, circulating water bowls, flavored or nutrient enriched water. One study found that while the population of the cats in the study did not demonstrate an increased water consumption with any one particular water delivery device, that there were individual cats who did have a higher water consumption with particular devices.[7] Another found that a quick change led to increased stress in some individuals, and changes may best be considered by adding water delivery options rather than acutely changing them.[8] Individual preferences indicate that clinicians may continue to recommend a variety of water delivery device options, so that we can determine if the patient has a preference.

Leading a cat to water is certainly easier than making him drink. Therefore, increasing dietary water is another method of achieving increased water consumption over the day. One study in 1999 by Markwell et. al. indicated that increasing water turnover in cats with FIC can significantly reduce recurrence of clinical signs.[9] The average commercial dry provides 10-12% water; whereas, the average commercial canned diet provides 78-82% water depending on the texture of the canned diet. It has been found that cats do not drink enough water when eating a

dry diet to compare to the amount of water provided when eating a canned food diet.[10] If the cat does not have a distinct textural preference, adding water to canned or dry diets may be another method to increase water consumption.

Supplements

The urinary bladder wall contains a glycosaminoglycan layer, and clinical studies in both affected humans and cats with idiopathic cystitis have documented an abnormality to this layer.[2] In addition, cats affected by FIC have been found to have lower urinary glycosaminoglycan levels than normal cats.[11] While oral N-acetyl-d-glucosamine has been shown to increase plasma glycosaminoglycan levels, the two clinical studies that have evaluated this oral supplement have failed to find a clinical benefit in lower urinary signs when compared to placebo.[2,11] In 2014, one small prospective study has suggested a potential benefit to glycosaminoglycans infused into the urinary bladder with a urinary catheter in cats with obstructive FIC.[12] However, another randomized placebo controlled blinded prospective study performed 2 years later failed to demonstrate a benefit when pentosan polysulfate sodium was infused three times over 48 hours in cats with obstructive FIC.[13]

Cranberry juice has long been associated as beneficial for urinary tract health. There is one new study evaluating the impact of a cranberry extract supplement on a small population of cats with FIC. During the 60-day prospective randomized clinical trial, the cats that received the cranberry extract supplement displayed improved to resolved lower urinary tract signs within 2 weeks of therapy and resolution by day 30.[14] Although human and canine trials have implicated decreased bacterial adhesion as the primary benefit of cranberry extract, cranberry extract has also been found to inhibit the activity of cyclooxygenase-2 (COX-2) and suppresses the release of C-reactive protein, tumor necrosis factor-α and several pro-inflammatory interleukins. It is these secondary benefits that could be the mechanism of action for cats with FIC.[14]

Monitoring and Recurrence

Monitoring for recurrence should also be paired with the attempt at identifying an environmental trigger in concert with recurrence of clinical signs. Recurrence of clinical signs have been reported to affect 15% to 65% of cats with acute idiopathic cystitis within one to two years after the initial episode.[4] One study additionally found that of those cats that experience recurrence, more than 50% of those cats will experience at least 2 relapse events.[15] However, this same study found that not all recurrences were the same cause as the original diagnosed event.[15] Age has had a varied impact on obstruction, with one study finding that older cats were at a higher risk for re-obstruction and another that found that older cats in general were less likely to have an obstruction.[16]

Clearly multiple strategies will need to be considered in order to decrease the recurrence rate for cats with this significant disease, and assumptions cannot be made regarding the etiology of recurrent clinical signs.

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Identifying & Treating Chronic OA Pain: Help is on the Way!

Elizabeth Colleran, DVM, MS, DABVP (Feline)

Pathophysiology
Osteoarthritis (OA) is a common and complex progressive disease. Clinically it is defined as a slowly evolving articular disease characterized by the gradual development of joint pain, stiffness, and the limitation of range of motion. Pathologically at has been described as a disorder of synovial joints characterized by deterioration of articular cartilage and by the formation of new bone at the joint surfaces and margins. The median age of affected cats in another study was 10.2 years and increasing age was clearly a risk factor for the development of osteoarthritis and other degenerative arthropathies.

In cats older than 12 years of age one study found a 90% prevalence of all types of degenerative joint disease. (DJD) DJD is not the same as OA though the terms are commonly used interchangeably. OA is a subset of DJD which includes all forms of degenerative pathology of skeletal joints.

The hip and elbow joints are most commonly affected and bilateral disease was invariably a feature. In a group of 100 randomly selected cats aged up to 20 years old almost all of the cats had radiographic evidence of degenerative joint disease (DJD). Affected joints in descending order of frequency were hip, stifle, tarsus, and elbow.
OA associated pain starts at the peripheral join and results in decreased ability to perform daily activities and decreased mobility. This initiates musculoskeletal deterioration due to decreased use and altered body carriage. Additionally, the nociceptive pain input into the system can result in sensitization and more pain. Heightened pain results in further negative effects on the musculoskeletal system – muscle atrophy, trigger point development, muscle pain – which in turn results in a greater burden of pain as a result of decreased bone support. Thus, there is concurrent deterioration of the musculoskeletal and sensory systems. Pain also has an effect on cognitive function and on emotional states, resulting in heightened fear, anxiety and poor sleep. These changes in turn feedback and heighten pain. The inability to perform daily activities, resulting from pain and deterioration of the musculoskeletal system, also drives negative affective changes through decreased and altered actions with the cat's environment.

Caregiver Observation
Owners may be completely unaware of subtle changes in their cat's behavior or of their potential significance as indications of pain. A validated musculoskeletal pain index can be helpful in uncovering evidence. (www.painfreecats.com) Among these may be:

- Avoiding other household members
- Increased grumpiness
- Decreased grooming
- Restlessness
- Changes in elimination behavior
- Clumsiness
- Reluctance to jump up or down

In the veterinary setting, assessing a cat's emotional and physical characteristics is often confounded by the stress of taking this territorial animal out of his home range and surrounding him with strangers. It can be especially challenging to assess gait and chronic musculoskeletal pain in an animal whose instinct is to freeze or flee or to distinguish pain from fear. With this in mind, a validated pain score has been developed the Feline Musculoskeletal Pain Index (FMPI) which gives the power of observation to caregivers in the home. Questions are addressed towards specific indicators using accessible language.

Arguably most important role of the caregiver in the diagnosis of OA pain is the use of video and photography. Most households have a "smart phone" with photographic and video capability. In the comfort of the home range, the locomotion of a cat may be most reliably observed and largely absent from the examination room. The quality of the video in particular can be demonstrated to the caregiver and is comprised of view tips and techniques to make it both a useful and efficient component of the diagnostic process. While caregivers will be tempted to provide long video segments, lovingly made, instructing them to limit the clip to a minute or less and from a distance where evaluation of the whole cat is critical to efficient examination time.

Physical Examination
A comprehensive physical examination is important but may yield little beyond assessment of the cat's gait in the examination room unless the circumstances are carefully managed. A quiet, secure and low stress environment is

key. The cat should be allowed to acclimate to the room at which time a visual assessment of gait may be possible. A feline facial pheromone diffuser plugged in overnight in the room can help reduce a fear response. Cats do not walk in straight lines, are not usually trained to the leash and generally are more interested in investigating the unfamiliar environment or seeking somewhere to hide. In some cases it is possible to assess their willingness to jump. Palpation and manipulation of the joints must be done gently and it is not unusual for some cats to resent this even if joints are normal and pain-free.

A set of comprehensive videos giving full instruction on the appropriate position and method of physical examination is available online.

With so many complex changes occurring and multiple joint often involved, staging of the OA patient may seem daunting. However, staging is probably best performed by assessing the overall impact on the whole cat. A simple staging of the impact of OA based on activity and mobility could be:

Stage	Activity/mobility
1	Early signs of activity impairment
2	Intermittent signs of activity impairment
3	Obvious activity impairment and some decrease in mobility
4	Loss of mobility with significant pain

Key Therapeutic Points

Multi-Modal Treatment

Targeted multi-modal pain management is intended to reduce the risk of drug toxicities and to target the different components of chronic pain, including maladaptive pain.

Gabapentin

Pain modulation happens in the dorsal horn of the spinal cord. In the dorsal horn, there are dramatic anatomic changes that happen in the face of chronic maladaptive pain. Gabapentin affects the alpha-2-delta subunit of the calcium channel in the dorsal horn. This drug is really part of the gold standard for managing chronic maladaptive pain in humans, and what has recently become available is information that it also can play an important perioperative role in reducing the reliance that humans have on post-operative opiates. The downfall for gabapentin is that it must be dosed appropriately, Somewhere between 5-20 mg/kg two to three times per day. Under dosing patients will not address maladaptive pain. Doses should commence at 50mg/cat at night for 3-4 days because sedation may occur initially and alarm the caregiver. The dose is then titrated until it is effective. The second step is to give a dose every 12 hours. Dose effectiveness may change over time and should be regularly interrogated.

Polysulfated Glycosaminoglycans

Adequan is a polysulfated glycosaminoglycans that can be given subcutaneously in cats and is very helpful and well-tolerated. Use in cats is extra-label but is nonetheless an important mainstay of OA pain management. Owners can be instructed in subcutaneous administration and the entire bottle dispensed. The dose is 4.4 mg/kg twice weekly for 4 weeks, once weekly for 4 weeks and then at an interval that reflects effective duration, every 10-15 days. Owners will recognize the day on which the cat appears less comfortable and administer in a one day shorter interval.

NSAIDs

Nonsteroidal anti-inflammatory drugs (NSAIDs) are indicated in the treatment of pain and inflammation associated with OA, as they produce analgesic and anti-inflammatory effects. However, the potential toxicity of these compounds must be considered. NSAIDs act predominately by blocking the inflammatory effects of prostaglandins through inhibition of the breakdown of arachidonic acid buy cyclo-oxygenase (COX), specifically COX-2, which is responsible for producing inflammatory prostaglandins. COX-1 also plays an important part in the inflammatory process and pain perception.

Nutriceuticals

Diets rich in omega-3 fatty acids sourced from fish oil are recommended for cats with OA. Not only are the absolute levels of these omega-3 fatty acids important but also the ratio of omega-3 to omega-6 fatty acids. These diets have been shown to improve weight-bearing and reduced inflammation. Cats given a diet rich in omega-3 or supplemented with omega-3 fatty acids may be comfortable on lower doses of NSAIDs after a period of 6 to 8 weeks. Other sources include Wellactin 125 mg/ml (Nutramax) and Nordic Naturals 150mg/ml. Extrapolated dosage for cats is 75mg/kg/day.

Pulsed Electromagnetic Field Therapy

Pulsed electromagnetic field (PEMF) therapy is a non-invasive, non-thermal treatment that involves pulsing electromagnetic fields in tissue to promote healing. PEMF devices have been approved by the U.S. Food and Drug

Administration (FDA) to treat non-union fractures and cleared to treat post-operative pain and edema, osteoarthtitis and plantar fasciitis. Implementation of PEMF therapy in veterinary medicine is increasing. Pathologies that are often treated with PEMF devices include bone fractures, inflammation and arthritis, pain, edema, and chronic wounds. Though there is a growing body of basic and clinical evidence in support of PEMF treatment as a therapeutic modality, veterinary practitioners and animal owners report significant confusion about PEMF devices largely due to the number of different types of devices and the varying amounts of evidence that support each type of device.

Feline-Specific Anti-Nerve Growth Antibody
Neutralizing antibodies against nerve growth factor (NGF) are analgesic in rodent models, naturally occurring degenerative joint disease(DJD) pain in dogs and chronic pain in humans. Currently, the nonsteroidal anti-inflammatory drug (NSAID) meloxicam is approved in Europe for use in treating chronic pain and cats, but has not been approved for this use in the United States. There are concerns about the use of NSAIDS for long periods of time and cats, especially because of the majority of cats presenting with DJD related pain have evidence of chronic kidney disease. A double blind, placebo controlled randomized pilot study with 12 cats in each of three groups evaluated the efficacy of a fully felinized anti-NGF antibody (NV-02) for the treatment DJD pain and mobility impairment in cats. The results of this study showed a clear positive treatment effect with NV–02 in the study cats given the drug. The beneficial effects were seen for objectively measured activity, and also, despite a large caregiver placebo effect, for owner assessed subjective measures. The duration of affect appear to be about six weeks, based on objectively measured activity. This is similar to the duration of efficacy of 0.2 mgs/kg IV in dogs of at least four weeks. The investigators concluded that the potential impact in veterinary medicine of an injection lasting approximately six weeks for the control of long term pain in the cat is very positive and clinically relevant. Further clinical studies are warranted.

Summary

1. Osteoarthritis is an important cause of chronic pain and loss of quality of life in cats
2. There are multiple tools available to help clinicians and caregivers recognize the behaviors that demonstrate pain, create a sense of urgency around its treatment and evaluate the efficacy of a pain management plan upon implementation
3. A multi-modal pain management plan is necessary to improve mobility and quality of life
4. Future scientific investigations will result in new methods of pain management that will integrated into a multimodal plan
5. Clinicians have an obligation to balance the importance of relieving pain and the impact that their plan may have on the relationship between cat and caregiver

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2021 CONFERENCE

Anesthesia, Analgesia, & Surgery

Sept. 30 – Oct. 3, 2021
Phoenix Convention Center
Phoenix, AZ & Virtual

SATURDAY, OCTOBER 2, 2021

Schedule is in Mountain Standard Time (same as Pacific Daylight Time over these dates)

TIME	SESSION TITLE	SPEAKER	ROOM	SPONSOR/ PARTNER
6:00 - 7:00 am	Early Riser Yoga Class*		Sheraton Hotel - Paradise Valley	
7:00 - 8:00 am	Breakfast		Exhibit Hall	
8:00 - 9:00 am	The Whole Package: Anesthesia & Surgery Tips for Common but Sometimes Tricky Cases LS	Drs. Sheilah Robertson & Bryden Stanley	North Ballroom A - D	
9:05 - 10:00 am	Intestinal Anastomosis: Tips to Make it Easier LS NOD	Dr. Howard Seim	North Ballroom A - D	
10:00 - 11:00 am	Networking Refreshment Break		Exhibit Hall	
10:25 - 10:50 am	AAFP Membership Meeting LS		North Ballroom AB	
11:00 - 11:50 am	Making End of Life Decisions LS	Dr. Sheilah Robertson	North Ballroom AB	IAAHPC
	Visceral Organ Biopsy LS NOD	Dr. Howard Seim	North Ballroom CD	
11:55 - 12:45 pm	The Last Appointment: How to Navigate Smoothly Through Euthanasia Appointments LS	Dr. Sheilah Robertson	North Ballroom AB	IAAHPC
	Surgery of the Pancreas, Liver, & Biliary System LS NOD	Dr. Howard Seim	North Ballroom CD	
12:45 - 2:15 pm	Lunch		Exhibit Hall	
1:00 - 2:00 pm	*Lunch & Learn #1:** Monitoring the Difficult Diabetic Cat: Role of Continuous Glucose Monitoring	Dr. Catharine Scott-Moncrieff	121A-C	Boehringer Ingelheim
1:00 - 2:00 pm	*Lunch & Learn #2:** Enhancing Compliance & Reducing Stress: A Modern Perspective on Feline Parasite Protection	Dr. Robert Lavan	122A-C	MERCK Animal Health
1:00 - 2:00 pm	*Lunch & Learn #3:** Digital Cytopathology: Real-time Expert Help in Your Everyday Practice	Dr. Eric Morissette	124AB	ZOETIS PETCARE
2:15 - 3:05 pm	Creating a Culture of Perioperative Safety in your Clinic LS	Drs. Sheilah Robertson & Bryden Stanley	North Ballroom AB	IDEXX
2:15 - 2:40 pm	Wound Management Secrets LS NOD	Dr. Howard Seim	North Ballroom CD	
2:40 - 3:05 pm	Managing Feline Ear Polyps LS NOD	Dr. Howard Seim	North Ballroom CD	
3:10 - 4:00 pm	The Whole Package: Anesthesia & Surgery Tips for Common but Sometimes Tricky Cases in Kittens & Young Cats LS	Drs. Sheilah Robertson & Bryden Stanley	North Ballroom AB	
3:10 - 3:35 pm	Feline Subtotal Colectomy LS NOD	Dr. Howard Seim	North Ballroom CD	
3:35 - 4:00 pm	Colopexy for the Treatment of Recurrent Rectal Prolapse LS NOD	Dr. Howard Seim	North Ballroom CD	
4:05 - 4:25 pm	*Oral Abstract Session:* False Positive FeLV ELISA Results in Cats With Hemolytic Disease LS	Dr. Matthew Kornya	North Ballroom AB	
4:05 - 4:45 pm	Why Being a Cat Friendly Practice Matters		North Ballroom CD	Cat Friendly Practice
6:30 - 10:30 pm	A Feline Fete Offsite Event**			Elanco

*Separate Registration Required. No fees associated.
**Separate Registration Required. Additional fees apply.

Please Note: Dr. Seim's lectures will not be available on-demand after the in-person presentation or live-streaming for virtual attendees.

LS Live Streamed

NOD Not available On-demand

The Whole Package: Anesthesia & Surgery Tips for Common but Sometimes Tricky Cases

Sheilah Robertson, BVMS (Hons), PhD, DACVAA, DECVAA, DACAW, DECAWBM (WSEL) &
Bryden Stanley, BVMS, MVetSc, MANZCVS, MRCVS, DACVS

Overview of this session

The idea behind this session is to hear from "both sides of the table", meaning looking at cases from the viewpoint of the surgeon and anesthetist; each have different concerns, but both have the welfare of the patient as their common goal so communication with each other is essential before, during and after the procedure.

Feline urethral obstruction is frequently encountered in general and emergency practice. Depending on the time between the obstruction occurring to the time of presentation clinical signs vary from mild to severe. Rapid triage is required to determine life-threatening issues due to severe electrolyte (hyperkalemia), acid-base imbalances and hydration status. Choosing the right drugs and techniques for sedation, analgesia or anesthesia is important for a good outcome. Tips and trips for relieving the obstruction will be shared, along with how to make the best decisions for repeat offenders. Surgical tips for performing a successful perineal urethrostomy will be shared. The goal of the session is to elevate you and your team's confidence with these cases.

Introduction

We have chosen to discuss urethral obstruction a case – a common medical condition in cats. Obstruction may be caused by an intraluminal object, most commonly urethral plugs or urethroliths, but graphospasm, trauma, congenita defects, strictures and neoplasia are other possible causes. An extra-urethral mass may also result in obstruction. The goals of therapy in obstructed cats is to restore urine flow however, restoring urine flow and overlooking dehydration and electrolyte abnormalities is associated with poor outcomes. Cats will present at varying times after obstruction – the longer this has been the more serious their condition. They may be lethargic, anorexic, weak and may have started vomiting, but if the problem has been overlooked by the owner, they may be moribund. Evaluation of the emergency feline patient can begin before the patient arrives by gaining information from the owner via a telephone conversation. The usual signs reported by the owner are difficulty urinating. Blood in the urine, frequent trips to the litter box, vocalizing while trying to urinate and frequent licking at the penis and prepuce. However, some owners may not notice the cat has not urinated for some time and may think the cat is constipated. A hospital standard operating procedure that details how the team receives and assesses different types of emergency cases is an extremely important tool that every team member should be familiar with. The veterinary staff should receive hands-on simulated training using different patient scenarios, along with education about feline-specific emergency cases. By doing this everyone knows what to do when an emergency case comes through the door.[1] In the case of a blocked cat all the equipment that will be required for the initial assessment and for unblocking the cat and be ready at the examination station.

Anesthesia concerns in urinary obstruction cases – triage and stabilization

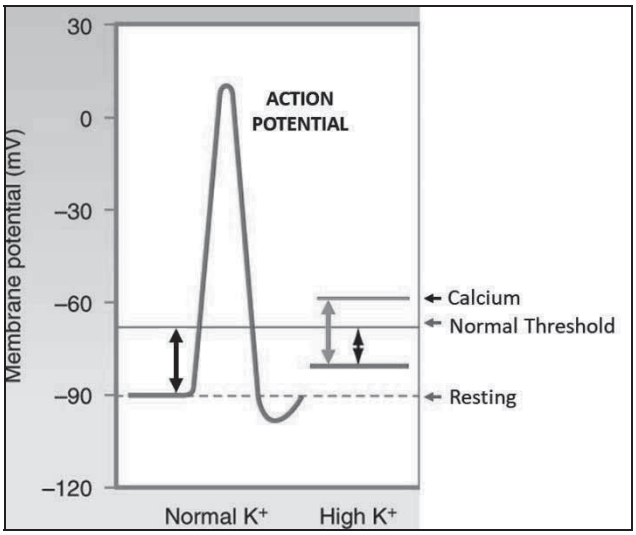
Severe dehydration, electrolyte and acid-base abnormalities must be corrected before sedation or anesthesia. Hyperkalemia is the most common electrolyte abnormality encountered and can be life threatening. Hyponatremia and hypocalcemia are also detected in approximately 50% of cases. If the blood potassium concentration is > 7 mEq/l (mmol/l) institute therapy immediately to protect the heart. Electrocardiographic abnormalities and bradycardia may be present. Sedation or anethesia should not proceed until the potassium is < 5.5 mEq/L (mmol/l) and severe metabolic acidosis has been corrected. While the patient is stabilized, cystocentesis should be performed to decompress the bladder which improve patient comfort and relieves pressure on the diaphragm, it also makes the next steps (urethral catheterization easier). Note: save urine for analyses and culture.

Treatment for hyperkalemia include the following, and more than one strategy may be needed.[1]

1. *Calcium gluconate* 10% 0.5–1.5 ml/kg intravenously to stabilize cardiac conduction; given over 5–10 mins while monitoring the electrocardiogram. NOTE: this buys you time and protects the heart by re-establishing the difference between the resting and normal threshold which has been decreased by hyperkalemia; it does not alter serum potassium concentrations (Figure 1).
2. Intravenous (IV) administration of a *balanced electrolyte solution* for rehydration, dilution of extra cellular potassium and restoration of acid–base balance. Normal (0.9%) saline is only used if a balanced electrolyte solution is unavailable. As blood pH is restored, potassium re-enters cells and decreases circulating blood levels. The volume and rate of administration of IV fluids is dictated by the patient's presenting signs – a 20-30 mL/kg bolus may be needed for moribund cats.

3. An IV bolus of *short-acting insulin* (e.g., regular insulin) at a dose of 0.1 to 0.5 U/kg; an IV bolus of 25% *dextrose* is given at a dose of 2g per Unit of insulin administered; this promotes intracellular uptake of potassium. Following the initial insulin and dextrose boluses, dextrose can be continued as an infusion.
4. Sodium bicarbonate is usually listed as a possible treatment but is reserved for cases where the blood pH is ≤ 7.1.

Figure 2. The effect of calcium on cell membrane polarization.



Sedation for urinary catheterization
Attempts to establish urethral patency start after the patient has been stabilized and has shown response to treatment. Sedation will be needed for urinary catheter placement. Butorphanol alone (0.1-0.2 mg/kg IV) may be sufficient. If the cat does not tolerate the procedure with butorphanol alone, alfaxalone can be given in small (0.5 -1.0 mg/kg) intravenous increments. Midazolam (0.1-0.2 mg/kg) can be added as this will result in additional urethral relaxation.

Sacrococcygeal block
A sacrococcygeal epidural block with a local anesthetic agent is easy to perform and highly recommended to provide analgesia and increase the success of urethral catheterization.[2, 3] After it has been introduced to some veterinary clinics it has been described as a ‘game changer”.
See resources for how to view an excellent video on this procedure.

Establishing urethral patency
Each clinician has their preferred method and tools for catheterizing the urethra. Open ended tomcat catheters and Minnesota olive-tipped urethral catheters are often used. This procedure must be done gently to avoid inflammation and long-term damage. Once the obstruction is relieved remaining urine is drained and the bladder flushed and drained until the solution being retrieved is clear of blood and debris.

An indwelling catheter – yes, or no?
This is a good question, and the answer is “it depends”. Factors to consider in this decision are:

- How easy was it to establish patency?
- Quality of urine stream
- How big was the bladder at presentation?
- Is there blood in the urine?

Indwelling catheters are not something cats like! They should be made of a soft material and be flexible. The tip should only be a short distance into the bladder for maximal comfort. Suture the catheter to the prepuce using the wings (if the catheter comes with them) or using a butterfly tape. The catheter is then attached to a closed collection system. These catheters can usually be removed in 1-3 days – the duration is guided by how the cat responds clinically and how the bladder recovers. A “recovered” bladder will feel small and contracted around the tip of the catheter.

Ongoing treatment and follow-up
Preventing re-obstruction is the goal, however recurrence rates vary from 22-36%. Urethral relaxants can be initiated while an indwelling catheters in place and continued after their removal.

Ensuring a low stress home environment and dietary changes are all part of the follow-up process.

Urethral relaxants
Phenoxybenzamine and prazosin are both used to promote urethral relaxation, but the latter is preferred. Prazosin is an alpha$_1$-adrenergic blocker (alpha$_1$-antagonist) is the antispasmodic of choice because of its fast onset of action and superior efficacy over phenoxybenzamine.[4] The recommended dose of prazosin is 0.25 – 0.5 mg per cat (not mg/kg) PO every 12 to 24 hours. Acepromazine lowers the proximal urethral pressure via its alpha$_2$-adrenergic blocking action but is rarely a good choice in cats with acute urinary obstruction because most are dehydrated, and the resultant vasodilation can result in severe hypotension.

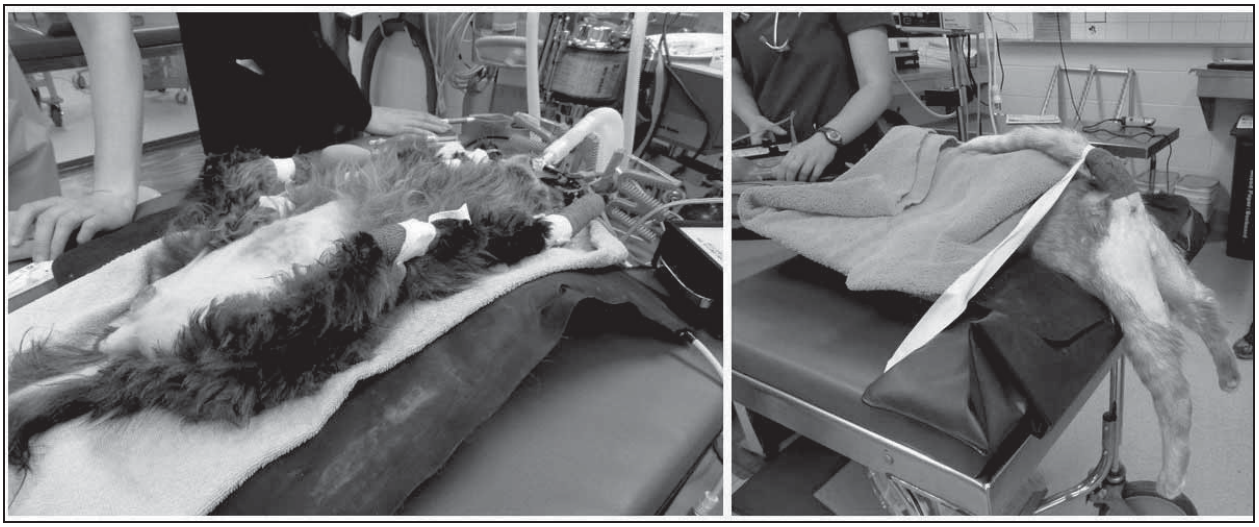
Surgical management
Perineal urethrostomy (PU) is considered a salvage procedure but will be required for some patients. The decision to perform this surgery is based on the functional state of the urethra. Reasons include:

- Urethral stricture
- Penile or urethral trauma
- Priapism

In some cats, the frequency of re-obstruction, ongoing costs for the owner and the cat's quality of life may be the deciding factor for surgery.
Excellent anatomical knowledge and surgical technique are essential for a good outcome. Complications include stoma stricture, wound dehiscence, urine scalding, incontinence, and recurrent bacterial urinary tract infections. Other surgical procedures include prepubic urethrostomy, subpubic and trans-pelvic urethrostomy.

Positioning for PU surgery
Two positions are used to perform a perineal urethrostomy (PU) and is based on surgeon preference. The two positions are shown in **Figure 2.**

Figure 2. Positioning of cats for PU surgery.



It is only recently that iatrogenic nerve damage caused by patient positioning has been studied in feline surgery. In a prospective, randomized study Slunsky and colleagues studied the consequences of positioning cats in dorsal or ventral recumbency for PU surgery.[5, 6] They studied motor response (patellar tendon, gastrocnemius muscle, pelvic limb withdrawal and perineal reflexes) and the presence of spinal pain in the lumbosacral region, motor function of the tail and fecal continence, before surgery, and 24 h and 14 days after surgery. They found that regardless of position, briskness of the perineal reflex was significantly decreased and the occurrence of spinal pain significantly increased 24 h after surgery; by day 14 after surgery these changes were no longer present.[6] In a cadaveric study they looked at the diameter of the vertebral canal in the lumbosacral and sacrococcygeal column (L6-Co2) in cats in dorsal and ventral recumbency using computed tomography.[5] The study concluded that from an anatomical perspective dorsal recumbency produced less severe alterations in the diameter of the vertebral canal compared to ventral recumbency. More studies are required to develop a position that does not result in postoperative discomfort and temporary nerve damage.

Urethral obstruction is a condition that clinicians see in daily practice. A successful outcome depends on quick recognition by the owner (therefore owner education is important), a quick diagnosis and treatment of life-threatening hyperkalemia, dehydration and acid-base balance (using standard operating procedures and checklists), followed by

reestablishing urethral patency without causing trauma. Follow-up includes dietary changes, stress management and owner education and with these, surgical intervention may be prevented.

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Resources

- VIDEO: Performing a sacrococcygeal epidural block. VETgirl Video: Coccygeal Block - YouTube, www.youtube.com/watch?v=KhAN4SavVzg
- Little, S.E. The Lower Urinary Tract pp 998-1004. In: The Cat Clinical Medicine and Management. Editor: Susan E Little. Elsevier Saunders (publisher), St Louis. 2011. ISBN 978-1-4377-0660-4 DOI https://doi.org/10.1016/C2009-0-40456-2
- Christopher Adin DVM, DACVS: How to perform a feline perineal urethrostomy. In DVM 360. November 11th 2015. www.dvm360.com/view/how-perform-feline-perineal-urethrostomy

NOTES:

Intestinal Anastomosis: Tips to Make It Easier

Howard B. Seim III, DVM, DACVS

If you would like a copy of this surgical procedure go to www.videovet.org.

Key Points

- Pay attention to basic surgical principles
- Submucosa is the layer of strength
- Use synthetic absorbable suture materials
- Appositional techniques are best
- Intestinal sutures should engage at least 3 - 4 mm of submucosa
- Intestinal sutures should be no further apart than 2 - 3 mm
- Always handle bowel wall using atraumatic technique
- Examine the integrity of your anastomsis visually
- 50 - 60% of the 'small intestine' can be resected

General Principles of Small Intestinal Surgery

1) Incorporation of the collagen laden submucosal layer in the surgical closure.
2) Minimize trauma and contamination.
3) Maintain good blood supply to the surgical site.
4) Avoid tension across the suture line as this may increase the possibility of leak and/or breakdown.
5) Pay attention to your established criteria when suturing intestinal defects.

Operative Considerations

1) Proper **"packing off"** of the surgical field using moistened laparotomy pads should be performed around the **exteriorized** bowell to prevent accidental abdominal contamination from intestinal contents.
2) Keep abdominal contents warm and **moist** throughout surgery with a warm, balanced electrolyte solution.
3) Handling abdominal viscera should be kept to a minimum. **Gentle manipulation** of intestine with moistened gloves or stay sutures is helpful in preventing unnecessary tissue trauma. **DeBakey** forceps are the most atraumatic forceps for handling abdominal visceral organs.
4) The collagen laden, tough **submucosa** is the layer of strength in the small intestine; this layer must be incorporated into any small intestinal closure.
5) It may be difficult to visualize the submucosal layer due to **mucosal eversion**. Visualization of submucosa may be enhanced if everted mucosa is trimmed away.
6) Intestinal contents should be "milked" away from the anastomosis site. **Intestinal clamps** (e.g., Doyen intestinal clamps, Alice tissue forceps with a rubber feeding tube interposed, hair clips, or Penrose drains) may be used to prevent intestinal contents from contaminating the surgical site whilst manipulating intestine during anastomosis.
7) The anastomosis should be **irrigated** prior to its return to the abdominal cavity and instruments and gloves changed prior to abdominal closure.
8) **Abdominal lavage** with 2-3 liters of body temperature, sterile, physiologic saline solution should be accomplished prior to closure. The ob¬jectives of repeated abdominal lavage include dilution of bacteria and endotoxin and mechanical removal of fibrin and necrotic debris. The fluid of choice is body temperature, sterile, physiologic saline solution with no additives (i.e. betadine solution, chlorhexidine, antibiotics, etc). Lavage solution is poured into the abdominal cavity using a sterile stainless steel bowl, the abdominal viscera gently aggitated, and fluid and debris suctioned out with a suction device and a Poole suction tip. Injecting antimicrobials or other products into the abdominal cavity is not recommended.

Suture Material

Absorbable Suture

Catgut. Catgut is **NOT** recommended for any visceral organ surgery. Its unpredictable absorp¬tion and rapid loss of tensile strength in such situations may result in an unacceptably high number of anastomotic leaks and /or breakdowns. Use of catgut suture in gastrointestinal surgery is not recommended.

Dexon, Polysorb, and Vicryl. Synthetic absorbable braided suture (i.e., polyglactin, poly¬glycolic acid) have become very popular. The braided nature however does result in increased tissue drag and difficult knotting ability.

Biosyn and Monocryl. These sutures have similar properties to Dexon, Polysorb and Vicryl however they are monofilament. They were developed to overcome the problem of tissue drag and knot slipping found in the braided synthetic absorbables. Their predictable hydrolytic absorption is unaffected by their immediate environment (i.e., in¬fection, contam¬ination, hypoproteinemia). They retain high tensile strength for a long period of time (2 3 weeks) and have very good handling characteristics. These suture materials are ideal for use in gastrointes¬tinal surgery. These sutures are the authors choice for gastrointestinal surgery.

PDS and Maxon. PDS and Maxon, are synthetic absorbable monofilament suture materials with similar properties to that of Dexon and Vicryl. They have been shown to retain approximately 70% of their tensile strength at 3 4 weeks, and are absorbed by hydrolysis (unaffected by infection, con¬tamination, hypoproteinemia). These suture materials are ideal for use in gastrointes¬tinal surgery. Possible disadvantages include stiffness, a tendency to kink and prolonged absorbtion time.

Nonabsorbable Suture
Nylon, Polypropylene. Monofilament, nonabsorbables are excellent suture materials for use in contaminated or infected surgical sites. They have a high tensile strength, are relatively inert in tissue, noncapillary, and do not act as a nidus for infection. These materials pas¬s through tissue with essentially no tissue drag and have ex¬cellent knot tying security at sizes 3 0 to 5 0.

Silk, Mersilene, Bronamid, Vetafil. Multifilament nonabsorbable sutures should **NEVER** be used in gastrointestinal surgery. They may harbor infection for years and may result in suture related abdominal abscesses or draining tracts.

Suture Size
For the majority of small intestinal surgical procedures in cats, 4-0 is recommended. The tensile strength of this size suture is greater than the tensile strength of the tissues that are being sutured (i.e., intestinal wall). Larger size suture may contribute to anas¬tomotic failure by increased trauma to tissues and its effect on the blood supply of tis¬sue margins.

Needles
Swaged-on "atraumatic" reversed cutting, narrow taper point, or fine taper cut needles can all be used for gastrointestinal surgery. The author prefers a narrow taper point needle. Needle diameter should approach the diameter of the suture.

Suture Placement
When suturing intestine, sutures should be placed 3 4 mm from the cut edge of the intestinal serosa and no more than 2 3 mm apart. It is important to recognize everted mucosa and be sure the 3 - 4 mm bite in the intestinal wall is not just in mucosa but engages all layers of the intestinal wall. Measure your intestinal wall bite from the cut edge of the serosa.

Suture Patterns
There is considerable controversy regarding specific suture pat¬tern for use in small intestinal surgery. Everting, inverting, and ap¬positional suture patterns have been used experimentally and clinically for suturing enterotomies and anastomoses. Appositional patterns are recommended as they cause little lumen compromise postoperatively.

Everting
Everting patterns (i.e., horizontal mattress) have been shown to encourage adhesions and result in lumen stenosis. This technique is NOT recommended. The everting technique is not to be confused with the mild eversion of mucosa that occurs in the appositional techniques described below.

Inverting
In small animals adequate lumen diameter is an important consideration with any techni¬que. Inverting patterns result in substantial lumen compromise of the small intestine and are NOT recommended in dogs and cats.

Apposition
Anatomic apposition of individual layers of the bowel wall (i.e., mucosa, submucosa, muscularis, and serosa) result in primary intestinal healing. This technique is superior to inverting or everting techniques because apposition of intestinal margins eliminates lumen compromise. This is the authors preferred technique for suturing all hollow viscus organs in the abdominal cavity. Suture patterns of choice include:

1) Simple interrupted apposing. This technique involves suturing all layers of the intestinal wall and tying the knots on top of the serosa to approximate cut edges. The sutures should be tied tight enough to

effect a watertight seal, yet not so tight as to blanch the tissue and cause ischemia of intestinal margins. This technique is simple, fast, reliable, and does not result in lumen compromise.
2) Simple continuous apposing. This technique is similar to the simple interrupted appositional technique however, a continuous suture pattern is used rather than an interrupted pattern. Advantages include more efficient anastomosis, equal suture tension over the entire anastomosis, airtight-watertight seal, and mucosal eversion is minimized. This is the authors preferred suture pattern for suturing all hollow viscus organs in the abdominal cavity.

Intestinal Anastomosis
Intestinal anastomosis is indicated for resection of nonre¬ducible intussuscep¬tion, necrotic bowel wall secondary to complete intestinal obstruction, intes¬tinal volvulus, stricture secondary to trauma, linear foreign body with multiple perforations, and intestinal neoplasia (e.g., leiomyoma, leiomyosarcoma, adenocarcinoma).

After a complete ab¬dominal exploration, the affected length of bowel is delivered from the peritoneal cavity and isolated with the use of moistened laparotomy pads and crib towels. If possible, the intestinal anastomosis should be performed on a water resistant surface (e.g., plastic drape, crib towel) to prevent 'strike' through contamination.

Once the level of resection has been determined, the appropriate mesenteric vessels are identified and ligated, and the portion of intestine to be resected is isolated by clamping the bowel at a 60° angle away from the mesenteric border. This angle ensures adequate blood supply to the antimesenteric border.

Everted Mucosa
Occasionally when the segment of intestine to be removed is amputated mucosa 'everts' from the cut edge of the intestinal wall making it difficult to visualize the cut edge of the serosa. If this occurs it is 'highly' recommended to excise the everted mucosa to enable the surgeon to easily visualize the cut edge of the intestinal serosa. It is vital that the surgeon engage at least 3 – 4 mm of intestinal wall with each suture to guarantee adequate bites in the collagen laden submucosa.

Bowel Lumen Diameters
In cases where the oral end of the bowel is dilated and the aboral end is normal size, several options exist to create intestinal lumens of equal diameter:

1) Increase the angle of resection on the smaller diameter segment of bowel (i.e., aboral segment). This will increase the orifice size by 5 10 mm depending upon bowel diameter.
2) In larger lumen size discrepancies the antimesenteric border of the smaller diameter stoma can be in¬cised longitudinally to enlarge the lumen diameter.
3) An end to side anastomosis can be performed by closing the larger diameter stoma of the in¬testinal resection with a single layer continuous apposing suture pattern then anastomosing the smaller diameter segment of bowel to an appropriate size enterotomy made in the antimesenteric border of the larger diameter segment of bowel.
4) The larger diameter segment of bowel can be made smaller in diameter by suturing its cut edge until its lumen is equal in size to the smaller diameter intestine (this technique is often used for subtotal colectomy in cats).

Intestinal Anastomosis Technique
See the Feline Surgery - GI Cases for a detailed video description of this technique available at www.videovet.org.

When suturing an anastomosis, atraumatic handling of bowel wall and perfect anatomic apposition of incised margins is important. It is recommended to begin suturing at the mesenteric border as this al¬lows adequate visual¬ization of mesenteric vessels and helps prevent encircling these ves¬sels when placing the first few sutures. Any of the appositional suture patterns previously described (i.e., simple continuous or interrupted) will result in a high success rate, both in the short-term (i.e., leakage, breakdown) and long term (i.e., stricture, stenosis).

The following tips may prove helpful when performing an intestinal anastomosis (see the anastomosis video clip at www.videovet.org for detailed description of the surgery tips below:
1) First, place a stay suture to hold the mesenteric border of each segment of bowel in apposition. Tie this suture, leave the ends long, and place a hemostat on the suture end without the needle.
2) Place a second stay suture in the antimesenteric borders of each segment to be sutured to bring the ends of the intestinal segments into apposition. Place a hemostat on the ends of this suture.
3) Place gentle traction on the mesenteric and antimesenteric stay sutures to bring the two intestinal segments into apposition. Make certain the lumen diameters of each bowel segment are identical.

4) Using the needled segment of suture from the mesenteric stay suture, begin a simple continuous appositional anastomosis being careful to get a 3 - 4 mm bite in the submucosa and placing each suture no more than 2 - 3 mm apart (2 mm apart in cats). When the anastomosis is complete, tie the suture to the mesenteric stay suture.
5) If a simple interrupted apposing suture pattern is used, be careful to get a 3 - 4 mm bite in the submucosa and place each suture no more than 2 - 3 mm apart.
6) Evaluate the integrity of the anastomosis. The author's preference for evaluating the integrity of the anastomotic closure is to visually examine each suture to be certain that suture placement has met your strict criteria (i.e., sutures are no more than 2 - 3 mm apart and have a 3 - 4 mm bite in the submucosa.

Postoperative Care
Intravenous fluids to maintain hydration and ensure renal function are continued postoperatively, until the patient begins to eat and drink. Intravenous fluids should then be tapered over a 24 to 48 hour period.

Feeding
Early return to enteral feeding is best for the overall health of the intestine. Feeding the postoperative gastrointestinal surgical patient is generrally based on the following criteria:
a) preoperative condition of the patient
b) the condi¬tion of the bowel at the time of surgery
c) surgical procedure performed (i.e., enterotomy, anastomosis, pylorectomy)
d) presence or absence of peritonitis
e) postoperative condition of the patient.
The earlier patients can be returned to oral alimenation the better.

Complications
The most common postoperative complication of small intestinal surgery is leakage; leak is either associated with breakdown of the anastomosis or improper surgical technique (i.e., improper suture placement, inappropriate suture material, knot failure, sutures to far apart, inappropriate bite in the collagen laden submucosal layer, suturing nonviable bowel).

A presumptive diagnosis may be accomplished by the following:
1) Body temperature (may be up if acute or down if moribund).
2) Abdominal palpation: periodic, gentle abdominal palpation for pain (gas or fluid?).
3) General attitude (depression anorexia).
4) Incision: examination of the patients incision for drainage (look at cytology if drainage is present)
5) CBC: leukocytosis followed by leukopenia (sepsis), or a degen¬erative left shift may imply breakdown.
6) Glucose: low glucose generally implies sepsis (this occurs early in sepsis and may be used as a screening test).
7) Abdominal radiographs: generally not helpful, they are difficult to critically assess due to the presence of postoperative air and lavage fluid. It can take 1 - 3 weeks for peritoneal air to diffuse from the abdominal cavity after routine abdominal surgery. Time variation is dependant upon the amount of air remaining in the abdominal cavity postoperatively (i.e., large deep chested animal vs a small obese animal).
8) Abdominal tap (paracentesis): a four quadrant abdominal tap is accomplished by aspirating fluid using a 5cc syringe and 20 gauge needle or placing a plastic IV catheter into the peritoneal cavity and allowing fluid to drip onto a slide. This may be the most sensitive diagnostic test for determining the presence or absence of intestinal leak.
9) Peritoneal lavage (if paracentesis is not productive): infuse 10-20cc/kg of sterile physiologic saline solution into the ab¬dominal cavity, then gently pal¬pate the abdomen and repeat the four quadrant paracentesis. This technique increases the sensitivity of paracentesis to 90%.
Once fluid has been obtained, a smear should be stained and evaluated microscopically. Depending upon the cell types seen, a determination of the presence of leakage can be made.

Below are examples of expected cytology in patients with and without leak.
1) Healthy PMNs with few degenerate PMNs and a moderate number of red blood cells: This cytology may be expected in any postoperative abdominal procedure (e.g., OHE, abdominal exploratory, cystotomy). Your index of suspicion for anastomotic breakdown should be low. However, if clinical signs continue to deteriorate, repeat paracentesis (2 - 3 times daily, if necessary) to determine the "trend" of the abdominal fluid cytology is recommended.
2) Healthy polymorphonuclear leukocytes with bacteria located intra or extracellularly, degenerate PMNs with intracellular bacteria, free bacteria, or food particles imply breakdown. Exploratory laparotomy is indi¬cated.

In a recent morbidity/mortality study of patients undergoing intestinal surgery it was found that animals requiring a second abdominal surgery to treat intestinal disorders were less likely to survive than patients requiring only one laparotomy. Also, the longer it took to determine whether or not intestinal leakage had occured the less likely the patient would survive reoperation. **The take home message is:** pay attention to detail during the first surgery and if a leak occurs, diagnose it and treat it as soon as possible.

Prognosis
The overall prognosis for uncomplicated GI surgery is excellent. The surgeon must pay attention to detail when suturing any hollow viscus organ with liquid contents.

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Making End of Life Decisions

Sheilah Robertson, BVMS (Hons), PhD, DACVAA, DECVAA, DACAW, DECAWBM (WSEL)

Introduction

Suffering and Quality of Life (QoL) are terms that are widely used in veterinary medicine, but without a consensus of what these terms mean. Many publications that describe a QoL tool do not define the term. Our feline patients meet the prerequisites for suffering which are sentience and consciousness. A useful definition of sentience is "the ability to have feelings that matter", including negative (e.g., pain, fear) and positive (e.g., pleasure) feelings, and these are also classified as emotions. Suffering is a mental state associated with unpleasant physical and emotional experiences. Suffering in turn, disrupts an animal's QoL. Quality of Life is a balance between positive and negative inputs. It is important to remind ourselves that animals live in the present, so QoL is "how an animal feels about its current circumstances". The challenge for us is how do we "measure" something that is multifactorial and cannot be easily measure objectively. It is difficult to determine the internal states of animals who cannot self-report. Proxy decisions will be made for animals by their owners or by veterinary professionals. The individuality of what contributes to QoL adds to the complexity of assessing whether or not an animal is enjoying life. Just as with people what cats enjoy or find unpleasant varies. Some of us are happy and content with sedentary activities such as reading a book, but others are only happy on an adventure that is physically demanding such as mountain climbing. Although rigorous scientific proof of suffering is difficult to obtain, we can make logical arguments for its existence in different patients under a wide variety of conditions. Historically, veterinary medicine has focused on physical health, but we are now embracing the impact of mental health on an animal's overall enjoyment of life. This is reflected in the veterinarian's oath which states that we will use our "*scientific knowledge and skills for the prevention and relief of animal suffering".*

Because cats are living longer, and more advanced medical and surgical procedures are available, monitoring QoL is essential – we must always remember that if we prolong a cat's life it should never be at the cost of quality. As new treatments and procedures become available the question that should be asked is "just because we can, should we?" it is worth comparing what we may choose to do when faced with a daunting medical treatment; we may opt for a radical procedure or an unpleasant round of therapy for ourselves because we can rationalize that temporary suffering may lead to a long and good life. In the same circumstances a feline patient cannot know what the future holds, therefore QoL must be good on many more days than it is bad. Monitoring over time will help the veterinary team and owner see if treatments and interventions are working, but also assist in making difficult decisions such as ending curative treatments and electing palliative or hospice care, or euthanasia. Animal welfare is not just about good physical health and avoidance of suffering, it includes the promotion of positive emotions. Assessing and monitoring QoL of a pet is a team effort involving the veterinarian, veterinary staff and the owner(s). As in human medicine there may not be agreement among everyone. There are multiple inputs to physical and mental health; some negative inputs are shown in Table 1.

Table 1. Examples of physical and mental states that cause a negative impact on QoL.

PHYSICAL	MENTAL / EMOTIONAL
Pain caused by surgery(acute) Pain caused by osteoarthritis (chronic)	Anxiety and phobia
Nausea and vomiting secondary to chemotherapy of chronic kidney disease	Fear
Constant pruritis	Isolation and loneliness
Breathlessness due to respiratory disease, brachycephalic syndrome or cardiac disease	Boredom or frustration
Thirst due to diabetes mellitus or chronic kidney disease	Stress

The list of things relevant to an animal's enjoyment of life includes but is not limited to the following: social relationships, a sense of control, a sense of security, mental stimulation, and health. Pain is a conscious emotion and

a large detractor from QoL because it is defined as a distressing experience associated with actual or potential tissue damage with sensory, emotional, cognitive, and social components".[1]

In a survey of cat owners whose cats had heart disease, it was clear that owners were interested in extending survival times but achieving a good quality of life was more important and it emerged that owners were concerned about their ability to detect suffering.[2] So clearly cat owners need our help when their cat has a chronic disease.

Quality of Life Assessment Tools

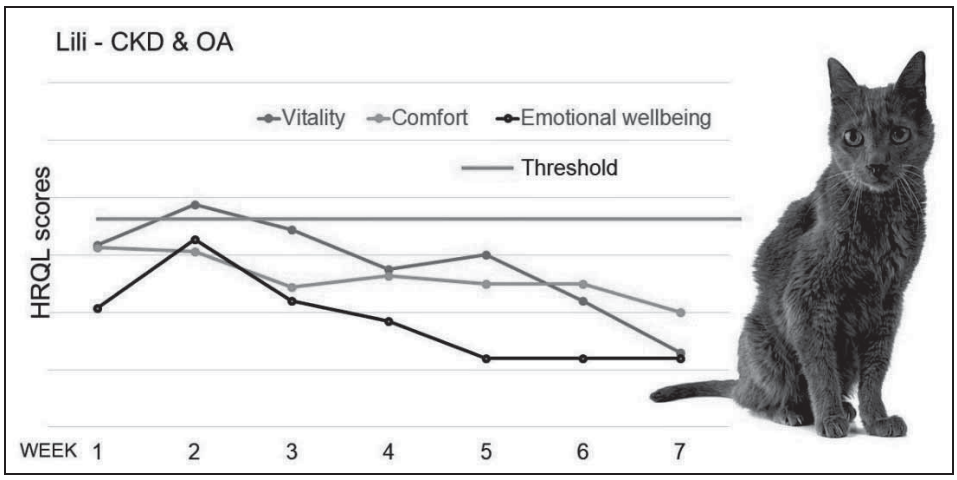
In cats, assessments depend on clinician or owner (a proxy) so are termed "observer related outcomes [OROs]". There are many tools, instruments and questionnaires in the literature, some are disease specific, and some are generic to overall health. Quality of Life tools for cats with diabetes mellitus,[3] cardiac disease,[4] chronic kidney disease,[5] and degenerative joint disease have been published.[6] Assessment tools can be used as an outcome measure for an intervention or treatment and when recorded over time they aid in decision making.

In many cases our feline patients do not have a single ailment but several comorbidities, and the impact of adverse side-effects of treatment must also be factored in (e.g., nausea, radiation burns) therefore, another approach is to use Health-Related Quality of Life (HRQoL) instruments which are more generic or "global" and capture overall physical and emotional well-being. HRQL tools quantify the impact of disease and its treatment on an individual's daily well-being.[7] Based on extensive testing the key domains used for assessing HRQL in cats are vitality, comfort and emotional wellbeing.[8] Many simple QoL assessment tools can be found with an internet search and these are widely used but have not been tested for validity or reliability and these limitations must be acknowledged.

New Technology

With today's rapidly advancing technology web-based or "app" based tools are gaining popularity and have many benefits including speed, ease and reliability of assessment. Examples of these tools are those developed by NewMetrica (www.newmetrica.com) which take as little as 5 minutes for the owner to complete in the comfort of their home; this is a "for fee" instrument. In cats, vitality, comfort and emotional well-being are assessed using 20 questions. The patient is compared to an "average healthy cat" and to itself over time. The interval between assessments and alerts can be individualized for each patient and the expected disease trajectory (slow decline or rapid decline). In their new publication[7] Davies and colleagues have drawn on the extensive data gathered from the original generic feline health-related quality-of-life instrument[8] and by using normalized scores from healthy and sick cats created threshold scores above which 70% of healthy cats should score. In addition, they have derived what they term the "Minimal Important Difference" in scores; after all this is what we are interested in, not just a change in a number but whether this change equates to a clinically meaningful improvement for the cat. In this Open Access paper, they review how the instrument works using cats with different degrees of severity of osteoarthritis and also follow an elderly cat with osteoarthritis and hyperthyroidism to show how changes over time assist the owner to make end-of-life decisions. An example of a cat named Lili who has chronic kidney disease and osteoarthritis is shown in Figure 1.

Figure 1. Monitoring HRQoL over time. Threshold = 70% of healthy cats will score above this.



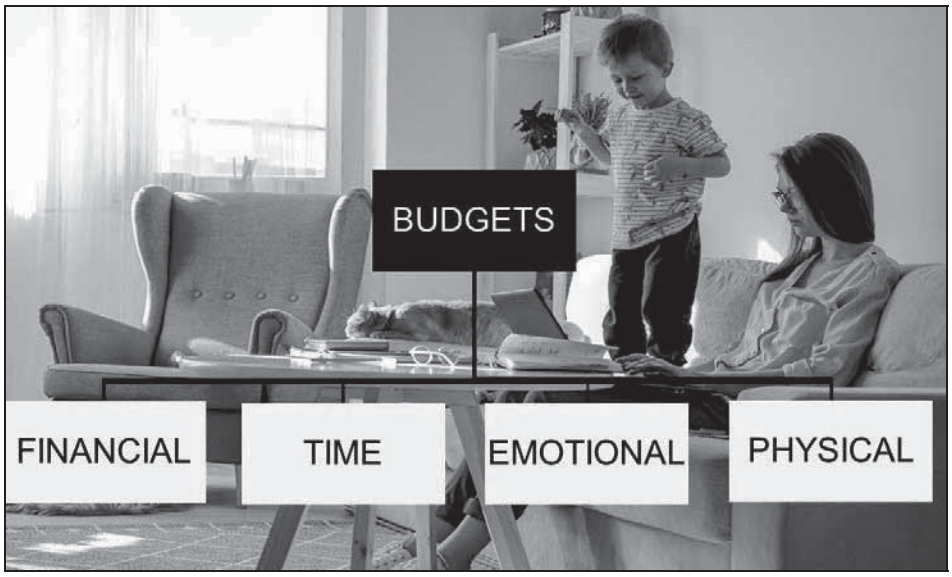
The Role of Owners

When a cat has a chronic disease that negatively affects QoL, this can also affect the caregiver's QoL. Cats with cognitive dysfunction or nighttime restlessness may disrupt routines in a household. These may be "make or break" situations where euthanasia is being considered because one of the family's budgets (see below) are exhausted.

The Four Budgets (Figure 2.)

Owners have four budgets that must be considered when making treatment plans; these are financial, time, emotional and physical. The "weight" that each of these carries will vary among different owners. These budgets combined with the pet's QoL will guide clinical decisions.

Figure2. The four budgets that play a role in EOL decision making



The Veterinarian's Role

Our role can be simply defined as "To partner with the owner to achieve the best outcome for the cat". Veterinarians may have a different perspective from the owner about a particular cat's quality of life, or prospects for quality of life. We must remember the four budgets that owners have when helping them make decisions. We must also be realistic and offer sound advice about procedures that may or may not improve an animal's quality of life. Animals are often very adaptable to specific treatments, for example an amputation or enucleation – but each case must be individually considered.

Improving Quality of Life

Osteoarthritis is not a curable disease, but the pain associated with it can often be well managed. Treatment is holistic (pharmacological and non-pharmacological) and includes weight management, exercise, mental stimulation and providing solutions to help these cats with "activities of daily living". The use of low/easy entry litter boxes, providing easy access to favorite locations (windowsills), and safe places to rest, and teaching owners how to perform range of motion exercises and massage can significantly improve a cat's QoL.

Anticipatory Grief

"How we seek to spend our time may depend on how much time we perceive ourselves to have." — *Atul Gawande.*[A] At some point, owners begin to understand that time with their cat is limited and as with people begin to wonder how they can make the time left the best it can be. This is also the time that anticipatory grief can surface. Anticipatory grief refers to a feeling of grief occurring before an impending loss, but emotions including anger and despair are also common. It is our duty to bring up euthanasia, despite how difficult this conversation is, and help the owner make good decisions. In human medicine, the benefits of a structured "serious illness conversation" early after the diagnosis of a disease that cannot be cured (but can be palliated), have been documented, but requires comprehensive physician training.[9, 10] Recently a similar approach has been proposed in veterinary medicine with the introduction of a serious veterinary illness conversation guide.[11]

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The Last Appointment: How to Navigate Smoothly Through Euthanasia Appointments

Sheilah Robertson, BVMS (Hons), PhD, DACVAA, DECVAA, DACAW, DECAWBM (WSEL)

Introduction

"Life is meaningful because it is a story. Both a story and a life depend crucially on how it ends. In stories, endings matter".

Atul Gawane, Being Mortal: Medicine and What Matters in the End

This discussion focuses on owned cats when a decision is made to euthanize them. This in no way diminishes the importance of how we deal with euthanasia of cats in shelters, however that is a topic that deserves its own discussion.

Euthanasia is an important part of our duty as veterinarians and there are many reasons for ending an animal's life. When we, or the owner can no longer provide the pet with an acceptable quality of life, euthanasia should be regarded as a treatment option and not a failure. The "last appointment" a veterinarian has with a pet is often the one to perform euthanasia and this is an emotional time for the owner and the entire health care team. It can also be a "make or break" appointment which dictates whether or not the client will return to the same practice if they acquire a new pet. How should we approach euthanasia in a way that considers the best interests and welfare of all stakeholders (with the cat being central to the discussion) and issues including, but not limited to ethics, finances, religious beliefs and emotional wellbeing? It is likely that every veterinary graduate will perform a euthanasia, yet there is little time devoted to this subject in the veterinary curriculum leaving many new doctors unsure of both the technical components of the procedure (the science of veterinary medicine, or the science of death) and how to deal with their own emotions, those of owners and coworkers, which we can think of as the "art of euthanasia". Providing a "good death" requires that we draw on both the science and art of veterinary medicine. The rest of this discussion focuses on "the how to do it" and do it well.

Mapping the Ideal Euthanasia Experience

There are multiple steps involved in the euthanasia process and each one must be well coordinated; communication within the team and between the team and owner is essential. If we look at how people evaluate an experience, there are two main times to consider; while they are "in it" and afterwards, and the view or recollection of each period may be quite different. The so called "Peak-End" rule suggests that the worst moment and the one at the very end are what stick in people's minds. In his book, Being Mortal [A], Atul Gawande discusses how people rate a painful or unpleasant procedure as being "not so bad" if the very end is comfortable or less painful than the worst part they endured. Although our aim is for every step to be as good as it can be under the circumstances, that last moments spent with their beloved cat is especially important to owners. It can be helpful to use a map and create specific "standard operating procedures" to help you navigate from the beginning to the end, which includes after the euthanasia has been performed. Working with your team to make each step the best it can be and for the flow from one to the next be seamless is time well spent.

Some practices offer in-home appointments for euthanasia and there are a growing number of in-home euthanasia services throughout the country. Many times, the procedure is performed in the clinic or hospital that the owner has used for all their cat's medical care. Sometimes it happens during a crisis in an emergency room and each party is a stranger to each other. Within a clinic there may be enough space for a comfort room that is used for breaking bad news and performing euthanasia. When space is limited, an examination room is used. With some planning, an examination room can quickly be transformed into a softer less clinical environment. When owners are asked about euthanasia experiences the "cold metal table" is very frequently mentioned as something negative which sticks in their mind. Another commonly brought up memory is of "when they took my cat to the back". This is something to avoid, as discussed later, intravenous catheters are not always required for euthanasia and separating the pet from the owner at such an emotional time can be devastating for them (see "things on the never do list" below).

Creating the Right Environment

Placing a plant in the corner of the room and putting some cushions and fleece blankets on, or over tables and chairs is simple to do. Ideally there should be a dimmer switch so that you can create soft lighting, or alternatively switch off harsh overhead lighting and use a lamp. A sound machine (waterfall or waves) can be soothing. A small basket with supplies for the owner should be in the room; thoughtful supplies include tissues, wet wipes, a small mirror (mascara runs when you cry), and a bottle of water. After sedation, offer owners some time alone with their cat. Discuss that this should be no more than 5-10 minutes and supply them with a wireless doorbell to press when they are ready (choose a place elsewhere in the clinic to put the receiver to summon you). Notices or flags (coded for euthanasia)

can be placed outside the room so everyone in the veterinary team know that a euthanasia is in progress so they can keep quiet and avoid accidentally entering the room. Items such as an electric candle and sign can be placed in the reception area to alert other clients that a euthanasia is in progress.
It is essential to make a note in the owner's file denoting which room their pet was euthanized in – this room should be off limits for that client with other pets, or a new pet. If it is the only room you have, be aware it may bring up difficult memories for the client.

Some Things on the "Never Do" List:

- Never get the sex or name of the cat wrong.
- At no time during the appointment should the cat be separated from the owner.
- Do not outline every possible thing that could go wrong.
- If it is taking longer than expected for the patient to become sedated or the heart to stop, never say "he/she is fighting it".

Performing the Procedure

You must be current with, and follow all Drug Enforcement Administration, Federal, State and State Board rules and regulations for the ordering, use, transport, and disposal of controlled drugs.

Sedation / Pre-Euthanasia Anesthetic Protocols

Why sedate prior to euthanasia? This allows for minimal restraint during euthanasia and also allows the owners time with their cat when it is in a relaxed, peaceful, sleeping state – this can be a great comfort to many owners when their pet has been struggling prior to this appointment. Sedation also allows the owner, if they wish, to have time alone with their cat and to have them on their lap or next to them for the final phase of the procedure.

The goals of pre-euthanasia sedation are to use a protocol that is consistent (always works), has a predictable time to onset, a consistent duration, can be given intramuscularly (IM) or subcutaneously (SC) and causes minimal reaction by the patient when it is injected, and few, if any unwanted side effects. We are now exploring techniques that avoid injections for example sedation with oral gabapentin, or transmucosal tiletamine and zolazepam.[1] Because there are numerous published protocols this suggests that the "perfect" one does not exist for every cat. I would advise trying several protocols, until you find the one you like best; you will soon know what works for the very ill, geriatric frail animal versus a still feisty cat.

Table 1 shows several recommended protocols for cats. Reducing the reaction by the patient can be achieved by using size 25-27g needles and injecting slowly. Adding a small (~ 0.1 mls) amount of Vitamin B12 (pH 7.8) solution to the syringe seems to reduce the sting of administration. Lidocaine has also been suggested to reduce the reaction to injection. If the first injection is not sufficient, and you have allowed enough time to pass (~10 minutes), stay calm, make sure you have back up supplies and repeat the sedation. If the euthanasia is planned in advance, it may be possible for the owner to administer oral medication before arrival at the appointment (e.g., gabapentin).

Euthanasia Techniques – Drugs and Routes of Administration

Examples of euthanasia solutions: DEA Schedule CII (pentobarbital alone) – Fatal Plus®
DEA Schedule CIII (phenytoin or lidocaine added) – Somnasol®, Euthasol®, Beuthanasia-D®.
Intravenous injection is ideal, and the medial saphenous vein is a good choice in cats so that the owners can remain stroking their cat's head and speaking to it. Placing a soft fleece blanket over the cat and turning slightly towards the rear end of the patient, can often prevent the owners from seeing what you are doing. If you let the bottom hind-leg drop downwards, the vein will often fill on its own negating the need for a tourniquet. If a tourniquet is used, invest in one that is easy to release with one hand. Instead of alcohol which looks and smells clinical, wet down the fur with a wet swab or spray (use a small "spritz" bottle) of water; adding a few drops of lavender or rose water is a good idea. If you do shave over the vein, use small, cordless, and quiet clippers which are well maintained. Avoid IV catheters and use a small gauge butterfly needle instead; this is easier to place and can be very quickly removed at the end of the procedure. In some cases, the IV route will be challenging or you first (or second) attempt fails. Other routes of administration are acceptable if the cat is unconscious or unresponsive; if a cat does not respond to a noxious stimulus (e.g., a toe pinch), I feel confident using a non-IV route – this is another reason to always use a 2-step process; sedation/anesthesia followed by euthanasia. These other techniques are explained in detail in the AVMA 2020 Euthanasia Guidelines. More resources are given under *suggested reading*. They include intra-renal (my first choice for cats), intrahepatic, intracardiac and intraperitoneal. Please refer to these resources for descriptions of how to perform these techniques and dose adjustments for euthanasia solutions.

Things That Make a Difference – Verbal Priming

Replace “you” with “we” whenever possible, for example, instead of “you will know when it’s time” say “we will work together to know when it’s the best time”. Instead of saying “there’s nothing more you can do” say “you have done an amazing job”. If an owner says, “this must be the worst part of your job”, reply with “this is an honor”.

Memorials
Many things can be done to honor the pet, including fur clippings, paw prints (clay or ink), memorial cards, photographs, and on-line (social media) posts.

Aftercare and Removing the Pet
Using nice baskets and blankets to “tuck” a cat in (do not cover the head) can be immensely powerful as described by this owner: “the surprising part to me was how the little things that you did made such a difference. I had imagined that you would bring in a cardboard box to put her in, but no, you brought in a pretty basket with a brightly colored pillow to put her on. The image of her lying there was my last memory of her, and it was beautiful”. When the owner is ready to leave, have someone on your staff come in to be with the pet, so they do not feel it is alone. Aftercare may be burial, private, or communal cremation, aquamation is now an option for pets. This is usually discussed before the procedure, but be prepared for owners to change their choice, so remain flexible.

Follow-Up
Follow-ups with the clients will vary – if it is a long-term client, you likely know what would work for them. However, a phone call is always good, even if you end up leaving a message, and e-mail is also appropriate in most cases. Leaflets about grieving, how other pets and children in the household may react are available and should be provided; these allow the client to read them in their own time because of their emotions during the appointment they are unlikely to remember much of what you said.

As veterinarians, we have the honor of being allowed to perform euthanasia; with thought and preparation this “last appointment” can bring closure to a family and leave them with good memories of their precious 4-legged family member.

Table 1. Suggested pre-euthanasia sedation protocols for cats; these protocols should result in a deeply sedated or anesthetized cat within 3 to 6 minutes.

Drug Concentrations:
Tiletamine-zolazepam = 100 mg/ml (50 mg/ml tiletamine + 50 mg/ml zolazepam); Ketamine = 100 mg/ml; Acepromazine = 10 mg/ml; Midazolam = 5 mg/ml; Butorphanol 10 mg/ml. NOTE: nalbuphine (not a controlled substance) can be substituted for butorphanol.
Doses given in milliliters; all drugs combined in a single syringe.
Route of administration: intramuscular (IM) or subcutaneous (SC).

1. “KAT”

Weight lbs.	Weight kg	Ketamine	Acepromazine	Tiletamine-zolazepam
≤ 10	≤ 4.5	0.1	0.1	0.2
10-20	4.5 – 9.0	0.15	0.15	0.3

2. “KBAM”

Weight lbs.	Weight kg	Ketamine	Butorphanol	Acepromazine	Midazolam
≤ 10	≤ 4.5	0.3	0.3	0.1	0.3
10-20	4.5 – 9.0	0.4	0.4	0.1	0.4

3. Using Tiletamine-zolazepam reconstituted with acepromazine and ketamine (reduces total volume of injection)

Reconstitute Tiletamine/zolazepam powered with 2.5 mls of acepromazine and 2.5 mls of ketamine		
Weight in lbs.	Weight in kg	Dose (mls)
≤ 10	≤ 4.5	0.2
10-20	4.5 – 9.0	0.3

Reference(s)
1. Nejamkin P, Cavilla V, Clausse M, et al. Sedative and physiologic effects of tiletamine-zolazepam following buccal administration in cats. J Feline Med Surg 2020;22(2):108-113.

Suggested Reading

- Cooney KA, Chappell JR, Callan RJ and Connally BA. *Veterinary Euthanasia Techniques.* Ames: Wiley-Blackwell, 2012.
- Gardner M and McVety D. Letting Go – Handling Euthanasia in Your Practice. In: Gardner M and McVety D (eds) *Treatment and Care of the Geriatric Veterinary Patient.* Hoboken: Wiley-Blackwell, 2017, pp 327-336.
- Gardner M. The Final Chapter. In: Gardner M and McVety D (eds) *Treatment and Care of the Geriatric Veterinary Patient.* Hoboken: Wiley-Blackwell, 2017, pp 337-341.
- Feline specific End-of-Life resources
- End of Life Toolkit | American Association of Feline Practitioners: available at: https://catvets.com/end-of-life-toolkit/
- Alternative routes for euthanasia: Alternate Routes for Euthanasia | Clinician's Brief (cliniciansbrief.com) www.cliniciansbrief.com/article/alternate-routes-euthanasia
- Cooney, K. Euthanasia Protocols (2021) Euthanasia Protocols | Clinician's Brief (cliniciansbrief.com) www.cliniciansbrief.com/article/euthanasia-protocols
- AVMA Guidelines for the Euthanasia of Animals: 2020 Edition www.avma.org/resources-tools/avma-policies/avma-guidelines-euthanasia-animals

NOTES:

Creating a Culture of Perioperative Safety in Your Clinic

Sheilah Robertson, BVMS (Hons), PhD, DACVAA, DECVAA, DACAW, DECAWBM (WSEL) &
Bryden Stanley, BVMS, MVetSc, MANZCVS, MRCVS, DACVS

Checklists are for everyone. They minimize human error and are utilized in multitude of professions and trades.

Evolution of the Surgical Safety Checklist (SSC)

The formal checklist first came about after an aviation accident in 1935.[1] Boeing had won a competition to build a long-range bomber for the US military, with a huge plane that could fly faster, longer and carry five times as many bombs as other designs… it was named the 'flying fortress' and had 4 huge engines. During a public test flight, the plane crashed after it was just 300ft into the air, killing all in front of military brass and the press. It was thought that this complex plane, with its 4 engines, was just 'too much airplane for one man to fly', and Boeing lost the contract to Martin and Douglas' smaller, simpler plane. However, the investigation revealed that the experienced test pilot had simply forgotten to release the locking mechanism on the elevator and rudder controls. Subsequently, a group of test pilots got together to work out how to get this plane to fly safely. They concluded that even highly-skilled teams need tools to optimize consistently good outcomes and came up with an ingeniously simple pilot's checklist (Figure 1). They went on to fly that plane 1.8 million miles without an accident. The US Military ultimately purchased 13,000 more of the planes (renamed the B-17), which enabled the devastating bombing campaign across Nazi Germany. Essentially, the pilots had reduced human error significantly by resorting to simple, step-by-step checks before take-off, flight, landing and taxiing. About 70 years later, this type of list has also proven to significantly reduce adverse events in the medical arena.

Figure 1: The B-17 Checklist:

APPROVED B-17F and G CHECKLIST

REVISED 3-1-44

PILOT'S DUTIES IN RED

COPILOT'S DUTIES IN BLACK

BEFORE STARTING
1. Pilot's Preflight—COMPLETE
2. Form 1A—CHECKED
3. Controls and Seats—CHECKED
4. Fuel Transfer Valves & Switch—OFF
5. Intercoolers—Cold
6. Gyros—UNCAGED
7. Fuel Shut-off Switches—OPEN
8. Gear Switch—NEUTRAL
9. Cowl Flaps—Open Right—OPEN LEFT—Locked
10. Turbos—OFF
11. Idle cut-off—CHECKED
12. Throttles—CLOSED
13. High RPM—CHECKED
14. Autopilot—OFF
15. De-icers and Anti-icers, Wing and Prop—OFF
16. Cabin Heat—OFF
17. Generators—OFF

STARTING ENGINES
1. Fire Guard and Call Clear—LEFT Right
2. Master Switch—ON
3. Battery switches and inverters—ON & CHECKED
4. Parking Brakes—Hydraulic Check—On-CHECKED
5. Booster Pumps—Pressure—ON & CHECKED
6. Carburetor Filters—Open
7. Fuel Quantity—Gallons per tank
8. Start Engines: both magnetos on after one revolution
9. Flight Indicator & Vacuum Pressures CHECKED
10. Radio—On
11. Check Instruments—CHECKED
12. Crew Report
13. Radio Call & Altimeter—SET

ENGINE RUN-UP
1. Brakes—Locked
2. Trim Tabs—SET
3. Exercise Turbos and Props
4. Check Generators—CHECKED & OFF
5. Run up Engines

BEFORE TAKEOFF
1. Tailwheel—Locked
2. Gyro—Set
3. Generators—ON

AFTER TAKEOFF
1. Wheel—PILOT'S SIGNAL
2. Power Reduction
3. Cowl Flaps
4. Wheel Check—OK right—OK LEFT

BEFORE LANDING
1. Radio Call, Altimeter—SET
2. Crew Positions—OK
3. Autopilot—OFF
4. Booster Pumps—On
5. Mixture Controls—AUTO-RICH
6. Intercooler—Set
7. Carburetor Filters—Open
8. Wing De-icers—Off
9. Landing Gear
   a. Visual—Down Right—DOWN LEFT Tailwheel Down, Antenna in, Ball Turret Checked
   b. Light—OK
   c. Switch Off—Neutral
10. Hydraulic Pressure—OK Valve closed
11. RPM 2100—Set
12. Turbos—Set
13. Flaps ⅓—⅓ Down

FINAL APPROACH
14. Flaps—PILOT'S SIGNAL
15. RPM 2200—PILOT'S SIGNAL

Introduction into Hospitals
It is estimated that more than half of the adverse events in hospitals are associated with surgical procedures.[2] In 2009, the World Health Organization (WHO) published the Surgical Safety Checklist.[3] Its purpose was to aid the surgical team to remember all the details required during an operation. It consisted of a **Sign In** portion (before anesthesia induction), a **Time Out** portion (before skin incision) and a **Sign Out** portion (before the patient left the OR). The aim was to prevent the uncommon error that could have disastrous consequences (the equivalent of a plane crash). It included over 20 items, such as confirming patient identity, surgical site, comorbidities, known allergies, anticipated complications and antibiotic prophylaxis. Additionally, it encouraged identification and communication between all the surgical team members.

Before its release, an earlier version of the SSC was trialed for a year at 8 hospitals globally. Results were remarkable: significant reductions in adverse events including complications, mortality in hospital, unplanned reoperations and surgical site infections.[4]

One of the main issues as the SSC was subsequently implemented ted on a large scale around the world was initial pushback from surgeons. They regarded the checklist as a challenge to their competence and resented the fact that the checklist had to be read out by a subordinate. Highly intelligent and highly educated people often think they don't need little reminders to remember the correct procedure. This is known as intellectual arrogance, features of which are:

- Having a ‘my way or the highway’ approach.
- Thinking they are “God” in a particular field or subject.
- Refusing to consider another viewpoint, especially from those considered ignorant.
- Tending to theorizing and expound on a subject.
- Resenting being contradicted, challenged, and sometimes even questioned.
- Being very confident in their own knowledge.
- Being smug, snobby, especially when proven right.
- Pretending to be broad-minded, but not really open to new evidence that may challenge their opinion.

Through some modifications aimed at promoting teamwork and communication, alongside the undeniable and repeatable results, the SSC has now become established and an absolute requirement before surgery in all major human hospitals. Surveys of users taken before and after implementation have shown that they are easy to use, and they had improved patient care. Even remaining skeptics, when asked, said they would want a checklist used on themselves if they were having an operation.

Checklists in Veterinary Medicine
Checklists are quickly becoming validated in large veterinary hospitals and have shown in several smaller studies to decrease the odds of surgical complications, exactly as in human medicine.[5, 6] Their use throughout major veterinary hospitals is unknown.

Our hospital has had several iterations of the SSC since 2011 with the aim of checking common requirements and fostering better communication and teamwork. Our first trial sheet (Figure 2) was explanatory and rudimentary, calling a ‘time out’ in the OR before surgery where the team is introduced to each other (this is useful in a teaching institution but may not be necessary in smaller practices) and requiring verbal confirmation of correct surgery on the correct patient and site, and list the critical elements of their plans for the surgery, samples to be taken, and confirming that prophylactic antibiotics have been administered if indicated. This initial ‘time out’ is undertaken BEFORE the skin is incised and is typically coordinated by the OR veterinary technician. There was also a ‘sign out’ that would occur before the patient left the OR, where the team would confirm that all requested samples have been obtained and located. There was initially some resentment from a few of the OR technicians and surgeons, but within a year, the practice was accepted as if we had always been doing it. This form has now evolved to a two-page document, which includes an Anesthesia Checklist, Surgery Checklist (common to all patients), separate mini-SSCs for General (Primary Care) Surgery, Orthopedics, Neurology and Soft Tissue, and a Recovery Checklist (Figure 3).

Figure 2: Original MSU CVM SSC:

THIS FORM MUST BE PLACED IN THE PATIENT'S MEDICAL RECORD *Version: Sep 2013*

SURGERY CHECKLIST – SOFT TISSUE

INTRODUCTION: The aim of the Surgery Checklist is to minimize complications associated with surgery and anesthesia. Completion of this form will document correct patient identity, the proposed procedure and surgical site, reconciliation of gauze sponges, appropriate antibiotic administration and sample collection and submission. It also introduces an element of teamwork should intra-operative complications (unanticipated or anticipated) occur. Completion of this form ensures compliance with AAHA surgery standards MA40 and SX02 (2011).

PROCEDURE:

- Call a "Safety Check." One person, usually the circulating surgical technician, will call a time out with the patient's checklist in hand.
- Verbally confirm the elements in the 4 sections of the Checklist, and check the relevant boxes.
- Sign and date the form.
- Retain this form in the patient's medical record

PATIENT ID

1. BEFORE SURGERY:

☐ Confirm patient identification
☐ Confirm primary surgeon: _____
☐ Introduction of people in the room and their role
☐ Confirm consent form is present which shows that the client
  ☐ Was informed of the procedure
  ☐ Was informed of the risks
  ☐ Was informed of the estimated costs
  ☐ Signed the form

2. BEFORE SKIN INCISION

☐ Confirm description of planned procedure
☐ Confirm site/side of surgical procedure

Discuss anticipated critical events / contingency plan
☐ Surgery – no critical events anticipated, or ☐ Surgery
☐ Anesthesia – no critical events anticipated, or ☐ Anesthesia

_____
_____
_____
_____
_____
_____
_____

☐ Antibiotic prophylaxis was administered within the previous 60 minutes or ☐ No antibiotic prophylaxis indicated
☐ Gauze count in: 4x4:_____lap:_____

Are samples to be obtained? ☐ No ☐ Yes (*list below*)	Histo	Culture	Other

3. IMMEDIATELY AFTER SURGERY

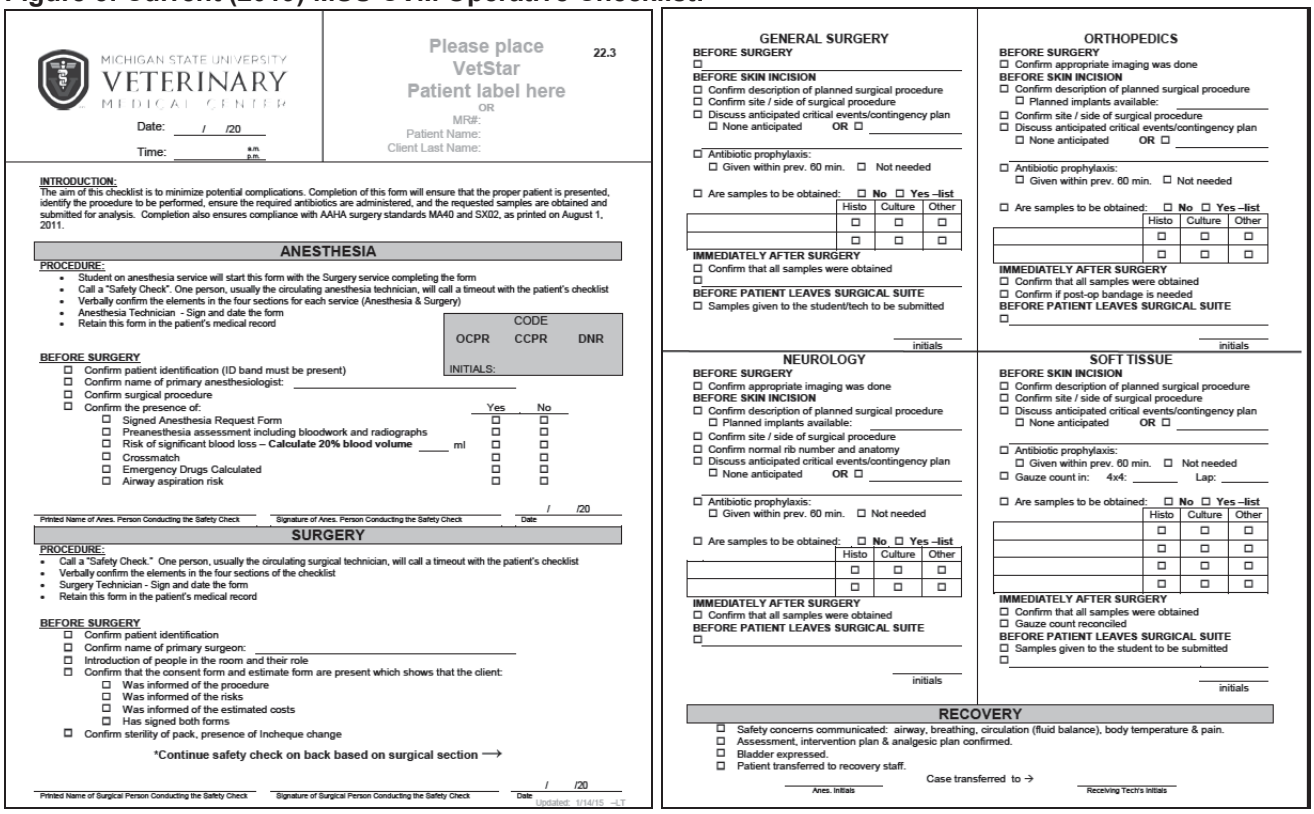
☐ Confirm that all samples were obtained
☐ Gauze count reconciled

4. BEFORE PATIENT LEAVES THE SURGICAL SUITE

☐ Samples given to the student to be submitted

_____ _____ ____/____/_____
Printed Name of the person conduction the safety checklist | Signature of the person conducting the safety checklist | Date

Figure 3: Current (2019) MSU CVM Operative Checklist:



MICHIGAN STATE UNIVERSITY VETERINARY MEDICAL CENTER

Date: / /20

Time: a.m. p.m.

Please place VetStar Patient label here OR MR#: Patient Name: Client Last Name:

22.3

INTRODUCTION:
The aim of this checklist is to minimize potential complications. Completion of this form will ensure that the proper patient is presented, identify the procedure to be performed, ensure the required antibiotics are administered, and the requested samples are obtained and submitted for analysis. Completion also ensures compliance with AAHA surgery standards MA40 and SX02, as printed on August 1, 2011.

ANESTHESIA

PROCEDURE:
- Student on anesthesia service will start this form with the Surgery service completing the form
- Call a "Safety Check". One person, usually the circulating anesthesia technician, will call a timeout with the patient's checklist
- Verbally confirm the elements in the four sections for each service (Anesthesia & Surgery)
- Anesthesia Technician - Sign and date the form
- Retain this form in the patient's medical record

CODE: OCPR CCPR DNR
INITIALS:

BEFORE SURGERY
- ☐ Confirm patient identification (ID band must be present)
- ☐ Confirm name of primary anesthesiologist: _____
- ☐ Confirm surgical procedure
- ☐ Confirm the presence of:

	Yes	No
☐ Signed Anesthesia Request Form	☐	☐
☐ Preanesthesia assessment including bloodwork and radiographs	☐	☐
☐ Risk of significant blood loss – **Calculate 20% blood volume** ____ ml	☐	☐
☐ Crossmatch	☐	☐
☐ Emergency Drugs Calculated	☐	☐
☐ Airway aspiration risk	☐	☐

Printed Name of Anes. Person Conducting the Safety Check | Signature of Anes. Person Conducting the Safety Check | Date / /20

SURGERY

PROCEDURE:
- Call a "Safety Check." One person, usually the circulating surgical technician, will call a timeout with the patient's checklist
- Verbally confirm the elements in the four sections of the checklist
- Surgery Technician - Sign and date the form
- Retain this form in the patient's medical record

BEFORE SURGERY
- ☐ Confirm patient identification
- ☐ Confirm name of primary surgeon: _____
- ☐ Introduction of people in the room and their role
- ☐ Confirm that the consent form and estimate form are present which shows that the client:
  - ☐ Was informed of the procedure
  - ☐ Was informed of the risks
  - ☐ Was informed of the estimated costs
  - ☐ Has signed both forms
- ☐ Confirm sterility of pack, presence of Incheque change

*Continue safety check on back based on surgical section →

Printed Name of Surgical Person Conducting the Safety Check | Signature of Surgical Person Conducting the Safety Check | Date / /20

Updated: 1/14/15 –LT

GENERAL SURGERY

BEFORE SURGERY
☐ _____

BEFORE SKIN INCISION
- ☐ Confirm description of planned surgical procedure
- ☐ Confirm site / side of surgical procedure
- ☐ Discuss anticipated critical events/contingency plan
  - ☐ None anticipated OR ☐ _____
- ☐ Antibiotic prophylaxis:
  - ☐ Given within prev. 60 min. ☐ Not needed
- ☐ Are samples to be obtained: ☐ **No** ☐ **Yes –list**

	Histo	Culture	Other
	☐	☐	☐
	☐	☐	☐

IMMEDIATELY AFTER SURGERY
- ☐ Confirm that all samples were obtained
- ☐ _____

BEFORE PATIENT LEAVES SURGICAL SUITE
- ☐ Samples given to the student/tech to be submitted

_____ initials

ORTHOPEDICS

BEFORE SURGERY
- ☐ Confirm appropriate imaging was done

BEFORE SKIN INCISION
- ☐ Confirm description of planned surgical procedure
  - ☐ Planned implants available: _____
- ☐ Confirm site / side of surgical procedure
- ☐ Discuss anticipated critical events/contingency plan
  - ☐ None anticipated OR ☐ _____
- ☐ Antibiotic prophylaxis:
  - ☐ Given within prev. 60 min. ☐ Not needed
- ☐ Are samples to be obtained: ☐ **No** ☐ **Yes –list**

	Histo	Culture	Other
	☐	☐	☐
	☐	☐	☐

IMMEDIATELY AFTER SURGERY
- ☐ Confirm that all samples were obtained
- ☐ Confirm if post-op bandage is needed

BEFORE PATIENT LEAVES SURGICAL SUITE
☐ _____

_____ initials

NEUROLOGY

BEFORE SURGERY
- ☐ Confirm appropriate imaging was done

BEFORE SKIN INCISION
- ☐ Confirm description of planned surgical procedure
  - ☐ Planned implants available: _____
- ☐ Confirm site / side of surgical procedure
- ☐ Confirm normal rib number and anatomy
- ☐ Discuss anticipated critical events/contingency plan
  - ☐ None anticipated OR ☐ _____
- ☐ Antibiotic prophylaxis:
  - ☐ Given within prev. 60 min. ☐ Not needed
- ☐ Are samples to be obtained: ☐ **No** ☐ **Yes –list**

	Histo	Culture	Other
	☐	☐	☐
	☐	☐	☐

IMMEDIATELY AFTER SURGERY
- ☐ Confirm that all samples were obtained

BEFORE PATIENT LEAVES SURGICAL SUITE
☐ _____

_____ initials

SOFT TISSUE

BEFORE SKIN INCISION
- ☐ Confirm description of planned surgical procedure
- ☐ Confirm site / side of surgical procedure
- ☐ Discuss anticipated critical events/contingency plan
  - ☐ None anticipated OR ☐ _____
- ☐ Antibiotic prophylaxis:
  - ☐ Given within prev. 60 min. ☐ Not needed
- ☐ Gauze count in: 4x4: _____ Lap: _____
- ☐ Are samples to be obtained: ☐ **No** ☐ **Yes –list**

	Histo	Culture	Other
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐

IMMEDIATELY AFTER SURGERY
- ☐ Confirm that all samples were obtained
- ☐ Gauze count reconciled

BEFORE PATIENT LEAVES SURGICAL SUITE
- ☐ Samples given to the student to be submitted
- ☐ _____

_____ initials

RECOVERY
- ☐ Safety concerns communicated: airway, breathing, circulation (fluid balance), body temperature & pain.
- ☐ Assessment, intervention plan & analgesic plan confirmed.
- ☐ Bladder expressed.
- ☐ Patient transferred to recovery staff.

Case transferred to → _____ Anes. Initials _____ Receiving Tech's Initials

A Note About Anesthesia Checklists

A check of the anesthetic machine and all ancillary equipment (e.g., endotracheal tubes, laryngoscopes, monitors) should be performed prior to each case. Ensuring that the pulse is monitored decreases feline mortality,[7] therefore having a Doppler or pulse oximeter that is in working condition and placed on the patient should be part of the anesthesia and patient safety checklist. The adjustable pressure limiting valves ("pop-off" valves) are responsible for "near misses", pneumothorax, cardiac arrest and death when accidentally left in the closed position, especially at the beginning of anesthesia when oxygen flowrates are high and the anesthetist has multiple tasks to attend to, therefore these must always be part of the anesthesia machine checklist.[8]

Not Just Surgical Safety Checklist….

At the MSU Veterinary Medical Center (35,000 cases per annum, 45 faculty, 30 residents, a plethora of interns, 150 clinical students), we have now instituted checklists and SOPs for many other areas of the hospital, including pre-anesthesia checklist, ICU and stepdown ward flowsheets, transfer of service, discharge, follow-up information, euthanasia, rabies exposure, etc. Especially with the transient population of students and interns, these forms are critical for consistency, communication and preventing data and information from 'falling through the cracks'.

Learning Objectives

- Appreciate the reason why even highly-skilled teams can benefit from basic checklists tools to optimize consistently good outcomes.
- Know that checklists have been validated in large veterinary hospitals and have shown to decrease the odds of surgical complications, as well as fostering better communication and teamwork.
- Realize other uses of checklists and SOPs - they can extend to all aspects of veterinary medicine.

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Additional Resources

RCVS Knowledge: Surgical Safety Checklist Manual for download.
https://knowledge.rcvs.org.uk/document-library/surgical-safety-checklist-manual/

Anaesthesia Records and Checklists

https://ava.eu.com/resources/checklists/

NOTES:

NOTES:

The Whole Package: Anesthesia & Surgery Tips for Common but Sometimes Tricky Cases (The Wee Ones)

Sheilah Robertson, BVMS (Hons), PhD, DACVAA, DECVAA, DACAW, DECAWBM (WSEL) &
Bryden Stanley, BVMS, MVetSc, MANZCVS, MRCVS, DACVS

Introduction

Overview of this session

The idea behind this session is to hear from "both sides of the table", meaning looking at cases from the viewpoint of the surgeon and anesthetist; each have different concerns, but both having the welfare of the patient as their common goal so communication with each other is essential before, during and after the procedure. The presenters (a surgeon and anesthesiologist) will use cases they have worked on together to demonstrate the principles of pediatric surgery. Cases include pectus excavatum, atresia ani and a kitten with a cleft palate.

Anesthesia and analgesia for cats at either end of their age spectrum deserves special attention. In this session we will focus on pediatric patients and their specific anesthetic and analgesic needs due to their unique body composition and physiology. In the AAFP 2018 Anesthesia Guidelines, life stages are discussed and cats for birth to 6 months of age are considered as neonates or pediatric patients.[1]

Anesthetic mortality

When it comes to calculating the risk of anesthesia in young animals there is confounding information. In a large prospective study (the Confidential Enquiry into Perioperative Small Animal Fatalities [the CEPSAF study]) of over 79,000 cats conducted between 2002 and 2004, those under 6 months of age had a lower mortality rate than any other age group.[2] However, regardless of age, cats weighing under 2 kg had an increased risk of an anesthetic related death compared to cats that weighed between 2 and 6 kg.[2] This correlation is likely linked to the development of perioperative hypothermia which is discussed later. The most common reason for anesthesia in kittens is for neutering and this had a lower risk of death compared to non-elective and emergency surgeries.[2, 3]

Until recently there have been no studies on a similar scale to the CEPSAF study. Levy and others (2017) reviewed the medical records of over 71,000 cats undergoing spay or castration at a high-volume clinic between 2010 and 2016.[4] Age was available in the electronic record for animals in the last 18 months of the study and 44% of cats were under the age of 6 months. There was no significant difference in mortality in this age group compared to adult animals, but the influence of weight was not investigated. Overall, the mortality rates were lower than in the CEPSAF study likely due to advances in anesthesia, surgery and monitoring, skilled surgeons specializing in spay and castration procedures, patient health status and short anesthesia and surgery times. It is noteworthy that the risk of mortality was twice as high in females compared to males and in agreement with the CEPSAF study mortality was higher in cats than dogs. This data provides us with specific areas to focus and improve on.

Analgesia for pediatric patients

Pediatric patients have their whole life ahead of them. Data from animal and human neonatal studies clearly demonstrate that inadequate pain management in early life alters neurodevelopment and pain thresholds resulting in long lasting and negative effects on pain experiences and behaviors later in life.
The example that resonates with many people is the study by Taddio and colleagues on male human infants.[5] The study was comprised of 3 groups of infants, 1. Uncircumcised infants, 2. Those that had received a topical local anesthetic for circumcision and 3. Those that received no analgesia for the procedure. At 4-month or 6-month of age the infants were videotaped during vaccination and their pain responses scored (facial action units, cry duration, and visual analogue scale pain scores). The results are summarized as "circumcised infants showed a stronger pain response to subsequent routine vaccination than uncircumcised infants. Among the circumcised group, preoperative treatment with a local anesthetic attenuated the pain response to vaccination).[5]

We must prevent and treat pain in young animals and understand that the adverse effects of pain far outweigh the side effects of the analgesic drugs and techniques at our disposal today. Providing a feline friendly environment is also important along with respectful handling as young cats will form an impression of a veterinary visit very quickly and if it is not a good one, future visits will be stressful for them and difficult for us. We now seeing the results of studies focused on the analgesic needs of young populations of cats. Simon and colleagues demonstrated that in cats, hydromorphone provided a shorter duration and smaller magnitude of antinociception at 6 months when compared with 9 and 12 months.[6] therefore we must consider that pediatric patients may require more frequent dosing of opioids and that pain scoring should be a key component of our perioperative assessment.

Polson and colleagues studied the effect of age on postoperative pain in cats undergoing ovariohysterectomy.[7] They found that wound tenderness was similar in cats under 4 months of age when compared to those over 4 months of age, but pain scores 9affective assessment of the impact of pain) was less in young cats. This may be related to the size of the incision required in kittens versus adults/older cats; inflammatory pain is related to the amount of soft tissue disruption and pain is primarily of an inflammatory nature after ovariohysterectomy – this study demonstrates that small incisions result in less pain.

Pediatric animals
Use reversible drugs
The ability to metabolize some drugs may be limited due to immature hepatic enzyme systems and this is the reason to incorporate short acting and / or reversible drugs into your protocols (Table 1).

Table 1: reversible anesthetic drugs

DRUG	REVERSAL AGENT
Dexmedetomidine	Atipamezole
Medetomidine	Atipamezole
Diazepam	Flumazenil
Midazolam	Flumazenil
Opioid agonists	Butorphanol or naloxone

Fasting times and hypoglycemia
The goal of preoperative fasting is to reduce the volume of stomach contents, and prevent gastroesophageal reflux (GER), regurgitation and aspiration. Withholding food for 6–12 h prior to anesthesia or instructions or 'nothing 'after midnight' have traditionally been recommended but are not evidence based. Studies on the duration of fasting on GER are conflicting in dogs. Feeding a small meal of canned food 3 hours before surgery reduced the incidence of GER in one study but not another, and shorter fasting times were associated with less acidic reflux. Other factors, including preanesthetic and anesthetic drugs, procedure, age and position during surgery, also influence GER. Long fasting times do not necessarily ensure that a cat's stomach will be empty. Stress, meal size and lack of dietary moisture can slow gastric emptying. Therefore, the anesthetist must always be prepared for perioperative vomiting. Although there are no data in cats, shorter fasting times (3–4 h) with provision of a small wet food meal 3–4 h before anesthesia may be adopted at the clinician's discretion. Water should be available until the time of premedication.[1]

Historically hypoglycemia has been highlighted as threat to pediatric patients due to low glycogen stores in their immature liver. Corn syrup is commonly given transmucosally in kittens with little evidence for its need. In a study of 8-16-week-old kittens that had their food removed at or before midnight on the day before surgery did not become hypoglycemic (≤ 60 mg/dl) and there was no difference in blood glucose levels between a control group and a group that received transmucosal corn syrup.[8]

Hypothermia
Their small size and large surface area to body weight ratio and lack of body fat makes young animals susceptible to hypothermia and this is likely one of the greatest but preventable threats to this patient population. Adverse effects of hypothermia include delayed recovery, increased bleeding and immunosuppression.

Cardiac output (SV x HR) in young animals is predominantly heart rate dependent as they have little ability to alter stroke volume. One common cause of bradycardia is hypothermia. Oxygen requirements are significantly increased when they shiver during recovery and may result in hypoxemia. Shivering and "feeling cold" is described as extremely unpleasant by humans during anesthesia recovery and exacerbates pain and discomfort. Attention to maintaining normothermia should begin at admission to the hospital or clinic and continue to discharge; Redondo and colleagues found an association between the temperature before premedication and the final temperature.[9] Both passive and active methods can be used to prevent hypothermia; these include but are not limited to blankets, insulating materials, warmed cages, circulating warm water blankets, forced warm air devices and conductive polymer fabric blankets. It is also important to avoid low ambient temperatures, drafts, and contact with cold surfaces. Equipment that should not be used due to the risk of thermal burns include electric blankets, heat lamps and hot water bottles.

Surgical preparatory solutions
There has always been considerable debate about the effect of preparatory surgical rinses and their effects of heat loss, especially in small patients. Two studies have now looked at the impact of rinse solution on body temperature. There was no clinically meaningful difference in body temperature between chlorhexidine and isopropyl alcohol rinses[10] and a comparison of water and isopropyl alcohol also showed no significant differences.[11]

Specific protocols
There are numerous protocols described in the literature for pediatric anesthesia, predominantly for neutering procedures. Many of these are considered a "total intramuscular" anesthetic technique providing unconsciousness, analgesia and muscle relaxation. The most common combinations include ketamine, an opioid (e.g., butorphanol, buprenorphine or hydromorphone) and an alpha$_2$-adrenergic agonist (e.g., medetomidine or dexmedetomidine). Using "fast-track" anesthesia and surgery principles is attractive in young animals, so they can resume normal activities including eating as soon as possible after surgery. There has been concern that reversing dexmedetomidine could compromise post-operative analgesia. Hasiuk and others compared pain and sedation scores after ovariohysterectomy in cats anesthetized with dexmedetomidine-ketamine-hydromorphone. All cats received meloxicam post-operatively and one group received atipamezole and one saline; there was no difference in analgesia scores between groups but mean time to sternal recumbency was 15 minutes in the atipamezole group and 60 minutes in the control group.[12]

The use of local analgesics is highly encouraged. These are non-controlled drugs, inexpensive, efficacious, easy to use and do not cause sedation. One technique is the intraperitoneal administration of bupivacaine in cats during ovariohysterectomy surgery.[13, 14]

Airway management
Cats seem especially prone to post-operative complications related to their airway. Their airway is small, delicate and prone to laryngospasm. The CEPSAF study suggested that use of an endotracheal tube for short procedures (< 30 minute) may be more detrimental than beneficial.[2] For this reason, a face mask or supraglottic airway device are acceptable alternatives for many cats for short procedures.

Monitoring
The small size of pediatric patients poses challenges for monitoring vital signs. In addition, monitors should be easy and quick to apply so that using them does not add to the overall anesthesia time. The most suitable monitors for pediatric patients include a pulse oximeter and non-invasive blood pressure monitor. A Doppler ultrasonic device is especially useful as it provides continuous audible information on blood flow and can also be used to manually measure systolic blood pressure.

A summary of tips for successful pediatric anesthesia:

- Fasting times; < 3 hours, with access to water at all times
- Weigh accurately
- If necessary, dilute drugs to ensure accuracy of dosing
- Use insulin or 1 mL tuberculin syringes to measure drug volumes accurately
- Include reversible drugs in the protocol, for example:
    - Diazepam and midazolam
    - Opioids
    - Dexmedetomidine, medetomidine
- Use analgesic agents preemptively
- Incorporate local anesthetics whenever possible
- Monitor heart rate
- Treat bradycardia
- Monitor SpO_2 (pulse oximeter)
- Prevent and treat hypothermia
- Minimize anesthesia time – this may require planning and staging complex procedures; for example, doing diagnostics on one day and surgery on another.

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NOTES:

Visceral Organ Biopsy

Howard B. Seim III, DVM, DACVS

If you would like a video of this surgical procedure go to www.videovet.org and or contact videovet@me.com

Key Points

- Open the abdomen from xyphoid to pubis
- Use the same method of exploration in each case
- When in doubt, biopsy, biopsy, biopsy
- Close the linea alba in a continuous pattern
- Do not suture the subcutaneous tissue in cats

General Considerations and Indications

The systematic thorough observation and palpation of all abdominal structures are mandatory with any exploratory. It is easy to miss a second intestinal foreign body or an area of metastasis if one does not get in the habit of complete exploratory. This can be done in any order but it is best to establish a routine and follow it for every exploration.

With experience it can be done in less than five minutes. The best way to recognize an abnormal finding is to know the normal. Take advantage of any laparotomy to observe normal structure, color, consistency and position of all abdominal organs.

Abdominal exploratory may be indicated in following situations:
Undiagnosed GI disorders
Urogenital abnormaities unresponsive to medical management
Abdominal disorders of unknown origin
Penetrating trauma
Acute abdomen
Generalized peritonitis
Diagnosis and treatment of portosystemic shunts
Uncontrolled abdominal hemorrhage

Preoperative Considerations

A midline abdominal celiotomy (xiphoid to pubis) is the easiest and most versatile approach. Rarely is it necessary to extend the incision into the thorax via a median sternotomy however if your index of suspicion is high that this may be necessary (e.g., diaphragmatic hernia, chylothorax, portosystemic shunt) the cat should be adequately prepared.

Abdominal Exploratory Technique

Position, Preparation and Draping
The abdomen is always clipped and prepared **wider** and **longer** (lengthwise most important) than you may anticipate for a "routine" procedure. This generally means from cranial to the xyphoid to a point 2-3 cm caudal to the brim of the pubis and laterally to the ventral lumbar musculature. The animal is placed in dorsal recumbency with front and hind limbs secured with ropes to the table.

A ventral midline incision is made from xyphoid to pubis. After identifying the linea alba **(the linea alba is palpable at the umbilicus)**, a scalpel blade is used to open the abdominal cavity via a stab incision. Mayo scissors are used to complete the abdominal incision. The falciform ligament is excised with scissors or cautery from its attachment to the midline. This will allow better inspection of viscera in the cranial quadrant of the abdomen and facilitate easier abdominal closure. Two 7'' Gelpi retractors are used as self retaining abdomenal wall retracrtors. Waterproof crib pads and moistened laparotomy sponges may be placed on the incision edges if abdominal viscera are to be brought out of the abdomen. All viscera must be kept moist with sterile saline solution.

Examination of abdominal viscera can be done in any order but it is best to establish a routine and follow it every time the abdomen is explored. Generally, start with proximal GI tract and move distally, then liver and pancreas, then urinary tract. Be thorough, and always be gentle when handling tissue. it is easy to miss a second intestinal foreign body or an area of metastasis if one does not get in the habit of performing a **complete** exploratory. With experience, complete exploration can be performed in less than five minutes. The best way to recognize an abnormal finding is to know the normal. Take advantage of any laparotomy to observe normal structure, color, consistency and position all of abdominal organs. You should be able to identify the following structures:

Closure
The linea alba is closed with monofilament or multifilament absorbable suture using a simple continuous pattern. If the abdominal incision was made directly on the midline (i.e., linea alba) closure requires full thickness bites of the linea alba. If the abdominal incision was slightly off the midline, suture the rectus sheath only (do not include rectus abdominus muscle or peritoneum). The most important tissue in the abdominal closure is the collagen laden external rectus sheath. Incorporation of the internal sheath (i.e., peritoneum) is unnecessary as the peritoneum has no holding power and may increase adhesion formation. Sutures should engage approximately 5-7 mm of rectus sheath on either side of the incision line.

Subcutaneous tissues do not need to be closed with suture in feline abdomional surgery.

Skin is closed with simple interrupted or simple continuous monofilament nonabsorbable skin sutures or a continuous intradermal suture (i.e., subcuticular).

Postoperative Care
Postsurgical care may include systemic antibiotics, appropriate pain medication, careful monitoring of the patient's breathing, temperature, and color. Hypothermic patients should be kept in a warming cage or on a warm water circulating blanket for at least 24 hours. Analgesics may be used to relieve patient discomfort, however care should be taken to monitor the effects of various analgesic drugs on respiratory effort.

Biopsy Techniques for Abdominal Organs
Liver
Liver biopsy is indicated whenever an abdominal exploratory is being performed in patients thought to have liver disease or in cases that liver disease was not the primary reason for exploratory but the liver appears grossly abnormal.

Surgical Technique
Liver Biopsy
Liver biopsy is one of the most important diagnostic aids available for evaluation of liver disease. Samples for cytologic examination may be obtained via percutaneous needle biopsy, laparoscopy, or exploratory laparotomy. Percutaneous needle biopsy techniques are the most efficient in terms of time and expense but may not be the most diagnositc.

Several techniques are available for obtaining liver specimens during exploratory laparotomy. The simplest method is placing an encircling ligature around a pedicle of liver tissue. As the ligature is tightened, it cuts through the hepatic parenchyma thus cluster ligating hepatic vessels and bile ducts. This technique is widely known as the Gillatine technique. In more bulbous liver lobes multiple Gillatine sutures are used to obtain the biopsy specimen. This method often requires the presence of diffuse liver disease to obtain a diagnostic biopsy unless the lesion is present on the marginal aspect of a liver lobe.

Localized abnormalities can be biopsied by wedge resections or partial lobectomy. Wedge resections may be performed by placing a row of overlapping, full-thickness, interrupted mattress sutures of 0 or 2-0 Maxon or Biosyn along each side of the wedge to be removed; these sutures should commence at the edge of the liver lobe and meet proximally to form a “V”. The sutures should be tied so as to compress the liver slightly but not cut into liver parenchyma. The wedge of tissue to be removed is incised about 5 mm from the suture line. Alternatively, the wedge may be removed prior to tightening the mattress sutures; preplaced mattress sutures are then gently tied with enough tension to control bleeding.

An alternate technique for use in patients with diffuse fibrotic liver disorders is performed by penetrating the affected liver lobe with a straight mosquito hemostat. The hemostat tip is placed on the surface of the liver lobe to be biopsied and gently plunged through the liver lobe until the tip of the hemostat is seen penetrating through the opposite side of the liver. The jaws of the hemostat are opened just wide enough to accept a piece of 2-0 or 3-0 suture. The suture is doubled on itself, the loop is passed into the jaws of the hemostats, and the loop pulled through the liver lobe. The exiting loop is cut leaving two strands of suture coursing through the liver lobe. Each strand is tied individually to “cut” through the liver. A “V” wedge is cut through the liver when both strands of suture have been tied. A number 15 BP scalpel blade is used to cut the V-shaped liver biopsy wedge from the sutures.

Pancreatic Biopsy
The old wives tale of “don’t touch the pancreas” needs to be put to rest. Gentle manipulation and biopsy of the pancreas is a predictably successful procedure with almost no incidence of postoperative pancreatitis.

Biopsy of the pancreas is performed in a similar manner as biopsy of the liver. In patients that have diffuse pancreatic disease the left limb of the pancreas is the preferred biopsy site. The left limb of the pancreas lies in the omental bursa. This can easily be found by elevating the omentum from the abdomen and separating its two 'leaves'. The leaves of omentum and penetrated and separated as the surgeon exposes the sublumbar region. There lies the left limb of the pancreas. The advantage of biopsing the left limb is it shares a blood supply with no other organ. It is very easy to biopsy a piece of pancreas off the tip of the left limb. Either a small biopsy can be excised with a Stevens Tenotomy scissors or an encircling ligature of 4-0 suture can be placed around the pedicle. As the ligature is tightened, it cuts through the pancreatic parenchyma, ligating vessels and pancreatic ducts. The distal pedicle of pancreas is then carefully amputated with a number 15 BP scalpel blade or metzenbaum scissors. Care is taken to avoid cutting the suture. If a relatively large portion of pancreas is to be removed a similar technique is used. In this situation, 2-0 or 3-0 monofilament nonabsorbable suture is recommended.

Stomach and Small Intestine
Cats with chronic vomiting or chronic diarrhea of unknown origin may require gastric and intestinal biopsies for definitive diagnosis. In many cases, the surgeon will examine the gastrointestinal tract carefully and conclude that there are no apparent abnormalities. In this situation, ALWAYS perform gastric and multiple intestinal biopsies (i.e., duodenum, jejunum, ileum). Remember these words of wisdom when concluding that you have a negative exploratory laparotomy "your eyes are NOT microscopes".

Gastric Biopsy
The stomach should be visually examined for any obvious abnormalities on the serosal surface. In addition, the stomach should be carefully palpated to determine if there are mural or mucosal abnormalities present. In the case of an observed or palpated abnormality, the surgeon should plan the gastric biopsy incision to include a portion of the abnormal stomach. Full thickness biopsies should always be taken. In the case of diffuse disease or if an abnormality cannot be located, a 3-4 cm incision should be made in the ventral aspect of the stomach equidistant from the greater and lesser curvature. Stay sutures are placed at the midpoint of the incisied edges and the interior of the stomach visually and digitally examined. If a mucosal abnormality is detected, the area should be biopsied either from inside the stomach of from the serosal surface directly over the lesion.

Gastric wall incisions (e.g., biopsy, gastrotomy, partial gastrectomy) should be closed with a single layer, simple continuous or simple interrupted suture pattern being careful to get full thickness bites. Sutures should be placed no further apart than 3 mm apart and at least a 4 mm bite of gastric wall is recommended. Monofilament absorbable suture with a sharp taper or taper-cut (penetrating point) needle is the authors' preference.

Small Intestinal Biopsy
Several techniques can be used to successfully biopsy the intestine. Always remember; FULL THICKNESS biopsy is mandatory for the pathologist to give you the the most accurate diagnosis.

The authors' preferred technique for intestinal biopsy is to use a 4-6 mm skin punch biopsy. It is importatnt to use a new and sharp skin punch biopsy instrument. The skin punch is placed on the antimesenteric border of the intestine and gently twisted and pushed until the punch is felt to penetrate the lumen of the intestine. The punch is withdrawn and the biopsy specemine is retrieved from the shaft of the biopsy punch or cut off the intestinal defect. The surgeon should be careful not to crush the specimen with forceps. Only handle one end of the specimen whilst excision the biopsy specimen. If excessive trauma is created during biopsy, the pathologist may not be able to determine if the pathology is real or surgically created. The excised piece of intestine is examined closely to ensure that all layers have been included in the specimen. The biopsy site is closed using a simple interrupted or simple continuous suture pattern. 4-0 monofilament or multifilament absorbable suture with a swaged-on sharp taper or taper-cut (penetrating point) needle is recommended. Care is taken to ensure that at least 3 mm bites are taken into the intestine and the sutures are no more that 2-3 mm apart.

An alternate technique is to make a 2-3 mm long incision on the antimesenteric border of the intestinal segment. A #11 or #15 BP scalpel blade is used to penetrate the intestinal wall. The blade is withdrawn to create a 2-3 mm long incision. A second parallel incision is made 1 – 2 mm from the original incision. A DeBakey forcep is used to grasp one end of the parallel incisions, a Metzenbaum scissor is used to cut out the piece of intestine. Closure of the defect is as described above.

Biopsy of the duodenum, jejunum, and ileum is recommended whenever a chronic vomiting/diarrhea patient is explored.

Complications associated with multiple intestinal biopsies are rare. Even patients that present with protein loosing enteropathy. One study looking at the complication rate of intestinal surgical procedures in patients with normal protein levels and patients that were hypoproteinemic found no difference. Complications in patients undergoing intestinal surgical procedures are generally related to the surgeons technical ability not the patients preoperative status.

NOTES:

Surgery of the Pancreas, Liver, & Biliary System

Howard B. Seim III, DVM, DACVS

If you would like a copy of the video of this surgical procedure go to www.videovet.org

Introduction
The incidence of histologically confirmed pancreatitis in cats and dogs ranges from 1.3-1.5%, respectively. Most dogs have acute pancreatitis and most cats have chronic pancreatitis. Clinical presentation and diagnostic criteria differ between species and type of pancreatitis. Acute pancreatitis is potentially reversible but can also be fatal while chronic pancreatitis generally has irreversible changes but is rarely fatal.

Acute Pancreatitis
Use of surgical intervention in managing pancreatitis is generally reserved for complex cases of pancreatitis (i.e., acute necrotizing pancreatitis, pancreatic abscess, pancreatic pseudocyst, generalized peritonitis secondary to pancreatitis).

Etiology
The etiology of pancreatitis is generally unknown.

Diagnosis
Acute pancreatitis is one of the most difficult diseases to diagnose. There is no one diagnostic test that has a high sensitivity for pancreatitis.

Biopsy provides the definitive diagnosis. Surgery or laparoscopy is generally required to obtain a diagnostic biopsy. Although acute pancreatitis is not generally considered a surgical condition patients progressing to a more severe necrotizing pancreatitis with pancreatic abscess and peritonitis may be candidates for exploratory laparotomy.

Medical Treatment
Initial treatment of pancreatitis should be supportive and should be tailored for the individual case. Basic therapy involves correction of fluid and electrolyte imbalance, nutritional considerations, pain management and the control of secondary complications.

Surgery of the Pancreas

Indications
Surgery is rarely indicated for pancreatitis. Surgery may be indicated for treatment of pancreatic abscess, septic suppurative peritonitis secondary to severe necrotizing pancreatitis, pancreatic pseudocyst, jejunostomy feeding tube placement, and open peritoneal lavage and drainage.

Pancreatic Examination
The abdomen is explored through a xyphoid to pubis midline abdominal incision. Grasping the descending duodenum and retracting it ventrally and toward the midline expose the right limb of the pancreas. The right limb of the pancreas is located in the mesoduodenum and shares its blood supply with the duodenum via pancreaticoduodenal artery and vein. The close association of pancreas and duodenum often makes partial pancreatectomy difficult without concurrent duodenal resection (this is particularly true in cats). In addition, the location of pancreatic duct entrance into the duodenum may also influence surgical options.

The left limb of the pancreas can easily be examined by breaking into the omental bursa and following the leaves of the omentum to the epiploic foramen. The left limb of the pancreas is located near the epiploic foramen in the dorsal abdominal cavity. It is not closely associated with any other abdominal structure and can easily be manipulated surgically.

Pancreatic Biopsy
The old wives tale “don’t touch the pancreas” needs to be put to rest. Gentle manipulation and biopsy of the pancreas is a predictably successful procedure with a low incidence of postoperative pancreatitis. Several techniques are available for obtaining pancreatic specimens during exploratory laparotomy. The simplest method is performed by cutting a strip of pancreatic parenchyma 2 to 3 mm thick along the border of the affected pancreas. Excessive bleeding is rarely a problem with this technique; hemorrhage is controlled via cautery or direct pressure. Diffuse

pancreatic disease must be present if this method is to be diagnostic. This is the author's technique of choice for feline pancreatic biopsy.

A second technique involves placing an encircling ligature around affected pancreatic tissue. An encircling ligature of 3-0 suture is placed around the base of affected pancreas. As the ligature is tightened, it cuts through the pancreatic parenchyma, ligating vessels and pancreatic ducts. The distal pedicle of pancreas is carefully removed with a number 15 BP scalpel blade or metzenbaum scissors. Care is taken to avoid cutting the suture. If a relatively large portion of pancreas is to be removed (e.g., removal of insulinoma), a similar technique is used. In this situation, 2-0 or 3-0 monofilament nonabsorbable suture should be used.

Partial Pancreatic Resection
The affected portion of the pancreas is identified. Margins between necrotic and viable pancreatic tissue are identified. Careful disection along these margins isolates the necrotic segment of pancreas. Encircling sutures are placed around the pancreas to adequately ligate vessels and ducts. The necrotic pancreatic segment is amputated and submitted for histopathologic evaluation and culture and susceptability testing. If areas of questionably viable pancreas remain in the abdominal cavity, omentalization of these margins is recommended (see description below).

Partial pancreatectomy of the right pancreatic limb is much more technically demanding than the left limb due to the shared pancreaticoduodenal blood supply of the right pancreatic limb, close associaiton of the pancreas with the duodenum, and presence of pancreatic and common bile duct papilla.

Pancreatic Abscess and Pseudocyst
If possible, pancreatic abscesses and pseudocysts should be resected via partial pancreatic resection as described above. Removal of as much necrotic tissue and debris as possible is likely to result in a more predictably successful outcome. However, some pancreatic abscesses and pseudocysts may involve the angle of the pancreas, pancreatic ductal system, and/or common bile duct drainage. In these situations the treatment of choice may be needle aspirate to identify the most ventral aspect of the abscess/pseudocyst, provide an adequate drainage point in the abscess wall, curettage the interior of the abscess, and suture a pedicle of omentum into the remaining abscess cavity. Advantages of this technique include preservation of the ductal system of the pancreas and biliary system, decreased surgical time, debridement and drainage of the abscess cavity is provided, and the angiogenic property of omentum may provide needed blood supply to remaining pancreatic tissue. Disadvantages include necrotic tissue may be left behind and smaller, unidentified abscess cavities may be left undrained.

Necrotizing Pancreatitits
Occasionally, exploratory laparotomy reveals a diffuse necrotizing pancreatitits with suppurative septic generalized peritonitis. In these cases the surgeons' objective should be to 'change the air in the abdominal cavity', debride as much necrotic tissue and debris as possible, provide drainage of any intra-abdominal abscesses, lavage the abdomen with 4 – 5 liters of body temperature sterile physiologic saline solution, place jejunostomy and gastrostomy feeding tubes, and consider leaving the abdomen open for adequate postoperative drainage. The prognosis for these patients is grave and surgical intervention is generally a last chance effort to control the source of the patients' systemic inflammatory response syndrome.

Tube drainage
Recently it has been shown that proper placement of intraperitoneal Jackson-Pratt drainage tubes can result in efficient postoperative abdominal drainage. In cats one drain placed in the cranial quadrant of the abdomen between the liver and diaphragm. The drain is exited at a point distant from the midline abdominal incision. This drainage system appears to be as efficient as the open peritoneal drainage / lavage techniques described below. A clear advantage of the drains is relative ease of management compared to open techniques.

Open Peritoneal Lavage and Drainage
Open peritoneal lavage and drainage is defined as a technique that provides postoperative peritoneal drainage through a partially open abdominal incision. This decision is based on several factors: a) an assessment of the degree of peritoneal contamination, b) ability to surgically remove all remaining debris from the peritoneal cavity, c) severity of the patients illness (patients with a more severe illness tend to be treated open), and d) when continued septic inflammatory processes are anticipated.

If the decision is made to "leave the abdomen open" partial closure is performed as follows:

a) Loops of monofilament nonabsorbable suture (e.g., prolene, nylon) are placed 2-3 cm apart on each side of the abdominal incision along its entire length.

b) Sterile 1/8" to 1/4" umbilical tape is threaded through the loops of suture in a "shoe lace" fashion and tied. This allows gentle ap¬position of wound edges, acts as a "net" to prevent evisceration, and allows adequate drainage of peritoneal fluid.
c) Several sterile laparotomy pads are then secured to the open incision. Umbilical tape is passed through the previously placed suture loops and tied over the laparotomy pads to hold them in place. The presence of laparotomy pads acts to absorb peritoneal fluid.
d) Several sterile surgical towels are placed over the laparotomy pads to increase absorptive capacity of the bandage.
e) Sterile absorbent cotton is placed over the towels and secured with plastic Steri drapes, kling, and elasticon in a snug belly bandage.
f) An inexpensive and effective alternative to “e.” above is use of a disposable diaper. The diaper is secured around the patients abdomen to cover the sterile towels.

Postoperative therapy includes intravenous fluids, antibiotics, periodic blood glucose analysis (as a monitor for sepsis), high protein alimentation, and bandage management. Fluid and protein losses can be significant, with hypoproteinemia and hypovolemia reported most frequently. If hypoproteinemia becomes severe (serum albumin < 2.0 mg/dl), plasma transfusions should be considered. Replacement of peritoneal fluid loss is important; quantitating losses is performed by weighing the bandage at each bandage change. High protein alimentation is provided by the use of commercially available liquid diets given through the gastrostomy or jejunostomy feeding tube. Feeding can begin immediately after jejunostomy tube placement or 24 hours after gastrostomy tube placement.

Bandage changes and continued peritoneal lavage are crucial in successful management of patients treated with open peritoneal drainage. At 24-hour intervals the patient is taken to the operating room, anesthetized, and the secondary and tertiary bandages removed. The abdomen is prepared for aseptic surgery, previously placed laparotomy pads and umbilical tape removed, and a sample of peritoneal fluid is taken for cytological evaluation. The abdominal cavity is re-explored (specifically areas of abscessation and necrosis) and lavaged (200-300 ml/kg body weight PSS). Primary closure of the abdominal incision is dictated by results of cytological evaluation at each lavage. As neutrophil morphology becomes normal and bacterial numbers decrease (approaching a serosanguinous exudate) routine abdominal closure is performed.

The reported mortality for patients with generalized peritonitis is reported to be as high as 68%, however the type of therapy for each case was not described. In two series of patients with generalized peritonitis specifically treated using open peritoneal lavage, the mortality rate ranged from 33 - 48%. The patients in these series represented the most severe cases of generalized peritonitis.

In general, if a positive response to open peritoneal lavage therapy is going to occur, it is seen by the third or fourth lavage ses¬sion. In the authors’ experience, patients requiring open peritoneal lavage beyond 4 days often develop severe complications such as anemia, electrolyte abnormalities, hypoproteinemia, antibiotic resistant infection of the peritoneal cavity, systemic inflammatory response syndrome and DIC. These complications coupled with unresponsive generalized peritonitis often result in a grave prognosis.

Conclusion
Acute pancreatitis can vary in severity of signs and often results in multiple organ system involvement. Despite extensive literature on pathogenesis of pancreatitis and its complications, there have been few notable advances made in its medical and surgical management. It is possible that future research on modification of enzymatic disturbances will result in an effective treatment for acute pancreatitis. Surgical treatment of pancreatitis remains a controversial topic and is generally reserved for patients with severe necrotizing pancreatitis with septic peritonitis or pancreatitis associated with pancreatic mass.

Surgery of the Liver and Biliary Tract

If you would like a copy of the video of these surgical procedures go to www.videovet.org.

Key Points
- Review hepatic anatomy prior to hepatobiliary surgery
- Handle liver biopsy specimens carefully; do not “create” liver pathology
- Total liver lobectomy is often less difficult than partial liver lobectomy
- Cholecystoduodenostomy is a predictably successful long term option for biliary diversion in dogs and cats
- Pay attention to detail when suturing gallbladder

Surgery of the Liver
Hepatic surgery frequently involves major operations on patients with significant illnesses. These patients have varying degrees of hepatic dysfunction and liver function tests are an integral part of the preoperative assessment. It is important to remember that the liver has a tremendous metabolic reserve, even a 70% decrease in function may not be manifested by gross metabolic abnormalities. The major technical challenge in liver surgery is hemostasis.

Preoperative Considerations
The liver is the largest glandular organ in the body, and it has a remarkable capacity for hypertrophy and hyperplasia. The liver performs many functions, including metabolism of carbohydrates, vitamins, fats, and protein; formation and excretion of bile; detoxification; phagocytosis; immune reactions; and synthesis of coagulation factors. Liver function tests include measurement of serum enzyme levels, protein, bilirubin, and bile acids. Hepatic insufficiency may be evaluated by measuring bile acids or an ammonia tolerance test. If ascites is suspected, paracentesis should be performed for fluid analysis. It is preferable that ascites be controlled prior to elective surgery.

Many patients suffering from liver disease are hyporexic or anorexic. If possible, a diet high in calories, protein, and carbohydrates should be provided prior to elective surgery. Plasma may be administered to achieve acceptable albumin levels. Vitamin K is administered until a normal prothrombin time results. If icterus is present, other fat-soluble vitamins are added. If anemia is present, transfusion with fresh whole blood may be indicated.

Decreased hepatic function may precipitate several problems that are of significance to the surgeon, such as delayed wound healing secondary to hypoproteinemia, altered drug metabolism, and certain coagulopathies. In hypoproteinemic patients, the use of synthetic absorbable or monofilament nonabsorbable suture materials are recommended. Whenever possible, patients with chronic liver disease should be treated with drugs that do not require hepatic metabolism.

Patients with chronic end stage liver disease may have coagulopathies due to impaired synthesis of prothrombin and prothrombin-dependent clotting factors (VII, IX, X). It is important that bleeding disorders be detected prior to elective surgery, including needle biopsy. In the presence of obstructive jaundice, a prolonged prothrombin time should respond to parenteral administration of vitamin K. In this instance, correction may require transfusion of fresh whole blood or fresh frozen plasma.

Cases in which extensive manipulation of liver lobes is anticipated (i.e., partial or total lobectomy), antibiotics should be administered preoperatively.

Surgical Anatomy
Surgical exploration of the liver is generally performed via xiphoid to pubis midline celiotomy. A generous exposure is required to adequately visualize structures in the cranial quadrant of the abdominal cavity. Exposure may be extended cranially by median sternotomy and/or laterally by left or right paracostal incision.

The liver has three basic divisions: right division (i.e., right lateral lobe and caudate process of caudate lobe), central division (i.e., quadrate and right medial lobe), and left division (left lateral, left medial, and papillary process of caudate lobe). The lobes of the left division have narrow pedicles and comprise approximately one half of the total liver mass.

The liver has two afferent blood supplies; the common hepatic artery and portal vein, and one efferent blood supply; hepatic veins. The liver receives approximately 25 percent of the cardiac output. Three quarters of the hepatic blood flow is carried by the portal vein under low pressure (6 to 12 mm Hg); the remainder is carried via hepatic artery under systemic arterial pressure. The common hepatic artery is a branch of the

Surgical Technique
Liver Biopsy
Liver biopsy is one of the most important diagnostic aids available for evaluation of liver disease. Samples for cytologic examination may be obtained via percutaneous needle biopsy, laparoscopy, or exploratory laparotomy. Percutaneous needle biopsy techniques are the most efficient in terms of time and expense.

Several techniques are available for obtaining liver specimens during exploratory laparotomy. The simplest method is performed by cutting a strip of liver parenchyma 5 to 6 mm thick along the border of the liver lobe. Excessive bleeding is rarely a problem with this technique; hemorrhage is controlled via cautery or direct pressure. Diffuse liver disease must be present if this method is to be diagnostic.

A second technique involves placing an encircling ligature around a pedicle of liver tissue. As the ligature is tightened, it cuts through the hepatic parenchyma, ligating hepatic vessels and bile ducts. This technique has been criticized for leaving excessive amounts of devitalized parenchyma. This can be avoided by inserting scissors through the cut parenchyma and cutting hepatic vessels and bile ducts just distal to the ligature. This method requires the presence of diffuse liver disease to obtain a diagnostic biopsy.

More localized abnormalities can be biopsied by wedge resections or partial lobectomy. Wedge resections may be performed by placing a row of overlapping, full-thickness, interrupted mattress sutures of 0 or 2-0 Maxon along each side of the wedge to be removed; these sutures should commence at the edge of the liver lobe and meet proximally to form a "V". The sutures should be tied so as to compress the liver slightly but not cut into liver parenchyma. The wedge of tissue to be removed is incised about 5 mm from the suture line. Alternatively, the wedge may be removed prior to tightening the mattress sutures; preplaced mattress sutures are then gently tied with enough tension to control bleeding.

Wedge resection may also be performed utilizing the finger fracture technique (described in the section on partial liver lobectomy). The advantage of this method is the minimal amount of potentially devitalized liver parenchyma left behind.

Partial or Total Liver Lobe Resection
Indications for partial hepatic resection include: (1) trauma with subsequent hepatic necrosis, (2) hepatic cyst, (3) granuloma, (4) primary liver tumor, (5) liver lobe abscess, and (6) metastatic tumors. Uncontrollable hepatic hemorrhage and arteriovenous fistulas may also be indications for partial or total liver lobectomy.

In spite of careful parenchymal dissection, significant bleeding from incised liver margins may occur. Hemorrhage is initially controlled by direct pressure. Whenever possible, bleeding is controlled by ligation of individual vessels (i.e., 3-0 synthetic absorbable suture) or electrocautery. Application of a hemostatic agent such as Gelfoam has been recommended. Bleeding may also be controlled by suturing an omental pedicle flap over bleeding liver surfaces. Severe parenchymal bleeding may be controlled by compression of the hepatic artery and portal vein (also called the Pringle maneuver). This is done by inserting the index finger through the epiploic foramen and compressing the hepatic artery and portal vein between the thumb and index finger. Atraumatic vascular clamps may be used; however, the common bile duct is usually included in this tissue and is particularly sensitive to trauma. Vascular occlusion can be used for periods of up to 15 minutes without affecting hepatic structure and function. Failure to control hemorrhage by this technique indicates the point of hemorrhage is from hepatic veins.

Partial Liver Lobectomy
Partial liver lobectomy is best performed by variations of the finger fracture technique. This method minimizes hemorrhage and escape of bile associated with sharp dissection. The portion of liver to be resected is outlined by dividing Glisson's capsule with cautery or a scalpel. This results in an accurate separation. Next, the hepatic parenchyma is transected using a scalpel handle or compressing the parenchyma between the thumb and index finger. In smaller patients hemostatic forceps may be used. As the tissue is separated, blood vessels and bile ducts become readily visible. Vessels are ligated and the liver specimen removed.

Total Liver Lobectomy
In general, total liver lobectomy is anatomically preferable to partial lobectomy because it is associated with fewer technical problems and less blood loss. Liver lobectomy is best performed by careful and specific identification and ligation of hilar vessels and ducts. Pedunculated liver lobes are easily removed in this manner. Liver lobes intimately surrounding the caudal vena cava require careful sharp and blunt dissection to identify, isolate, and ligate hilar vessels. Liver lobes with sufficiently narrow pedicles can be divided by the finger fracture method; exposed vessels and ducts are individually ligated with monofilament nonabsorbable (nylon, polypropylene, novafil) or monofilament absorbable (Maxon, PDS) suture material. Care is taken to avoid leaving any devitalized liver tissue.

Complications following major hepatic resection include fever, portal hypertension, ascites, coagulopathies, icterus, persistent bile drainage, postoperative hemorrhage, sepsis, wound infection, and wound dehiscence.

Surgery of the Biliary Tract
Surgical diseases of the biliary tract are relatively uncommon in small animals. Generally, surgery is performed to repair incontinuities in the extrahepatic biliary tree that result from trauma. Occasionally, because of biliary tract obstruction, it is necessary to construct an alternate route for the flow of bile (e.g., cholecystoduodenostomy). In either case, definitive treatment involves restoration of the functional integrity of the biliary system.

Presurgical Considerations
The definitive treatment for most diseases of the biliary system is surgery. Animals with disorders of the biliary system are frequently quite debilitated. The animal's hydration status, as well as any electrolyte abnormalities, should be treated appropriately.

Normal bile is sterile. In cases of cholecystitis and cholangitis, however, bile frequently contains bacteria. Bile leakage can induce chemical peritonitis resulting in tissue irritation and permeability changes which may result in subsequent bacterial growth. Administration of preoperative and postoperative antibiotics is indicated in the preoperative treatment of these patients. Antibiotic therapy is best based on culture and susceptibility testing. Empirically used antibiotics include ampicillin, cephalosporins, and chloramephenicol, because they are excreted in the bile.

In cases of prolonged obstructed biliary disease, a deficiency of prothrombin and vitamin K-dependent coagulation factors can develop. Administration of vitamin K or a fresh whole blood transfusion may be indicated.

The principles of biliary tract surgery include: (1) accurate approximation of tissue layers, especially good mucosal apposition; (2) minimal tissue dissection to maintain good blood supply; (3) maintenance of adequate lumen size, and (4) tension free closure.

Suture materials best suited for biliary surgery include monofilament nonabsorbable (i.e., nylon, polypropylene, novafil) or monofilament absorbable suture (i.e., Maxon, PDS). Multifilament absorbable suture (i.e., Vicryl, Dexon) can be used but their braided nature results in excessive tissue drag. Suture needles recommended are similar for those used in intestinal surgery; fine taper, taper cut, or reverse cutting needles. The recommended suture pattern is single layer simple continuous appositional; each bite through all layers of gallbladder and intestinal wall. Single layer simple interrupted appositional suture pattern can also be used. Inverting suture patterns should be avoided as they tend to create unacceptable lumen compromise. Suture size is dependent upon the species and structure being sutured.

Gall Bladder:	cats and small dogs:	4-0 to 5-0
	large dogs:	3-0 to 4-0
Common Bile Duct:	cats and small dogs:	5-0 to 6-0 (difficult to see - loupes recommended)
	large dogs:	5-0 to 6-0

Surgical Anatomy
Biliary tract surgery is generally limited to the extrahepatic biliary system which includes hepatic ducts, common bile duct, cystic duct, and gallbladder. In the dog, hepatic ducts enter the cystic duct and common bile duct separately. The cystic duct extends from the neck of the gallbladder to its junction with the first hepatic duct. Distal to this, the duct continues to the duodenum as the common bile duct. The common bile duct empties into the duodenum at the major duodenal papilla. Blood is supplied to the gallbladder via the cystic artery, which originates from the left branch of the proper hepatic artery. The extrahepatic biliary tract is most often approached via a cranioventral midline celiotomy.

Surgical Techniques
Biliary Tears
Biliary tears are most frequently the result of blunt abdominal trauma and frequently present days to weeks after the traumatic episode. The common bile duct and cystic duct are the structures most frequently damaged. Small tears may be repaired using 5-0 or 6-0 suture in a simple interrupted pattern. It is advisable to preplace each suture prior to tying. Avulsions of the common bile duct from the duodenum or complete tears may be repaired by reimplanting the common bile duct into the duodenum (i.e., choledochoduodenostomy) or anastomosing gall bladder to duodenum (i.e., cholecystoduodenostomy). Torn hepatic ducts are generally ligated on each side of the tear; bile will be redirected through other hepatic ducts. Extensive damage to the gallbladder or cystic duct (i.e., necrotizing cholecystitis, traumatic rupture) is treated by cholecystectomy.

To prevent stricture formation of the common bile duct, reconstruction over a tube stent is recommended. Tubes should be made of polyethylene or silastic and may be straight, T-shaped, or Y-shaped. Straight tubes are preferred in small animals. Tube placement is technically demanding and can be performed as follows:

If the common bile duct is torn or transected:
1. pass the tube into the bile duct through the defect toward the gallbladder, pass the other end of the tube through the defect toward the duodenum, suture the defect using the tube as a stent to guide suture

placement, make no attempt to secure the tube to the bile duct or duodenum as it will pass into the duodenum and through the gastrointestinal tract in several days to weeks.
2. make a 2 - 3 cm incision in the duodenum to expose the common bile duct papilla, pass the tube into the papilla and across the bile duct defect toward the gall bladder, suture the defect using the tube as a stent to guide suture placement, make no attempt to secure the tube to the duodenum, suture the duodenotomy incision.
3. make an incision in the gallbladder, pass the tube into the cystic duct, common bile duct, past the common bile duct defect and into the duodenum, suture the defect using the tube as a stent to guide suture placement, make no attempt to secure the tube to the duodenum, suture the cholecystotomy incision (•because of the tortuous path taken by the cystic duct, this technique is difficult to perform consistently)
4. if the tube cannot be passed, ligate the common bile duct on each side or the defect and anastomose the gallbladder to the duodenum (i.e., cholecysto-duodenostomy)

Cholecystectomy
Indications for cholecystectomy include irreparable damage to the gallbladder or cystic duct, neoplasia, calculi, or infection (i.e., necrotizing cholecystitis).

Technique
The liver and gallbladder are exposed via cranial ventral midline celiotomy. The gallbladder is adhered to the right medial and quadrate lobes via peritoneal attachments. These visceral peritoneal attachments are incised along the junction of the gallbladder and liver. While applying gentle traction, the gallbladder is freed from the liver by blunt dissection. The gallbladder and cystic duct are freed to their junction with the common bile duct, being careful not to damage the common bile duct or hepatic ducts. The cystic duct and cystic artery are clamped and double ligated with 2-0 monofilament absorbable or nonabsorbable suture. The duct is transected between ligatures and the gallbladder removed. Bleeding from the raw surface of the liver is controlled by direct pressure from a gauze sponge, a hemostatic substance such as Gelfoam, or an omental pedicle flap. A sample of bile and gallbladder wall is taken for culture and susceptibility testing and the remainder of the gallbladder submitted for histopathologic examination.

Cholecystotomy
Cholecystotomy has been described as a treatment for obstructive jaundice and choleliths. The gallbladder is approached in the usual manner and packed off using moistened laparotomy pads. Stay sutures are used to hold the gallbladder in position and an incision is made. A piece of gallbladder wall and sample of its contents (i.e., bile, choleliths) are taken for culture and analysis. The gallbladder is lavaged and the cystic duct cannulated and flushed to establish patency. The gallbladder is closed in using a single layer simple continuous appositional pattern with synthetic monofilament absorbable suture material.

Biliary Enteric Anastomosis
Introduction
Obstructive biliary disease is frequently treated by construction of an alternate route for flow of bile. Anastomosis of the common bile duct to either the duodenum or jejunum is technically demanding and success is dependent upon patient size. The common bile duct in patients under 15 kg is so small that these techniques are technically difficult to perform. It is generally recommended to divert biliary flow from the gallbladder to the duodenum (i.e., cholecystoduodenostomy) or jejunum (i.e., cholecystojejunostomy).

Cholecystoduodenostomy:
Cholecystoduodenostomy is the anastomosis of gallbladder to duodenum.
Perform a ventral midline celiotomy from xyphoid to pubis:
1. Ligate the injured common bile duct cranial and caudal to the defect.
2. Dissect the gallbladder from its attachment to the right medial and quadrate liver lobes as described for cholecystectomy.
3. Place gentle cranial traction on the duodenum and incise the duodenocolic ligament (this helps relieve tension on the final anastomosis).
4. Bring the duodenum and gallbladder into apposition and place 4-0 or 5-0 nylon stay sutures 2 - 3 cm apart in the location of the proposed anastomosis.
5. Pack off the proposed anastomosis site with moistened laparotomy pads.
6. Make a 2.5 cm incision in the gallbladder and a parallel incision of equal length in the duodenum.
7. Begin suturing the edge of the gallbladder to the edge of the duodenum from within their lumens using 4-0 or 5-0 monofilament absorbable or nonabsorbable suture with a fine taper, taper cut, or reverse cutting needle in a single layer simple continuous appositional pattern penetrating all layers of the intestine and gallbladder. Sutures should engage 2 - 3 mm of tissue with each bite and be no further apart than 2 mm.

8. After completion of the primary suture line the remaining edges of the duodenum and gallbladder are sutured as described above to complete the anastomosis.

A frequent criticism of biliary enteric anastomosis is postoperative development of ascending cholangitis. Current literature suggests that postoperative cholangitis is more likely caused by stricture at the anastomotic site. This can be avoided by being careful to create a large stoma (i.e., at least 2 to 2.5 cm) during the anastomosis.

Cholecystojejunostomy Using a Roux-en-Y Loop
Cholecystojejunostomy using a Rou-en-Y Loop involves the advancement of a segment of proximal jejunum (approximately 40 cm in length) to the gallbladder. The anastomosis is performed in the manner described for cholecystoduodenostomy. An end-to-side jejunostomy is performed to restore intestinal continuity. The defunctioned limb of jejunum serves as a conduit for biliary secretions and helps prevent enterobiliary reflux.

NOTES:

Wound Management Secrets

Howard B. Seim III, DVM, DACVS

Split-Shot Wound Management

Key Points

- Skin has the ability to stretch when placed under mild tension
- Normal wound contraction often stops before wound edges appose.
- Split-shot wound management can be used to encourage skin edges to contract.

If you would like a video of this surgical procedure go to www.videovet.org and or contact videovet@me.com.

Indications

Use of various appliances to create tension on the local skin of non-contracting open wounds is not new. Subcutaneously buried silastic balloons (i.e., skin expanders) injected every 24 hours with varying amounts of saline will stretch local skin and have been used extensively in human plastic and reconstructive surgery. Skin expanders have also been described for use in veterinary patients. Skin expansion may be indicated in wounds that have undergone normal wound contraction without successful wound margin apposition. The most common locations for inappropriate wound contraction in small animals are extremities, head, and tail.

Applied Anatomy

Skin is made up of several layers that collectively form a complex organ system. Skin is not capable of regeneration. One method of getting 'more' skin for wound coverage is encouraging local skin to undergo intussusceptive growth. This can be accomplished by applying tension to local skin around the wound. If tension is constant, skin layers will accommodate the increase tension by becoming thinner thus allowing the skin to 'stretch'.

Anesthesia

Patients undergoing split-shot wound management should be placed under general anesthesia.

Technique: Positioning

Patients are positioned with the wounded area uppermost.

Patient Preparation

Wounds identified for split-shot wound management should be treated as an open wound until there is evidence of a healthy granulation tissue bed. Routine aseptic preparation of the local skin is performed.

Special Instruments and Suture

Metallic split-shot (i.e., other than lead) can be purchased at any local sporting goods or fishing store. Split-shots are placed in a cold sterilization media for an appropriate time period and thoroughly rinsed prior to use. Monofilament non-absorbable suture with a swaged-on taper needle, size 00 to #1 depending upon location and size of wound is recommended. A sterile rubber bumper is fashioned from a feeding tube or catheter.

Split-Shot Technique

The wound and surrounding skin are prepared for aseptic surgery. Two bumpers are created by cutting one 1/2 inch piece off the flanged end of a 20 French feeding tube or catheter. This segment of tube is then split in two.

An appropriate size monofilament nonabsorbable suture is selected. The skin edges are gently undermined being careful not to trim the wound edge. The swaged-on needle is placed through the rubber bumper and enters the wound at the commissure. The wound edges are then sutured using a simple continuous pattern. Care is taken to engage the needle in the tough collagen laden subcutaneous tissue. Patients with thin subcutaneous tissue (i.e., cats, small dogs, areas of thin skin) may require penetration of skin instead of subcutaneous tissue. Once the entire length of the wound has been sutured, the suture is passed out through the skin of the remaining commissure of the wound. Knots are not tied in either end of the suture.

Gentle traction is placed on the exiting ends of the suture until mild tension is placed on the wound edges and local skin. A split-shot is placed on each end of the exiting suture against the bumper. The split-shot is then gently but firmly clamped against the suture; this maintains tension on the skin edges and local skin. The wound is bandaged, an Elizabethan collar placed, and the patient confined to a cage. Each day the bandage is removed, the ends of the suture gently pulled and a split-shot is placed between the bumper and the original split-shot. Daily tension is

performed without the need for general anesthesia or sedation. Skin may be responsive to tension for 7 to 10 days. When the wound is closed to your satisfaction, the suture and bumpers are removed. The remaining wound is bandaged only if it requires further protection.

Tie-Over Bandage Technique
If you would like a video of this surgical procedure go to www.videovet.org and or contact videovet@me.com.

Key Points
- The most important aspects of wound management are debridement, debridement, debridement.
- The solution to pollution is dilution.
- A tie-over bandage can cover the most difficult to bandage wounds.
- A tie-over bandage can help 'stretch' local skin.

Wound Management
The area should be clipped and cleaned as soon as possible to provide a clean environment beneath the bandages that will eventually be applied. Sterile, water-soluble gel placed on the wound is a convenient means of temporary wound protection. Dried blood and debris should be removed from the surrounding skin with antiseptic soap, using care to avoid contact between the soap and exposed tissues which can result in lipolysis and tissue damage. The primary goal of wound management is to decrease bacterial numbers and debris and enhance the animal's defense mechanisms (i.e., debridement). Gross particulate matter, hair, etc. should be removed manually from the wound. Lavage is beneficial in further decreasing infection-promoting debris and bacteria. Saline is indisputably the ideal lavage solution, although dilute chlorhexidine (0.05 to 0.005%), or povidone-iodine (0.01%) may be used. The effectiveness of lavage is dependent upon volume and pressure. Studies have shown that high pressure (25-60 psi) is superior to low pressure (0.5-5.0 psi) when wounds are only lavaged one time. Medium pressure, which has also been shown to be beneficial can be generated using an 18-gauge needle and large syringe (35-60 ml). Surgical debridement of necrotic-appearing tissue and embedded foreign material limits nutrients for bacterial growth and enhances the animal's local defense mechanisms.

Open Wound Management
Open wound management allows optimal drainage and daily inspection, debridement and lavage of tissues. Following surgical excision of necrotic tissue, etc., continued mechanical debridement can be performed using an adherent dressing (wet-to-dry, dry-to-dry, or wet-to-wet). Wide-mesh gauze sponges are ideal for adherent bandages. The type of dressing used depends on wound conditions. Wet-to-dry dressings can be used for wounds with necrotic tissue, foreign matter and viscous exudate. The wet dressing dilutes the exudate and allows absorption. As the dressing dries, necrotic tissues adhere to the gauze and are removed with the bandage. Dry-to-dry dressings have similar indications as wet-to-dry except without the presence of viscous exudate. Wet-to-wet dressings are indicated when viscous exudate is present without necrotic tissues. The contact adherent layer should be covered by an absorbent outer layer. Once necrotic tissues have been removed and granulation tissue begins to form, adherent gauze should be replaced with nonadherent pads (telfa).

Second Intention Healing
Second intention healing occurs by formation of granulation tissue, wound contraction and epithelialization. The advantages of this process are drainage remains optimal, wound infections are rare and the time and expense of surgery is avoided. However, second intention healing may cause disfigurement or loss of function due to wound contracture, and the epithelium formed may be easily disrupted.

Tie-Over Bandage: Indications
Large surface area wounds (i.e., abdomen, thorax, back, neck) or wounds in 'difficult-to-bandage' areas (i.e., tail, perineum, head, paraprepucial,proximal extremeties) may not be amenable to routine bandaging techniques. These areas generally lend themselves nicely to placement of a tie-over-bandage.

Technique
The wound bed is prepared as described above. Several # 0 or #1 monofilament non-absorbable suture loops are placed in the skin on the periphery of the wound. Loop sutures are generally placed 360o around the wound and spaced 2 or 3 cm apart. Appropriate wound covering materials are placed in the wound bed (i.e., wet to dry, gauze, telfa, etc) and a sterile laparotomy pad placed on top to provide protection to the wound. Several lengths of 1/4 inch or 1/2 inch umbilical tape are passed through the loops of suture, over the laparotomy pad and through the suture loop on the opposite side of the wound. The umbilical tape passes over the wound mutiple times to hold the laparotomy pad in place (an therefore the wound covering materials). Enough traction is placed on the suture loops to place mild tension on the skin edges of the healing wound. This bandage is easily removed and replaced for ease of bandage change.

Once the granulation bed is healthy and the wound is considered surgically clean it can be closed primarily (i.e., delayed primary closure). If there are small defects at the time of suture removal these can generally heal by second intention.

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Managing Feline Ear Polyps

Howard B. Seim III, DVM, DACVS

If you would like a video of this surgical procedure go to www.videovet.org or contact videovet@me.com.

Key Points

- Polyps can occur in the nasopharynx, external ear canal and/or middle ear
- The origin is thought to be the lining of the tympanum
- Treatment is surgical removal of the polyp origin - ventral bulla osteotomy
- Prognosis is favorable to excellent

Definition

Inflammatory polyps are protruding, pedunculated growths from the mucous membrane arising secondary to chronic inflammation and local tissue irritation.

Synonyms

Ear polyps, ear canal polyps, middle ear polyps, nasopharyngeal polyps

General Considerations

Pathophysiology

The lining of the tympanic cavity, auditory canal, and nasopharynx is reported to be the site of origin of most inflammatory polyps in cats. The exact cause of the polyps is unknown, however because of the young age of the majority of cases reported, a congenital origin has been suspected. Clinical signs vary and are generally associated with the location of the polyp. Nasopharyngeal polyps generally cause signs of upper respiratory distress, whereas ear canal and middle ear polyps case signs of otitis external and otitis media, respectively. The most likely anatomic location of origin of nasopharyngeal, ear canal, and middle ear polyps is the lining of the tympanic cavity.

Diagnosis

Clinical presentation:

Signalment

Cats are generally young with a mean age of 13.6 months, however age may range from 3 months to 8 years. There is no sex or breed predisposition.

History

The history is variable and may include nasal discharge, sneezing, loud respirations, dyspnea, dysphasia, scratching at the ears, drainage or foul odor of the ear canal, Horner's Syndrome or head tilt. Duration of signs may be from one week to several years. Signs are dependent upon location of the polyp (i.e., nasopharynx, ear canal, middle ear).

Physical Examination

Physical examination findings may be dependent upon the location of the polyp. Polyps located in the nasopharyngeal region may be visualized orally as a mass causing a bulging of the soft palate. Light general anesthesia allows cranial retraction of the soft palate with a spay hook and direct visualization of the polyp protruding from the nasal cavity. Polyps located in the external ear canal can be visualized by direct otoscopic examination. The polyp looks like a smooth dome-shaped mass. Polyps located in the middle ear cannot be visualized on physical exam, however clinical signs of otitis externa or otitis media should make one highly suspicious of a polyp located in the tympanic bulla.

Radiography

A skull series of radiographs including oblique views allow adequate visualization and evaluation of the bulla. The normal density of the bulla's interior is air. If a fluid or bone density is seen, pathology within the tympanic cavity exists. A true lateral skull x-ray will result in the left and right bulla superimposed over each other. This superimposition of bulla's can be eliminated by rotating the skull slightly to project each bulla on the radiograph. The normal thickness of the bulla wall is similar to that of an egg shell. If thickening of the bulla wall is identified radiographically, pathology within the tympanic cavity exists. Nasopharyngeal polyps may be seen as a soft tissue (fluid) density in the caudal nasal cavity. Patients that present with polyps in the external ear canal or nasopharynx should have the tympanic bulla evaluated radiographically to rule out middle ear involvement.

Laboratory Findings
Laboratory findings in cats with inflammatory polyps are generally normal.

Differential Diagnosis
Nasopharyngeal polyps should be included in the differential diagnosis of young cats examined because of upper respiratory clinical signs (nasal discharge, sneezing, and stertorous respirations). Ear canal polyps and middle ear polyps should be included in the differential diagnosis of young cats examined for clinical signs of otitis externa or otitis media, respectively.

Medical Management
Nasopharyngeal polyps can initially be treated by placing traction on the polyp. Traction is successful in 50-70/% of nasopharyngeal polyps.

Ear canal polyps can also be treated initially using traction however, ear canal polyps tend to be very friable and complete removal is often difficult. Reoccurrence of ear canal polyps is common.

Middle ear polyps are generally considered surgical. It may be possible to access the middle ear via the external ear canal but complete removal of the polyp is difficult due to the small diameter access point. Surgical excision of the polyp and its cell of origin (lining of the tympanic bulla) will result in 80 - 90% cure.

Surgical Treatment
Surgical excision of nasopharyngeal, ear canal, and middle ear polyps may be the treatment of choice. The technique is dependent upon the specific location of the polyp or polyps.

Preoperative Management
Prophylactic antibiotics are administered preoperatively. Intravenous fluids should be administered during surgery.

Anesthesia
General anesthesia is performed using any standard anesthetic protocol. Patients are generally young and have no other complicating factors to consider.

Surgical Anatomy
The bulla in an anesthetized cat can generally be palpated just caudal to the angle of the mandible and tempro-mandibular joint. The soft tissues can be compressed until the prominent dome shape of the tympanum is reached with the tip of the index finger. The feline bulla has an osseous septum dividing the bulla into dorsomedial and ventrolateral compartments.

Positioning
Patients are positioned depending upon location of the polyp or polyps.

Nasopharyngeal: dorsal recumbency with the mouth opened.
Ear canal: lateral recumbancy with the affected ear uppermost.
Middle ear: dorsal recumbancy with the front legs retracted caudally.

Surgical Technique
Surgical technique also depends upon the location of the polyp or polyps.

Nasopharyngeal
The patient is placed in dorsal recumbancy with the mouth widely opened. Use a spay hook or similar instrument to retract the soft palate cranially. To date, the author has not needed to split the soft palate to gain adequate exposure of a nasopharyngeal polyp. It can be helpful to pass one or two sutures through the polyp to act as handles to manipulate the polyp during traction. It is helpful to get a mosquito hemostat or right angle forcep around the base of the polyp to apply traction. Slow steady traction applied to the polyp will generally result in complete removal of the dome shaped portion of the polyp as well as the long stalk that traverses through the Eustachian tube and originates in the middle ear. 60 – 70% of nasopharyngeal polyps removed via traction will result in a cure (i.e., no ventral bulla osteotomy will be needed.

Ear Canal
Patients with inflammatory polyps in the ear canal generally present with signs of chronic recurrent otitis externa. Occasionally they present with middle ear signs as well. External ear canal polyps tend to be extremely friable and hemorrhagic. Grasping these polyps from an ear canal approach is often unrewarding as it is difficult to grasp the

friable polyps and remove them from their middle ear origin. In addition, the added exposure gained from a lateral ear resection does not seem to improve the surgeon's ability to successfully remove the polyp. The author has recently taken a different approach to these polpys. First obtain skull radiographs to evaluate the bulla, examine the ear canal, locate the polyp and attempt traction/biopsy. If radiographs suggest middle ear disease and the biopsy result is inflammatory polyp, a ventral bulla osteotomy is performed first (see below) and the ear canal polyp is removed from the bulla. Once the interior of the bulla is exposed and any middle ear polypoid tissue or pus removed, the external ear canal is explored. The polyp is then identified and removed using traction from the middle ear as well as from the external ear canal.

Middle Ear
A ventral bulla osteotomy is the technique of choice for removing middle ear polyps in cats. The ventral aspect of the bulla has the thinnest and easiest bone to penetrate in the dog and cat bulla. The osseous bulla can be palpated just caudal to the angle of the mandible and T-M joint. A 4 - 5 cm longitudinal incision is centered over the bulla. Blunt dissection is performed until the surface of the osseous bulla is seen. A periosteal elevator is used to expose the osseous surface of the ventral aspect of the bulla. A 1/8" Steinmann pin is used to drill a hole in the most ventral aspect of the bulla. The hole is enlarged with rongeurs until the interior of the bulla is easily visualized. The osseous septum is identified and removed in order to facilitate complete exploration of the tympanic bulla. All polypoid tissue is removed leaving the interior of the bulla free of epithelial lining. Culture and susceptibility testing of the tissue lining the bulla is performed. All remaining tissue is submitted for histopathology. Soft tissues are closed to manage dead space. Subcutaneous tissue and skin are closed routinely. The author no longer inserts a drain in the bulla for postoperative drainage.

Special Instruments
Steinmann pins,Jacobs chuck, rongeurs, periosteal elevator, curettes are necessary to facilitate ventral bulla osteotomy.

Postoperative Care and Assessment
After surgery cats should be given broad-spectrum antibiotics for 7-14 days. Intravenous fluids are continued for one day post op and food and water are generally given the day after surgery.

Complications
90-95% of cats can be expected to develop a Horner's Syndrome after ventral bulla osteotomy; about 90% resolve within one month. Reoccurrence of polyps in cats undergoing ventral bulla osteotomy is uncommon (<10%). If the traction technique only (no ventral bulla osteotomy) is performed in animals with nasopharyngeal or ear canal polyps, recurrence of polyps is more likely (about 50%).

Prognosis
Complete excision of inflammatory polyps results in a favourable long-term prognosis.

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Feline Subtotal Colectomy

Howard B. Seim III, DVM, DACVS

Key Points

- Pay attention to the unique blood supply to the colon
- Increase collagenase activity occurs 5 - 7 days after colotomy/anastomosis
- Colon is a high pressure conduit system
- Subtotal colectomy may be curative for megacolon in cats

If you would like a video of this surgical procedure on DVD, go to www.videovet.org or email VideoVet at videovet@me.com.

Surgical Management of Megacolon

Clinical Presentation

Megacolon is a condition in which the ascending, transverse, and descending colon are chronically large in diameter and filled with inspisated stool. Patients generally present with a history of chronic constipation (i.e., weeks to years), tenesmus, and weight loss. Males are more commonly affected than females and the age ranges from one year to 12 years.

Etiology

The etiology of megacolon is a functional defect of the colonic smooth muscle. It is thought to be either congenital, acquired, or idiopathic. The idiopathic form is the most common type seen in the cat.

Diagnosis

Diagnosis of idiopathic megacolon in cats is usually made on the basis of history, abdominal palpation, and radiography. Confirmation is based on exploratory laparotomy.

Treatment

The decision to operate is generally made on the basis of the constipation becoming progressively worse and responding only to multiple enemas and manual deobstipation. Exhaustive medical therapy is generally performed prior to surgical intervention using a varitey of diets and colonic motility modifiers.

Preoperative Management

Preoperative bowel preparation, using antibiotics administered orally or multiple cleansing enemas is probably useless in cases of severe constipation or obstipation. A parenterally administered antimicrobial agent, with a spectrum of activity directed toward coliforms and anaerobes, is probably the most efficacious preoperative management. Compacted stool from chronic obstipation is best removed at surgery rather than trying to remove it pre operatively.

Subtotal Colectomy

Subtotal colectomy is the surgical procedure of choice in cats with megacolon. This technique is performed regardless of how much of the colon appears diseased. The surgical objective is to remove all of the colon except what is necessary to reestablish bowel continuity. When the ileocecocolic valve is removed (i.e., which is done if the cecum appears grossly abnormal), a 1.5 - 2 cm segment of descending colon just proximal to the pubis (i.e., colorectal junction) is saved to accommodate the ileo-colonic anastomosis. When the ileocecocolic valve is retained (i.e., which is done if the cecum appears grossly normal), a 1 cm segment of ascending colon is preserved to accommodate the colonic anastomosis.

Several techniques have been described for performing the colonic anastomosis. The author's technique of choice is an end-to-end anastomosis. The procedure is performed using a single layer simple continuous or simple interrupted appositional pattern with 3-0 or 4-0 synthetic absorbable suture. Because of lumen diameter differences between the ileum and colon, it is necessary to place several sutures in the larger diameter bowel (i.e., colon) in order to create similar size lumen diameters thus resulting in a watertight anastomosis.

After the anastomosis is completed, the peritoneal cavity is thoroughly lavaged with 200 - 300 ml/kg of warm, sterile physiologic saline solution prior to closure. In situations where the anastomosis is under any question, particularly with respect to color and blood supply (i.e., tissue viability), it is advisable to place an omental patch over the

anastomotic area to help provide a source of blood supply and lymphatic drainage, as well as to help support the anastomosis.

Postoperative Care
Immediately postoperatively patients should be supported with a balanced electrolyte solution intravenously until they are able to maintain their hydration status. Antimicrobial treatment is generally continued for five to seven days post operatively. Patients are returned to their normal diet within 24 hours and allowed water ad libitum.

Results
Long term results have been somewhat variable from case to case, but generally:

1. patients generally maintain fecal continence post-operatively.
2. after a 10-15% weight loss 2 - 3 weeks postoperatively, body weight is regained within 3 - 7 weeks
3. watery to mucoid stools occur during the first 3 - 7 weeks followed by mucoid to semi-solid to formed stools by 3-6 months. This is thought to be due to ilieal adaptation thus allowing efficient water absorbtion.
4. frequency of stools is approximately six per day initially followed in 1-2 months by four per day, then at six months to 2-3 stools per day (range 1-4 stools per day).
5. owner satisfaction has been excellent in the majority of cases.

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Colopexy for the Treatment of Recurrent Rectal Prolapse

Howard B. Seim III, DVM, DACVS

If you would like a copy of the video of this surgical procedure go to www.videovet.org.

Rectal Prolapse
Rectal prolapse is a sign, not a disease. Some of the underlying etiologies include intestinal parasitism, chronic diarrhea, dystocia, or any disease-causing chronic tenesmus, stranguria, or abdominal pressing. Diagnosis is made by visual observation of a red tube-like protrusion of rectal mucosa.

Rectal prolapse must be differentiated from a prolapsed intussusception. This can be done by placing a finger or blunt instrument such as a thermometer between the prolapsed mucosa and mucocutaneous junction. If resistance is met, the diagnosis is rectal prolapse. If the finger or instrument is easily passed, a prolapsed intussusception is diagnosed. Prolapsed intussusception requires urgent exploratory laparotomy to reduce or resect the intussusception.

Rectal prolapse can be managed by several methods including reduction and purse-string suture, amputation, or colopexy. The technique selected depends upon viability of the prolapsed tissue, size and reducibility of the prolapse, and recurrence after a previous technique has failed. In small animal practice, patients with rectal prolapse are generally presented early; before significant mucosal necrosis occurs. Therefore, initial management generally involves reduction and placement of a purse-string suture. This is accomplished by general anesthesia, application of 50% dextrose to reduce mucosal edema, gentle reduction of the prolapsed tissue, and placement of a purse-string suture. This suture is tied just snug enough to prevent rectal prolapse yet loose enough to permit defecation. Topical anesthetic ointment (e.g.,1% dibucaine) [Nupercainal ointment] can be instilled in the rectum postoperatively and continued for two to three days after purse-string removal. The purse-string suture remains for two to three days. Diagnosis and treatment of the underlying cause aids in ultimate success.

A nonreducibile viable prolapse or a recurrent rectal prolapse may be treated by celiotomy and colopexy. A ventral midline celiotomy is performed and the prolapse reduced by gentle traction on the colon and concurrent manipulation of the prolapsed rectum.

Colopexy
Once the rectal prolapse is reduced the colon is gently retracted into the abdominal cavity and brought against the left sublumbar body wall. Care is taken to ‘pexy’ the colon in its ‘functional’ position in the abdominal cavity. Do not place excessive tension on the descending colon during colopexy. The peritoneal surface of the left sublumbar body wall is scarified. A similar sized area of colonic serosa on the antimesenteric border is also scarified. Scarified surfaces of the colon and sublumbar body wall are sutured using a two-layer closure. The dorsal margins of each scarified surface are sutured together first, using a simple interrupted or simple continuous suture pattern with 4-0 synthetic absorbable suture material. Next, the ventral margins of the scarified surfaces are sutured together in a similar fashion completing the colopexy. Care is taken to make certain sutures do not penetrate the lumen of the colon. Abdominal closure is routine. Topical anesthetic ointment is instilled rectally after surgical correction and continued for five to six days postoperatively.

Prognosis
The prognosis for rectal prolapse is favorable if the underlying problem can be identified and controlled.

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Monitoring the Difficult Diabetic Cat: Role of Continuous Glucose Monitoring

Catharine Scott-Moncrieff, MA, VMB, MS, MRCVS, DACVIM, DECVIM, DSAM

Pathophysiology of Diabetes Mellitus

Diabetes mellitus (DM) is a common endocrine disease in cats characterized by an absolute or relative deficiency of insulin. This results in a decreased ability of cells to take up and utilize glucose, amino acids, fatty acids, and electrolytes. Insulin deficiency results in increased gluconeogenesis, glycogenolysis, lipolysis, ketogenesis, and protein catabolism. Predisposing factors in cats include obesity, advancing age and being male.

Two types of DM are recognized in man, and these classifications can be applied to the disease in cats. Type I DM (insulin dependent diabetes mellitus) is due to an absolute deficiency of insulin. This form of diabetes is characterized by minimal secretory response to β-cell secretagogues such as glucagon. Type II DM (non-insulin dependent diabetes) is characterized by an abnormal pattern of insulin secretion in combination with peripheral insulin resistance, and results in a stable reregulation of the blood glucose concentration at a higher concentration. This form of diabetes mellitus is most common in cats. The two types of diabetes are classically distinguished by characteristic responses to challenge by insulin secretagogues such as glucose, glucagon, or arginine. In type I DM, there is a decreased or negligible secretion of insulin compared to normal animals, whereas in Type II DM, total insulin secretion may be normal or increased, although the pattern of secretion is abnormal and the amount of insulin is insufficient to prevent hyperglycemia. The phenomenon of glucose toxicity complicates interpretation of glucagon tolerance tests in cats, and the glucagon tolerance test is of little practical utility in clinical practice. Factors that likely influence the need for exogenous insulin in individual diabetic cats include the severity of pancreatic pathology, whether the pancreatic pathology is progressive or static, presence of concurrent disease that results in peripheral insulin resistance, presence of obesity, the carbohydrate content of the diet and the ability to achieve good glycemic control.

Diagnosis

The diagnosis of DM is made based on characteristic clinical signs of diabetes mellitus (polyuria, polydipsia, polyphagia, and weight loss), and documentation of hyperglycemia and glycosuria. In cats, the diagnosis is complicated by stress hyperglycemia. When making a diagnosis of DM in cats, it is therefore important not only to document persistent hyperglycemia and glucosuria, but also to rule out other diseases that may cause similar clinical signs such as hyperthyroidism and gastrointestinal disease. Measurement of fructosamine concentrations or urine glucose concentration of samples collected in the home environment, may allow the clinician to distinguish between stress induced hyperglycemia, and persistent hyperglycemia due to diabetes mellitus. Measurement of fructosamine is unreliable for cats with concurrent hyperthyroidism because increased protein turnover decreases fructosamine concentration. Glucosuria may also occur secondary to ketamine anesthesia, chronic renal failure, and post-obstructive diuresis so is not on its own diagnostic for diabetes mellitus. The presence of significant ketonuria or ketonemia and concurrent hyperglycemia is diagnostic for diabetes mellitus.

Cats are also unique in that DM in this species may go into remission. Up to 70% of diabetic cats have been reported to go into spontaneous clinical remission, with good glycemic control. Unfortunately, the glucagon tolerance test is not useful in predicting whether or not a cat is likely to go into diabetic remission.

Insulin Therapy

Classification of Insulin: It is very important for clinicians prescribing insulin to understand the characteristics of the different products that are commercially available. Insulin may be classified by insulin source, insulin formulation, or duration of action. Insulin formulations that are currently available include short duration regular insulin (designated R), moderate duration NPH insulin (designated N), moderate duration Lente insulin (designated L), and long duration PZI insulin. Insulin may be of either porcine or human recombinant origin and the concentration may be either 100 units/ml (human products) or 40 units/ml (veterinary products). A number of human recombinant insulin analogues are also available.

Insulin Products Used for Long-Term Control of DM in Cats

Intermediate Acting:
NPH Insulin (neutral protamine hagedorn)
Products: (**Humulin N** [Lilly] ,**Novolin N** [NovoNordisk] Both human recombinant 100 U/ml

Lente Insulin (65% crystalline and 35% amorphous)
Product Vetsulin (Merck) pork 40 U/ml

Long Acting:
PZI insulin
Insulin complexed with protamine and zinc.
Product: ProZinc [Boehringer Ingelheim] human recombinant (40 U/ml)

Glargine
Insulin analogue
Product: **Lantus [**Sanofi-Aventis], human recombinant (100 U/ml)

Detemir
Insulin analogue
Product: Levemir [NovoNordisk], human recombinant (100 U/ml)

The three insulin products that are most effective for first line treatment of diabetes mellitus in cats are Protamine zinc insulin, Lente insulin, and Glargine insulin. NPH insulin tends to have a very short duration of action in cats and is not recommended as first line insulin.
The starting dose for insulin in a new feline diabetic patient is 0.25 – 0.5 Unit/kg or 1-3 U/cat. It is recommended that PZI and Glargine insulin are both started at the lower end of this dose. It is difficult to predict in advance which cats will do better with which insulin formulation. Cats should be carefully monitored for occurrence of hypoglycemia, because of the possibility of remission of diabetes mellitus. A blood glucose curve should be performed 7-14 days after making any change in insulin formulation. Whichever formulation is chosen, twice a day insulin therapy is more likely to result in good glycemic control than once a day therapy. If twice a day treatment is not possible once a day therapy with PZI or Glargine can result in effective control of clinical signs in some cats.

Goals of Insulin Treatment:
The primary goal of insulin therapy in diabetic patients is to control clinical signs of DM while avoiding hypoglycemia. Severe hypoglycemia can be life-threatening and even mild insulin- induced hypoglycemia can result in clinical signs of poor glycemic control due to the insulin resistance that results from secretion of anti-insulin hormones such as glucagon, growth hormone, cortisol, and epinephrine. Persistent severe hypoglycemia can lead to permanent neurologic damage. The long-term benefits of tight glycemic control, while well established in human diabetic patients have not been demonstrated in cats; although theoretically better glycemic control should result in fewer diabetic complications such recurrent infection, proteinuria, and cataract formation. The likelihood of diabetic remission is higher with tighter glycemic control however. The goals of diabetic regulation should therefore take into account the lifestyle of the owner, the presence of concurrent illness, the age of the patient, and the practicality of tight glucose monitoring.

Ideally the blood glucose should be maintained between 100 to 200 mg/dl, however most patients will have some blood glucose concentrations that fall outside this range and most patients are clinically well regulated if most of the blood glucose concentrations are less than 300 mg/dl. Occult hypoglycemia is an important cause of poor glycemic control and can lead to unnecessary visits to the emergency clinic. The insulin dose should be decreased if the blood glucose falls below 80 mg/dl on the BG curve. It is important to remember that it is difficult to assess the duration of insulin action if the glucose nadir is in the hypoglycemic range because this can lead to release of counter-regulatory hormones such as glucagon which drives the blood glucose back up prematurely.

Monitoring the Diabetic Patient:
The ideal monitoring strategy should be multimodal and individualized for the patient and owner(s). Parameters that can help in assessing the adequacy of diabetic control include clinical signs, serial blood glucose concentrations measured at home or in the clinic, fructosamine concentrations, glycosylated hemoglobin concentration (HbAIC), and urine glucose concentrations. The presence of ketones in the blood or urine can also be useful to indicate the presence of impending diabetic ketoacidosis. The most important factor in assessing diabetic control is whether clinical signs are well controlled. Blood glucose concentrations, urine glucose concentrations and glycated proteins should be interpreted in the light of the clinical signs. Monitoring should be individualized to meet the needs of the

patient and owner. Although blood glucose curves have been considered to be the gold standard for evaluating glycemic control, they have some serious limitations. Blood glucose curves are affected by stress and there can be marked day to day variability. Blood glucose curves are expensive and require collection of multiple blood samples that can be stressful to the patient even when performed by the owner at home. Misinterpretation of blood glucose curves due to the effects of occult hypoglycemia can lead to incorrect treatment decisions. Newer continuous interstitial glucose monitoring techniques are changing the approach to blood glucose monitoring. These systems allow continuous evaluation of interstitial blood glucose concentration for up to 14 days via a small flexible subcutaneous catheter, replacing the blood glucose curve. The newer systems are affordable, easy to use, and well tolerated by patients. The reports can be downloaded as a pdf and allow an integrated analysis of changes in blood glucose over a 14 day period.

The Freestyle Libre device is the most common CGM used in veterinary medicine. Purchase of the sensor and reader requires a prescription. The sensor is a one-time use disposable device while the reader is a onetime purchase and can be used multiple times with different sensors. The reader allows wireless monitoring of the interstitial glucose. Alternatively, you can download the Freestyle Libre app for Android or iPhone to monitor glucose and download the data to your phone from the sensor, but there are several advantages of using the dedicated reader. The reader and the app can also be used concurrently as long as the reader is initially used to set up the sensor.

Two different devices are available: the Libre 14 day device and the Freestyle Libre 2 device. The Freestyle Libre 14 day is the device most frequently used in cats.

To place the freestyle Libre 14 day sensor you will need a reader, a new sensor, a set of clippers, alcohol swabs, a pair of small hemostats, and a tube of tissue glue. Ideally the sensor should be placed in a location that the pet cannot access to remove or disrupt the sensor. The best site is usually on the dorsal or ventral neck or thorax. The skin needs to be healthy and free of any dermatologic lesions. I recommend clipping a region that is approximately a 4-5cm square, which is slightly larger than the sensor that measures 3.5 cm in diameter. After clipping, the skin should be cleaned with alcohol and allowed to dry. An alternative is to use a bandaging product such as Vetwrap to remove the hair, oil, and dander. Once you have prepared the skin, the sensor should be prepared for placement. The sensor comes in two parts; the sensor applicator and the sensor pack. First check that the product codes of the sensor and applicator are identical. Then peel the lid completely off the sensor pack and unscrew the cap from the sensor applicator. Place the sensor applicator into the open sensor pack and line up the dark mark on the applicator with the mark on the sensor as shown. Place on a hard surface and push down firmly on the applicator until it comes to a complete stop. Remove the loaded applicator from the sensor pack and turn it over. The needle and underside of the sensor disc are visible in the applicator. The needle contains a 5 mm filament. Once the applicator is deployed the needle inserts the filament under the skin and then retracts back into the applicator. The needle *does* not remain in the patient. Before placing the sensor, it is recommended to place a few drops of tissue glue around the underside of the disc to ensure that it stays adhered to the skin. The applicator is now ready to use. Be sure to apply the sensor immediately after applying the tissue glue to prevent the sensor from sticking to the applicator.

To place the sensor, place the loaded applicator on the prepared skin taking care to place it at 90 degrees to the skin. Push down firmly on the applicator and hold for approximately 30 seconds. Then gently remove the applicator from the sensor disc taking care that the sensor disc remains on the skin and does not pull away with the applicator. Sometimes it is necessary to use a pair of hemostats to assist in retracting the applicator.

Once the applicator has been removed, push down firmly on the edges of the sensor to make sure it is completely adhered to the skin. Sometimes it is necessary to add additional tissue glue. Depending upon the patient, the sensor can be left uncovered, or covered by an adherent dressing, a pet sweater, or a thunder shirt. A covering is recommended in active patients or patients with house mates that might attempt to remove the sensor. The reader is able to read the sensor through a jacket or bandage. Although the sensor is waterproof, we do not recommend bathing the pet or allowing the pet to swim while the sensor is in place.

Once the sensor has been placed, switch on the reader and pass the reader over the sensor. When the reader scans the new sensor, it will detect the sensor and a start new sensor box will appear on the reader. After clicking on the start new sensor box, scan the sensor again and the reader will indicate that the sensor can be used in 60 minutes. Sixty minutes later, scan the sensor again and the first glucose reading will be displayed on the screen. Once the sensor and reader are paired together, you cannot use another reader.

The sensor measures the interstitial glucose every minute and stores this data every 15 minutes on the disc. The disc on the patient can store up to 8 hours of data. Every time the sensor is scanned, the data is downloaded onto

the reader. The sensor can be scanned at any time but it needs to be scanned at least once every 8 hours in order to obtain continuous readings. Data from the reader can be uploaded to a computer for viewing as a pdf file any time during the life of the sensor. Complications with both the device and the patient do sometimes occur. Patients can develop erythema at the placement site and occasionally abscesses associated with the insertion site have occurred. Additionally, the device can sometimes fail or fall off early, and of course some patients can remove the device early. Once the sensor has recorded for 14 days it should be removed. Some sensors are easily removed by gently peeling from the skin, but sometimes an adhesive remover solution is required to remove the disc if it is closely adhered to the skin.

The daily and weekly glucose curves that are generated by the Freestyle Libre sensor should be interpreted similarly to blood glucose curves and the duration of insulin action and maximum blood glucose lowering effect (nadir) assessed. The Libreview software also provides a monthly summary with daily average blood glucose concentrations, insights into the glucose pattern over time which can be used to assess the average insulin response and information about how much time the glucose concentration is Very high, High, In target Range, Low or very low.

Glycosylated proteins also allow assessment of longer-term glycemic control and can aid in interpretation of blood glucose curves. Glucose binds irreversibly to serum proteins and hemoglobin and these products persist for the life of the proteins. The resultant products can be measured in serum or whole blood respectively. Fructosamine indicates adequacy of glycemic control over the previous 2-3 weeks, while HbA1C reflects glycemic control for the previous 4-6 weeks.

Urine glucose concentrations can also be used to assess glycemic control and are particularly helpful in cats to assess for the presence of diabetic remission as well as to detect relapse. Urine glucose should not be used to determine the daily dose of insulin but trends in urine glucose can be very helpful in assessing diabetic control especially if assessed on a consistent basis and recorded in a diary or log.

Diabetic Remission
A unique feature of diabetes mellitus in cats is that some diabetic cats become non-insulin dependent after treatment has been initiated. From 15 to 70 % of cats with DM, have been reported to go into spontaneous clinical remission after initiation of insulin treatment. This is termed diabetic remission. Diabetic remission is typically defined as euglycemia that persists for greater than 4 weeks without the use of exogenous insulin. The duration of remission is variable with some cats requiring insulin treatment again within a few weeks to months and other cats remaining in remission for months to years.

Influence of Diet: It has been proposed that low carbohydrate diets increase the chance of diabetic remission in newly diagnosed diabetic cats. A prospective study comparing a low carbohydrate-low fiber diet to a moderate carbohydrate-high fiber diet in 63 diabetic cats showed improvements in glycemic control in both groups, but there was a higher rate of remission of diabetes mellitus in the low carbohydrate-low fiber diet. These findings support the clinical opinion that low carbohydrate diets in conjunction with good glycemic control increase the likelihood of diabetic remission. If diabetic remission occurs in cats it is most commonly in the first few months of treatment.

Influence of Insulin: It has been shown that strict glycemic control is important in achieving diabetic remission and it is clear that diabetic cats can go into remission with any insulin if good glycemic control is achieved. Most cats have better glycemic control with long acting insulin (PZI or Glargine) so most clinicians recommend these insulin formulations as the insulin products of choice in diabetic cats.

Other Factors: Other factors that have been documented to increase the likelihood of diabetic remission in cats include short duration of diabetes mellitus (< 180 days), administration of glucocorticoids prior to diagnosis, low insulin dose required to achieve glycemic control, and lack of polyneuropathy. Age, sex, body weight, presence of renal failure, presence of hyperthyroidism, or presence of obesity at diagnosis have not been shown to influence the likelihood of remission. Serum concentrations of glucose, fructosamine, insulin, glucagon, and insulin growth factor I are not different between cats that do and do not achieve remission, but cats achieving remission have a higher glucagon to insulin ratio.

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Enhancing Compliance and Reducing Stress: A Modern Perspective on Feline Parasite Protection

Robert Lavan, MS, MPVM, DVM, DACVPM

Introduction

Cat owners may not realize that their cats are at risk for parasites like heartworm, fleas or ticks, particularly if the cats are considered "indoor". This presentation reviews several studies with cat owners, conducted during 2018-2021 by the Merck Animal Health (MAH) Center for Observational and Real-World Evidence (CORE). These studies demonstrate:

1. The importance of good communication between the veterinarian, veterinary staff and pet owner around ectoparasite risks;
2. The potential impact of dosage purchase timing on the effectiveness of flea and tick control and
3. Improvement is needed in adherence to veterinary recommendations for flea and tick control.

Satisfaction, Preference and Adherence Studies (SPA)

In 2015, the MAH CORE Team began talking to companion animal owners and veterinarians around the world to understand owners' perceptions regarding parasite, particularly flea and tick, control and prevention. Very often, pet owners thought they needed a shorter duration of protection per year for their dogs and cats compared to the recommendation of their veterinarian (approximately 12 months for fleas and ticks). Around 25% of surveyed cat owners could not recall the veterinary recommendation or thought it was shorter than 12 months. Clinic transaction records were examined to determine how many doses of flea and tick protection were taken home by cat owners in the U.S., U.K. and Australia [1,2]. In the U.S., cat owners annually took home on average 2.8 months of Advantage® II, 3.6 months of Frontline® Gold for Cats and 4.2 months of Bravecto® Topical Solution for cats.

The Importance of Cat Owner Adherence in Protecting the Health of the Cat

Veterinarians help owners to improve the health of their cats and a key action supporting this is prescription of appropriate medications. The cat owner is then responsible for taking the medication home and providing on-time doses for the entire prescription as recommended. Researchers use several methods to monitor pet owner adherence to veterinary recommendations. Unfortunately, owners often fail to follow the prescription guidance. The animal's response to therapy may be interpreted with the assumption that the medication was given as prescribed. However, it is difficult for veterinarians in clinical practice to know exactly when and how medications were given to animals under treatment. An animal's poor response to a medication may be interpreted by the owner as a lack of efficacy or even as an incorrect prescription when in fact the cause was related to incomplete or delayed dosing.

What Factors Influence Cat, Flea, and Tick Medication Efficacy?

Flea and tick medications for companion animals have been available for many years. In 2014, a new class of ectoparasiticides, the isoxazolines, were introduced to provide a novel effective way to kill fleas and ticks on dogs, with introduction for cats in 2015. Most medications in this class are labeled for monthly re-dosing and are given orally to dogs and applied topically to cats. The fluralaner-based ectoparasiticides for dogs and cats in contrast have a label re-dosing interval of up to 12 weeks, under the brand name BRAVECTO®. These extended duration medications are recognized by veterinarians and pet owners for their convenience and ease of use. Additionally, field studies in several countries demonstrate that dog and cat owners, on average, take home more months of flea and tick protection when they are prescribed an extended duration medication compared to a monthly redosed product [3-5]. In addition, a study in the United States in 2000 examined flea and tick medication dose purchase timing [6].

Transaction records demonstrated that:

1. Cat owners in the U.S. purchased far fewer months of protection per year than recommended by their veterinarians;
2. Cat owners prescribed extended duration fluralaner went home with more months, on average, compared to monthly flea and tick products; and
3. M cat owners who purchased two or more doses from the veterinary clinic had large gaps between adjacent purchases. These gaps often meant that a single dose was followed by a multi-week period without flea and tick protection before another dose was obtained. For monthly products, one treatment is inadequate to resolve a flea infestation and a gap will allow the parasites to remultiply. The extended efficacy duration of fluralaner over 12-weeks means that one dose is sufficient to resolve a flea infestation, with an efficacy that is unaffected by gaps between doses.
4. Cat owners recognized that extended duration dosing to protect their cat is less stressful for themselves and their cats because fewer doses need to be administered.

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Digital Cytopathology: Real-time Expert Help in Your Everyday Practice

Eric Morrissette, DVM, DACVP (Clinical)

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Anesthesia, Analgesia, & Surgery

2021 CONFERENCE

Sept. 30 – Oct. 3, 2021
Phoenix Convention Center
Phoenix, AZ & Virtual

SUNDAY, OCTOBER 3, 2021

Schedule is in Mountain Standard Time (same as Pacific Daylight Time over these dates)

TIME	SESSION TITLE	SPEAKER	ROOM	SPONSOR/ PARTNER
6:15 - 7:15 am	Early Riser Yoga Class*		Sheraton Hotel - Paradise Valley	
7:30 - 8:30 am	Breakfast		Exhibit Hall	
8:30 - 9:20 am	Detecting, Diagnosing, & Monitoring Feline OA Pain: A Practical Approach LS	Dr. Duncan Lascelles	North Ballroom A - D	ZOETIS PETCARE EveryCAT
9:25 - 10:15 am	NSAIDs for Chronic Pain Control in Cats: An Update LS	Dr. Duncan Lascelles	North Ballroom A - D	ZOETIS PETCARE IVAPM
10:15 - 10:45 am	Networking Refreshment Break		Exhibit Hall	
10:45 - 11:35 am	How to Perform a Successful Orthopedic Examination LS	Dr. Duncan Lascelles	North Ballroom AB	ZOETIS PETCARE IVAPM
	Perineal Urethrostomy & Other Options in Cats with FUS LS	Dr. Bryden Stanley	North Ballroom CD	
11:40 - 12:30 pm	Anti-NGF mAbs for Chronic Pain Control: The Science LS	Dr. Duncan Lascelles	North Ballroom AB	ZOETIS PETCARE IVAPM
	Revisiting Halsted's Principles (But Not His Habits!): Tips to Better Surgery LS	Dr. Bryden Stanley	North Ballroom CD	
12:30 - 1:45 pm	Lunch		Exhibit Hall	
12:40 - 1:40 pm	*Lunch & Learn #1:** Update on the Management of Stress Associated Illness in Cats	Dr. Michael Lappin	121A-C	Purina Pro Plan Veterinary Diets
12:40 - 1:40 pm	*Lunch & Learn #2:** Procedural Sedation & Analgesia in the Cat	Dr. Brad Simon	122A-C	Dechra
12:40 - 1:40 pm	*Lunch & Learn #3:** Stem Cell Therapy in the Domestic & Exotic Feline: Could This be the Answer to Your Difficult Cases?	Dr. Robert Harman	124AB	VetStem Biopharma
1:45 - 2:35 pm	Anti-NGF mAbs for Chronic Pain Control: The Evidence LS	Dr. Duncan Lascelles	North Ballroom AB	ZOETIS PETCARE IVAPM
	Chylothorax: An Update LS	Dr. Bryden Stanley	North Ballroom CD	
2:40 - 3:30 pm	Wearables for Diagnosis & Monitoring of Pain: Where Are We? LS	Dr. Duncan Lascelles	North Ballroom AB	ZOETIS PETCARE IVAPM
	Atypical Cutaneous Infections in Cats LS	Dr. Bryden Stanley	North Ballroom CD	
3:30 pm	End of Meeting			

*Separate Registration Required. No fees associated.

LS Live Streamed

Detecting, Diagnosing, & Monitoring Feline OA Pain: A Practical Approach
Duncan Lascelles, BSc, BVSc, PhD, FRCVS, CVA, DSAS(ST), DECVS, DACVS

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NSAIDs for Chronic Pain Control in Cats: An Update
Duncan Lascelles, BSc, BVSc, PhD, FRCVS, CVA, DSAS(ST), DECVS, DACVS

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How to Perform a Successful Orthopedic Examination
Duncan Lascelles, BSc, BVSc, PhD, FRCVS, CVA, DSAS(ST), DECVS, DACVS

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Anti-NGF mAbs for Chronic Pain Control: The Science
Duncan Lascelles, BSc, BVSc, PhD, FRCVS, CVA, DSAS(ST), DECVS, DACVS

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Anti-NGF mAbs for Chronic Pain Control: The Evidence
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Wearables for Diagnosis & Monitoring of Pain: Where Are We?
Duncan Lascelles, BSc, BVSc, PhD, FRCVS, CVA, DSAS(ST), DECVS, DACVS

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Perineal Urethrostomy & Other Options in Cats with FUS

Bryden Stanley, BVMS, MVetSc, MANZCVS, MRCVS, DACVS

Introduction

The technique of feline perineal urethrostomy (PU) is an effective way of reducing signs of urethral obstruction in many cases of feline lower urinary tract disease (FLUTD). It is critical that the urethral obstruction component of the condition be accurately diagnosed, and not confused with conditions of similar presentation such as feline idiopathic cystitis or feline encrusting cystitis. Urethral or bladder neoplasia, or masses arising from adjacent pelvic structures can also cause signs of obstruction. Long-term surgical outcomes following PU will not be as favorable for such conditions, although presenting clinical signs may be similar.

PUs were commonly performed in the 70s and 80s due to the high incidence of struvite urolithiasis.[1-3] Significant work was undertaken to evaluate the effect of the surgery on the urethral sphincter function, concluding that the effects are not clinically significant in the long-term. This resulted in validation of both blunt and sharp dissection techniques to preserve urethral function over the years.[4-7] The increased incidence of recurrent bacterial urinary tract infections following PU was also investigated, and concluded that the 20% prevalence was likely due to the underlying uropathy, rather than the PU procedure itself, and over 88% of clients think their cats have a good quality of life post-operatively.[8,9] As dietary formulations were improved and cats were less prone to struvite formation, the need for the procedure declined and very little surgical literature addressing FLUTD was published in the 1990s. However, in recent years, with the increasing incidence of calcium oxalate urolithiasis, PUs have once again become a commonplace surgical intervention. It can also be performed for other reasons such as distal penile cicatrix formation, distal urethral neoplasia, polyps or trauma.

The PU procedure consists of resecting the penile portion of the feline urethra, which has an extremely small lumen, and creating a permanent ostomy from the wider pelvic urethra to the skin. The stoma is created at the level of the caudal ischium, in the perineal skin ventral to the anus, hence the term perineal urethrostomy. Because the pelvic urethra is so much wider than the penile urethra, a well-developed urethrostomy gives the cat a wider and shorter urethra, far less prone to obstruction from calculi or urinary grit.

When performed correctly and for the right indication, PU has an excellent prognosis for resolution of clinical signs. Cats are at higher risk of urinary tract infections, but as discussed previously, this is due to the underlying urinary tract pathology rather than attributable to the PU technique. Normal cats undergoing PU do not have increased risk of cystitis.[9] Despite early studies showing some decrease in urethral pressure profilometry,[4,5] and veterinary urban mythology, permanent urinary incontinence from PU has not been reported (as far as the author is aware). Complications that have been reported include stricture formation at the stoma site (most commonly), bruising due to extravasation of urine, hemorrhage and wound dehiscence. Most of these complications can be avoided by meticulous technique and accurate apposition of tissues (two of Halsted's Principles!). The three most critical aims to ensure a successful outcome in a PU are to ensure that:

1) the urethra is well mobilized,
2) the stoma is located in the (wide) pelvic urethra, and
3) accurate apposition of mucosa to skin is obtained.

The actual PU procedure is well described in most textbooks. The following suggestions and counsel arise from the author's experience over the last 30 years with this procedure, recommendations of others and wisdom gleaned from complications.[10,11]

Positioning

Perineal urethrostomy has traditionally been performed with the cat in a modified Kraske position - sternal recumbency with perineum slightly elevated and the pelvic limbs hanging over the end of the table and the tail pulled craniodorsally. The tail should not have too much traction placed upon it and the inguinal area should be well padded. The operating table may be tilted to elevate the hindquarters - taking care not to compromise respiratory function. A purse string suture placed in the anus, and appropriate signage (to ensure removal of the purse-string) placed on animal.

More recently, the procedure has been performed by some surgeons in dorsal recumbency with the pelvic limbs pulled cranially, thus elevating the perineum so that it points upwards. The preference of positioning at this time is largely decided by the individual surgeon, although there is some evidence to suggest that dorsal recumbency may be less compromising to the spinal canal.[12] Consider performing a pudendal nerve block.[13] Place a urethral catheter if possible, but do not damage the urethral mucosa.

Magnification
Even if you are a young, fabulous surgeon with perfect vision, use binocular loupes, usually 2.5x. Trust us on this one – your accuracy in placement of appositional sutures will be superior with magnification.

Ventral Ligament and Ischiocavernosus Muscles - Transect
Always visually identify these structures and sharply dissect them from their ischial origins. The ventral ligament and both ischiocavernosus muscles should be completely transected with scissors or judicious electrocautery close to the ischium, leaving the bulk of the tissue with the urethra. Complete transection is required to adequately mobilize the urethra. Leaving most of the ischiocavernosus muscles with the urethra provides good landmarks and support for later tension-relieving suture placement.

Mobilize the Urethra
Ensure that the urethra is completely free from its ischial and pelvic attachments. This is often a step where less experienced surgeons can be somewhat tentative. To completely release the urethra, bluntly dissect with a firm finger to a depth of 4-5 cm into the pelvic canal, for 360 degrees. It has been shown and it is the author's experience that neither sharp nor blunt intrapelvic dissection significantly alters the urodynamic function.[7] Mobilization is adequate once the bulbourethral glands sit at the level of the skin, without any traction being place on them.

Use the Retractor Peni Muscle as an Orientation Guide
Keep the retractor peni muscle on the urethra at this stage as a landmark to locate the dorsal aspect of the urethra as it is mobilized. Once the bulbourethral glands are identified, the retractor peni muscle can be resected.

Use Fine Tenotomy Scissors and Stay on Dorsal Midline
The lumen is located (this is when a catheter helps!) and a #11 blade then tenotomy scissors are used to very carefully incise the dorsal midline of the urethra. The urethra is slowly incised proximally until the level of the bulbourethral glands. Some cats do not have large or obvious bulbourethral glands, but because you have the bulk of the ischiocavernosus muscles, they can be used as a guide and they are located at a similar position. The tips of a pair of mosquito forceps can be carefully introduced to the level of box hinge, as confirmation that the wider pelvic urethra is present. Transect the urethra just proximal to the penis itself, still leaving about 1.5 cm of penile urethra as a drainage board. Leaving any longer portion can result in mucosal necrosis.

Tension-relieving Sutures
Place a of 4-0 PDS through each bulbourethral gland/ischiocavernosus and secure it to the hypodermis at the 10 and 2 o'clock positions. This relieves tension on the primary mucosa-to-skin suture line, as well as providing stability to the PU as you begin to suture. A continuous suture of 5-0 is started on either side, starting at the dorsal aspect. It is critical to identify and include the urethral mucosa, as the splayed bulbospongiosus can be confused for mucosa. This is why loupes are so good here. The penile urethra is transected about 1.5 – 2.0 cm from the stoma (a mattress suture will prevent any hemorrhage from the corpus), and suturing is continued until both sides meet at the ventral aspect. This provides an elongated area of mucosa distal to the stoma, which can act as a drainage board. Two or three interrupted sutures can be placed to close the dorsal aspect of the stoma.

Damaged Mucosa and Poor Dorsal Apposition.
Sometimes the urethral mucosa is damaged from repeated catheterization attempts and reblockage events. I call this "trashed mucosa syndrome". A damaged urethral mucosa can be difficult to identify and suture accurately, and thus there is a higher chance of subsequent dehiscence and stricture. If you suspect a "trashed" mucosa, try to delay the surgery for 5 days while cat has a catheter in place. If you come across damaged urothelium in surgery, or it has split longitudinally into the pelvis, place sutures down the sides as much as possible. Often the dorsal 2-3 sutures will not hold or will be impossible to place. These cases need to have a 6Fr Foley silastic catheter left in place for about 5 days. This will prevent extravasation of urine and the extreme discoloration and discomfort associated with urine leakage. The mucosa heals rapidly and the catheter can typically be removed in about 5 days.

PU Revisions
Most referral institutions see a fair number of failed PUs, mostly strictured stoma sites. In nearly all of these cases, either inadequate initial mobilization was performed or the mucosa was not identified and sutured accurately.[10] Revising these PUs is similar to performing an initial PU, ensuring that the urethra is adequately mobilized, the stoma is created in the pelvic urethra, and the mucosa is accurately apposed to the skin.

Transischial Urethrostomy
In rare cases, there truly is not adequate length of pelvic urethra available at the level of the caudal ischium. We have seen this in several cases of severe scarring, in perineal trauma cases and in some revisions of PUs. For these

cases, the described transischial approach by Bernarde and Viguier is recommended and we have had excellent results with this technique.[14] It appears to have superior outcomes to the prepubic urethrostomy.

The cat is placed in dorsal recumbency with the pelvic limbs pulled gently cranially. A ventral midline approach to the ischium is made. The caudal 1.5 cm of the ischium is removed with a high speed burr or rongeurs, and the periurethral tissues dissected away. The catheterized pelvic urethra is mobilized quite easily and gently mobilized ventrally through the ostectomy. A longitudinal incision is made in the ventral aspect of the pelvic urethra and the urethra mucosa is accurately sutured to the skin. This technique takes a little longer than a standard PU, but provides consistently good results compared to prepubic urethrostomies. We have seen no urine scalding or incontinence in our limited cases.

Key Points

- Perineal urethrostomy (PU) in cats has once more become a commonly performed procedure.
- When performed correctly and meticulously, outcomes are typically excellent, with full continence.
- The increased incidence of urinary tract infections seen following PU is likely not due to the procedure, but rather the underlying uropathy.
- Several suggestions and recommendations arising from experience and the literature are discussed to optimize outcomes when performing PUs, including some alternative techniques.

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Revisiting Halsted's Principles (But Not His Habits!): Tips to Better Surgery

Bryden Stanley, BVMS, MVetSc, MANZCVS, MRCVS, DACVS

Introduction

Following graduation, we climb a steep learning curve as we adjust to the demanding lifestyle of the practicing veterinarian. It is often a few years before we feel at ease with our career. Without doubt, mistakes will be made, and there will be stressful times. However, we strive to learn from our mistakes, and certainly try not to make the same mistake twice! As our career specializes into a specific discipline or interest (such as surgery!), and our experience grows, we develop a personal set of standards and protocols. Here is list of guidelines and tips will minimize complications, maximize clinical competence and enhance confidence in the surgical arena.

Tip 1. Halsted's Principles

Since William Stuart Halsted first espoused his principles at the turn of last century, surgeons around the world have adopted them as guidelines to surgical technique. Over a century later, these principles are still relevant and form the basis of modern surgical craftsmanship:

(i) Strict aseptic technique

Louis Pasteur (and others) elaborated his Germ Theory in the late 1870s, and Joseph Lister subsequently developed his most successful antiseptic techniques. This paved the way for the development of modern aseptic technique early last century. There are now established protocols for preparing the patient, surgical site, operating room, instrumentation, implants, and the surgeon. This has led to marked reduction in infection rates in all surgical procedures, especially those classed as 'clean' and 'clean-contaminated'. It is easy to forget how far we have come since the late 1800s and we often become lazy in upholding aseptic principles. The indiscriminate use of antibiotics in human surgical wards has been shown to adversely affect the post-operative infection rate.

(ii) Gentle tissue handling

Any tissue that is being left in the body should be handled as atraumatically as possible. The use of atraumatic forceps (such as Debakeys), stay sutures and skin hooks are recommended. Tissues should always be kept moistened and warm, and if not part of the surgical procedure, they can be packed off to avoid unnecessary exposure to the intense surgical lights or any potential contamination.

(iii) Hemostasis and fine suture material

Halsted originally ruled meticulous hemostasis and used hundreds of hemostats in surgery; we have evolved an approach where we strive for control of hemorrhage such that we have a clear surgical field. Small bleeders will often not require ligation unless they are persistent. Today, there are a number of ways to achieve hemostasis - pressure (two minutes), hemostats, ligation, electrocautery, laser, ultrasonic scalpel. Remember to be as atraumatic as possible, limiting use of electrocautery to just the vessel, not surrounding tissue. Char should be removed following laser dissections. Fine suture material tied with short ends should be used for ligating vessels, to limit the amount of foreign material left behind in the wound. A transfixation suture should be used for larger arteries.

(iv) Sharp anatomic dissection of tissues and preservation of blood supply

Tissues that need to be traversed should be dissected out along natural anatomic planes when possible, as long as this does not compromise margins for any tumor resection. Any structure that is to be left in the body must have an adequate arterial supply and venous drainage.

(v) Accurate apposition of tissue layers

As the surgeon is closing the wound, tissue planes should be accurately and anatomically reduced. Careful identification of structures, and confirming orientation should be performed at this time. Several layers of secure closure will limit post-operative seroma formation as well as reducing tension on the final cutaneous suture line. Only as much suture as necessary should be used.

(vi) Obliteration of dead space

Any defect that is left behind in a closed wound can fill with serum or blood, delay healing and act as ideal media for bacterial growth. Dead space can be obliterated by suturing, bandaging or providing drainage. Active closed suction drainage is generally preferred to passive drainage systems.

(vii) Minimal tension

Tension is the enemy of healing. No wound should be closed with such tension that it would lead to ischemia, subsequent necrosis of the tissues and suture cut-out. If tension precludes a direct appositional closure, then a tension-relieving technique, skin flap or other reconstructive procedure should be employed.

Tip 2. Knowledge
Ironically, it is only following graduation from veterinary school that one realizes precisely how relevant those years were. For the surgeon, the study of anatomy, physiology, and pathology are particularly important. All veterinary surgeons should have an anatomy text, including topographical illustrative texts as well. Many surgical procedures have a limited exposure to the area (e.g., larynx, liver, ischiorectal fossa) and it is critical to know what is beyond the visible surgical field. It is highly recommended to perform anatomic cadaver dissections for various structures such as: the larynx, middle ear, trachea, thoracic inlet, liver and extrahepatic biliary tree, ischiorectal fossa, and various joints and vertebrae. Cadavers are also useful for practicing a specific procedure before performing it for the first time on a client's much-loved companion. Always understand the function of any structure you will be removing or modifying in the body, e.g., the six functions of the spleen, what the omentum does, whether a cat needs its ileocolic valve, how much small intestines can be resected before signs of short bowel syndrome are manifest.

Tip 3. Instrumentation and Equipment
It is so important to have the right instrumentation in surgery - tools that will facilitate the procedure as well as improve the quality and outcome of the surgery. Spending time researching instrumentation and spending money on quality is well worth the investment. Having ready access to retractors, fine tissue forceps, different suction tips, and a variety of scissor types make surgery much easier and more fun. It is also worth having a large instrument tray so that your instruments can be laid out in a routine fashion – and one should learn to replace instruments down carefully and systematically. A Mayo stand is suitable for many procedures, but a large, mobile back table is required for involved procedures.
Other necessary equipment includes adequate lighting for surgery. Two dedicated surgery lights with variable intensity settings are most helpful. Double articulated satellites are easy to position, and the ability to focus the beam is also useful.
Fine surgical procedures, such as ureteral or neurosurgical procedures, or procedures performed on small animals (less than 1kg) should be performed with magnification. Magnification can be provided with binocular loupes, which come in several magnifications and fitting options. Magnification can also be provided with the operating microscope.
Although not strictly equipment, the value of a trained assistant is immense, and should not be underestimated. When contemplating a complicated procedure, consider calling in a competent assistant to assist. Likewise, a trained nurse or animal health technician, who knows where things are and what they are called, will allow the surgeon to concentrate on the procedure with minimum distraction.

Tip 4. Plan (and Alternate Plan)
Never go into a surgery without a plan of what you are going to do. In fact, try to have an alternate plan or two, in case things don't go according to the original plan. This is especially relevant in reconstructive surgery. Be prepared for things that are likely to go wrong, and have an idea of what you may do to address this.

Tip 5. Positioning
It is well worth spending some time precisely positioning the patient for surgery, even for routine abdominal exploration. Ensuring that the larynx is elevated for a lateral laryngeal approach, that the neck is well extended for a ventral tracheal or laryngeal surgery, the ear canal at a good angle for approaching the lateral wall of the tympanic bulla, the perineum is sufficiently elevated for a perineal urethrostomy procedure, the maxilla is hung at the right level to allow illumination and comfort – these are just a few examples of how correct positioning can greatly help the surgeon. Remember that cats cannot have their jaw held open for prolonged periods in surgery. For some extensive reconstructive techniques, the patient may require repositioning during the surgery, so think ahead with extra drapes and towel clamps. It is also beneficial for the surgeon to familiarize him/herself with different positions. Learn to operate on both sides of the patient.

Tip 6. Attitude
Cultivate an approach to surgery that is calm and controlled, meticulous and planned. As you are scrubbing, think about the surgery ahead. Go through the patient's details in your mind and run through the planned procedure, step by step. Imagine different scenarios that could happen and ensure that you have a prepared reaction. In surgery, there is an advantage to being a perfectionist, almost to the point of being an anal retentive, but not to the point of being paranoid or obsessed. Don't lose your temper; always stay calm and controlled, as this will facilitate clarity of thought and enable you to take a wisely considered action.

Tip 7. Time & Trouble
It is stressful to start a two-hour procedure when there is only one hour until evening consultations. Give yourself enough time to do a procedure (I try to never start a major procedure after 4pm, otherwise I won't be home until 9pm). Feeling pressured to hurry during a procedure will surely impact negatively on one's surgical technique. This is when mistakes will be made, something will go wrong and tempers will flare. One should have plenty of time to

complete the procedure - although it is important not to dawdle! Every move you make should get you towards the end of a procedure, but not at the expense of making a mistake.
If you find yourself in trouble in surgery, there are a few things you should do. First of all, don't look away from the surgical site if you can help it. Take a deep breath, mentally step back, and evaluate the situation. There is nearly always time for a minute of reflection. If you lose your temper, or panic, things will only spiral downwards. Stay in control of yourself and your motor skills, and have confidence in yourself. Get an assistant scrubbed in. And never, *ever*, throw instruments.

Tip 8. The Medical Record
Any procedure you perform needs to be documented. For surgical procedures, a detailed surgery report should be written, noting material used, procedures performed, implants placed, tissues taken and any intraoperative complications. Drugs used and measurements taken under anesthesia should be recorded. Any measurement, examination finding, or any change in the clinical condition of a patient should be noted, dated and signed. Any communication with the owner (or other people involved in the case management) should be recorded and the date and time entered. The medical record is a legal document and can be used in a court of law. It is imperative that you document your actions, not only because it is a lasting history of patient care, but it is also protection of your professional actions.

Tip 9. Biopsy
Many conditions remain undiagnosed or inappropriately resected due to the lack of histopathological examination. Many times this is due to an unwillingness of the owner to spend money on something that is not immediately therapeutic. Not only is it worthwhile to spend the money, it is often critical to the ultimate success of the case. It is also worth the effort to get to know your local pathology laboratory, and befriend the pathologist. Find out what samples they would prefer to provide you with the best feedback, e.g., the edge of a lesion, several areas of a lesion, what size of liver biopsy? Cultivate a working friendship with the laboratory, so that you feel that you can always call and speak to the pathologist. Remember to provide them with all the relevant history and an accurate description of the lesion you are sampling. This will be of benefit to them, you, the client, and ultimately the patient. Under this tip, it is also worth mentioning other diagnostic tools that one can consider, especially if things don't look typical. Cultures (aerobic, anaerobic, fungal, mycobacterial), imaging techniques, screening tests for underlying medical conditions should be considered. Never forget the value of a thorough workup.

Tip 10. Communication
Everything in life depends on communication. Many incidents of litigation in the veterinary field are due to inadequate interaction between veterinarian and owner. We need to be able to extract the relevant history from a client, in a chronological order. We also need to make sure the owner is fully informed as to the differential diagnoses, the diagnostic plan and inherent costs involved. The owner has the right to an accurate prognosis, which is neither overly optimistic nor pessimistic. It is only once all cards are on the table that the owner and the veterinarian can rationally discuss the course of diagnostics and therapy that will be chosen for the patient.

This list of tips is an attempt to impart an overall philosophy to surgery - a way of helping one to avoid making mistakes that have been made before (often by me). It is hoped that with recognition and acceptance of some of this information, confidence and clinical competence will improve, and outcomes will benefit as a result.

Recommended Reading

Genius on the Edge: The Bizarre Double Life of Dr. William Stewart Halsted
By Gerald Imber
ISBN-13: 978-1607146278
ISBN-10: 1607146274

The Butchering Art: Joseph Lister's Quest to Transform the Grisly World of Victorian Medicine
By Lindsey Fitzharris
ISBN-13: 978-0374537968
ISBN-10: **0374537968**

Harvey Cushing: A Life in Surgery
By Michael Bliss
ISBN-13: 978-0195329612
ISBN-10: 0195329619

NOTES:

Chylothorax: An Update

Bryden Stanley, BVMS, MVetSc, MANZCVS, MRCVS, DACVS

Anatomy of the Lymphatic Vascular System

The lymphatic system consists of a tissue component and a vascular component. The tissue portion plays a major role in immune defense mechanisms, whilst the vascular component of the lymphatic system really acts as an auxiliary to the venous part of the vascular system. The vascular component includes lymph capillaries, larger vessels and lymph transporting ducts. As blood flows through capillary beds, significant amounts of fluid and proteins (up to 50% of the total circulating protein) escape into the interstitial compartment. This fluid (generally clear and colorless) readily enters the lymphatic capillaries and returns slowly via the afferent lymphatic ducts to the lymph nodes, then via the efferent lymphatic ducts and eventually the systemic venous system. Lymph typically contains proteins and cells (polymorphonuclear cells, mononuclear cells and red blood cells), but lymph from each region of the body has a characteristic composition. Lymphatic villi in the intestines absorb emulsified fat and thus the lymphatic vessels (called lacteals) appear milky or “chylous”. Small lymphaticovenous communications have been demonstrated to nearly all the veins of the body, especially in the renal area, but there is a major collecting system (the cisterna chyli) just dorsal to the aorta in the lumbar region, through which caudal lymphatic fluid and chyle accumulates, before travelling cranially through the thoracic duct before returning to the systemic venous system. The small lymphatic capillaries are simple, transparent endothelial tubes, but the larger lymphatic vessels are surrounded by poorly organized smooth muscle and a thin fibrous adventitia. Upon gross inspection however, even the larger vessels appear incredibly thin and difficult to identify. Flow of lymph depends mainly upon movement of adjacent muscles, although some weak intrinsic contractions have been noted. Large lymphatic vessels contain valves, and when obstructed, lacteals can show a ‘string of beads’ appearance.

Lymphatic drainage of the thoracic limbs and head and neck is via the lymph nodes to the right and left tracheal trunks. The right tracheal trunk usually terminates into the venous junction of the external jugular and the right subclavian. The left tracheal trunk usually terminates into the thoracic duct.

Lymphatic drainage of the pelvic limbs (via the iliac lymph nodes) and the abdominal viscera (via the mesenteric lymph nodes) is to the cisterna chyli. The cisterna chyli is a bipartite structure that lies immediately dorsal to and closely associated with the abdominal aorta. The part that lies ventral to the aorta is plexiform, and extends from the caudal pole of the left kidney to cranial mesenteric artery. It communicates via are variable network of connections to the more cranial part that lies dorsal to the aorta. This part is saccular, and extends from the left renal hilus to the celiac artery – but can be quite erratic in location, and sometimes even extends through the aortic hiatus of the diaphragm before it narrows into the thoracic duct. The thoracic duct is the main channel for the return of lymph from the caudal body and abdominal viscera; it is the cranial continuation of the cisterna chyli. Its exact point of origin is variable, depending on the rather erratic location of the cisterna chyli. It seems to begin mostly as a single duct, but can then become quite plexiform in nature - most notably in the caudal thorax. It is closely associated with the left (cats) or right (dogs) dorsal aspect of the thoracic aorta until the level of the sixth thoracic vertebra, where it traverses to the left side, running cranioventrally to terminate in the junction of the left external jugular vein and the cranial vena cava. When a major duct such as the thoracic duct is ligated, the lymphatic system opens up lymphaticovenous anastomoses upstream to the obstruction.

Etiologies of Chylothorax

Chylothorax is defined as the accumulation of chyle within the pleural cavity. It does not occur commonly, but is seen on a regular basis in referral institutions in both cats and dogs, and can be devastating for both pet and owner. Reported etiologies for free chyle collecting in the thorax include right-sided cardiac failure (cardiomyopathy, congenital anomalies), pericardial disease, diaphragmatic malformation, diaphragmatic hernia, mediastinal neoplasia (lymphoma, thymoma, heart based masses), granulomas, lymphangiectasia, lung lobe torsion, jugular venous thrombosis, dirofilariasis, blastomycosis, and traumatic or iatrogenic rupture of the thoracic duct. Generally when the thoracic duct has been lacerated (trauma or surgery) the resulting chylothorax tends to resolve with a thoracic drainage catheter for several days, as the duct heals rapidly.[1-8]

Although it is critical to rule out the etiologies previously mentioned, in many presentations no specific underlying cause is identified and the condition is termed “idiopathic”. Very little is known about the underlying pathology of “idiopathic” chylothorax. It is suspected that some type of mediastinal lymphangiectasia causes a lymphatic obstruction, possibly associated with a transmural insufficiency that allows chyle to leak through the thin endothelial walls of the thoracic duct. Idiopathic chylothorax in cats may have a predisposition in purebreds, especially Oriental breeds. Cats tend to develop fibrosing pleuritis more readily than dogs with chylothorax, although with chronicity the

pleurae become thickened in all animals. (Breeds of dogs reported to be predisposed are Afghan hounds, Borzois, Salukis, and Mastiffs. However, it can be seen in any breed or mixed breed).

Diagnosis of Idiopathic Chylothorax
Clinical signs of pleural effusion include increased respiratory rate (sometimes with abdominal effort), restrictive breathing pattern, lethargy, inappetance, exercise intolerance, coughing (especially common in cats) and occasionally vomiting.[5] Physical examination typically reveals muffled heart sounds, decreased lung sounds ventrally and increased dorsally, and occasionally cyanosis (depending on severity). There is a lack of resonance upon thoracic percussion. Weight loss occurs with chronicity.[1,5]

Differential diagnosis of any pleural effusion includes hydrothorax, hemothorax, pyothorax and chylothorax. A thorough work up (which is largely to rule out an underlying cause) includes complete blood count, serum biochemistry, heartworm test, thoracic and abdominal radiography, abdominal ultrasonography, echocardiography, pleural fluid cytology and analysis, pleural fluid culture. **Thoracocentesis** is required to obtain pleural fluid sample for definitive diagnosis and will often provide relief of respiratory distress if a significant volume of fluid is removed. The technique is typically performed initially through the right 5th intercostal space, with the animal in sternal recumbency, using a butterfly needle, extension tubing and a 3-way stopcock. Aseptic technique is indicated. To eliminate the trauma associated with repeated thoracocenteses, a MILA thoracic drainage catheter can be placed under a short anesthesia using the Seldinger technique.

Chyle is classed as a modified transudate (protein > 2.5 g/dL, cell count 6,000-7,000), with predominant cell types lymphocytes and non-degenerate neutrophils. With chronicity, more macrophages can be present. The fluid has a characteristic milky white or milky pink appearance to it and special staining will reveal the presence of chylomicrons. Definitive confirmation of chyle, however, is obtained by demonstrating significantly increased fluid triglyceride concentration compared to the serum levels. Thoracic CT will provide a more thorough assessment of intrathoracic structures and is typically performed with a CT lymphangiogram before definitive surgical intervention is undertaken.

Management Options
Idiopathic chylothorax can be extremely challenging to manage successfully. Failure to resolve the pleural effusion is frustrating to client and clinician, and potentially devastating to the animal. Over the years several numerous medical and surgical interventions have been employed, with varying degrees of success. Medical management consists of dietary modification (to decrease fat absorption into the lymphatic system), and pharmaceutical intervention (to decrease chyle volume and thoracic duct flow) such as rutin or octreotide.[9-11] Corticosteroids and diuretics have also been used. During medical management protocols, the thorax must be repeatedly drained to maintain comfort, which until recently has carried increased morbidity. The placement of a pleural port to provide low morbidity repeated drainage events will greatly facilitate management (see below).

Idiopathic chylothorax is often refractory to medical management, and major surgical intervention is frequently required. The goals of surgical interventions are to divert the flow of chyle away from the thoracic duct system, drain pleural accumulation of chyle, and/or facilitate flow into the systemic venous system through pressure changes. Many different procedures have been described including passive or active pleuroperitoneal shunting, pleurovenous shunting, pleurodesis, thoracic omentalization, cyanoacrylate instillation, pericardectomy, thoracic duct ligation and cisterna chyli ablation.[12-15]

Core Procedure:
Although the most effective choice of surgical intervention has yet to be definitively validated, individual or en bloc ligation of the thoracic duct and all identifiable collaterals has been at the core of surgical treatment. Thoracic duct ligation is typically performed through a left caudal intercostal approach in the cat (and a right caudal intercostal approach in the dog). Complete resolution of chylothorax with thoracic duct ligation *alone* is reported in ~ 60% of cases, even when pre- and post-ligation lymphangiography and vital staining (using methylene blue) is performed to identify anatomic variations of the thoracic duct network. In a low percentage of animals, a non-chylous effusion can continue.

Adjunctive Procedures:
Over the past decade, several adjunctive surgical procedures to thoracic duct ligation have been reported that appear to result in overall improved outcomes. These include cisterna chyli ablation and pericardectomy. These are usually done in addition to thoracic duct ligation. The aim of cisterna chyli ablation is to destroy the cisterna chyli (the collecting reservoir into which the intestinal lymphatics drain, and from which chyle drains into the thoracic duct) which completely disrupts the flow of chyle into the thoracic duct. The aim of pericardectomy is to decrease right-sided venous pressure, thus facilitating drainage of the chyle into the venous system. When either of these techniques is performed concurrently with thoracic duct ligation, success rates for resolution of chylothorax increase

in dogs; this is likely similar for cats.[16] Recent comparison of outcomes after various combination of these procedures suggest that thoracic duct ligation + cisterna chyli ablation will have a superior outcome compared to thoracic duct ligation + pericardectomy. Many surgeons will undertake all these procedures (i.e., thoracic duct ligation, cisterna chyli ablation and pericardectomy) in an effort to optimize outcome for their patients. There is some evidence to suggest that in cats, cisterna chyli ablation has no added benefit.[12]

Minimizing Operative Morbidity:
Each of the previously mentioned procedures has been described with separate approaches - a left 9th or 10th intercostal thoracotomy for thoracic duct ligation (right in dogs), followed by median celiotomy for cisterna chyli ablation, and a 5th intercostal thoracotomy for the pericardectomy. That is a lot of surgery! Procedural modifications have now been developed which decrease operative time and patient morbidity, without compromising outcome. Such modifications include:

- Endoscopic approaches (either transdiaphragmatic through the abdomen or thoracoscopic).[17]
- A single, paracostal approach to provide simultaneous access to both the cisterna chyli and the thoracic duct.[18]

These techniques appear to substantially decrease postoperative discomfort and hospitalization time. In the paracostal approach, the patient is positioned in lateral recumbency with the thoracolumbar region elevated by a rolled towel bolster. A dorsal, paracostal approach allows access to the dorsocranial abdomen and retroperitoneum – where the cisterna chyli is located. From this approach, the diaphragm can be retracted caudally, then incised parallel to its costal attachment. By placing stay sutures into the pars costalis, the diaphragm can be manipulated to expose the caudal thorax and retropleural space – and the thoracic duct. Also from this single approach, the mesenteric lymphatics (either lymph node or vessel) can be accessed to introduce dye to highlight the cisterna chyli and thoracic duct. This vital staining is essential before undertaking any dissection near the thoracic and abdominal aorta, as the nearly invisible thoracic duct and cisterna chyli are closely associated with the aorta. Once the cisterna chyli and thoracic duct are identified by their blue coloration from the vital staining, careful dissection around the thoracic duct can be performed, and the duct and any collaterals can be ligated or hemoclipped close to the diaphragm. At this stage, the cisterna chyli tends to plump up and tcan be more clearly exposed with careful dissection, before its destruction by tearing it gently away from the underlying aorta. Closure of the diaphragm and abdomen is routine. The paracostal approach, with its low morbidity, can be performed bilaterally under one anesthesia, or staged if chylous effusion persists due to the presence of a right-sided thoracic duct collateral. Pericardectomy is usually performed through a right 5th intercostal thoracotomy or thoracoscopically. It appears better to remove all the pericardium ventral to the phrenic nerves.

Pleural Port Placement:
Another technique that has decreased the morbidity associated with repeated thoracic drainage is the placement of a subcutaneous pleural port, leading to a fluted or fenestrated thoracic catheter.[13] Placement of this device eliminates the need for a post-operative thoracic drain, and allows for early discharge from critical care into the home. Drainage is then accomplished by the transcutaneous insertion of a 19 gauge Huber needle into the port, and 3-way stopcock. Chylous effusion can sometimes persist for up to a month in some cases of chylothorax, before finally resolving (continued leakage through the aortic hiatus?), so the ability to repeatedly drain the pleural cavity with virtually no discomfort to the animal is most valuable.

Overall success rates are probably around 80-90% when all three procedures (thoracic duct ligation, cisterna chyli ablation, pericardectomy) are performed. If chylous effusion persists, we recommend reoperation on the left side through a paracostal approach, or intermittent drainage through the pleural port on a long-term basis. Some animals will develop a non-chylous effusion, requiring long-term repeated drainage. All animals with pleural effusion are susceptible to lung lobe torsion.

Summary
"Idiopathic" chylothorax is a serious condition that is poorly understood. Clearly, further basic research is indicated to fully characterized the condition and elucidate the underlying etiology and pathophysiology. Further clinical research is indicated to validate the best combination of interventions to maximize outcomes, including the cost-effectiveness of various lymphangiographic procedures. Although we have improved management over the last decade, we need to strive for better outcomes. It is prudent to provide means of regular, intermittent drainage (i.e., subcutaneous pleural ports).

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NOTES:

Atypical Cutaneous Infections in Cats

Bryden Stanley, BVMS, MVetSc, MANZCVS, MRCVS, DACVS

Introduction

Veterinarians do not see the large number of chronic, non-healing wounds that our human counterparts attend to, probably because the common comorbidities that adversely affect wound healing in humans, such as obesity, alcoholism, chronic (over 40 years) poorly-controlled diabetes and cardiac disease are not as common in cats. Cat abscesses and lacerations often heal without complication. Cat skin also has a laxity that allows contraction to play a larger role in healing than in species with a tighter skin. However, there are occasions when a wound does not heal as expected.

A basic failure of any part of the healing process will delay wound healing. However, many wounds that are perceived to be non-healing are in fact simply just not provided with the right conditions in which to heal. Reviewing prior management is a critical first step when evaluating an atypical or non-healing wound. Management factors that impede normal healing include tension, motion or pressure forces that are acting on the wound. Wound contraction will stop if the tension on the wound edges exceeds the pull of the myofibroblasts. The resultant defect may still epithelialize, but it will need to be assessed carefully for fragility of the epithelial covering. Skin over bony prominences is particularly prone to ischemia from prolonged pressure due to inadequate bedding, or inappropriately constructed bandages. Ischemia leads to necrosis and development of a decubital ulcer (pressure sore). Relieving pressure is imperative, and a variety of padded doughnuts, slings, beds, whirlpool and physical nursing regimes have been described. There may be value in some topical wound stimulating medications such tripeptide-copper complex. Areas such as the axilla, inguinal area, lip commissure, footpads and skin over joints are subject to repeated shearing forces, which will disrupt wound healing. We should always anticipate that these areas will be a challenge; immobilization and cage rest should be instituted early in the healing process, and carried through until epidermal integrity is established (even longer for cats, which have a tendency to form indolent wounds). Wounds that are too moist become macerated, or wounds that dry out become desiccated and both of these factors will impede healing. Inadequate surgical debridement of devitalized tissues is devastating for wound healing, and prolongs the inflammatory phase. Contaminated and dirty wounds must be meticulously debrided, both surgically and with intermittent high-pressure lavage. Closing a wound over non-viable tissue and/or detritus is a common reason for delayed healing and dehiscence.

Systemic factors such as malnutrition, uremia, endocrinopathies, exogenous corticosteroids, extreme age and chemotherapy will also slow down healing. Wound factors such as irradiation, neoplasia, foreign bodies and envenomation will also heal slowly and with complications.

Clinical Presentation of Atypical Mycobacterial Infections

One of the most challenging of wounds in cats is the infection of the skin and subcutis with mycobacterial organisms.[1] Less commonly, Actinobacillus, Actinomyces and Nocardia can cause granulomas in cats, but the most common are the Mycobacteria - and these are probably underdiagnosed. Any type of infection can seriously and adversely impact wound healing, but the rapidly-growing mycobacteria that tend to proliferate in the fatty panniculus layer in cats, are particularly challenging. These mycobacteria are ubiquitous in the soil as saprophytes; it is unknown why some animals are predisposed to infection while the majority are not. Cats tend to be female and often overweight. The inciting inoculation may be environmental trauma, scratching, or a bitewound. Early in the course of the infection, these wounds can be mistaken for cat bite abscesses.

The classic signs of these atypical mycobacterial infections are the development of discolored (purple) skin with thinning and alopecia, often in the axilla, flank or inguinal fat pad areas.[1] There may be subcutaneous nodules or 'lumpiness'. Mycobacterial panniculitis lesions will very often develop punctate fistulation with serous, watery purulent drainage. As the wound persists, the main differential diagnosis at this chronic stage is probably a foreign body that has developed a draining tract, so imaging such as ultrasonography, radiography with or without sinography or CT should comprise part of the work up. Lesions are very characteristic; they will persist (or recur following classic drainage for a presumed cat bite abscess) and become more extensive, sometimes covering a large area of the trunk, but rarely extending through body wall or to any other organs. Some cats may show systemic signs of lethargy, inappetance, intermittent pyrexia and weight loss, but often cats appear quite systemically unaffected, apart from the irritation of the lesion.

Diagnosis

These mycobacteria are acid-fast, Gram-positive bacilli with cell walls rich in mycolic fatty acids. They are termed "rapidly-growing" because compared to other mycobacteria associated with feline mycobacteriosis (e.g., tuberculous forms)[2] they can produce visible colonies within a week of culture at room temperature on routine media. The most common species isolated in cats are *Mycobacterium fortuitum*, *Mycobacterium smegmatis* and *Mycobacterium chelonae*.[1,3] Histologically, tissues have a pyogranulomatous inflammation of the hypodermal fat, dermis and sometimes fascia and muscle. Organisms are challenging to find but occasionally acid-fast bacilli can be seen in macrophages.

If a wound has been appropriately managed and any of the previously mentioned systemic and/or wound factors that could be preventing healing have been addressed or ruled out, yet you are still faced with a non-healing, atypical wound, then a mycobacterial infection should be high on the list of suspicion. Following imaging as previously mentioned, a deep macerated tissue culture (rather than surface swab) is indicated for these wounds, as they reside in the fat, often within macrophages or fat droplets. Aerobic, anaerobic, mycobacterial and fungal cultures should be requested. Communication with the laboratory is prudent, to specifically inform them of your suspicion of a mycobacterial infection. Biopsy for histopathology is usually submitted at the same time, to definitively rule out neoplasia, and on the chance organisms may be seen in the sections.

Once diagnosed, mycobacterial infections will almost always require a combination of surgical resection and prolonged antibiotic therapy. They typically will not respond to antibiotics alone. Surgery should be meticulous and thorough, concentrating on removal of all affected skin and subcutaneous tissues - which are characteristically discolored. With extensive lesions, closure will require either tension-relieving technique or a skin flap. Prolonged antibiotic therapy has historically centered around fluoroquinolones, although enrofloxacin is not recommended in cats due to its retinopathic effects. If possible, finding a laboratory that will not only speciate but also undertake antimicrobial sensitivity testing is ideal. Marbofloxacin is often prescribed empirically, and more recent generation fluoroquinolones such as moxifloxacin and pradofloxacin have shown significant efficacy.[4,5]

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NOTES:

Update on the Management of Stress Associated Illness in Cats

Michael R. Lappin, DVM, PhD, DACVIM

Introduction

Stress associated illnesses in cats are common and include in part, diarrhea, recurrent respiratory tract disease signs, and chronic or recurrent signs of lower urinary tract disease that often relate to feline interstitial cystitis (FIC).[1-4] The proposed pathophysiological pathways resulting in the clinical manifestations of FIC were recently reviewed.[2] The reference also provides a great description of the use of multimodal environmental modification (MEMO) in the management of cats with chronic or recurrent lower urinary tract disease signs likely due to FIC.[2] In my experience, many of the components of MEMO can be beneficial in the management of some causes of diarrhea and some causes (particularly feline herpesvirus 1 [FHV-1} of the recurrent upper respiratory tract disease syndrome.

In the luncheon associated with these proceedings, several research studies completed in the Center for Companion Animal Studies that evaluated the use of nutrition in the management of feline disease syndromes that likely are exacerbated by stress will be discussed.

Effect of a Commercially Available Probiotic on the Fecal Microbiome of Cats Undergoing Mild Stress

The safety, immunomodulating properties, and clinical efficacy of the probiotic *Enterococcus faecium* SF68 have been described in a number of feline studies.[5-7] In one study, cats that were chronic carriers of FHV-1 had stress induced by moving from group housing to caged housing and back repeatedly.[6] The cats supplemented with a placebo were more likely to have increased activation of FHV-1 associated conjunctivitis compared to cats supplemented with probiotic.[6] At the time, these observations believed to exclusively relate to the immune stimulating effect of this probiotic.[5,8] However, it was also one of the first experiments to show that stress in cats leads to decreased fecal microbiota diversity and that supplementing with the probiotic led to a maintenance of microbiota diversity.[6] Thus, this probiotic appears to have both immune enhancing and stress modulating characteristics.

Effect of *Bifidobacterium Longum* 999 Supplementation on Stress Associated Findings in Cats with Feline Herpesvirus 1 Infection

The following abstract was presented at the American College of Veterinary Internal Medicine (ACVIM) Annual Forum in 2021 and provides evidence that a different probiotic, *Bifodobacterium longum* strain 999 (BL999) can modulate stress by interacting with the fecal microbiome. For this proceedings and meeting, only the information presented previously at ACVIM will be discussed as the manuscript resulting from the work is in review.

> *Bifidobacterium longum* strain 999 (BL999) is a probiotic (Purina® Pro Plan® Veterinary Supplements; Calming Care) that has been shown to lessen anxiety in dogs and is known to be safe in cats. Feline herpesvirus 1 (FHV-1) is the most common infection of cats and clinical disease can be exacerbated by stress. The primary hypothesis was that cats supplemented with the BL999 containing product would have higher relaxation scores, lower stress markers, and lower FHV-1 clinical scores than cats supplemented with the same product, but without BL999 as a placebo when mild stress was induced by changing the type of housing.
>
> This 12-week study enrolled 24 cats with chronic subclinical FHV-1 infection that were randomly divided into two groups. The cats were supplemented with BL999 (group 1) or placebo (group 2) daily. After BL999 was supplemented for 42 days to achieve probable maximal effects, the cats were moved from the individual gang rooms into cages, back into gang rooms, and then back into cages to induce stress over the next 42 days while behavioral, clinical, and biochemical markers were measured.
>
> Both supplements were well tolerated and there was no obvious vomiting or diarrhea. During the stress periods, the cats supplemented with BL999 were significantly less likely to have abnormal serum cortisol concentrations ($P = 0.0059$) or sneezing ($P < 0.00001$). During the times cats were housed in cages, those supplemented with BL999 were significantly more likely ($P < 0.0001$) to reach out to the scorers through the cage bars and were significantly less likely ($P < 0.0003$) to pace in the cages.
>
> The results of the study suggest that BL999 is well tolerated by cats, reduces stress, reduces stress associated problems like activated FHV-1, and increases social interactions between cats and people.

Additional field studies are ongoing to collect additional clinical information from client owned cats with anxiety or stress associated illnesses. Further information to explain the interactions between the gut and the brain of cats and other species is needed.

Effect of 2 Urinary Diets on Hematuria in Shelter Cats with Suspected Interstitial Cystitis

Recently, feline diets have been formulated that dissolve struvite cystoliths and prevent recurrent of both struvite and calcium oxalate cystoliths. An open trial with one of the diets (Purina Pro Plan Veterinary Diet UR Urinary St/Ox) was recently completed in cats with radiodense cystoliths that had been relinquished to animal shelters due to periuria and other signs of chronic or recurrent lower urinary tract diseases.[10] In that trial, 5 of 12 cats had the stones resolve within 2 weeks of starting the diet suggesting struvite cystoliths. The other 7 cats had stones that would not be expected to have been dissolved by the diet.[10]

When the open trial was completed, we continued accruing cases for either attempted dissolution of the cystoliths or to assess the effect of 2 diets on resolution of hematuria associated with presumed idiopathic FIC.[11] The following abstract was presented at the American College of Veterinary Internal Medicine (ACVIM) Annual Forum in 2020 and provides evidence that a veterinary diet could be of benefit managing cats with presumptive FIC. For this proceedings and meeting, only the information presented previously at ACVIM will be discussed as the manuscript resulting from the work is in review.

> There are multiple different veterinary prescription diets that are purported to aid in the management of struvite and calcium oxalate crystalluria and to dissolve struvite cystoliths. Whether positive effects are induced by these diets in cats with suspected feline interstitial cystitis (FIC) that is possibly associated with stress is unknown. The purpose of this pilot study was to determine if there were differences in clinical outcomes in cats with suspected FIC that were fed one of two different veterinary prescription diets.
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> In this IACUC approved study, cats relinquished to animal shelters in North Central Colorado that were noted to have hematuria and clinical signs of lower urinary tract disease were transferred to the Veterinary Teaching Hospital. All cats had 2 view abdominal radiographs made, were assessed by abdominal ultrasound, and had urine collected by ultrasound guided cystocentesis for urinalysis and aerobic bacterial culture and sensitivity. Cats with hematuria but no other abnormalities (classified as FIC) and cats with radiodense cystoliths were gang housed in 2 different housing chambers and were randomized to be fed one of two veterinary prescription diets (Purina St/Ox or Hill's c/d Multicare). Cats in the FIC group were housed overnight individually in cages on Days 2, 6, 9, 13, 16, and 20 with Purina Tidy Cat® Litter System without absorbent pads to collect free catch urine for repeat urinalyses. Cats with radiodense calculi were radiographed weekly, with stone removal and analysis planned if the cystoliths did not dissolved after 28 days of dietary management.
>
> At the time of abstract submission, 21 cats had been evaluated. A total of 4 cats either did not meet the entry criteria and were returned to the shelters (2 cats) or had concurrent underlying diseases (IRIS Stage II CKD or development of clinical FIP while on study) and so were excluded. All 4 cats with radiodense stones were fed St/Ox. The cystoliths dissolved in 2 cats and the 2 cats that required surgery had calcium oxalate cystoliths. Of the 13 cats with suspected FIC that completed the dietary trial, 6 were initially fed St/Ox and 7 were fed c/d. Five of 6 cats with suspected FIC fed St/Ox had hematuria resolve in the 28 day observation period. In contrast, 6 of 7 cats with suspected FIC fed c/d had persistent hematuria and were switched to St/Ox. This difference in response to the first diet was statistically significant ($p = 0.03$). Of the 6 cats with persistent hematuria on c/d, 3 resolved while fed St/Ox and 3 had persistent hematuria.
>
> Significantly more cats with suspected FIC had apparent first-time responses to St/Ox than to c/d in this mild stress model. The cystoliths that dissolved on St/Ox were presumed struvite and the calcium oxalate stones are not expected to dissolve with dietary management. Continued data should be collected from additional cats to verify the results of this study.

It is proposed that cats are naturally chronically dehydrated, and so inducing increased water consumption may have the added benefit of lessening stress due to dehydration in cats (Dr. Deb Greco, personal communication). The Purina diet has a higher sodium concentration (1.2%) than the alternate diet (0.37%). Whether this characteristic explains the differences between groups in study described will be evaluated in future studies.

During the luncheon, we will also discuss several other studies of diets or supplements that may play a role in the management of stress associated diseases in cats.[12-14]

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Procedural Sedation & Analgesia in the Cat

Bradley T. Simon, DVM, MS, DACVAA

Introduction

Sedation, chemical restraint and analgesia are a daily routine in feline practice. In some cats, especially those with fractious, fearful or excited behavior, sedation is required to render the patient cooperative. It is also used to facilitate diagnostic procedures (e.g. venipuncture for hematology, imaging, etc.). Procedural sedation and analgesia (PSA) is the art of depressing the conscious state, while maintaining appropriate cardiopulmonary function to perform minimally invasive or objectionable procedures.[1] In general, PSA is perceived as an uneventful procedure with low risk of complications, however, some protocols used for PSA may induce unconsciousness and the loss of protective reflexes, similar to that observed with general anesthesia. In these cases, there is a misleading idea that these patients are "just sedated" when they are indeed anesthetized. The following lecture discusses appropriate PSA protocols and procedures to ensure adequate patient safety and procedure success.

Risk Factors for Complications During PSA

Practitioners should consider that PSA is not always safer than general anesthesia. For example, general anesthesia along with endotracheal intubation is often better suitable when airway control is recommended to maintain adequate ventilation and oxygenation for more extensive and invasive procedures. Profound sedation may not be suitable for all patients and can come with its own inherent risks. The decision between PSA and general anesthesia should be dependent on evaluating the advantages and disadvantages of each.

The prevalence of mortality following anesthesia and/or sedation in cats can be as high as 0.24%. The primary causes for anesthesia- or sedation-related mortality in cats are cardiopulmonary (72%), unknown (20%), neurological (5%), or renal (3%). Certain patient risks factors may increase the likelihood for morbidity and/or mortality. Extremes in age and body weight were associated with increased odds of mortality following sedation and anesthesia in cats.[2,3] Himalayans were reported to have an increased risk of complications likely due to their brachycephalic conformation[4], as they are prone to respiratory complications and aspiration pneumonia during anesthesia. Additional risk factors include the need for emergent and/or major procedures, excessive fluid therapy, systemic disease, and lack of monitoring.

Monitoring During PSA

Appropriate monitoring for PSA prevents, detects, and aids in treatment of immediate complications such as hypoxia, hypoventilation, cardiovascular depression, post-sedation delirium, prolonged emergence, and aspiration. Monitoring should be documented and include the assessment of oxygenation, ventilation, perfusion, thermoregulation, degree of consciousness, and pain. Adverse side effects may occur during the sedation or recovery period. As a general recommendation, clinicians must continue to monitor patients until they are responsive to normal stimuli, regain protective airway reflexes, and maintain normal cardiopulmonary parameters for at least 3 hours post sedation. Some patients may require continuous monitoring and oxygenation. Capnography is not often employed as many times patients are not intubated, however, a side stream adapter can be placed in the patient's nostrils to estimate end tidal carbon dioxide values and monitor ventilation. Pulse oximetry is a valuable tool but can be misleading for patients receiving high levels of fractional inspired oxygen. Therefore, pulse oximetry may be more beneficial for patients receiving room air than capnography as desaturation is more likely to occur prior to changes in ventilation. Non-invasive blood pressure monitoring is recommended during PSA to provide subjective assessments of organ perfusion.

Pre-Examination and Assessment Sedatives: Gabapentin and Trazodone

Cats often show signs of fear and aggression when presenting at a veterinary clinic. At-home oral sedatives that pet-owners can administer may alleviate stress and anxiety in these patients, providing a safer environment for staff and a more pleasant experience for the animal. Gabapentin is an anti-epileptic medication, available in capsule or liquid form for oral administration. The administration of 100 - 150 mg gabapentin orally to cats by the pet-owner 90 minutes prior placing it in its carrier for veterinary hospital transport can reduce its anxiety and may increase compliance in cats associated with transportation and veterinary examination.[5] Owners typically report that their cats experience mild to marked sedation, display increased affectionate behavior and also reduced fear of dogs.[5] Peak clinical effects occur 2 to 3 hours after administration and resolve within 8 hours.[5] Adverse effects associated with this technique are rare. Vomiting may occur with the 100 mg capsules[5], as the authors have not witnessed this side effect with the oral liquid formulation. It is important to remember that orally administered gabapentin does not provide significant analgesia in cats[6], and therefore, an opioid should be considered in painful patients or for minimally invasive procedures. Trazodone, a serotonin antagonist and reuptake inhibitor, may also reduce stress and

fear in cats. Oral administration of 50 – 100 mg provides sedation, reduces anxiety during transport, reduces activity, and improves ease of handling during veterinary examination.[7,8] Recommendations are to administer trazodone 60 – 90 minutes prior to transport or 90 – 120 minutes prior to veterinary examination.[7] Peak effect is approximately 2 – 2.5 hours following oral administration.[8] Gabapentin and trazodone have minimal effects on the cardiopulmonary system[5,7], and therefore may be excellent sedatives in systemically ill non-compliant cats.

Maintenance Fluid Therapy

Fluid therapy may be necessary during PSA, but is not required. Determining if a patient requires intravenous fluids is dependent on hydration status, physical condition, and duration of the procedure. The administration of inappropriate quantities of intravenous fluids significantly increased the likelihood of anesthesia- and/or sedation-related deaths in cats.[2] Guidelines for anesthesia maintenance fluids rate have been published in cats (3-5 mL/kg/hour).[9] Inappropriate use of intravenous fluids in euvolemic patients can result in volume overload and the development of pulmonary and peripheral edema. A thorough evaluation of the patient's hydration status and estimated losses during the procedure should help guide the veterinarian in determining if intravenous fluids are required.

Fasting Recommendations

Fasting may reduce regurgitation and aspiration pneumonia and, in turn, the sequelae of desaturation, hypoxemia, sympathetic activation, and potentially death. Currently, there are no fasting requirements for patients requiring PSA. Veterinarians should perform PSA with caution in non-fasted cats and consider general anesthesia with intubation of the trachea in cats with increased risks for aspiration (e.g. central nervous system, respiratory or gastrointestinal disorders).

Procedural Sedatives and Analgesics

Overview

When possible, neuroleptanalgesia is recommended during PSA and involves the combination of an opioid analgesic and a tranquillizer or sedative. This technique has the potential benefits of producing a greater degree of sedation and analgesia with reduced adverse cardiopulmonary effects, when compared with either drug administered alone at similar doses. Acepromazine, benzodiazepines or α_2-adrenergic receptors agonists (e.g. dexmedetomidine, medetomidine or xylazine) are used in combination with an opioid for PSA. The magnitude of sedation and analgesia and the quality of recovery are better with the combination than each drug used alone[10]. Due to this, lower doses of each drug can be administered in this case and therefore adverse effects may be reduced with neuroleptanalgesia. With some occasional cases, opioids may be used alone for PSA or when the combination of benzodiazepine-opioid is indicated (e.g. extremes in age or moderate to severe systemic disease). The choice of an opioid will depend on the onset, duration and level of analgesia required for the procedure. Alternative methods for achieving PSA, such as chamber induction using inhalant anesthetics, can be useful to protect handlers from injury but may cause airway irritation[11] and an excitatory phase in patients, in addition to the environmental concerns over waste anesthetic gases. Moreover, this technique may be associated with increased risk of anesthetic-related morbidity or mortality due to the excessive inhalant anesthetic concentrations required to induce adequate sedation and avoid involuntary excitement.[12] The remaining sections discuss evidence-based PSA combinations performed in cats.

Specific drugs and combinations

Acepromazine combinations. Acepromazine decreases reaction to external stimuli and has been used in combination with butorphanol, buprenorphine or methadone as premedication. These combinations produce a mild calming effect with third-eye lid protrusion, purring and kneading, or as a deeper state of tranquilization for 2-3 hours. Acepromazine-opioid combinations will usually produce mild sedation and experienced support staff or veterinarians are often needed for physical restraint and handling. Acepromazine should not be used for PSA in cats with hypovolemia, dehydration or in procedures with high risk of bleeding. Hypothermia and hypotension may occur by blockade of α_1-adrenergic receptors. Acepromazine combinations should be used with caution in hypovolemic and in hypotensive patients non-responsive to positive inotropes and vasopressors. Acepromazine has some antihistaminic effects and should not be administered to patients undergoing intradermal skin testing.

Agonists of α_2-adrenergic receptors combinations. Agonists of α_2-adrenergic receptors provide sedation, muscle relaxation, analgesia and chemical restraint in a dose-dependent manner. They can produce emesis, especially when administered alone, due to direct stimulation of the chemoreceptor trigger zone. Vomiting becomes an issue in cats with increased intraocular and intracranial pressures. These drugs cause peripheral vasoconstriction, hypertension with reflex bradycardia and decreases in cardiac output. Note that the use of anticholinergics with agonists of α_2-adrenergic receptors is normally contraindicated. α_2-adrenergic agonists are mostly reserved for cats with stable hemodynamic function. Hypothermia can occur via depression of the hypothalamic thermoregulatory center and the lack of muscle activity during PSA. Dexmedetomidine and medetomidine are selective agonists of α_2-

adrenergic receptors and should be preferred over xylazine. Xylazine should not be administered in systemically ill, pediatric, or geriatric cats. Dexmedetomidine-butorphanol is a popular drug combination for PSA with short onset of action (approximately 5 minutes). This combination provides superior sedative effects and lower prevalence of vomiting than dexmedetomidine-buprenorphine during PSA for diagnostic procedures (ultrasound, radiography, computed tomography scan), blood sampling, minor wound care and chemotherapy treatment administration.[13] However, studies have shown that the analgesia produced by dexmedetomidine-buprenorphine is superior.[14,15] The addition of ketamine (3 mg/kg) to dexmedetomidine (5 µg/kg) and butorphanol (0.3 mg/kg) will increase the duration of action by approximately two-fold.

Dexmedetomidine combinations usually decrease ejection fraction and fractional shortening, and increase end-diastolic and end-systolic volume in cats. This may affect the interpretation of echocardiography results. Midazolam-butorphanol-dexmedetomidine or ketamine-dexmedetomidine combinations decrease cardiac output (approximately 50%) and significantly more than ketamine-midazolam-butorphanol (34%).[16] In contrast, medetomidine alone increased afterload and was able to attenuate signs of dynamic left ventricular outflow tract obstruction in cats.[17] For this reason, some veterinarians use low dose medetomidine combinations for sedation in cats with hypertrophic cardiomyopathy. Cardiac output is predominately maintained via heart rate rather than contractility in the pediatric patient (cats less than 4 months of age), therefore administration of any α_2 receptor agonist in pediatric cats can severely reduce cardiac output and tissue perfusion and requires extreme caution. Similarly, these drugs should not be administered in patients with life-threatening bradyarrythmias (e.g. bradycardia secondary to urinary obstruction).

The oral transmucosal (buccal) route of administration has been used with medetomidine or dexmedetomidine as an alternative to intramuscular injections in cats. The drug is injected with a 1-mL syringe into the cheek pouch to avoid swallowing. Dexmedetomidine (40 µg/kg) in combination with buprenorphine (0.02 mg/kg) produced chemical restraint in cats when drugs were administered either buccally or intramuscularly. Sedative effects were not different between groups, however, intramuscular produced superior sedation compared with buccal dosing when lower doses of dexmedetomidine (20 mcg/kg) were used with buprenorphine.[18] The author has used this approach in aggressive feline patients via spraying these drugs into the patient's mouth from a distance through a cage during "hissing".

Antagonists of α_2-adrenergic receptors (atipamezole for dexmedetomidine and medetomidine; yohimbine for xylazine) can be administered intramuscularly to hasten recovery and antagonize potential adverse effects. Analgesia and muscle relaxation will be also antagonized. Atipamezole is typically administered IM at equal dose volume as the dexmedetomidine (0.5 mg/mL) or medetomidine volume. When using dexmedetomidine at 0.1 mg/mL concentration, the volume of atipamezole should be reduced to 1/5th of the dexmedetomidine dose volume.

Benzodiazepines. The administration of benzodiazepines inconsistently produces sedation, and more commonly results in transient excitement or aggression in adult healthy cats.[19] There is generally a clinical impression that benzodiazepines cause minimal cardiovascular depression, but in one early study doses of 0.1 mg/kg of diazepam reduced systolic blood pressure and cardiac contractility, potentially because of the presence of propylene glycol present in the formulation.[20] Benzodiazepines have a synergistic effect with barbiturates, propofol and alfaxalone. In the authors' experience, midazolam-opioid combinations can be used in geriatric or critically ill cats to produce sedation for minor diagnostic procedures. Benzodiazepines are also used as part of ketamine combinations. Diazepam should not be administered intramuscularly because the drug is hydrophobic and contains propylene glycol, which causes pain at injection; midazolam is water soluble and recommended for injectable PSA protocols. Flumazenil (0.01-0.04 mg/kg) is the antagonist of benzodiazepines.

Ketamine-based Combinations. Ketamine, an N-methyl D-aspartate (NMDA) antagonist, causes and is used as an adjunct analgesic in patients with hyperalgesia or central sensitization. It can be administered intravenously, intramuscularly, or buccally in cats. In humans, ketamine used at subanesthetic doses (<1 mg/kg) rapidly decreased the perception of severe, acute pain and provided an opioid-sparing effect.[21,22] Its ability to provide similar analgesic effects at low doses is yet to be determined in cats. This drug is known for causing "emergence phenomenon" (dysphoria during recovery), although this is not routinely seen with subanesthetic doses (<0.5 mg/kg).[23] Ketamine is always administered in combination with sedatives and analgesics. The swallowing reflex is well maintained, but the risk for aspiration is still present.

Ketamine-based protocols are used to produce chemical restraint for PSA. The drug must be combined with a muscle relaxant agent (i.e. midazolam or an agonist of α_2-adrenergic receptors) to prevent hypertonus, seizure activity and hypersalivation. The drug has an acidic pH and causes pain during intramuscular administration. For this reason, appropriate physical restraint is required for the administration of ketamine combinations. Ketamine has the potential to increase heart rate via increases in sympathetic tone and should be avoided in patients with hypertrophic cardiomyopathy (HCM) or tachyarrhythmias.

Tiletamine-Zolazepam and Combinations. Tiletamine and zolazepam is available as a white powder combination (500 mg combined) and is reconstituted with 5 mL of sterile water resulting in a 100 mg/mL solution. Alternatively, tiletamine/zolazepam powder can be reconstituted with 100 mg of xylazine and 400 mg of ketamine and administered intramuscularly at 3.3 mg/kg to cats for anesthesia. Following reconstitution, any unused drug should be discarded after 7 days when stored at room temperature or after 56 days when refrigerated. This drug combination is widely used in feline practice for PSA and surgery. Sympathetic stimulation is observed after drug administration. Tiletamine-zolazepam can produce muscle rigidity, myoclonus, salivation, respiratory depression and prolonged recovery times from anesthesia, which is a potential concern for patient welfare. The combination of low doses of tiletamine-zolazepam with methadone provided superior sedation than acepromazine-methadone in healthy cats before neutering.[24] Similar to ketamine combinations, Tiletamine-Zolazopam combinations should be avoided in cats with HCM.

Alfaxalone and Combinations. Alfaxalone is a synthetic neurosteroid anesthetic drug that has been used for PSA in cats. The sedative and cardiorespiratory effects of alfaxalone have been evaluated when the drug was administered alone or in combination with butorphanol, hydromorphone or dexmedetomidine. These protocols are versatile with a wide margin of safety and used for various procedures in combination with opioids. Hypoventilation is a potential adverse effect with alfaxalone in cats. Ataxia, excitement and hyper-reactivity in some individuals during the recovery phase have been observed by the author; these effects may be attenuated by the administration of a sedative or tranquillizer. Alfaxalone-based protocols may involve large-volume IM injections, particularly with higher doses (> 5mg/kg). Cats may react to the injection even after sedation. The high volume of injection produces discomfort and violent behavioral reactions at injection. Lower IM doses may be more tolerated (e.g. 2 mg/kg). Quality of PSA recovery is a concern with alfaxalone. Studies have reported cats moving incessantly with thrashing, paddling, trembling, and pacing in the cage.[25]

Propofol. Propofol is sometimes administered as small boluses for PSA but it can induce adverse effects, especially in ill cats. The drug produces dose-dependent cardiorespiratory depression with variable changes in heart rate, decreases in cardiac contractility and respiratory rate, hypoxia, hypercapnia, and vasodilation. Although hypotension may be observed following propofol administration, it is often mild in healthy cats. Apnea may occur, especially after rapid bolus administration. Caution is required when using propofol for PSA in patients with respiratory compromise and oxygen supplementation should be provided.

Small doses of propofol (1 mg/kg) may induce light sedation with signs of excitement and increased muscular activity in healthy cats (ASA I or II) sedated with acepromazine-methadone.[26] In contrast, these doses have been shown to induce smooth and mild sedation in critically ill cats with urinary obstruction requiring PSA for urethral catheterization after sedation with midazolam-opioid.[27] The development of Heinz bodies following a 30-minute infusion of propofol has been reported in cats, but only following the third day of administration.[28] The concern for Heinz bodies development following the administration of propofol in cats is undetermined, as it does not appear to have clinical significance even following 24 hours propofol infusions.[29]

Local Anesthetics. The use of local regional techniques should be employed whenever possible due to their excellent analgesic efficacy and safety profile. These techniques typically require sedation prior to administration, but allow a substantial decrease in parenterally administered sedatives thus decreasing systemic side effects. Commonly used local anesthetics are lidocaine and bupivacaine. Local regional techniques used include: topical anesthesia, local/infiltrative anesthesia, regional or peripheral nerve block anesthesia, and intravenous regional anesthesia. The onset of lidocaine is fast (<5min) with duration of 1-3 hours, while the onset of bupivacaine is slower (10-15min) but with duration of 4-12 hours. Vasoconstrictors such as epinephrine (5 mcg/ml of local anesthetic) or dexmedetomidine (1mcg/mL of local anesthetic) can be used to prolong the duration of these local anesthetics by decreasing systemic absorption. In awake patients, the author recommends alkalinizing the local anesthetic by the addition of bicarbonate in order to reduce the anesthetics' acidity. This will decrease pain during injection. Clinical signs, though rare, associated with local anesthetic toxicity include central nervous system excitation followed by depression, hypotension, ECG abnormalities, and finally cardiovascular collapse.

Recovery Procedures

The quality of recovery is dependent on body temperature, duration of procedure, drug antagonism, pain and patient health status and behavior. Complications may occur during the sedation period, however, the majority of fatalities (52-60%) have been reported to occur within three hours after the end of the procedure.[2,3] Prolonged hypothermia and emergence, collapse, and excitement may occur during recovery. This is particularly true when anesthetics are administered for PSA. Post-procedure excitement or delirium can be controlled with dexmedetomidine (0.5 – 1 µg/kg IV) administered slowly for re-sedation and a quiet environment away from other animals. Reversal agents for opioids, benzodiazepines, and α_2 adrenergic agonists should be readily available and administered in cases of

prolonged emergence from PSA. Monitoring should continue for a minimum of three hours following procedure completion and animals should not be left unattended for long periods of time until they have recovered. Patients are considered fully recovered when they are responsive to normal stimuli, have regained protective airway reflexes, and are able to maintain normal cardiopulmonary parameters. Some cats may require continuous monitoring and oxygenation. If intubation was necessary, extubation is recommended when a convincing swallowing reflex is present. Cats should be monitored for laryngospasm and upper airway obstructions following extubation. Following PSA, a small amount of water and food can be offered to patients that are awake and standing with minimal to no ataxia.

Conclusions

Feline patients often require PSA in veterinary practice for various procedures. Complications may occur, especially with cats presenting with specific risk factors. The choice of drug protocols varies with the procedure type and duration, health status of the patient and co-morbidities. The need for analgesia dictates the type of opioid to be administered. The results of clinical and experimental trials are difficult to extrapolate to every case, and an individualized approach should be taken. Monitoring, fluid therapy and good practices are paramount for successful PSA in cats.

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NOTES:

Stem Cell Therapy in the Domestic & Exotic Feline: Could This be the Answer to Your Difficult Cases?

Robert Harman, DVM, MPVM

Introduction

You may be familiar with Stem Cell Therapy (SCT) as something that is used widely in canine and equine patients to treat orthopedic and internal medicine diseases. In feline medicine, the most published stem cell therapies are in chronic kidney disease, gingivostomatitis, and inflammatory bowel disease. A recent review article highlights these therapies[1]. Osteoarthritis (OA) is very common in older cats, but perhaps not diagnosed or recognized nearly as often as in canines. In a survey of the incidence of OA, 90% of cats 12 years of age or older had radiographic evidence of OA[2]. In the author's registry, 13% of the clinical feline patients were treated for osteoarthritis.

VetStem Biopharma (VSB) is a veterinary cell therapy company. It has provided cell processing, storage, and cell doses for therapy in 40 species of domestic and exotic animals since 2002 with total treatments of greater than 30,000. VSB has also conducted pilot and formal FDA randomized clinical studies and has over 15 peer-reviewed published studies and book chapters dedicated to cellular therapy. This retrospective is intended to review literature and the VSB clinical patient registry data on the use of stem cell therapy in domestic and exotic felines.

What is Stem Cell Therapy?

Stem cell therapy is a subset of the broad category of regenerative medicine. There are a variety of sources and types of stem cells. This article will focus only on adult stem cells and not embryonic stem cells. In the literature, you will find considerable debate about definitions, but broadly, adult stem cells are cells that respond to local environmental cues (e.g. inflammation, ischemia) and then act in one or more manners to reduce inflammation and pain, reduce degeneration, or manage/stimulate repair of tissues and organs. These stem cells are released from their storage sites and are activated by injury signals, taking their "instructions" from cells and cytokines at the injury site. This means the stem cells can provide "injury-specific" or "adaptive" response in many different tissue sites, making them unique in the realm of therapies. Most often these adult stem cells are called mesenchymal stem cells (MSCs) as initially these cells were found in bone marrow, adipose, and other mesenchymal tissues. In order to best understand how to utilize stem cell therapy, we will briefly review the following mechanisms of action:

- Cell/Tissue Regeneration
- Anti-inflammatory
- Immunomodulatory
- Pain Block

Cell/Tissue Regeneration

The MSC has been shown to impact cellular regeneration by at least three different mechanisms: (1) direct differentiation; (2) growth factor stimulation of local progenitor cells; (3) growth factor stimulation of angiogenesis. Researchers in osteoarthritis therapy have published on the impacts of stem cell therapy in the regeneration of cartilage. Serious full-thickness cartilage lesions have been healed with hyaline cartilage in rigorous rabbit models of stifle injury [3]. Similarly, it has been shown that adipose stem cells have the ability to be chondroprotective as demonstrated in the rabbit cruciate ligament injury induced OA study [4]. In a human dose-escalation study of adipose stem cell effects on cartilage regeneration, histology demonstrated significant hyaline-like cartilage regeneration and patients had improved knee function at 6 months after injection[5]. In liver fibrosis, stem cells have been shown to stimulate mitosis of the remaining normal hepatocytes but also to block and resolve fibrosis. In a recent presentation at the American Association of Zoologic Veterinarians (2019), Dr. Matt Kinney presented a case series of adipose stem cell treatments for acute on chronic liver fibrosis in Cheetahs demonstrating significant prolongation of quality of life by intravenous administration of adipose stem cells. This was based upon considerable preclinical research showing blockade of fibrosis and stimulation of hepatic regeneration[6, 7].

Blood flow is required for adequate healing of tissue damage and lack of blood leads to chronic non- healing wounds. MSCs have been shown to produce angiogenic factors such as vascular endothelial growth factor (VEGF) and insulin-like growth factor (IGF-1) that recruit endothelial lineage cell types and induce vascularization[8]. In a canine study of oral ulcers, ASCs stimulated vasculogenesis and improved healing rates compared to controls or dexamethasone treated ulcers[9].

Anti-Inflammatory Mechanisms

Inflammatory conditions such as osteoarthritis (OA), gingivostomatitis, IBD and many others dominate our clinical case load. Chronic inflammation underlies many dermatology conditions and is central to formation of scar tissue.

The chronic inflammation in OA causes pain and reduction in joint function, which impairs the quality of life for the patient. MSCs have anti-inflammatory functions and capabilities that may assist in turning a degenerative joint into a regenerative joint. MSCs have been shown to respond to triggers such as interlukin-1ß (IL-1ß) and tumor necrosis factor-alpha (TNF-α) by producing anti- inflammatory compounds such as IL-1 receptor antagonist protein (IRAP), hepatocyte growth factor (HGF), and transforming growth factor-beta (TGF-β)[10, 11]. These anti-inflammatory cytokines are a powerful balance to inflammation in the joint and other locations in the body.

Immunomodulatory Mechanisms
In a practical sense, MSCs have the ability to shift a patient from a TH1 (inflammatory) phenotype to a TH2 (anti-inflammatory) phenotype with a reduction in TNF-α and interferon-gamma (INF-γ) [12]. These strong immunomodulatory capabilities are being harnessed to treat a number of veterinary immune- mediated diseases such as feline gingivostomatitis [13], dry eye [14], and inflammatory bowel disease [15]. Immune-mediated arthritis and multiple sclerosis have been effectively treated with intravenous stem cell therapy[16-18].

Pain Block Mechanisms
Pharmacological interventions in veterinary pain management have been mainly palliative. Although they temporarily relieve pain, they do not address the core underlying mechanisms causing the pain. Neurotropic factors are critical in the development and survival of neurons and they participate in the regeneration and repair of nerves [19, 20]. MSCs have been shown to produce an array of cytokines and growth factors, including many neurotropic factors[21].

In published studies regarding the use of ASCs in the treatment of OA in the canine, pain measures such as pain on joint manipulation, visual analogue scores of lameness, or gait analysis have been substantially improved [22-26]. In a recent publication of a large-scale randomized clinical trial on the effect of allogeneic (donor) ASCs in OA, pain on manipulation was also improved [27]. In a large (1,128 patients) case-control human study of adipose SVF injection for OA, 63% showed at least a 75% improvement in pain score at 12 months after injection with no serious side effects[28].

Neuropathic pain may come from physical (impingement, trauma, burn), chemical, or biologic direct damage to nerves. Intravenous stem cell therapy has been shown effective in reducing pain for extended periods of time in animal models and in the clinic [29-32]. A recent review of stem cell therapy in veterinary pain management covers this topic [33].

Sources of Stem Cells
Mesenchymal stem cells are a class of adult stem cells arising from tissues including adipose, bone marrow, and many others. MSCs can be sourced from most tissues with blood vessels, but adipose appears to be a superior source [34, 35], and it is the most commonly used source in veterinary medicine. As stated by the authors of the 2018 feline review article above, “currently, adipose-derived MSCs (mesenchymal stem cells) are most commonly used in clinical applications due to ease of attainment and their superior proliferative ability[1].”

How Are Stem Cells Used Clinically?
Typically, stem cell therapy is applied via local tissue injection at the site of injury or disease or via a vascular route. Targeted delivery to the CNS can be done via intrathecal injection. Intravenous administration is most commonly used for systemic diseases and particularly in immune-mediated diseases where access to the immune system is needed. Stem cells are applied clinically to: (1) improve quality of life (reduce pain and disability); (2) reduce progression of degeneration; and (3) repair/regenerate damaged tissues and organs. Cells used therapeutically today, unless inside of an FDA clinical trial, must be autologous (from the patient). Generally, tissue is extracted, and cells are isolated from the tissue for use in the same patient. In the case of adipose tissue, there are published reported uses of either use non-cultured stromal vascular fraction (SVF) cells or culture expanded cells. SVF cells can be used freshly or after thawing from cryobanking. The SVF contains adipose stromal cells (ASC) as well as pericytes, endothelial cells and cells of hematopoietic lineage. It is critical to do any cell isolation according to FDA guidance or utilize a company that is FDA compliant.

Many degenerative and chronic diseases require multiple doses over the lifetime of the patient. As such, it is wise to cryobank part of the initial cells for use in the future.

Domestic and Exotic Feline Use
Overview
Based on the VSB clinical therapy patient registry and the peer-reviewed literature[1], the most prevalent stem cell therapy targets in feline medicine are generally the following:

- Chronic kidney disease
- Osteoarthritis

- Gingivostomatitis
- Inflammatory bowel disease

There are no peer-reviewed publications on stem cell use in OA in cats. However, there are over 100 canine studies including blinded, controlled studies that practitioners can use for guidance. In addition, there are a large number of human OA studies using stem cells. At VetStem Biopharma, SVF and ASC therapeutic cells have been provided to practitioners for over 60 feline cases where OA was the primary complaint. These are prospective cases and not controlled clinical trials. The mechanisms of action and pathophysiology of the OA and orthopedic soft tissue disease are quite similar between mammalian species.

For reference, VetStem has provided therapeutic stem cells (SVF, ASC) to practitioners to treat the following conditions in domestic cats (Table 1) and for use in exotic cats (Table 2):

Table 1. Feline conditions treated with adipose stem cell therapy from VetStem

Disease or Condition	#of Cases	%of cases
Gingivostomatitis	40	11%
IBD	19	5%
Renal Disease	207	55%
Liver	3	1%
Neurological	9	2%
Osteoarthritis	61	16%
Atopy/Skin Disease	8	2%
Other AutoImmune	5	1%
Cardiac	1	0%
Other orthopedic (fracture, Cruciate)	21	6%
Other	3	1%
	377	

Table 2. Exotic cat adipose stem cell collection and/or therapy from VetStem

Species	Indication	# treated
Cheetah	Liver Fibrosis	2
Panther	Osteoarthritis	2
Leopard	Osteoarthritis	1
Tiger	IBD	1
Mountain Lion	Osteoarthritis	1
Lion	Storage Only	1
Tiger	Storage Only	1
Cheetah	Storage Only	2
Total		**11**

The use of stem cells in exotic species has recently been reviewed in the new Fowler's Zoo and Wild Animal Medicine book [36].

Chronic Renal Disease

Chronic kidney disease (CKD) in the feline is a major cause of debilitation and death [37]. Recent reviews suggest that CKD may be the number one cause of morbidity and mortality in the aged cat. Therapies available include medical management, dietary control, dialysis and kidney transplant [38]. For most cat owners, dialysis and kidney transplant are beyond economic and practical reach. In the last decade, refereed journal articles have been published showing the possibility of using mesenchymal stem cells as a therapeutic option. The authors hypothesized that intravenous mesenchymal stem cell therapy could improve the clinical course of CKD [39-42]. We have compiled the data from 40 clinical cases treated by veterinarians using intravenous administration of adipose-derived stem cells for CKD.

A total of 40 cats were treated and had adequate pre and post treatment data for analysis. The average age for cats was 12.2 years and the average body condition score was 3.0/5.0. The average dose was 4.92 x 106 nucleated cells using a Nucleocounter™ with an average number of initial doses per case of 1.8 and the average total doses of 3.3. Clinical pathology data is reported for pre-treatment, at 180 days, and at 330 days, with averages as follows: BUN: 61.9, 52.0, 60.8, Creatinine: 3.96, 3.03, 3.78. By day 180, on average, BUN improved 16.0% and creatinine improved 23.5%.

Clinical Pathology Data		
Parameter	BUN	Creatinine
Pre-Rx	61.90	3.96
180 Days	52.00	3.03
Percent Improvement	16.0%	23.5%
330 Days Follow-up	60.80	3.78

Feline CKD Case Series	
# Cases Treated	40
Average Age (yrs)	12.2
Average Dose*	4.92 x 10(6)
Initial Doses	1.8
Total Doses	3.3
* Total nucleated cells, Nuclecounter	

There was a trend to significant improvement in BUN and creatinine at 180 days. Improvement in these parameters was seen through an average of 330 days in a population of significantly diseased patients in which these parameters would have been expected to deteriorate. There were no reported adverse events in these treated cats. This study was not blinded. This limitation makes outcome conclusions more difficult, however the study measures indicate that the therapy may be providing clinical benefit with low risk. Additional controlled studies are planned to further evaluate the benefit of cell therapy in CKD.

Osteoarthritis

While orthopedic conditions are prevalent in the feline patient, often owners do not recognize the signs, or unwilling to explore treatment options more than NSAIDs or pain medication. So, you may feel uncomfortable recommending SCT as an option. But what about those patients that have renal complications or owners who would prefer a more natural approach? SCT may be a great option for those patients. To date, VetStem has veterinary clients who have treated over 60 feline patients for osteoarthritis as the primary complaint. Stem cells are a reasonable treatment modality as they are anti- inflammatory, block pain, and regenerate tissue, without the level of side effects of some drugs. VetStem processed cells have also been used to treat several Exotic felines for orthopedic conditions (see table below).

Table 3. VSB Feline patient registry cases of exotic felids with osteoarthritis

Species	Disease	Number
Panther	OA – Elbow, hip	2
Leopard	OA - shoulder	1
Mountain Lion	OA - hip	1
Total		**4**

Feline Chronic Gingivostomatitis (FCGS)
Feline chronic gingivostomatitis (FCGS) is a severe oral inflammatory disease of cats with an estimated prevalence of 0.7%–12% of the US cat population[43-45]. Clinical signs are moderate to severe oral pain and discomfort, including inappetence, reduced grooming, weight loss, and hypersalivation[45, 46]. The most common treatment is full mouth extraction with approximately 60% of cats responding. Those cats that do not respond well to the extractions can require lifelong therapy with antibiotics, corticosteroids, and pain medication (refractory FCGS)[45]. The pathogenesis of FCGS is not well understood but is proposed to be due to the host immune system responding inappropriately to chronic oral antigenic stimulation, possibly secondary to underlying oral bacterial or viral infections[47, 48]. Arzi et al. at UC Davis have conducted and published two studies on the use of adipose-derived stem cells to treat refractory FCGS in cats with full mouth extractions. The first study evaluated autologous adipose stem cells in a two-dose regime of 20 million stem cells per dose intravenously. Five of seven cats had either complete remission or substantial clinical improvement[13]. In the second study, they used allogeneic (donor) adipose stem cells and found 4/7 cats responded with three cats as non-responders[49].

VetStem has provided stem cell processing for 40 cats with FCGS. While we do not have outcome data on all of the cases, we have collected evidence from owners and veterinarians that the cats have done well after injections. Two injections are given intravenously two weeks apart. FCGS is a frustrating disease to manage and Stem Cell therapy may be a treatment method that could have long lasting positive effects, without negative side effects or dwindling effect after repeating treatments as corticoid steroids do.

Inflammatory Bowel Disease
Inflammatory Bowel Disease (IBD) in cats is a group of idiopathic, chronic gastrointestinal disorders characterized by mucosal inflammation[50, 51]. IBD is commonly distinguished from food-responsive and antibiotic-responsive causes of enteropathy by their response to immunosuppressive therapy as opposed to dietary or antibiotic therapy alone. While the underlying cause of IBD remains unknown, accumulating evidence suggest that intestinal inflammation results from altered interaction between gut microflora and the immune system in the mucosa of the host[52, 53]. A review of the literature regarding cell-based therapy of Crohn's Disease and Ulcerative Colitis (the two most prominent of the inflammatory bowel diseases in the human) yields a vast array of animal model and human clinical trials that support the concept of cell therapy for IBD[54-59]. T cells in the gut mucosa are considered the primary effector cells and are responsible for the production of cytokines that are responsible for inflammation[53]. Mesenchymal stem cells have shown the ability to migrate to areas of inflammation, down-regulate inflammation, modulate the immune system, stimulate neoangiogenesis, and repair damaged tissues[60]. Human Phase III pivotal studies are underway in the US and other countries with very encouraging outcomes to date. The EU has now approved an adipose stem cell therapy for use in humans with Crohn's fistulas. The therapeutic value of stem cell use for IBD is theorized from the animal model and human data available in the literature and the data regarding mechanisms of action of stem cells.

IBD Case Study
Patient Name: Lovey
Breed: Himalayan
Age: 4 years
Sex: Female Spayed

Lovey was treated with a commercially available flea prevention treatment and shortly after displayed a clinical reaction. Her clinical signs were inappetence, emesis and diarrhea. She lost weight rapidly and thus was taken to the specialty center. Patient had lost a significant amount of body weight and was dehydrated. Intravenous fluids were started. The differential list of possible causes was lymphoma, IBD and foreign body. Endoscopy was performed to rule out lymphoma and to determine if IBD was the cause of the symptoms. At this time a feeding tube was placed into the patient and adipose was collected in order to provide autologous stem cells for treatment, if appropriate. A total of 26.35 grams of adipose tissue was processed at the VetStem Biopharma laboratory yielding 5.44 million stem cells. This was only about 206,000 cells per gram which is considered low. Debilitated animals tend to have lower cells per gram. Pathology results showed no lymphoma but was positive for IBD, so treatment with stem cells was determined to be a viable option.

A single dose with a total of 3.2 million stromal vascular cells were given intravenously approximately 5 days after the endoscopy and placement of the feeding tube. Within two days of receiving the stem cells the feeding tube was removed as the patient appeared ready to eat and was attempting to remove the feeding tube herself. Appetite returned but vomiting and diarrhea did not return. Patient steadily gained her weight back. None of the symptoms recurred. No pharmacologic interventions were used. Lovey lived to be 13 years old.

Summary
Stem cell therapy for orthopedic conditions has been used for a considerable length of time with a solid safety profile in animals and humans. In the cat, CKD has predominated the discussion of cell therapy with clinical evidence for efficacy and safety in this disease. In other internal medicine diseases such as IBD, asthma and FCGS, there is early investigational evidence. In orthopedics, especially OA, there is a large volume of evidence on the efficacy and safety in intraarticular therapy in many species of mammals to support the practitioner in making an informed and evidenced-based decision on therapy of their feline patients.

The ability of the cells to reduce inflammation and regulate the immune system response indicates that it may be useful in a range of disease processes. The VSB patient registry data across 31 species indicates that stem cell therapy results are similar in different species and is it is likely that stem cell physiology is highly conserved across all mammals as a way to regenerate and improve function and quality of life. With the limited number of approved medications for the feline patient, the use of autologous cells may be one of the best and safest options.

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SESSION TITLE	SPEAKER	SPONSOR/PARTNER
Environmental Needs for Cats with DJD: Preserve Access to Promote Comfort	Dr. Margaret Gruen	IVAPM
Feline-Friendly Handling & Interactions: Evidence-based Techniques	Dr. Ilona Rodan	Ceva, Royal Canin, sleepypod
Hands-Free Radiology: Strategy, Training, & Implementation Ideas	Dr. Dennis Keith & Ms. Carolyn Spivock	
What About Cats? Rehabilitation Techniques for Feline Patients	Dr. Kristin Shaw	Zoetis Petcare
Cats Gotta Scratch: The Case Against Feline P3 Amputation	Dr. Robin Downing	IVAPM, Morris Animal Foundation
Managing Chronic Pain Following P3 Amputation	Dr. Robin Downing	IVAPM, Morris Animal Foundation
Oral Abstract - Feline Histoplasmosis: Serology as a Non-Invasive Diagnostic Alternative	Dr. Mariana Jardim	

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Nursing Management of the Urinary Obstructed Cat	Mr. Harold Davis	NAVTA
Anesthetic Monitors: Understanding Their Use & Limitations	Ms. Heidi Reuss-Lamky	NAVTA
Who Needs an Anesthetic Plan? YOU DO!	Ms. Heidi Reuss-Lamky	NAVTA
Purr-fect Feline Anesthesia	Ms. Heidi Reuss-Lamky	NAVTA
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Treatment of Chronic Pain	Ms. Alison Gottlieb	NAVTA
Feline Chronic Pain: Getting Cat Owners on Board	Ms. Alison Gottlieb	NAVTA
Feline Nursing Care for the Hospitalized Patient	Ms. Alison Gottlieb	NAVTA

Environmental Needs for Cats with DJD: Preserve Access to Promote Comfort

Margaret Gruen, DVM, MVPH, PhD, DACVB

Introduction

Degenerative joint disease (DJD) is currently considered to be the most common cause of chronic pain and mobility impairment in cats. The presence of degenerative joint disease is associated with changes in activity, social behavior, and temperament in cats (Benito et al., 2013; Bennett & Morton, 2009; Clarke & Bennett, 2006; Klinck, Frank, Guillot, & Troncy, 2012; Zamprogno et al., 2010), and the prevalence of DJD increases with increasing age (Lascelles et al., 2010; Slingerland, Hazewinkel, Meij, Picavet, & Voorhout, 2011). DJD in cats likely results from a combination of genetic, metabolic, and biomechanical factors, similar to osteoarthritis in people (Lee et al., 2013), though knowledge in this area is still developing. Despite increasing awareness of DJD among veterinarians, diagnosis of DJD still lags behind the documented prevalence (Lascelles et al., 2010), in large part due to the difficulty of measuring pain, and the absence of a reference-standard for diagnosis.

The presence of DJD and associated pain affect cats' quality of life. While much work has focused on the development and evaluation of treatments for chronic pain in cats, one way that we can help cats and owners is to provide information about environmental modifications that can preserve access and promote a healthy environment for cats. Understanding cats' natural history and environmental needs informs the environmental changes that are most beneficial for cats.

We start with cats' natural history. Cats are mid-level predators, and show behaviors typical of both predator and prey. They have a flexible social structure, with group size dictated by concentration of resources. They are slow to welcome newcomers to a group, but do form strong social bonds with other pets and people. Vertical space is important for cats in providing a feeling of safety and as a means for sharing space, and cats use scent marking for communication and to avoid conflict (and cats are quite conflict averse). In natural settings, their time budget includes plenty of sleep (44% of the day), rest (25%), and hunting (17%) with grooming (8%), travel (3%), eating (2%) and other activities (1%) making up the balance. Their history and evolved preferences are important in considering how we meet the goals of environmental enrichment, which include maintaining physical health, increasing use of the environment, preventing development of abnormal behaviors, and providing opportunities for choice and control through promoting species-specific normal behaviors.

Behavioral Signs of DJD in Cats

With their status as mid-level predators, it is sometimes thought that cats hide pain. However, cats actually show a range of behavioral signs of pain that caregivers and veterinarians can detect. Perhaps partially due to their history, cats often do not display these signs in the veterinary clinic, putting caregivers in the best position to watch for these changes, and note when they occur. As changes in behavior that result from DJD pain develop over an extended period of time, signs may go unnoticed unless caregivers know what to look for in their cat. These signs include difficulty in jumping up (hesitation, missing/not clearing the jump with their hind legs, pulling themselves up with their front legs), jumping down (reaching down before jumping, awkward or heavy landing, turning sideways to land), climbing stairs (stopping midway, bunny hopping, moving diagonally), difficulty in the litterbox (getting in or out, holding posture for elimination), and changes in play (laying down to play, less interest in play). Caregivers can also observe changes in social interaction, less tolerance of petting, changes in mood, and changes in where cats rest. Because of individual differences in behaviors, it is important for caregivers to know what is normal for their cat, and to be watching for changes as cats age. Veterinarians can help by having caregivers take video of their cats performing activities at home to be evaluated in the clinic. The best activities are the ones most commonly affected by DJD pain (jumping up, jumping down, walking, going up and down the stairs). These can be captured in short clips as each behavior takes only a few seconds; these videos can provide enormous insight for veterinarians. When caregivers are aware of DJD and associated pain, they are often more engaged in the monitoring and treatment, including the environmental changes that benefit these cats.

Environmental Needs for Cats

The environmental needs for cats with DJD are not fundamentally different from the needs of all cats, but the way that we provide them often has to be modified. This is particularly true in the United States, where the majority of cats are housed indoors, and all their environmental needs must be provided by their caregivers. The basic environmental needs include: social interaction with people, comfortable resting spaces, exercise, play, feeding, scratching, and toileting areas. Social groups of cats can share resources, but these are often not shared across social groups, so should be provided as an "environment of plenty".

Given the high percentage of their time spent sleeping and resting, cats need safe spaces, typically elevated, in order to meet this need and to rest comfortably. When cats have DJD and mobility impairment, access to these sleeping and resting spaces needs to be preserved. Three-dimensional space is important to cats' sense of safety and their ability to "get away" when needed, and increased 3-D space has been associated with fewer agonistic interactions between cats. As jumping, running, and climbing ability decreases, it becomes important to provide ways for cats to get to these areas, or access alternative safe spaces. Ramps, stairs, and yoga mats can help cats continue to access their preferred spots, and using key-access cat doors can allow cats to enter or exit a room without being followed by others.

For litterboxes, two things can be assessed: the cat's core area and the accessibility of the box and entrance. The cat's core area is where they spend 50-75% of their time (Sung & Crowell-Davis, 2006). Cats with DJD may begin to narrow this core area, so this needs to be reassessed periodically, with owners noting where their cats spend time. For the box itself, a low entry (easily walked into) and high sides (if holding postures is problematic) are the two best features. Often caregivers can make these themselves using a sweater box with a "U" cut into the side for entry.

Scent is another important component of enrichment. This includes avoiding aversive scents (these vary by cat), promoting positive scents (including olfactory enrichment like silvervine and catnip), and offering opportunities for scent marking (by retaining comfortable bedding and scratching substrates). Scratching is used for both scent marking and nail conditioning. Positions and types of scratching substrates need to be considered in cats with DJD, particularly if resting or core areas have changed, as cats will often scratch soon after waking. Cats with DJD may need to be offered a variety of scratching substrates including different materials and orientations (horizontal vs. vertical).

Play remains important for cats as they age, and many cats with DJD will continue to play when given the opportunity. Too often, people assume cats no longer want to play, and do not engage with them. Play has been associated with fewer behavior problems in cats, and can be a source of social interaction and exercise. Wand toys make good choices for interactive play with owners. As hunting makes up the third largest "bucket" of a cat's time budget, using food toys can be a great way to provide enrichment for cats that meets this behavioral need. The article by Dantas et al (2016) is an excellent resource on food toys that can be purchased or made at home, and includes ways to introduce them to cats, and avoiding common obstacles to the use of food toys (Dantas, Delgado, Johnson, & Buffington, 2016).

Conclusion

Enrichment for cats with DJD is designed to meet the goals of maintaining physical health, increasing use of the environment, preventing development of abnormal behaviors, and providing opportunities for choice and control. Cats with DJD may have decreased ability to cope with change and environmental stress, and their enrichment needs reflect a modification of the resources provided to all cats. Preserving access to 3-D space, safe areas, and predictable routines help us meet our goals and promote quality of life for our feline friends.

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Feline-Friendly Handling & Interactions: Evidence-Based Techniques

Ilona Rodan, DVM, Dipl. ABVP, Feline

Introduction

Feline-friendly handling and interactions benefit all practices that work with cats, increasing feline welfare, human safety, increased job satisfaction, and client loyalty. As veterinary professionals, we took an oath to strive to promote animal welfare, defined as protecting the physiological and psychological well-being of animals, as well as the individual animal's ability to cope mentally and physically at any point in time.[1] Although veterinary care positively impacts quality and length of life, almost half of cats do not receive annual care, mainly due to distress surrounding the veterinary visit.[2-4] Sadly, the veterinary visit can also impair welfare, perhaps long-term.[5-8]

Understanding the species is the foundation of feline-friendly handling and improved welfare during veterinary visits. Cats are unique as the only solitary hunter that can live amicably with people. As such, they have strong survival instincts and protective mechanisms when they perceive threats - not uncommon during veterinary visits. Recognizing and alleviating feline distress surrounding the veterinary visit prevents feline negative emotions and undesirable behavioral responses. Fortunately, several studies help us recognize feline handling techniques and interactions that improve feline visits. The bonus is that these evidence-based techniques also increase human safety.[9-12]

How Veterinary Visits Impact Feline Welfare – The Good and the Bad

Veterinary care improves feline physical health. Unfortunately, it may also impair welfare if we don't make changes to minimize feline distress. Although we cannot ask the cat what specific aspects of veterinary care impair their welfare, we can ask their proxies – animal welfare experts, veterinarians, and cat owners.

What Animal Welfare Experts and Veterinarians Say

A survey of animal welfare experts and veterinarians, both with and without expertise in animal welfare, identified 85 factors that negatively impact feline (and canine) welfare. Of these, 70% significantly impaired patient welfare.[5] The challenge started at home, getting the cat into the carrier and transport to the practice. At the practice, factors included olfactory, auditory, novel environment, separation from family, inadequate analgesia, physical restraint, and the attitude of veterinary team members.[5] Fortunately, 68% of the identified factors could be improved in an average veterinary clinic.[5]

What Owners Say

A survey of more than 1,000 cat owners suggests that cats show impaired welfare during all stages of the veterinary visit – starting at home, in the waiting room, moving to the exam room, on the exam table, and after returning home.[6] Owners also said that restraint, pain, and anxiety led to aggression directed towards veterinarians and owners.[6]

Even though cat owners love their cats,[13] the 2017-18 AVMA Pet Ownership and Demographics Sourcebook indicated that only 54.3% of households with cats as the only companion animal visit the veterinarian at least annually.[14] The average number of annual veterinary visits was 0.7%, and stress surrounding the veterinary visit was a major factor.[7] Owners seek a veterinarian based on their knowledge, kindness, compassion and respectful and gentle handling of cats; they will change veterinarians if their cat is not handled in this manner.[13,14]

Short- and Long-Term Impacts of Veterinary Care on Welfare

Cats have good long-term memory, and previous negative experiences can impact how a cat will respond in the future.[15,16] For example, a cat that is painful or fearful during a veterinary visit may respond with anxiety and aggression at future visits. Also, there is evidence that a negative veterinary experience in young puppies can impact their long-term welfare, leading to chronic fear or anxiety regardless of environment, and this is likely to occur in kittens too.[8] Some cats may do better with house calls, but struggling and vocalization occur more commonly in the home environment.[17] Most do well in practices as long as we take measures to provide a safe space (e.g., the bottom half of the carrier), respectful handling, and familiarity of team members.[17] In fact, cats do well during second visits when the veterinarian and team members are familiar.[17]

There is also impaired health and welfare for many cats that do not receive regular veterinary care. Only 54% of companion cats visit a veterinarian annually,[4] with distress surrounding the veterinary visit as a major factor.[3]

1. Understanding the Cat and Why They React as They Do

How Cats Differ from Other Social Species

Understanding the cat is essential to feline welfare and our safety. Whereas other domestic animals evolved from pack or herd animals, cats evolved from an asocial species, *Felis silvestris lybica*.[18] The domestic cat has retained all of its' ancestor's behaviors except for sociability. As the youngest of the domestic animals,[18] the domestic cat is not necessarily fully domesticated.[19] Thus, it is more likely to anticipate threat in unfamiliar situations, such as the veterinary hospital.[20] Its strong protective mechanisms include territoriality, keen senses, and communication, all of which function to prevent conflict and potential injury that could impact its survival. These survival mechanisms are commonly observed during veterinary visits.

It is critical to appreciate that the cat does not want to be aggressive – this is its last resort. Fortunately, we can support our feline patients and reduce undesirable behavioral responses by providing an environment that respects the cat's senses, safe territory, and respectful handling and interactions that allow the cat a sense of control. Although feline communication developed to protect oneself against unfamiliar cats, we can learn to interpret body language and facial expressions (see **Table 1**) and how to respond to prevent exacerbation of signs.

Sentience

Cats, like all mammals, are sentient beings, able to experience both positive and negative experiences, with an awareness to seek the positive and avoid the negative.[1] Promoting positive emotions – including normal species-specific behaviors – and minimizing negative emotions, such as fear, enhance feline welfare.[21] Each cat needs to feel safe and to be able to find pleasure and comfort in the environment.[1]

Understanding the Cat's Keen Senses

Cats perceive the world differently than humans. They gather information through their senses, and the information is sent to the brain, which compares it to their formative and other experiences. Based on this information, emotional motivations to survive or enhance their well-being occur, triggering the behavioral response.[22]

The cat's sense of smell is approximately one thousand times more sensitive than ours, and cats also possess a vomeronasal organ to detect scent.[21] Promoting positive scents and avoiding those cats find offensive increase positive emotions in cats at the clinic. Relaxed cats often accept treats or highly palatable cat food during veterinary visits. Unfamiliar or unpleasant scents should be minimized or completely avoided when possible. These include the smells of unfamiliar people, other unfamiliar or disliked companion animals, disinfectants with scent, perfumes, and rubbing alcohol.

Cats, in general, can hear both higher and lower frequencies and the ultrasonic chatter of rodents, making their hearing range superior to most mammals, including people and dogs.[23,24] Cat-specific music decreases stress in awake cats, both at home and in the exam room.[25] In a study of cats listening to different music genres while anesthetized, classical music decreased heart rate and blood pressure when compared to all other genres. It may also reduce anesthetic doses.[26] The study did not analyze cat-specific music. Loud noises such as phones, centrifuges, washers, dryers, human voices, and the sounds of other animals should be avoided when possible and minimized when not.

Although the cat's color vision and acuity are not as good as most people's, their vision functions well to see in dim light and detect motion. Visual threats arouse them, and visibility of unfamiliar or disliked animals should be avoided. Allow the cat to feel hidden by coming down to their level and examining them from the side or behind, rather than from the front. Prepare the exam room and kennels in advance to avoid visual threats.

The Individual Cat

A cat's individual ability to cope in different environments and situations is based on its genetics, its parents' sociability to humans, the queen's health and experiences during pregnancy, and their own experiences.[27,28] The most significant experiences occur during the sensitive period of development, between 2-9 weeks of age.[27] If a kitten is handled positively and frequently during this stage and by people of different genders and ages, including children, the cat will be more amenable to handling and less fearful of even unfamiliar people for life.[28] If instead a cat was never socialized to people early in life, it will be more fearful during veterinary visits.[28]

Additionally, a study of over 5,000 cats demonstrated that kittens not kept with the queen and siblings until 12 weeks of age were aggressive towards both familiar and unfamiliar people.[29] An adverse experience at any time, such as tight restraint, pain, or fear during a veterinary visit, can lead to the cat becoming highly reactive at future visits. Even worse, there is mounting evidence that routine outpatient visits, starting with first visits, can contribute to lifelong patient anxiety.[8,30]

2. Prevention Starts at Home

Carrier Training
Promoting positive emotions and facilitating the exam for the cat and owner begins with carrier training cats at home.[31] Treats provided during training allow exploring or foraging for food which is part of a positive emotional motivation system. Two studies indicate the importance of carrier training for cats. to alleviate feline and owner distress and increase human safety. The first study used behavioral conditioning in laboratory cats to train them to enter a carrier voluntarily using treats.[32] The average training time was seven subsequent once-a-day sessions (average 6-9 sessions), gradually increasing time in the carrier and then with the door closed for up to 2 minutes.[32] As the final step, cats were carried within the carriers from one area to another. Carrier and transport training, even in initially fearful cats, improved feline welfare and human safety.[32] In the second study, cats were trained to carriers and transported by car.[31] This training reduces signs of stress during transport and shortens the duration of the veterinary visit, indicating that owners should be encouraged and educated to carrier train their cats.[26] See **Table 2** for carrier training videos.

Other Positive Training
For owners that follow through with feline training recommendations, cats can also be trained for mini-exams and to get onto a small pet scale. Training cats to small pet or baby scales helps to minimize fear with scales at the veterinary practice. Weighing cats at home every two weeks will also help clients recognize weight gain or unintended weight loss to aid in early detection and early veterinary care. Mini-exams also make cats more comfortable during veterinary exams and may result in earlier detection. Start training as early as possible. However, if not trained earlier, adult and senior cats can be readily trained to acclimate to the carrier and mini-exams.

Transport
One study educated owners prior to feline anesthesia to use F3 pheromone (Feliway Classic) in the carrier and to keep the carrier covered and stable from home to practice. These cats were not trained to carriers. When compared with cats whose owners did not follow the transport education, cats showed fewer signs of fear and tolerated handling better.[33] Also, sedation induction time was shorter, and the needed dose of Propofol was lower.[33]

Overall Recommendations
It is ideal for cats to be carrier trained as well as trained to mini-examinations. Request that clients bring familiar items such as bedding, treats, and toys. Even if that has not occurred, recommend spraying or wiping bedding and the carrier cover with Feliway Classic. Explain how covering the carrier with a towel or blanket before leaving home and keeping the carrier covered until in the exam room can reduce feline fear by minimizing arousal of the senses. According to the Center for Pet Safety Crash Tests, place carriers on the floor of the back seat; the only carrier that is safe to seat belt in the back seat is the Sleepypod. Playing cat-specific music may also be helpful. If motion sickness, prescribe maropitant. If fear/anxiety occurs surrounding the veterinary visit, recommend anxiolytics to be given prior to subsequent visits (anxiolytics discussed later).

3. Cat Friendly Practice
Established by the American Association of Feline Practitioners and the International Society for Feline Medicine, the Cat Friendly Practice/Clinic® program (CFP/CFC) is a global initiative designed to elevate care for cats by reducing the stress for the cat, caregiver, and also the entire veterinary team. The CFP and CFC programs help reduce distress associated with veterinary visits, improve the quality of care provided, and support the veterinary team so that the entire staff is educated and knowledgeable about the cat's distinct needs and behaviors. There are different certification options for the practice and every team member, regardless of title. In a 2020 survey, 99% would recommend CFP to others, 81% reported increased visits due to the CFP program, and 70% reported increased revenue due to the CFP program.

4. One Room/One Suite
As it takes 5-10 minutes for a cat to acclimate to a new location,[34] it is best to keep the cat in one room or suite or condo (AKA cage). For outpatients, take the cat directly from vehicle to exam room, minimizing the sights, sounds, and smells of the busy practice, as well as the visibility of unfamiliar animals and people. A concierge service is highly successful, with the cat and owner remaining in a temperature-controlled vehicle until the exam room is ready, avoiding a waiting room with other pets. If not possible, have a feline-only waiting area, cover the carrier with a towel impregnated with synthetic feline pheromones (Feliway Classic), and place the covered carrier on an elevated surface.

Prepare the exam room with all that may be needed for the appointment before bringing the cat to the room. Have towels, a high-sided cat bed (they are easy to wash and dry) or another place to hide, treats, a small pet scale, and sample collection supplies in the room. A variety of feline treats and some toys are essential additions to exam

rooms! As most practices do not have multiple otoscopes/ophthalmoscopes, blood pressure machines, etc., these can be carried in when the doctor +/- technician/assistant enter the room to prevent the commotion of frequent trips in and out of the exam room.

The cat should remain in the covered carrier or be allowed to explore if it so chooses. To prevent patient arousal, do not have someone check TPR and weight before the doctor comes in. Not removing the cat from the carrier more than once and doing all of the examination at one time is also more efficient. The doctor can perform the exam on the vast majority of patients without any support.

If it is necessary to transport the cat to another area of the practice, carry the cat within its closed and covered carrier, avoiding high traffic and noisy areas. Avoid the treatment area due to the additional activity and noise that can increase fear. Cats examined in the exam room with the owner present had fewer signs of fear/anxiety, and the heart rate was 30 beats/minute lower than in the treatment area.[35]

If hospitalization or boarding is needed, prepare the suite (AKA cage) or condo with all the cat's needs before removing the cat from the exam room. Cats boarding or hospitalized for more than 24 hours need a suite with more floor space and height to allow for more normal cat behavior.[36] This increased space allows for separation of litterbox from feeding and resting areas.[36] Cats should also have a perch, and if current cages do not have one, there are inexpensive options to provide a perch. Hiding areas placed on a side wall are necessary and facilitate removal of the patient from the suite. If your feline housing for these cats is not condos or double compartment cages, add a portal between two side-by-side cages to allow a larger suite. See the following links:
https://www.sheltermedicine.com/library/resources/?r=cat-cage-modifications-making-double-compartment-cat-cages-using-a-pvc-portal.
https://www.sheltermedicine.com/library/resources/?r=what-is-double-compartment-aka-double-sided-housing-and-why-is-it-essential-for-housing-cats-and-dogs-in-animal-shelters-clinics-and-hospitals

An added benefit to allowing more normal cat behavior is that cats usually don't soil cages or move items around to find a hiding space if one is provided. Feeling safer, the cage usually only needs minor cleaning without removing the cat and placing it into another suite. They also are more likely to interact positively with caregivers. "Spot clean" without chemicals and without disturbing the cat; instructions are available at Instructions_for_Spot_Cleaning_Cat_Cages_2015_ck.pdf.

5. Positive Visits and Interactions from the First Visit On
As veterinary visits can cause chronic fear and distress, they must be as positive as possible from the first visit on. How we interact with the cat is critical. Giving the cat choice of location and position is essential (evidence provided in next tip). While bonding with the client, assess the cat's emotional state from a distance, just as we assess for respiratory distress. Based on the emotional assessment, we form a plan to handle the cat. (how we interact with cats with negative emotions will be addressed under "When cats are still challenging").

First visits can be highly positive, distracting or redirecting kittens and unfearful cats to a treat, preventing negative associations with veterinary care. One can also entice cats to where you want them to go by placing delicious treats, such as the lickable treats, in that location. Even if cats cannot be distracted, end on a positive note as pediatricians and pediatric dentists do, sending home something the cat likes.

6. Gentle Handling is Superior to Tight Restraint
Many articles allude to the fact that cats are more reactive with physical restraint, increasing the likelihood of human injury.[37-43] Surveys indicate that injury rates are reduced for veterinary professionals in Cat Friendly Practices that use more gentle handling techniques. In 2018, scientific evidence demonstrated that cats respond negatively to tight restraint when compared with passive handling techniques. [40] Tight restraint consisted of placing a cat in lateral recumbency, with its' back against the holder, while holding front and back legs, allowing little to no movement. Passive handling provided the cat choice to stand, sit, or lay down, with the ability to move head, body, and limbs. The odds of struggling were 8.2 times higher with tight vs. passive restraint, exams took longer with full restraint, and cats were more likely to escape after it. Body postures and other negative behaviors that demonstrated signs of distress were noted with tight restraint. [41] Additionally, when cats were brought back to the handling locations, they showed aversion towards the environment where they were tightly restrained, choosing to spend more time in the environment where passively handled.[40]

Another study indicated that gentle or passive handling was superior to tight restraint, clipnosis, and scruffing.[42] Additionally, scruffing, shaking, forceful stretching, and restraint gloves lead to loss of sense of control, a cause of poor feline welfare. Fortunately, another study indicated that a complete physical examination was possible without any restraint in 76% of cats.[43]

The Fewer People, the Better
The examiner can perform most or all of the physical examination on their own. Ideally, examine the cat in the carrier if it chooses. to remain there, either by removing the top half of a hard-sided carrier or through a wide opening of a soft-sided carrier. Cats that like to sit on laps may prefer to be snuggled in the examiner's lap, either facing the client or hidden within bedding.

If assistance is needed, one additional handler is acceptable, but not more as that is likely to lead to more potential for feline fear and struggling. Sedation or rescheduling a preventive care appointment is recommended if the cat cannot be handled comfortably. When indicated, give sedation in the exam room.

Preferred Areas of Touch
Cats prefer human touch in the same regions that socially bonded cats groom one another to strengthen the social bond.[44,45] These regions are over the cat's facial glands, which produce pheromones to communicate between members of the same species. [44,45] The facial glands consist of the temporal glands between the ears and eyes where the fur is often thinner, the cheek glands, perioral glands around the corners of the mouth, and the submandibular gland in the chin area.[45] Massaging, petting, or gently rubbing these areas while remaining to the side or behind the cat helps to reduce feline distress.

7. Hiding Options
As territorial animals, a safe space is essential for survival, and hiding is an important coping mechanism, especially in an unfamiliar environment. Studies prove that hiding options reduce distress and negative emotions.[46-49] Provide options to hide during appointments, hospitalization, and boarding.

Examination and completion of many procedures can be performed with little or no assistance when cats feel hidden due to the cat's increased sense of security in its safe territory or hiding place. The handler's position to the side or behind the cat – and not in front – furthers the cat's sense of being hidden.

Hiding options in hospital and boarding suites or condos (AKA cages) allow for more restful sleep and improved recovery.[47,48] Placement should be so that the opening does not face the front of the suite, and the cat has the option to remain hidden or peer out. Cats housed in cages are more likely to approach people and retreat less when provided a hiding option.[48] Ideally, perform examinations, pain scores, and blood pressure measurements when indicated within the suite, with the cat remaining hidden if it so chooses. If a cat housed in the clinic does not approach when a person comes to greet them, and if removal from the cage is necessary, remove the cat within the hiding place. At discharge, if the hiding place is not the carrier, have the carrier next to the suite to ease removal.

Preferred Hiding Options
Hiding options that allow easy access for veterinary care include the bottom half of a hard-sided carrier, a soft-sided carrier with a large opening, a cardboard box with an opening on the side, a high-sided or igloo cat bed, blankets, and towels. Familiar and favored feline bedding is ideal, although not all owners remember to bring them; have cat beds and other options available at the practice. Soft high sided and igloo cat beds can be placed in washers and dryers between patients and last for years.

One or two towels rolled into a donut-shape that opens in the front is an excellent option for cats in the post-operative period when they may need urgent care. In awake cats, place boxes or beds against a side wall of suites to allow the cat the choice to hide or to watch what is going on.

8. Slow Blink
Slow blinking is thought to be associated with positive emotional communication.[50] Cats are more likely to slow blink back if a person blinks slowly in their direction, even if the person is unfamiliar.[50,51] The cat responding with a slow blink also has reduced body tension.[50,51] Ensure that the blinking is slow, as rapid blinking is a sign of fear/anxiety.[52] The author has "slow blinked" with very positive results for many years, even with cats displaying negative emotions. A good time to start this is when obtaining the history, making eye contact with the owner, and explaining to them that you will slow blink in the cat's direction without staring at them, which could be threatening.

9. Order of Exam
Ideally, bring the cat directly from the vehicle to the exam room and allow the cat the choice to remain within the covered carrier while obtaining the history. History collection is also a great time to assess the cat's emotional state from a distance and to think about the best options for handling this individual cat. Remember to slow blink.

The majority of cats prefer to remain within the carrier throughout the visit, even if not carrier trained. Most of the examination can be done while the cat remains in the carrier and facing away from you, further alleviating feline distress and increasing the accuracy of exam findings and diagnostic tests. For cats that choose to remain within the carrier, do whatever is possible there first, and only move the cat once to complete what is difficult to do within the carrier.

The order of the examination should start with the least distressing for that individual cat, usually auscultation of the heart and lungs. Most cats do best if orthopedic and oral examinations are performed at the end of the examination; these sites are more likely to be painful, and cats are usually less familiar with owners touching them. Perform the retinal exam after auscultation and palpation. In most cases, weigh the cat at this point in the examination. Move the scale covered with a towel close to the carrier. Place a treat on the towel and allow the cat to choose to go onto the scale by itself. If the cat stays in the carrier, zero the scale, gently pick up the cat only a few inches above the carrier and scale, and place it on the scale. Diagnostics, starting with blood pressure, and treatments should follow. Most Cat Friendly Practices do not take temperatures in apparently healthy and awake patients. There is wide variability between axillary and rectal temperatures, making axillary temperature measurements unreliable.[53]

Allowing clients to remain with their cats during all outpatient procedures usually reduces stress for both cats and owners. It increases client appreciation and respect for the veterinary care provided in your practice. It is helpful for most cats to have the owner remain in the room minimally for the blood pressure even if they do not want to observe other diagnostics.[34]

Measure the blood pressure from any limb or one inch from the base of the tail, whichever is most comfortable for the cat. However, sarcopenia can impact the appendages, making blood pressure results more accurate from the tail in sarcopenic cats.[54] Over the coccygeal artery is also advantageous in cats with severe osteoarthritis in the limbs and aroused cats.

Cats should also remain in a comfortable position for venipuncture. Many cats do well in a semi-lateral position to collect from the medial saphenous or a sternal or sitting position for jugular collection. Use dilute chlorhexidine solution rather than rubbing alcohol for venipunctures and intravenous catheterization. Unless collection is from the jugular vein, use a 25 gauge butterfly catheter to facilitate collection.

Cystocentesis can be performed in a comfortable lateral or standing position or via ultrasound-guided collection. If done in lateral position, let the cat hide by covering the front half of the body and massaging over the facial pheromones. Do not pull out hind feet; instead, move the lateral thigh back, placing a hand over the femur and avoid placement on the joints.

10. When Cats are Still Challenging

Assessing feline emotions and behaviors aids safe interactions with cats and enhances their well-being. As less experienced individuals are more likely to be injured,[55,56] it is also an excellent teaching tool. The emotions to consider in practice have been reclassified to fear, anger/rage, contentment/happiness, joy/play, and interest.[22,57,58] Note the number of positive emotions. In a recent study, 35% of cases had more than one emotional response.[58] We will address how to interact and handle cats with positive and negative emotions.

Positive Emotions

Contentment/happiness, joy/play, and interest are all positive emotions seen during veterinary visits. Content cats have the lowest risk of impaired welfare and pose the least risk to the handler. These cats have all their needs met and are accepting of their current state.[58] Thus, the importance of the AAFP Cat Friendly Practice program and positive training to further aid feline contentedness. Ask owners about their cat's preferences to facilitate interactions.

Cats, however, can be challenging to handle with other positive emotions. The emotions of joy/play and interest both carry a moderate risk to patient welfare and handler injury. Interest is caused by the presence of a novel stimulus or seeking behaviors.[58] There are three different forms of play that can occur with the joy/play emotion - locomotor, social, or object play.[58] The emotions of interest and joy/play can be met with appropriate play. Interest can also benefit from feeding enrichment and visual stimulation.[58] However, if interest and joy/play are not satisfied, the emotion of anger/rage can occur. The goal is to meet the positive emotional needs of these patients. Delicious treats can distract these individuals and even redirect them to where you want them to go, such as the scale, satisfying their emotional needs, and facilitating handling.

Negative Emotions

Negative emotions are not bad emotions! They function to support survival.[20] Fear is a protective (negative) emotion in response to an immediate perceived or threat of danger. It carries a high risk for impaired welfare and moderate risk for handler injury.[58] The behavioral responses are to withdraw or escape, and these cats are often hypervigilant. Pain can be considered part of this emotional system, with pain exacerbating fear and fear exacerbating pain.[22,59,60] It is important to recognize that pain is both a sensory and emotional response, impacting physical function and the patient's emotional welfare.[61] An example is people with chronic pain are more likely to have depression. Degenerative joint disease, lower urinary tract disease, and periodontal disease are well-recognized painful and chronic conditions in cats. Since fear or anxiety can exacerbate pain, resolution includes both minimizing perceived threats and administering analgesia.[62]

Anger/rage is also a protective emotion. It results in a high risk of both impaired welfare and handler injury. There is a frustrated desire to perform an action, including escape, exploration, or competition for resources.[58] These cats are more likely to become quickly frustrated and aggressive.

The Traffic Light Rule for Feline Interactions

A helpful plan for handling and interacting with cats is the WSAVA Animal Welfare Guidelines' traffic light for assessing the animal's emotional state.[1] Green means proceed, meant for calm and relaxed cats in a low state of emotional arousal. Yellow, slow down, is for cats are in a heightened state of emotional arousal, either freezing (inhibition) or fiddling. Red or stop is for cats in a very heightened state of emotional arousal, either fleeing or fighting.

Pharmacological Treatments

Pharmacotherapy can significantly lessen a cat's distress, but if indicated, they should be used concurrently with a cat-friendly environment and feline-friendly handling when indicated.

Anxiolytic Before Veterinary Visit – Who Needs It and What to Give

Gabapentin is an excellent feline anxiolytic and more effective than other pharmaceuticals and nutraceuticals.[63,64] Studies demonstrate that the lowest cat stress scores are at 2-3 hours.[63,64] In practice, the general dose is 20mg/kg is 100mg/cat, but some cats become very sedated.[64] Gabapentin is renally excreted, and the dose should be reduced in cats with chronic kidney disease, perhaps by 50%.[65] Gabapentin comes in 100mg capsules, and most cats will consume the powder from the capsule mixed into canned food. The drug does not work transdermally.[66] Ideally, cats that have had a previous negative experience at the veterinary practice benefit from a combination of carrier training and gabapentin at future visit(s). Additionally, cats born to feral parents, those not socialized to people during the sensitive period, or that have had a bad experience at any time in life - even if not associated with veterinary visits – are good candidates to receive gabapentin before veterinary visits. Other anxiolytics may be given in conjunction to the gabapentin. Clients should administer anxiolytics at home prior to outpatient appointments and admittance for procedures including anesthesia or boarding. Anxiolytics are not effective if a cat is already aroused.

When Sedation is Recommended and What to Use

There is less need for sedation when cats are given gabapentin prior to veterinary visits and handled respectfully in an optimal feline-friendly environment. However, if gabapentin was not administered to a cat demonstrating negative emotions prior to the appointment or additional therapy is needed, sedation is usually indicated. Recommend sedation if it takes more than two people to respectfully and safely handle a patient, if the cat is hissing and lunging and turning towards a person while still in a closed carrier, if struggling, or if painful procedures where analgesia is insufficient. Anesthesia is also necessary for some patients. However, in an apparently healthy cat, a good option is to reschedule the appointment, combining an examination with a needed procedure (e.g., dental prophylaxis). In these cases, send home a prescription of gabapentin and advice on carrier training.

Benefits of sedation for examining certain patients and procedures include less physical restraint, decreased stress, simpler airway management, avoidance of inhalants, and rapid recovery.[61] Good feline sedation options are dexmedetomidine and alfaxalone, usually in combination with other drugs such as opioids for analgesia. Alfaxalone (2mg/kg) is apparently safer in cardiac disease, and occult heart disease is not uncommon in cats. This information has not been confirmed in cats with hypertrophic cardiomyopathy. Still, it is based on studies in healthy cats indicating no change in echocardiographic measurements with alfaxalone.[67] In contrast, dexmedetomidine may cause decreased heart rate, increased blood pressure, and echocardiographic changes of both atrial and ventricular size and function.[61,68] Butorphanol provides superior sedation and a lower incidence of vomiting than buprenorphine when given intramuscularly in combination with dexmedetomidine.[69]

Concluding the Appointment - Client Education
For clients that have not yet trained their cat to the carrier and mini-exams, this is a great time to educate them. There are carrier training resources through Cat Friendly Practice and Cat Friendly Homes.

Conclusion
Feline-friendly handling techniques prevent feline stressors, subsequently reducing the negative emotions and behaviors that team members often consider difficult.

Table 1. Recognizing the behavioral response to negative emotions to help develop a plan for interacting with and handling of individual cats.

Body Postures	Facial Expressions	Inhibition of normal behaviors
Hiding Crouched Head lower than rest of body In the back of the carrier or cage Tense muscles Hypervigilant Piloerection Trembling Sweaty paws Unsheathing claws Swatting Lunging	Dilated (fully or partially) pupils Oblong pupils Pupils fixated on the subject Ears held back or rotated to the side Whiskers splayed out Lip licking Rapid blinking Drooling Mouth open – hissing, shrieking	Inappetence or not eating Inhibition of groom Not eliminating Lack of play behavior Inactivity Failure to sleep - Hypervigilant - Feigned sleep

Table 2. Carrier training video links:
Cat Carrier Training, Part 1: https://www.youtube.com/watch?v=mM2BXLJkLhc
Cat Carrier Training, Part 2: https://www.youtube.com/watch?v=wtRCxysZEro&t=4s
Cat Carrier Training, Part 3: https://www.youtube.com/watch?v=OVH31RWfwzg
Carrier Training, Friends not Foes: https://www.youtube.com/watch?v=9RGY5oSKVfo&t=312s

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Available upon request.

NOTES:

Hands-Free Radiology: Strategy, Training, & Implementation Ideas

Dennis Keith, DVM, DACVR and Carolyn Spivock, RVT

Introduction

- Do your technicians wear gloves each and every time they restrain a patient for a radiographic procedure?
- Are your patients calm, comfortable and compliant during the entire procedure?
- Have you seen your staff dosimeter readings (exposure) diminish over time?
- Has the diagnostic quality of your radiographic images improved over time?

Safely obtaining diagnostic quality radiographs is of paramount importance for your patients and for your hospital team. Capturing properly positioned radiographs, while minimizing exposure to radiation and reducing stress for our patients and team members is always the goal. The balance between the advantages of using ionizing radiation for diagnostic imaging and the potential hazards it poses for our teams and patients has been a difficult challenge.[1] Hands-Free Radiology has the potential to change that balance by optimizing the benefits while greatly reducing the risk. Implementation of a Hands-Free approach to diagnostic imaging does not happen overnight. It requires the participation of the entire hospital team to advocate for its importance, develop smarter workflows, and ensure patient safety and comfort.

Why Is This Important?

For Our Teams

A brief internet search quickly reveals the rising levels of awareness surrounding health and well-being. The ability of ionizing radiation to damage DNA and create health concerns represents an opportunity to change historical processes which create risk. Finding ways to address personal safety, and reduce stress, will help the team members feel appreciated and valued.

A person's exposure to ionizing radiation typically consists of [2]:

- Background exposure, which consists of small doses from natural sources.
- Medical exposure, which occurs when a person has a radiographic procedure (including CT) or scintigraphic scan.
- Occupational exposure, which occurs when a person is exposed to ionizing radiation at their workplace.

While background exposure is inevitable, and medical exposure is carefully considered to ensure the benefits outweigh the risks, *there is no level of occupational exposure that is considered complete safe.* Therefore, veterinary hospitals operate under the ALARA principle, which requires that occupational exposure be *as low as reasonably achievable*.

Hands-Free Radiology makes reasonable changes to the workflow which greatly reduces staff exposure, while improving patient comfort, and delivering consistent radiographic quality. By actively addressing the patient anxiety and fear, we also create a safer environment for our staff by reducing the likelihood of bites, scratches, and other adverse animal-human interactions.

For Our Patients

Modern veterinary practice involves the active process of evaluating our patient's experience for the potential to induce fear, as well as the potential to cause pain. Obtaining diagnostic images can be a stressful and potentially even a painful experience for our patients. Whether they are in need of survey studies to confirm their current health status or an image is needed to aide in the diagnosis of a concern, our patient's overall health and wellbeing must be taken into consideration. Treating each patient as an individual and being able to adapt to their needs and present situation has to be in the forefront of our minds.[3] It is important for team members to recognize early signs of fear, anxiety and pain and do what they can to minimize or mitigate that for their patient.

The radiology suite is a dark room, with a bright light, unfamiliar sounds and smells and they are on a hard table. You then have team members donning protective gear, including gloves to hold a patient in place. These gloves prevent the connection made by direct contact. It is very much the opposite of the compassionate and soothing environment we hope to provide to our patients. Actively addressing the anxiety and stress, as well as the use of sedatives when appropriate help make the radiographic process less fearful, less painful, and less stressful.

Program Goals
Our Hands-Free Radiology program would have the following goals.

- Reduce the exposure of staff members to ionizing radiation.
    - By reducing the number of staff present during the radiographic exposure, and by increasing the distance between the patient and the staff member.
- Reduce patient stress and anxiety during the procedure.
- Improve radiographic quality by reducing motion during the procedure and creating greater awareness of patient positioning for optimal diagnosis.
- Recognize our staff health and safety, as well as their importance to our organization.

General Strategies
Distance Over Shielding
At its core, Hands-Free Radiology reduces staff exposure levels by moving the primary protective strategy from shielding to distance. One beauty of the trefoil used to warn people about radiation, is that it can remind us of the three primary protective strategies: Time, Distance, and Shielding.

Time is the easiest of these to comprehend. If you need to retake an image once, the exposure is doubled, if you do a second retake, the exposure is tripled. Reducing retakes by preparing properly, thorough training on the operation of the machine, and sedating patients to reduce motion will reduce staff exposure.

Shielding is the most visible strategy. Everyone recognizes the lead aprons, gloves, glasses, and thyroid guards so common in our practices. Scatter radiation has relatively low energy, which makes lead a viable option for protection. Unfortunately, there is a limit to the amount of lead that can be worn while performing the necessary tasks, which means that lead equipment cannot sufficiently protect against the energy of the photons in the primary beam.

The strategy I see most practices neglecting is distance. Increasing the distance between the source of the radiation, and the staff member can greatly decrease their exposure.

This reduction in exposure is governed by the *inverse-square law* which states that exposure is reduced by the square of the distance from the source to the person. So, if we can increase the distance between the patient and the staff member from 1" (holding) to 36" we would expect a reduction in their exposure by a factor of 1296. Extending that distance to 6 feet (72") would quadruple the reduction again (reducing by a factor of 5184).

How does shielding compare to distance as a strategy? A typical lead apron with 0.5mm lead equivalence weighs up to 7kg and reduces exposure to the protected areas by 99.9% at 50kVp [4] (a factor of approximately 1000). 6 feet of distance reduces total body exposure by a factor of 5184. Switching from shielding to distance as our primary strategy to reduce exposure has the potential to significantly diminish the risk. We recommend the staff member wears protective gear and utilizes additional shielding such as mobile lead barriers or lead lined drywall (in addition to 6 feet of distance) to create the lowest possible exposure, which should be negligible in such a situation.

Patient Compliance and Workflow
Generally, skilled technicians can use passive restraint devices to restrain calm and compliant pets without the need of sedatives. We can also work to prevent wind-up by ensuring patients are treated in feline-friendly and low stress ways. As an organization we consulted with anesthesiologists and developed some simple anxiolytic and sedation protocols that facilitate patient comfort and compliance.

> *For cats, a sedation protocol with butorphanol and midazolam will often produce a compliant patient. However, in healthy cats a microdose of dexmedetomidine may increase the effect if needed.*

However, the additional time required for the patient to become sedate does mean that routine radiographic procedures are scheduled separate from annual exams, emergency imaging should be done following pain management, and that the proper equipment needs to be readily available.

Each of these presents an opportunity to improve. A schedule for routine imaging could be developed so that more trained and experienced staff are on duty to perform the procedures. Changing client expectations that their pet's pain will be treated prior to imaging should reduce their concern, and result in more diagnostic images. However, these also require that everyone involved understand the goals, and are ready to answer client questions, pause to evaluate patient readiness, and generally remove the pressure of immediacy that we so often experience.

Implementation Strategies for Hands-Free Radiology
Equipment, Supplies, and Changing Expectations

A successful Hands-Free Radiology strategy would first depend on adequate training and equipment. We have developed a brief list of positioning devices and equipment that should be made readily available to technicians. When selecting specific equipment, care should be taken to evaluate durability, flexibility, and ease of care/disinfection. Sandbags or weighted devices must be flexible enough to be shaped around more sensitive anatomy such as the ventral neck. The total weight of these devices should be appropriate for the patients being imaged, with smaller, lighter devices available for cats. Foam positioning devices can be found in both covered and uncovered options, although covered devices are recommended for ER and other high throughput facilities.

Example List: Supplies and Equipment

- PPE (apron, gloves, thyroid guard, goggles/glasses)
- V-Troughs
- Table pad
- Sandbags of appropriate size
- Foam positioning wedges and blocks
- Ties, tape, flexible straps
- Towels
- Pheromones/mimics pheromones
- Moveable lead shield
- Pedal /Button outside of room
- Sedation chart
- Diagnostic imaging positioning posters/aides

Example: Topics for Team Training and Discussion

- Talk about concerns and obstacles.
- Evaluate your current process and what you want to change.
- Discuss communication strategies for effective communication within the team and also with clients
- Determine additional training needed images can be obtained with competence and confidence.
- Roleplay how the front desk discusses this or describes this to a client.
- Analyze and discuss the impact to the hospital workflow when scheduling radiographs.
- Develop and review sedation protocols and appropriate monitoring for patients.

Strategies for Success
Promoting a safety culture in your hospital can truly improve the potential for success[7]. The aspects of the Nuclear Regulatory Commission's (NRC) safety culture include:

- Leadership Safety Values and Actions
- Problem Identification and Resolution
- Personal Accountability
- Work Processes
- Continuous Learning
- Environment for Raising Concerns
- Effective Safety Communications
- Respectful Work Environment
- Questioning Attitude

Keeping all of these aspects in mind can help your hospital and team truly be successful in this initiative. Collaboration and cooperation are the true keys to success and focusing on what is best for your individualized patient and your team.

Approaching Hands-Free Radiology from a team approach is important for overall success. Having all members of the hospital team participate and understand the importance for the safety of our patients and our team helps with the adoption of this technique and methodology. Some hospitals may already have this approach, but we hope there will a wider change in the industry. Introducing these ideas and continually revisiting them on a monthly or quarterly basis, celebrating wins and identifying challenges help ensure all members of the team can influence the overall approach and success of implementation and sustainability.

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NOTES:

What About Cats? Rehabilitation Techniques for Feline Patients
Kristin Shaw, DVM, MS, PhD, DACVS, DACVSMR

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Cats Gotta Scratch: The Case Against Feline P3 Amputation

Robin Downing, DVM, MS, DAAPM, DACVSMR, CVPP, CCRP

Overview of P3 Amputation (Feline Toe Amputation)
This is about more than mere scratching - - scratching is hard-wired – it's a cat's keyboard. It produces olfactory markers and visual markers, allows them to remove old nail sheaths, and it provides exercise/stretching that just plain feels good!

So, how did P3 amputation (feline toe amputation) become a "thing"? As more cats were being kept indoors, in conjunction with the invention of kitty litter, the idea of feline toe amputation was first presented in a letter to the editor in the *Journal of the American Veterinary Medical Association* in 1952 by a Chicago veterinarian. There was no study of short-term or long-term effects - - it was just an idea. The AVMA states that "Onychectomy is an amputation and should be regarded as a major surgery." Removal of the third phalanx – analogous in humans to cutting off each finger at the last knuckle. And, tendonectomy is no picnic. It severs the tendon that controls the claw in each toe, so cats keep their toes but can't control them.

What excuses are offered for feline toe amputation?

- Concerns about scratching children
- Autistic children
- Immune suppressed or seniors in the home
- Destructive scratching – cats now live indoors

As for concerns about scratching children, amputated cats are generally more likely to bite. Here is what is important - - teach APPROPRIATE play! What about autistic children? Austria, Australia, Brazil, Finland, Germany, the Netherlands, New Zealand, and the United Kingdom all have autistic children (and immunocompromised folks), yet feline toe amputation is ***banned.*** With immunosuppressed/seniors living in a cat home, the CDC does NOT recommend toe amputation or relinquishment. Instead, the CDC recommends the following:

- Cats should live inside (less prone to parasites)
- Cats have appropriate flea protection (*Bartonella* exposure*)*
- Play using interactive cat toys
- If amputated, cats may be more likely to bite (potentially a more serious issue for this population)

Destructive scratching is another excuse for feline toe amputation. 1.4 million cats are euthanized in shelters annually, and at least half are behavior related. Inappropriate elimination leads the list at 37 to 43% among reasons for relinquishment. Here are additional reasons that are cited:

- Aggression – 10 to 18%
- Biting – 14%
- Intolerant of children – 11%
- Destructive Scratching – 8 to 10% (low on the list)

Here are some things to consider. Onychectomy has long and short-term complications, including pain, hemorrhage, soft tissue swelling, nerve trauma, infection, lameness (Patronek 2001; Mission et al 2002). There is some suggestion that amputated cats are more likely to bite and eliminate inappropriately (Patronek 2001; Yeon et al 2001). Phantom pain is common post amputation in humans – but we can't ask cats. And, "The pain literature suggests it's likely" (Downing 2016). When pain is poorly managed at the outset (e.g. at surgery) this means ongoing, perpetual, self-sustaining chronic maladaptive pain that constitutes life-long torture (WSAVA, 2014; Costigan, 2009; Dahl, 2011). Cats still are not receiving aggressive multi-modal post-operative pain management, setting the stage for "forever pain".

More things to consider… Approximately 60% of a cat's body weight is carried on front feet, and amputation alters foot biomechanics and changes how cats move. Altered biomechanics enhances the development/progression of OA (Downing 2016). Approximately 63% of cats showed radiographic evidence of residual P3 fragments from poor surgical techniques (Martell-Moran, Solano, et al, 2017), and this is "…like walking on nails" (Downing 2016). There is an association between declaw & back pain (altered biomechanics), aggression and barbering, plus

inappropriate elimination (neuropathic pain in feet). The odds of relinquishment are likely greater with these than from scratching behaviors.
Biting/aggressive cats are far more dangerous than cats who may scratch humans (usually by accident). "In view of these findings the on ongoing practice of declawing cats should be further questioned." (Martell-Moran, Solano, et al, 2017). In 18 declawed cats with a history of missing their litter boxes, a two-week trial of a pain relief drug (Buprenorphine) and 90 percent begin to use their boxes regularly again (Gaskin, 2017). This reflects chronic maladaptive pain.

Many declawed cats develop hyperflexion, or club-footedness - - a callous on the hyper-flexed digit paw pad is common and is ***abnormal.*** Walking on the amputated toe tips is painful and this chronic pain worsens over time - - the pain can be so intense that the cat may have increased cortisol and thus an increased risk of diabetes. Cat owners may not report pain, but they often do report changes in cats' personalities - - some bite, some hide more. Gait changes make arthritis more likely (Gaskin, 2017).

So, does feline toe amputation prevent problems or add to them? What about more biting, inappropriate elimination, aggression to people and/or other cats? Both the AVMA and the AAFP have (finally) started to move toward a removal of feline toe amputation as an inappropriate procedure for veterinarians to perform, AND, the AAFP has (finally) taken a stand that Cat Friendly Practice certification WILL NOT HAPPEN in practices that continue to amputate cat toes.

Pain and Feline Toe Amputation
What about the pain aspect of feline toe amputation? First off, cat owners, by and large, do ***NOT*** understand that what we sanitize by calling it "declaw" is actually multiple toe amputation. With new cultural awareness about our returning wounded warriors, more of our clients understand the implications of amputation. From just the pain perspective (we'll get to biomechanics in a moment), feline toe amputation is not as simple as we once thought. First, consider the periosteum, rich in nociceptors (why fractures and OSA are excruciatingly painful). Also, joint capsules, which are cut during toe amputation, are rich with nociceptors. Next, fragmented bone, common in toe amputation, tries to find a fragment to which to heal leading to sharp proliferative edges. Proliferating or leftover sharp bone spurs perpetually poke at the underside of the skin at the end of the remaining toe. Only a few studies have evaluated the presence of leftover bone fragments or the regrowth of bony tissue, but it happens and condemns these cats to walking on needles/nails. And, remember, cats live to mask their pain.

Now let's talk about neuropathic pain… Post-amputation pain is an enormous issue in human medicine, and is acknowledged to be hugely prevalent and is generally refractory to treatment (as many as 2/3 of patients undergoing amputation) – Hsu & Cohen Journal of Pain Research. This is discussed as "post amputation pain" (PAP) and "phantom limb pain" (PLP). It is probably better for us to call it "altered sensation". Amputation means cutting nerves, and even with aggressive pain management, persistent & perpetual pain happens following cut nerves. Multiple studies in veterinary medicine demonstrate that cats generally do not receive appropriate pain management in the perioperative period. Humans describe their neuropathic pain as "tingling", "burning", "electric-like", "lancinating", "pins & needles", and "unpredictable" (Woolf, et al 2006). Cats are wired just as we are - - nerves are nerves - - so the probability that they will develop abnormal sensation is exceptionally high. The manifestation of neuropathic pain may include:

- Reluctance to walk on certain surfaces
- Reluctance to jump onto or off furniture, cat trees, windowsills, etc.
- Over-grooming of feet and/or legs

Biomechanics and Feline Toe Amputation
Let us now consider the biomechanics of feline toe amputation. Toe amputation forever alters the biomechanics of the feet, which alters the biomechanics of the entire body. Toe amputation changes the architecture of the feet adding stresses to tendons, ligaments, and joint capsules. Cats carry 60% of their body weight on the front feet, so altering foot biomechanics alters how the entire body moves.

Superimpose chronic, maladaptive, neuropathic post amputation pain onto altered front foot biomechanics and we amplify the downstream implications. The majority of cats >10 years old suffer from OA in at least one joint (Kerwin 2010, Lascelles 2010). Thus, altered whole-body biomechanics creates ergonomically unsound movement patterns resulting in altered joint force generation & micro-traumas. Altered joint force generation and micro-traumas in turn contribute to the development and progression of OA. Thus, toe amputation impacts more than just the joints of the front feet - - think facet joints of the spine, stifles (leading to ACL disease),the L/S junction, etc. In turn, OA elsewhere in the body adds to the amplified pain experience, altered movement, & interference with normal feline lifestyle.

Solving Scratching Issues
If destructive scratching is solved, then is feline toe amputation even an option? There are two solutions that work, and work best together. First, behavior modification (which takes some time), Pheromone products attract cats to appropriate scratching surfaces, and we must PROVIDE SCRATCHERS! Cats scratch inappropriately is there are either no posts or not enough for the number of cats in the home. Cats need both vertical & horizontal choices, and they must be in the right locations. Sometimes the substrate choices are not attractive to them. They may not have been encouraged or trained cats to use posts. And, poor posts can be a problem - - not sturdy, not tall. Remember, once they've scratched it – it's theirs!

Where should scratchers be located? Near where the family is. Near favorite napping locations (good for stretching when waking). Not next to another vertical scratcher (not side by side). As a part of feline aerobic center. Near windows. Near doors most often used by family. And, think about (at least) one for every cat in the household.

What about scratching school? You CAN train cats (kittens if possible) to use scratchers. You need catnip and Feliway Classic (at least). Clicker training, observational learning, physically helping the cat scratch (gently), and coaxing with a toy are all strategies that work. ***NEVER PUNISH*** cats for not using scratchers!!! Make inappropriate scratching places unattractive or uncomfortable to scratch where the cat ***is*** scratching AND simultaneously offer appropriate places to scratch. Deterring undesirable scratching can include:

- Keeping nails clipped
- Soft Paws (nail caps)
- Double sided tape/Sticky Paws
- Upside down rug runner
- Upside down car floor mat
- Aluminum foil (+/- sprayed with Bitter Apple)

Bioethics and Feline Toe Amputation
As a final focus, let's talk about the bioethics of feline toe amputation. Traditional medical ethics failed to keep up with emerging advancements. Medical decision-making is often not a simple yes/no proposition. Medical (and veterinary) professionals are distinguished from the general population by training, knowledge, and the provision of special services. We need to balance between "What is best for the patient?" and "What is best for the client?" Clinical bioethics is all about asking, "Just because we ***can***, does that mean we ***should***?"

The four cornerstones (moral norms) of clinical bioethical decision-making are respect for autonomy, nonmaleficence, beneficence, and justice/fairness. Respect for autonomy is traditionally applied only to clients in the context of decisions made after delivery of medical information and when considering the consequences. We have a positive obligation to deliver comprehensible information to our clients. It also means truth-telling, respecting confidentiality, obtaining consent before proceeding with procedures/treatments on the pet, and helping with decisions when asked.

How about respecting the autonomy of our patients? Consider this - - *"… our love for our pets should be shaped and informed by our recognition of the ways in which their needs and their lives are their* **own***, peculiar to the sorts of animals they are…"* (Hursthouse 2011). Companion animals can/do express preferences. Their preferences are expressed much like pre-verbal children. One can argue that cats would prefer to keep their toes.

As for nonmaleficence, this is often loosely translated as "Do no harm". Please ask yourself, does amputating P3 of cat toes cause harm? Of course it does. Toe amputation causes pain and altered biomechanics, altered ADLs, and altered natural behaviors.

Beneficence is next, and that means acting in the patient's best interest. Can amputating the toes of cats for convenience ever be argued to be in the ***cat's*** best interest? Respectfully, this appears to be a self-evident "no".

Finally, in the interest of fairness, we can ask if feline toe amputation ever be argued as fair to the cat with the attendant compromise to comfort and lifestyle? Again… no.

What does the future look like? Several facts have emerged:

- We know now more than ever before about the physiology and emergence of persistent maladaptive post amputation pain

- Cats are living longer and longer, making the biomechanical alterations/aberrations more important
- Cats ***do*** develop OA, and altered biomechanics contributes
- The US is one of ***very few*** developed nations in the world in which feline toe amputation remains legal
- Veterinarians are slow to change (as a profession)
- The time has come to make the transformational change to stop this barbaric practice
- Since self-regulation seems to be a problem, this mandate ***will*** come via legislation

NOTES:

Managing Chronic Pain Following P3 Amputation

Robin Downing, DVM, MS, DAAPM, DACVSMR, CVPP, CCRP

"They Don't Deserve to Hurt"

At The Downing Center for Animal Pain Management, LLC, this is our practice motto. We consider it our moral imperative to advocate on behalf of beings who cannot advocate for themselves. The consequences of unmanaged (or badly managed) pain move the patient along a spectrum from beneficial to a minor nuisance to a decreased quality of life to unbearable and, finally, to pathophysiologic effects (which can include death).

So, why is pain important? For years, chronic pain was tolerated in cats and dogs as a necessary evil. It is often cited as reason for euthanasia in order to relieve suffering, It is more complex than once thought. And is best approached from a multi-modal perspective. This means recognizing the need to utilize pharma, nutrition, physical medicine, nutraceuticals - - all the tools in our toolboxes.

Identifying cats with painful feet means ***listening*** carefully to their owners. Some clients witness their cats "walking funny". They may say that it looks like they are:

- Walking on glass
- Walking on nails
- Walking "lightly

Some clients witness their cats holding up a foot (or alternating feet) when they stop and sit, or that they prefer some surfaces to others. Some clients witness their cats licking their feet or forelimbs excessively. Conduct a careful physical examination with a focus on the feet and toes. It is important to identify abnormal tissue including residual bone fragments or regrowth/proliferation from the end of P2. With post-amputation pain, there may not be discomfort when the feet are palpated. Radiographs of the feet are important in diagnosing the need for additional surgery. In the absence of physical explanations for toe/foot pain, we must presume and address pathophysiology in the spinal cord and nerves.

This is called "maladaptive" pain (more later).

Setting client expectations is very important as these cats generally require lifetime management. Some of these cats had their toes amputated before they were adopted by their current owners, so you may never know details about their surgery.

Adaptive vs. Maladaptive Pain

We need to update our previous training about different "types" of pain - - acute vs. chronic, cancer pain, acute on chronic, etc. Pain happens on a spectrum - - transitioning/transforming from "adaptive" pain to "maladaptive" pain. If we deal with pain aggressively early on, we prevent the transformation to maladaptive pain. Maladaptive pain gives us more targets to treat. Adaptive pain includes nociceptive pain which is transient pain in response to a noxious stimulus. Inflammatory pain is also adaptive in its early stages, but if left unchecked it is the gateway to spontaneous pain and hypersensitivity to pain in response to tissue damage and inflammation (see: Clifford J Woolf, Annals Intern Med 2004). Maladaptive pain includes neuropathic pain, which is spontaneous pain and hypersensitivity to pain in association with damage to or a lesion of the nervous system. It also includes functional pain, which involves hypersensitivity to pain resulting from abnormal central processing of normal input. At the end of the day, maladaptive pain is the result of what we call "wind-up". This involves sensitization of nociceptors, and peripheral and central pain pathways, in response to a barrage of afferent nociceptive impulses resulting in expanded receptive fields and an increased rate of discharge.

Because maladaptive pain results from a cascade of events that includes altered anatomy (conformation), injury, inflammation, repetitive injury, inadequate pain management early, we recognize that amputating P3 (feline toe amputation) is precisely the type of tissue trauma that results in maladaptive pain in the toes and feet. Post-amputation pain (PAP) happens in an enormous number of human patients, and is a challenging and moving target - - these patients can (and do) change over time.

Addressing Maladaptive Pain

It is important to understand that there ***will*** be pain "downstream" in the body as a result of the altered biomechanics (e.g. in the facet joints of the spine) caused by the abnormal gait in these cats. We expect the incidence and intensity to increase with age as the tissues age. Prevention is the best strategy (more later). We need to look for pain in other parts of the body - - e.g. the torso - - and treat that pain as well. A multi-modal approach works best. In order to be most successful with these patients, we must FIRST break the pain cycle. Pharmacology provides us the

most effective options to achieve that disruption of the pain cycle quickly. Once the pain process is blunted, we can work through a long-term strategy for maximum comfort/function. Successful treatment of these cats means reframing the task to one of ***management*** rather than ***treat to cure.***

There is an inflammatory component to maladaptive pain, so managing inflammation is a part of the process. In the short term, NSAIDs play an important role but cannot be the ***only*** tool used. Adjunctive agents (pharma, non-pharma, and physical medicine) serve a critical role. We need to approach these patients with specific targets in mind:

- Physiologic targets for the body
- Receptor targets within the nervous system
- Anatomic targets - - e.g. cartilage/joints

Be sure to look at the ENTIRE patient to ensure that you have all the appropriate targets of therapy in mind at the beginning of your pain management strategy. Be sure to have a complete metabolic profile before beginning and update it at regular intervals - - early disease detection trumps irreversible adverse side effects. Make your plan, write it down, adapt it as needed.

Nutrition as Pain Management

Weight normalization is a critical adjunctive pain management tool. Overweight impacts all joints, including the damaged joints in the toes. All other pain management interventions work better for the patient once weight is normalized. Make as specific a plan as possible, write it out for the client, and then create a regular and consistent follow-up schedule. Only by engaging the client can you achieve compliance. Follow the science to recommend the best nutrient profile for the job. In cats we now have a "metabolic diet" that allows the body to burn fat and retain muscle. Prescribe a SPECIFIC nutrient profile, a SPECIFIC portion per day, and have your recommended product available. Clients need to be educated that over-the-counter pet foods will NOT do the job. Schedule regular weigh-in appointments to partner with clients for best success. Make the next weigh-in appointment at each scheduled weigh-in or other assessment. Painful patients will be presented for regular pain reassessments, so their weight should be recorded at each of these visits as well. Weight loss starts right away and so does breaking the pain cycle pharmacologically. After setting the stage for weight normalization, create a rational pain therapy plan by targeting specific receptors

Pharmacology and Pain Management

Targeted therapy is still a new concept in veterinary medicine. Educate clients about the need for poly-pharmacy. Initiate pain management plan, schedule regular reassessments for revisions of the plan, titrate to lowest effective doses (which may be "zero" for some medications).

NSAIDs remain a cornerstone of pain management - - even maladaptive pain - - decreasing inflammation and reducing pain. NSAIDs also act at various spots in nervous system. We have the ***most*** data in cats about meloxicam (see the *ISFM & AAFP Consensus Guidelines: Long-term use of NSAIDs in cats*). In my practice, I use meloxicam only VERY short-term, and with a titrating schedule. Meloxicam dosing:

- 0.05mg/kg daily for 4 day
- then 0.025mg/kg daily for 4 days
- then 0.01mg/kg daily for 4 days
- then 0.01mg/kg every other day for a total of 7 – 10 days

PLEASE NOTE: Precision dosing is critical, so we remove the syringe that comes with meloxicam and replace it with a 1cc oral dosing syringe that is calibrated to 1/100 cc. Create a prescription label with precise measurements and timing listed.

Gabapentin affects the α-2-δ ligand of the calcium channel in the dorsal horn of the spinal cord. It "unwinds" windup and central sensitization (Anesthesiology, V 101, No 6, Dec 2004). It is demonstrated to assist in dogs with presumed neuropathic pain (a form of maladaptive pain) (Aust Vet J 2009; 87:45–50). And, this retrospective study of 240 dogs receiving gabapentin for chronic pain (J Vet Med Res 7(4): 1194) articulates the wide range of doses that can/must be used.

Begin your dosing regimen with BID dose given once in PM for 3 – 4 days, then increase to BID. Sedation is dose-limiting side effect (reduce the dose if needed). After resolving sedation, if pain persists, attempt dose increases. Gabapentin has non-linear pharmacokinetics so dose escalations will be much different from what we are used to. I increase doses every 2 – 3 weeks to reach the desired effect. Clinically, in chronic/maladaptive pain cases, gabapentin improves outcomes in pain scores and function – both short and long-term. Dosing regimen:

- 5 – 10 mg/kg PO BID – TID to start

- Dose ONCE daily in the PM for 3 – 4 days, then BID
- Effects within 24 hours – consistent effects within 3 – 5 days
- Regular reassessments/dose modifications to reach pain relief

My own 10# (rescue) cat needed 300mg BID in order to move properly. She had:

- Front toes amputated as a kitten
- Chronic morbid obesity
- Bilateral ruptured ACLs with resultant stifle fusion
- Severe OA in lower spine

Do NOT stop gabapentin abruptly as you ***will*** induce rebound pain. Human maladaptive pain patients rarely stop gabapentin. We are "re-educating" the dorsal horn of the spinal cord and the micro-anatomic changes are not be reversible.

Amantadine acts on the NMDA receptor in the CNS and may be used long-term. It is a useful as an adjunct for chronic/maladaptive pain (published data in dogs – J Vet Intern Med Jan-Feb 2008;22(1):53-9). The dose used in cats by Dr. James Gaynor:

- 3mg/kg once daily for a 21 day cycle

Amantadine has no inherent pain-relieving effects, so it is used as an add-on. Compounding makes it affordable. PSGAGs provide the body with the building blocks of cartilage. They assist the body in the repair of cartilage experiencing micro-fractures from altered biomechanics, which provides indirect anti-inflammatory effects. PSGAGs work best when the body is still in motion and the joints are still in use. This is extra-label use:

- 2 mg/# SQ 2 X per week for 4 weeks
- weekly for 4 weeks
- then every 10 – 15 days long-term

Nutraceuticals and Pain Management
Nutraceuticals play a critical role in managing chronic maladaptive pain (follow the data).
Omega-3 fatty acids:

- Dose to EPA @ 50 – 100 mg/kg/day divided
- Need the triglyceride form – bioavailable
- Nordic Naturals® Omega-3 Pet Liquid, Nutramax® Welactin, Vetoquinol® Triglyceride OMEGA Liquid

UC-II (Undenatured Collagen Type II):

- Induces "oral tolerance"
- Immune modulation via lymphoid tissue (Peyer's patch) in gut

Microlactin®:

- Milk protein from hyper-immunized cows
- Inhibits cytokines that in turn inhibit neutrophils & blocks inflammation
- ***Different*** mechanism than NSAID/steroid, so can be used concurrently
- Takes time for peak effects (10 – 14 days)
- Establish pain relief and then begin titrating down NSAID or corticosteroid
- Few side effects reported (primarily GI)

Green-lipped mussel (*Perna canaliculus)*:

- Essential fatty acids - - EPA, etc.
- Palette of bioactive lipids
- Can be complemented by HA molecules of specific molecular weight
- **MUST** be manufactured in a way that does not cause denaturing or interfere with efficacy

With ***ALL*** nutraceuticals, it is the ***formulation*** not simply ***ingredients*** that must be evaluated in the target species

Physical Medicine and Pain Management
General nursing care, physical rehabilitation techniques, chiropractic techniques, acupuncture, and medical massage can all contribute to patient comfort. Likewise, environmental management and ecosystem management is important

- - surface management, living indoors vs. outdoors, stairs, etc. Physical rehabilitation techniques include cryotherapy, moist heat, massage, therapeutic exercise, passive/active ROM, therapeutic ultrasound, therapeutic LASER, acupuncture, chiropractic, electrostimulation, and tPEMF.

Preventing Maladaptive Pain
If you must provide a medically indicated toe amputation think ahead. Prevention is easier than treatment. Just like managing chronic maladaptive pain, a multimodal approach is best. Pain management happens before, during, and after the procedure. Multimodal therapy utilizes multiple actions on the CNS to prevent and treat pain.

Our protocol:

- Pre-op - -
  Acepromazine (diluted to 1mg/ml) SQ; 0.01mg/kg (in same syringe as opioid pre-med); Potentiates effect of opioid by acting synergistically; ***NO*** analgesic effects

  Hydromorphone (2mg/ml) SQ; 0.1mg/kg (in same syringe as ace pre-med); We deliver the PA about 15 – 20 minutes before placing the IV catheter; EMLA takes about 15 – 20 minutes to provide topical anaesthesia Cerenia (10mg/ml); 2mg/kg SQ; We deliver this as soon as the patient enters for surgery day; ***Profound*** improvement in patient outcomes; No vomiting pre-op; Awaken with no nausea; Happy to eat when they get home
- Induction/Maintenance - -
  We use a propofol/midazolam induction; Sevoflurane maintenance; Smooth to sleep, and smooth awake
- Local anaesthesia - -
  We use bupivacaine at formulary dose; Line block SQ on anterior/dorsal surface just distal to carpus; Bleb on palmar surface just distal to accessory carpal pad
- Post-op - -
  Meloxicam injection (5mg/ml); 0.1mg/kg SQ; Meloxicam oral (1.5mg/ml) – starting the day after surgery; 0.05mg/ml daily for 4 d, then 0.025mg/ml daily for 4 d;

  Buprenorphine (long-acting - Simbadol®) (1.8mg/ml); 0.24mg/kg SQ; We follow up with the owner for 2 subsequent doses the next 2 days

This is an aggressive protocol, but it has proven its utility by the outcomes we see. Such a proactive approach applies to any surgical procedure we perform. We find this approach to be particularly useful for dental interventions in cats when we must perform multiple extractions.

Pain Summary:
LOOK for pain and you will find it. Give the cat with toe amputations the benefit of the doubt about pain. Learn how to "ask" your patients if they hurt. Learn how to respond when they say "yes".

NOTES:

Management of the Emergent Feline Patient

Harold Davis, RVT, VTS (ECC) (Anesthesia/Analgesia)

The management of the emergent feline patient can be a challenging endeavor primarily because of the nature of the "beast". Aside from the obvious acute traumatic injury the cat is adept at hiding signs of illness. Chronic disorders may smolder until an acute and sometimes unrelated process is superimposed on them. Regardless of the species, the ultimate goal in the management of the emergent or critically ill patient is to optimize oxygen delivery (DO_2) to the tissues.

Initial Observation

An initial 'eye-ball' of the patient provides important information, before any hands-on contact is made. In this time two major issues are addressed. First, how serious does the situation look? Obviously, the animal that can maintain sternal recumbency and is aware of its surroundings is far less concerning than the animal in lateral recumbency with no apparent response to external stimuli. Second, are there any obvious life-threatening problems that will require attention at or before the time you can evaluate the A-B-Cs? Problems such as arterial hemorrhage or an open chest wound may warrant immediate intervention.

Patient History

The animal's signalment (age, sex, and breed) can provide direction for the diagnostic workup. For example, pediatric or juvenile patients are more likely to contract infectious conditions. Respiratory distress due to heart failure is noted more frequently in male than female cats. Feline asthma is noted more frequently in Siamese cats compared with other breeds. Signalment provides clues to the underlying disorder but never provides a definitive diagnosis.

Does the patient have any pre-existing medical conditions or on medications? Historically, the owner may be able to provide information that supports a reason for hypovolemia such as trauma, excessive urination, diarrhea, or vomiting. What is the travel history of the pet? This may assist in determining clinical suspicion for infectious or parasitic respiratory disease. Pet's environment gives the veterinarian a sense of potential exposure to toxins or infectious diseases. Animals that can run free or are unobserved can potentially be exposed to anything, such as anticoagulant rodenticide, forest fire, or house fire smoke.

Physical Assessment – Primary Survey and Resuscitation

The primary survey is the initial, brief assessment of the patient (1 – 2 minutes). When a life-threatening problem is identified then resuscitative action is instituted immediately. To maintain focus in managing the emergent or critically ill patient it is helpful to utilize the five-step "ABCDEs" method. The five steps and their order of priority are as follows:

A - Airway
B - Breathing (ventilation)
C - Circulation
D - Dysfunction or disability of the central nervous system
E – Examination/Exposure.

Airway/Breathing

The airway/breathing portion of the primary survey addresses those issues that can affect the patient's oxygenating and ventilating ability. Maintaining oxygenation is one of the primary goals of the critical care team in maintaining oxygen delivery.

Upper airway
- Inspiratory / expiratory stridor or stertor
- Cyanosis
- Extension of head and neck
- Orthopnea
- Choking
- Honking sounds

Lower airway
- Wheezes
- Abdominal effort/push with prolonged expiratory phase
-

Table 1 Clinical signs of airway obstruction

Assessment of the respiratory system and correction of abnormalities as rapidly as possible is critical in obtaining an optimal outcome for patients. First, airway and adequacy of ventilation should be assessed. This is done by visualization, auscultation, and palpation. Life-threatening airway/breathing problems may be due to apnea, airway obstruction (upper and lower – Table 1), penetrating and / or open chest wounds, pleural filling defects (pneumothorax, Pleural effusion, and diaphragmatic hernia – Table 2), pulmonary parenchyma disease (pulmonary edema, pneumonia – Table 3). Sometimes it may be difficult to differentiate respiratory distress due to respiratory disease from heart disease in the feline patient. The body temperature is frequently subnormal in cats with heart disease, but generally normal or elevated with pulmonary disease.

The presence of a heart murmur, gallop rhythm or arrhythmias is strong evidence for cardiac disease.

- Open mouth breathing
- Paradoxical respiration
- Tachypnea
- Cyanosis
- Orthopnea
- Crackles

Table 2 Clinical signs of pleural space defect

- Short shallow breaths
- Tachypnea
- Open mouth breathing
- Cyanosis
- Diminished to absent breath sounds

Table 3 Clinical signs of pulmonary parenchyma disease

Radiographs are generally not taken during the primary survey. It is important to remember that radiographs are not therapeutic and should not be performed until the patient is not in danger of imminent death. That said, radiographic imaging and point of care ultrasound (POCUS) can be helpful in making a diagnosis of pleural filling defects, pericardial effusion, rib fractures and pulmonary parenchymal injury. Of the two modalities, POCUS has the potential for being least stressful for the patient.

If in doubt about the patient's oxygenation status, supplemental oxygenation should be provided until it is proven that it is not required. Clinical signs (mentation /anxiety level, mucous membrane color, heart rate, respiratory effort, and rate), will have to be utilized to assess effectiveness in the absence of arterial blood gases or pulse oximetry. In addition to oxygen administration, other therapeutic options include airway suctioning, removal of airway obstruction, intubation, or tracheostomy tube placement, mechanical or manual ventilation, diuretic administration, temporary closure of open chest wounds, thoracentesis and / or thoracostomy tube placement and intermittent or continuous suction / drainage.

Circulation

Six perfusion parameters are used to assess the circulatory system. They include mentation, mucous membrane color, capillary refill time, heart rate, pulse quality, and extremity temperature. These clinical findings should be evaluated in combination; an abnormality in a single parameter does not have the clinical significance of multiple abnormalities. Clinical signs suggestive of decreased perfusion include decreased mentation, pale or grey mucous membranes, prolonged capillary refill, poor pulse quality, cool extremities, and decreased urine production. In the canine patient tachycardia is the appropriate and expected response to circulatory shock. Feline shock patients will often present without a tachycardia and this is not considered to have prognostic relevance as it does in dogs. Decreased perfusion may be due to hypovolemia as a result of external blood loss, concealed blood loss (loss into a body cavity or limb) or severe dehydration. It may also be due to pump failure (intrinsic heart failure, arrhythmias, cardiac tamponade).

Fluid resuscitation is the cornerstone of therapy for improving inadequate tissue perfusion. The goal is to fully resuscitate the patient in 10 – 20 minutes. First, venous access will need to be obtained by placing a peripheral catheter percutaneously in either the cephalic or medial saphenous vein. A potential problem with this technique is the possibility of the catheter tip flaring or tearing because of the drag on the catheter as it goes through the skin or the cat has tough skin. A facilitative incision or relief hole reduces the skin tension and friction against the catheter. A facilitative incision may be made with a number eleven blade or a 20-gauge needle. A 0.5 – 1 millimeter incision is made directly over the vessel extending through the dermis. Care should be taken to avoid the vessel when making the relief incision. Placement of an intravenous catheter is the opportune time to obtain blood samples for minimum database lob test.

In the event vascular access cannot be obtained the establishment of an intraosseous (IO – Bone marrow) line is a reasonable alternative. Fluid or drugs administered by this route are rapidly taken up into the circulatory system. The most common sites for access include the trochanteric fossa of the femur, the greater tubercle of the humerus, and crest of the tibia and the cranial aspect of the proximal humerus.

Fluid Type	Total Shock Dose
	Cats (mL/kg)
Isotonic Crystalloids	50 – 55
7.5% Hypertonic Saline	3 – 4
Synthetic Colloids	5 – 10
7.5% Hypertonic Saline & Synthetic Colloid	1.5 & 3

Table 4 Guidelines for shock doses of intravenous fluids in cats

Options for fluid resuscitation include isotonic crystalloids (Lactated Ringers, Hartman's Solution, Normosol R, Plasmalyte 148, and Normal or Hypertonic Saline), and colloids (Plasma, Hetastarch, Voluven, VetStarch and whole blood). Crystalloids are used most commonly in fluid resuscitation therapy. Crystalloids are dosed in 1/4 shock dose increments of the total shock dose (Table 4).

Catecholamines, such as dopamine or norepinephrine are indicated when the patient is unresponsive to vigorous fluid therapy and arterial blood pressure, vasomotor tone, and tissue perfusion have not returned to acceptable levels. These drugs support blood pressure primarily by causing vasoconstriction. It is suggested that if these drugs are used blood pressure monitoring is necessary. Dobutamine is a catecholamine that targets the heart, increasing myocardial contractility but it has little impact on vasomotor tone. It is used when myocardial failure is the suspected or known cause of poor perfusion. Catecholamines should not be a substitute for adequate volume restoration.

Dysfunction / Disability

Dysfunction/disability refers to the neurological status of the patient. This may be assessed through visualization and palpation. A cursory neurological examination is performed focusing on the patient's level of consciousness, pupillary size and light reflex, posture, and response to pain (superficial and/or deep).
Non-ambulatory traumatized patients should be treated as spinal trauma patients until proven otherwise. In the meantime, the patient should be immobilized. If suspected head injury the head and neck should be elevated at a 15 – 30-degree angle. Avoid applying pressure to the jugular veins; pressure on the jugular veins can lead to increased intracranial pressure. Oxygenation and ventilation must be supported because the cerebral vasculature is responsive to hypoxemia and hypercapnia, both situations can contribute to increased intracranial blood flow secondary to vasodilation. When there is evidence of fluid volume deficits, fluid resuscitation will be required. The type of fluid used is not as important as the end result of restoration of the volume deficit. Isotonic or nearly isotonic crystalloids, hypertonic saline and colloids (Hetastarch) have all been utilized. Hypertonic therapy such as mannitol or hypertonic saline is indicated in the treatment of suspected increased intracranial pressure. Signs of intracranial hypertension include Cushing's triad (Hypertension, bradycardia and bradypnea), deterioration in the patient's level of consciousness, posturing, and changes in resting pupil size and loss of pupillary light response.

Examination/Exposure

During this final phase of the primary survey a rapid whole-body examination is performed including abdominal palpation if not contraindicated. The goal is to determine and address any additional problems that may not have manifested itself during the initial phase of the primary survey. If necessary, the fur may be clipped to provide better exposure of the skin looking for wounds or defects. If toxins are present on the fur or skin they are rinsed off.

Minimum Laboratory Database
Laboratory test can be useful in assessing the condition of the patient. In the emergency setting there may not be sufficient time for a complete lab workup and a minimum database will have to be sufficient. At the very least pretreatment blood samples should be collected for testing once the patient's condition is stable. Each hospital will have to determine their definition of a minimum database, it can be as simple as a PCV, total protein, dipstick BUN, glucose, and blood smear. The database can also be as elaborate as those things previously mentioned and blood gases and electrolytes.

Secondary Survey
Following the primary survey, a secondary survey is performed. The secondary survey is the timely, systematic, and directed evaluation of each body system for injury. Injuries of a lower priority are addressed following initial stabilization. A thorough head to tail physical examination and history are completed. Finally, a comprehensive plan of diagnostics and monitoring is developed and carried out.

Specific Emergencies
There are a few emergencies that might be considered unique to the feline patient or at least occur more frequently than in other species. Regardless of the type of emergency, therapy is directed at optimizing oxygen delivery while sorting out or treating the primary problem(s).

Feline Lower Urinary Tract Disease (FLUTD) With Obstruction
Clinical Signs
Diagnosis can be arrived at relatively easily based upon history and physical examination. In one study the most common clinical signs reported by the owners were stranguria (89%) or dysuria (88)[i]. Other reported signs included vocalizing, lethargy, anorexia, vomiting and excessive licking of the perineal area[1]. During the physical examination the patient may present with signs suggestive of decreased perfusion, dehydration and a large firm non-expressible bladder.

What's to Be Done Immediately
- Place intravenous catheter
  - Initiate fluid therapy
- Check electrolytes
  - Treat life threatening hyperkalemia if present
- Relieve obstruction
- Assess azotemia

What Should Be Done Later
- Assess urine production which can be low, normal, or high
- Re-assess electrolytes
- Re-assess azotemia
- Comfort measures
- Catheter care (IV and Urinary)

Arterial Thromboembolism
Arterial thromboembolism (ATE) occurs when a fragment of an intracardiac (generally left auricular appendage) thrombus embolizes in the arterial circulation until it obstructs a distant vessel and infarction of that arterial bed occurs.

Clinical Signs
Clinical signs associated with aortic thromboembolism vary with the location of the embolus. In the case of a saddle thrombus, pain, pallor, paresis, poikilothermy and pulselessness may be observed. The muscles of the rear limb can be affected and are commonly swollen and turgid, particularly the gastrocnemius. Clinical findings will be similar to the aortic trifurcation but are typically asymmetric and affect a thoracic limb. Cats with aortic thromboembolism commonly have myocardial disease. Tachypnea is often interpreted as a sign of congestive heart failure (CHF) in cats with heart disease, cats with ATE may be tachypneic due to pain, whether or not they have CHF. Auscultation of crackles or radiographic evidence of pulmonary edema may help differentiate tachypnea from pain vs CHF. Cats with rectal temperatures < 98.6◦ F (37◦ C) are less likely to survive. A confirmand diagnosis of CHF may also worsen the prognosis.

Patient Assessment
Assessment may include the standard minimum data base (CBC, chemistry, and UA); cardiac workup (ECG, Echo, Chest rads); and coagulation profile. Those test that might be considered specific and sensitive for thromboembolism include: doppler flow studies, ultrasound to visualize the thrombus,) and glucose concentration comparison between a jugular/large vein in an unaffected limb and a large vein in an affected limb. A study showed that the dogs and cats with ATE, peripheral (affected limb) blood glucose concentration is significantly lower compared to systemic glucose concentrations. An absolute blood glucose concentration difference between central and peripheral venous samples of 30 mg/dL or more was 100% sensitive and 90% specific for predicting ATE in cats. [ii] Comparing the toenail bed color of the rear paws with the front paws may be a helpful assessment tool. The affected paws may be cyanotic compared to the unaffected paws.

What's to Be Done Immediately
- Administer oxygen if in respiratory distress
- Consider pain management - full mu-opioid receptor agonists
    - Fentanyl
    - Hydromorphone
    - Methadone
    - Oxymorphone
- Assess for and manage congestive heart failure.
    - Furosemide
    - Pimobendan
- Initiate antithrombotic therapy
    - Anticoagulant (Enoxaparin, Dalteparin, or Rivaroxaban)
    - Antiplatelet (Clopidogrel, Aspirin)

What Should Be Done Later
- Monitoring
    - Pain
    - Vital signs
    - Mentation/mobility
    - Renal function/electrolytes
- Nursing care
    - Recumbant patient care
    - Physiotherapy
    - Patient comfort care

Time and supportive care will help to determine the patient outcome. If cats survive the initial episode and discharged, they may succumb to a future thrombolic event. Some cats will regain completely normal motor function following an initial thrombolic event and some survivors are more likely to die due to CHF than ATE.

Summary
As stated earlier, the goal in the management of the emergent or critically ill patient is to optimize DO_2 to the tissues.

It is possible to have any one parameter within its normal range but have a patient whose overall system(s) are failing. As a result, it is important to have an understanding of what a single parameter tells you and how to integrate it with the other assessed variables. In addition, you need to look at the trends of previous measurements and consider the recent history of the patient.

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Nursing Management of the Urinary Obstructed Cat

Harold Davis, RVT, VTS (ECC) (Anesthesia/Analgesia)

Feline lower urinary tract inflammation is characterized by many clinical signs, one of which is partial or complete urethral obstruction. Urethral obstruction is not an uncommon condition seen in practice. One study reported that urethral obstruction represented approximately 9% of the annual emergency feline caseload seen by a busy university teaching hospital's emergency service.[i]

It is important for the Veterinary Nurse / Technician to have a basic understanding of the pathophysiology and the disease process itself; this enables the Veterinary Nurse / Technician to anticipate the needs of the patient and clinician. This discussion will be presented in the form of the nursing process (Patient assessment, nursing conclusion, planning of care, intervention and evaluation). The nursing process forms the foundation for decision-making and encompasses all significant actions taken by nurses[ii] (Veterinary Nurse / Technicians). It allows the technician to be proactive rather than reactive to changes in the patient's condition and it promotes a competent level of nursing care.

Pathophysiology

Urethral obstruction occurs most commonly in the male cat; idiopathic sterile cystitis, inflammation, spasm, the length and diameter of the urethra are contributing factors. Many obstructions are caused by struvite (magnesium ammonium phosphate) – containing mucous plugs that lodge in the penile urethra. Obstruction may also be caused by uroliths. In one study causes of urinary obstruction in 45 cats were found to be idiopathic (53%), uroliths (29%), and mucous plugs (18%) suggesting that functional obstruction may be more common than previously thought.[iii] With the obstruction, the bladder capacity is reached resulting in an increase in intravesical pressure. The backpressure extends to the tubules resulting in a decreased glomerular filtration rate (GFR) leading to impaired renal function and post renal azotemia (abnormal levels of nitrogen-containing compounds, such as urea, creatinine, various body waste compounds). Urea, creatinine, and phosphorous accumulate because of the impaired renal function. The patient develops metabolic acidosis and hyperkalemia due to the inability for the kidneys to excrete hydrogen ions and potassium. Another mechanism contributing to hyperkalemia includes the intracellular shift of potassium to the extracellular fluid in exchange for hydrogen ions. Decreased ionized calcium levels have been reported in cats with urethral obstruction. Low ionized calcium concentration may have a role to play in decreased cardiac function. Low ionized calcium coupled with hyperkalemia may have a worsening effect on the heart. Dehydration and volume depletion can result from vomiting and decreased water intake.

Patient Assessment

Diagnosis can be arrived at relatively easily based upon history and physical examination. In one study the most common clinical signs reported by the owners was stranguria (89%) or dysuria (88%)[1]. Other reported signs included vocalizing, lethargy, anorexia, vomiting and excessive licking of the perineal area[1]. During the physical examination a large firm non-expressible bladder is palpated. Hyperkalemia can be a life-threatening consequence of urethral obstruction. Of five physical examination parameters (heart and respiratory rate, temperature, pulse quality and the presence of arrhythmias) temperature and heart rate where the most useful predictors of severe hyperkalemia (>8.0 mmol/L)[iv]. A rectal temperature between 95°F (35°C) and 96.6°F (35.9°C) correctly characterized hyperkalemic status in 88% of the cats[3]. A heart rate of 120 BPM. (Moderate bradycardia) tended to have the best utility for correctly identifying hyperkalemic status, being successful nearly 93% of the time[3]. This study only looked at one population of cats and has not been validated. However, these parameters may be useful in rasing the index for suspicion when anticipating the needs of the patient or clinician.

Nursing Conclusions

Once the clinician has made a diagnosis the Veterinary Nurse / Technician should begin to consider the actual and potential problems or risk factors related to the urethral obstruction. This consideration will enable the technician to be able to anticipate needs and be proactive rather than reactive to changes in the patient's condition. The Veterinary Nurse / Technician should be able to recognize the risk factors and have a plan in mind as to what action will need to be taken to address the problem.

Risk factors prior to the relief of the obstruction include cardiovascular compromise and uroabdomen. Cardiovascular compromise secondary to either or both hyperkalemia and volume depletion is the most common immediate life-threatening problem. As mentioned previously, ionized hypocalcemia can be a contributing factor to cardiovascular compromise. Uroabdomen is secondary to inadvertent bladder rupture. There are several other risk factors that should be considered following the relief of the obstruction. They include post obstructive diuresis

leading to dehydration and or hypokalemia, anemia due to severe hematuria, and catheter (urinary and intravenous) related infections.

Planning of Nursing Care
The Veterinary Nurse / Technician will need to gather the necessary equipment and supplies to treat the patient. Oxygen will be administered to enhance oxygen delivery. Intravenous access is obtained to administer fluids and or emergency drugs. Urinary catheters and sterile saline will be used for retropulsing and relief of the obstruction. Blood will be collected for electrolytes, venous blood gases (to assess acid base status), packed cell volume / total solids, blood urea nitrogen and creatinine. An ECG may be needed to assess for hyperkalemic related cardiac conduction abnormalities.

Oxygen can be administered by face mask or flow-by. A peripheral intravenous catheter is placed using aseptic technique.

Intravenous fluids will be needed to correct any existing fluid deficits and to dilute the serum potassium level. A non-potassium containing crystalloid fluid such as 0.9% Normal Saline (Sodium chloride) is commonly recommended. Potentially, 0.9% Normal Saline may contribute to a dilutional metabolic acidosis. Balanced potassium containing electrolyte solutions such as Lactated Ringers, Hartmann's Solution or Normasol®- R (Hospira, Inc Lake Forest, IL) have also been used. Balanced electrolyte solutions may allow more rapid correction of blood acid base status within the first 12 hours of fluid therapy. The use of a potassium containing balanced electrolyte solutions do not appear to affect the rate of normalization of blood potassium in treated cats with urethral obstruction[v]. Both crystalloid solutions (0.9% saline and Lactated Ringers / Normasol®- R) appear safe and effective for fluid therapy in urinary obstructed cats.

Therapeutic options to treat hyperkalemia include the administration of calcium, insulin and 50% dextrose, and sodium bicarbonate. The administration of calcium antagonizes the effects of potassium on the heart and is used as an emergency intervention when hyperkalemia is considered severe. Calcium therapy does not decrease the blood potassium concentration. Regular insulin and dextrose administration cause potassium to shift from the extracellular fluid (ECF) to the intracellular fluid. The insulin dextrose combination has a slower onset of action when compared to calcium administration. Sodium bicarbonate administration can lower plasma potassium by raising the pH and driving potassium into the cells. Bicarbonate therapy should be given with care in patients with pre-existing low ionized calcium as it can lower it even further. It is recommended to supplement the patient with calcium prior to the administration of sodium bicarbonate. In addition to volume restoration, fluid therapy with crystalloids will dilute potassium in the ECF.

Urethral catheterization supplies include a 3.5 french open ended tomcat catheter (Argyle), a 3.5 – 5 french soft catheter that can be kept indwelling such as infant feeding tubes or commercially available urethral catheters, sterile gloves, 12 ml syringe, sterile saline and lubricating gel, tape, suture, an extension tubing, associated adapters and a sterile urine collection bag. As an alternative to commercial urine collection bags properly stored (non-dextrose containing, capped and stored for < 7 days) empty fluid bags may be used as collection bags. One study showed that IV bags stored properly for <7 days were not a source of aerobic bacterial contamination when used as a part of a urine collection system[vi].

In some cases, sedation may be needed. Intravenous ketamine in combination with diazepam or midazolam ± butorphanol are options. If cardiac abnormalities are detected or cardiac disease is suspected, then ketamine should be avoided. Propofol is also a consideration.

Veterinary Nurses / Technicians should recognize the characteristic ECG changes consistent with hyperkalemia (Figure 1). They include: bradycardia, diminished or absent p-waves, prolonged P-R interval, widened QRS complexes, tall (negative or positive) tented T waves, and sine waves. It possible for a cat to be hyperkalemic without displaying the characteristic ECG changes, however, if they exist the patient has clinically significant hyperkalemia.

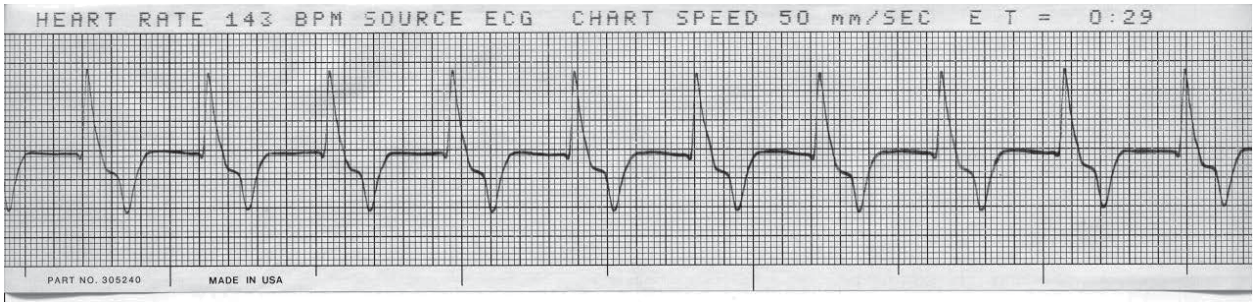

Figure 1 ECG of a hyperkalemic patient. Note the absent P-wave, widened QRS complex, and tall negative T-wave.

Analgesia such as butorphanol, buprenorphine, and hydromorphone may be considered for the alleviation of pain.

Implementation

The initial care of the urethral obstruction case is fairly straightforward. The immediate therapeutic goal is to relieve the obstruction and correct the metabolic abnormalities. The patient's condition will dictate treatment priorities. Relieving the obstruction is required for resolution of azotemia and hyperkalemia. In those cases where hyperkalemia and hypovolemia are life threatening, cardioprotective treatments and fluid resuscitation become the top priority.

Very sick cats with urethral obstruction may not require sedation to relieve the obstruction. The obstruction may be relieved by gently massaging the penis or by passing an open-ended tom cat catheter and flushing (retropulsing) the urethra with saline. In those rare occasions when the catheter cannot be passed a cystocentesis with a 22-gauge needle may be performed. The bladder should be drained, and the catheterization attempted. With the relief of the backpressure in the bladder it may now be possible to flush the plug into the bladder and pass the catheter. It should be remembered that the bladder is at risk for rupturing when performing the cystocentesis. Once the obstruction is relieved, a soft urinary catheter is placed until it is determined that it can be removed. On average the catheter is left in place for one – three days with the goal being as short a time as possible. The catheter should be attached to a closed urinary collection system to prevent infection and to monitor urine production.

Evaluation

Following the relief of the obstruction the patient will need to be monitored. Perfusion parameters (Heart rate, pulse quality, mucous membrane color, capillary refill time, extremity temperature, and mentation) are evaluated. In addition, body temperature, ECG, urine production, body weight, and repeat lab test.

Following de-obstruction, many cats will go through a post obstructive diuresis; urine output may be in excess of 2 mL's / kg / hr and can last up to 48 hours. If the urine production exceeds the fluid intake the patient is at risk for dehydration. It will be important to measure urinary output as fluid therapy will be based partially on urine production. Fluids are given to correct dehydration and to meet normal maintenance requirements as well as match urine output (Ins and outs). With "ins and outs" a baseline volume of fluids is given, and the urine output is matched, and the fluid rate is adjusted accordingly. For example, a 5 kg patient is receiving 20 mL's an hour of Lactated Ringers solution as its baseline volume and produces 40 mL's of urine in the last hour. We would administer 60 mL's an hour for the next hour. When the waste products are excreted the diuresis will usually subside. It is also possible that the fluid therapy can drive the diuresis. Eventually fluids will be tapered off. One approach is to decrease the fluid infusion by 25% to see if the urine production also decreases, if so, continued tapering of the intravenous fluids is suggested. Frequent body weight is another excellent way of assessing fluid balance. Potassium supplementation may be necessary because of the potential development of hypokalemia secondary to the post obstruction diuresis.

The frequency and the type of lab test performed are dictated by patient's condition and previous lab test abnormalities respectively.

The patient should be monitored for signs consistent with pain and treated accordingly. An Elizabethan collar is usually necessary to prevent the patient from pulling its catheter.

The patient is at risk for catheter related infections; IV and urinary catheter care should be performed. IV catheter care should be performed every 48 hours or on an as needed basis. The catheter dressing should be removed, and the site inspected, looking for signs of phlebitis, infection, and or thrombosis. While flushing the catheter with saline, the insertion site should be observed for swelling, leaking of fluid at the insertion site and pain upon injection. If the catheter site looks good, then the site should be cleaned with a chlorhexidine solution. When the catheter site is dry a sterile 2x2 gauze pad or band-aid is used to cover the insertion site. The catheter is re-bandaged. Urinary catheter care is performed every 8 hours. It entails cleaning the prepuce and its surrounding area with a mild soap or chlorhexidine and water rinse. The urinary catheter itself should be kept clean.

Client Education

The owner should be informed of the possibility of re-obstruction especially during the first 24 – 48 hours following the relief of the obstruction. The owner should be aware of both the significance and the clinical signs of urethral obstruction. They should be instructed to watch the cat's urination carefully. They should also be counseled in the water and dietary requirements of their cat. The cat should always have fresh clean water, the goal is to increase water intake which may entail changing to a wet diet. Magnesium restricted, acidifying diets should be fed to help prevent lower urinary tract inflammation or obstruction.

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Anesthetic Monitors: Understanding Their Use & Limitations

Heidi Reuss-Lamky, LVT, VTS (Anesthesia/Analgesia, Surgery), FFECP

Performing anesthesia is a task that most veterinary technicians undertake on a daily basis. Intra-operative monitoring is imperative for optimizing all anesthetic procedures. In addition to allowing informed, flexible and well-timed responses to changes in the patient's status, it can also serve as a database for comparison prior to subsequent anesthetic episodes. A variety of equipment is available to monitor the patient's physiologic parameters, including but not limited to stethoscopes, blood pressure monitors, electrocardiograph (ECG) tracings, pulse oximeters, end-tidal carbon dioxide monitors, and temperature probes. Is one monitor better than the others? One must first consider the overall effects of general anesthesia before evaluating monitors that would be ideal for assessing patients under general anesthesia. It is well known that inhalant anesthetics are potent respiratory depressants. They are potent vasodilators, readily causing hypotension at increased levels of anesthesia. Decreased cardiac output, central nervous depression, and muscle relaxation are also direct effects of inhalant anesthetics. With this information in mind, let's examine the various monitoring modalities and exactly what they tell us about the anesthetized patient.

Electrocardiography (ECG)
ECG monitoring is commonplace during general anesthesia. It is important to ensure good contact of leads to skin by either using ECG paste or alcohol when placing ECG leads. Avoid wetting large areas of the skin and direct contact with the table. Exact lead locations are not as important as ensuring that all waves are present (even if they are inverted). The P-wave represents atrial depolarization. The QRS-wave represents ventricular depolarization. The T-wave indicates ventricular re-polarization. It is important to realize that an ECG tracing does not provide information about chamber size, or how efficiently the heart is ejecting blood. Therefore, the ECG should be used strictly for the detection of dysrhythmias during the peri-anesthetic period.

Induction agents and disease processes may predispose patients to **cardiac arrhythmias**. Other potential causes of cardiac arrhythmias may include an inadequate or excessive anesthetic depth, pain, hypoxia, hypercapnia, heart or lung disease, and traumatic myocarditis. Electrolyte imbalances and acidosis may also be a source of cardiac arrhythmias. It is not always necessary to treat arrhythmias unless they are causing adverse affects to the patient. **Bradycardia** is commonplace in patients undergoing general anesthesia and can be defined as a heart rate of <100 beats per minute. There are numerous causes for bradycardia, which may include drug side-effects, excessive vagal tone, hypertension, hyperkalemia, uremia, hypothermia, increased intracranial pressure, *profound* hypoxemia, and deep-level inhalants, among others. **Tachycardia** is defined as >200 beats per minute in cats. Tachycardic states can lead to hypotension. There are many causes of tachycardia, which may include but are not limited to, drugs, an inadequate plane of anesthesia, hyperthermia, anaphylactic reactions, hypovolemia, early-stage hypercarbia, and numerous disease states.

Pitfalls associated with interpretation of ECG tracings can include lead mal-positioning due to broken clips or loose connections to the monitor. Electrical interference caused by cautery or other operating room equipment can also be problematic. Rate inaccuracies can occur based on the size of the waveform, resulting in either double-counting or non-counting issues. Patient motion secondary to shivering or increased respiratory rates can cause blurred or erratic tracings. As a final caveat, electrical activity is often the last aspect to completely disappear prior to the pronouncement of death.

Blood Pressure
It is important to realize that *all patients* experience some degree of hypotension during general anesthesia, and if the patient has pre-existing conditions that decrease blood pressure, hypotension will be exacerbated during anesthesia. Normal arterial blood pressure values for felines, systolic 120-170mmHg & diastolic 70-120mmHg.

Although *direct* blood pressure monitoring is considered the "gold standard", it is highly impractical when it comes to routine blood pressure monitoring in most privately-owned veterinary facilities due to the advanced skill level required to place arterial catheters and the need for 24-hour care. Therefore, only indirect methods of blood pressure monitoring will be discussed. There are 2 methods to measure blood pressure indirectly – either by using a Doppler or an oscillometric device (e.g., Dinamap, Cardell, petMAP). Regardless of the method used, selection of the correct sized blood pressure cuff *is imperative* for providing the most accurate results. In cats, it is acceptable to use a cuff that is only 30% of the circumference of the limb. The cuff should be snug, but not too tight. It is acceptable to use a piece of tape to keep it from becoming dislodged during cuff inflation. **Selection of an inappropriate cuff size is the most common source of errors.** If the cuff is too narrow or too loose, the reading will be falsely high. If the cuff is

too wide or too tight, the reading will be falsely low. Acceptable cuff locations include the forelimb, tail and hindlimbs, where the areas proximal to the carpus and tarsus work best. The ventral tail is a good choice in cats.

Oscillometric methods detect intracuff changes caused by the pulse wave. They calculate the systolic, diastolic and mean arterial pressure (MAP) as well as the heart rate. They frequently can be programmed to obtain readings at various time intervals (e.g., once per minute, per hour.)

Doppler methods use a 'return-to-flow' principle to detect the systolic blood pressure. Doppler measurements are most accurate when the systolic blood pressure is within normal limits and when the patient has good peripheral perfusion. In cats it is hypothesized that the resultant reading probably represents the MAP, therefore a correction factor of 14mmHg is added to the reading to more accurately reflect actual feline systolic pressures. Because the 'white coat' phenomenon has been well documented in humans, the patient should be calm and as well-acclimated as possible to avoid an inadvertent false diagnosis of hypertension or hypotension. Be warned that a Doppler can mistake heavy respirations for blood flow. Profound arrhythmias, hypothermia, patient motion, low batteries, and electrical interference can also impede obtaining good readings.

There are drawbacks associated with indirect methods of blood pressure monitoring. In general, they all tend to underestimate the actual blood pressure, and all work best when the MAP is between 60-100mmHg. Patient movement, smaller patient size (<5.0kg), cold or vasoconstricted patients, or patients with short-legs or excessive skin will all adversely affect results. Additionally, measurements may be difficult to obtain in patients with limb edema.

Pulse Oximetry

Pulse oximeters provide continuous and non-invasive monitoring of pulse and an estimate of arterial hemoglobin saturation (SpO_2), but do not provide data on the amount (partial pressure) of oxygen in arterial blood, as dissolved in plasma (PaO_2). Pulse oximeters can be used on the lip, tongue, ear pinna, prepuce, vulva, toe web or digits, metacarpus, tail, rectal mucosa or flank skin folds. If a skin-fold site is selected it should ideally be hairless, non-pigmented, and fairly thin-skinned (but not overly so).

There are 5 main types of hemoglobin: oxyhemoglobin, reduced hemoglobin (deoxyhemoglobin), methemoglobin, carboxyhemoglobin, and fetal hemoglobin. Since 95% of oxygen delivery to tissues is by oxyhemoglobin, saturation is of high clinical significance. Not all types of hemoglobin are capable of transporting oxygen, and as such are termed "dysfunctional hemoglobins." The presence of other light-absorbing types of hemoglobin such as methemoglobin and carboxyhemoglobin will cause the pulse oximeter to *overestimate* arterial oxygen saturation. Conversely, extraneous blood-borne dyes (such as methylene blue) are known to potentially *lower* SpO_2 readings to 85%, regardless of the true saturation value. Pigmented substances such as bilirubin lipids (hyperbilirubinemia) may also affect arterial blood light absorption and alter SpO_2 values. Other causes for erroneous SpO_2 values include severe anemia or hemodilution. Moreover, the pulse oximeter may display an SpO_2 reading of 100%, in spite of the considerable decrease in arterial blood oxygen content secondary to low hemoglobin values.

Further pitfalls of pulse oximetry use include erroneous and unreliable results or potential complete loss of function when peripheral pulsations are reduced or absent, as in the case of hypotension, hypothermia or hypovolemia. Other conditions that can contribute to unreliable pulse oximeter readings include arrhythmias and tachycardia, increased venous pulsations (e.g., right heart failure, tricuspid regurgitation, etc.), and movement artifacts (e.g., shivering.) Erroneous pulse oximeter readings may also occur when using certain Xenon arc surgery lights (resulting in an SpO_2 reading of 100% and a pulse rate of 180-225), without the probe being attached to a patient!

Finally, beware the pulse oximeter is surrounded by controversy in regards to its use as a monitoring device—it is either prized or despised. This is due, in part, to the **oxyhemoglobin dissociation curve**, which describes the non-linear relationship between PaO_2 and SpO_2. For example; patients breathing 100% oxygen may have a PaO_2 that is *5 times* greater than the SpO_2 (e.g., PaO_2 = 500 mmHg: SpO_2 = 100%). Since the oxyhemoglobin dissociation curve is sigmoid shaped, the hemoglobin saturation would demonstrate only a very slight increase—going from 98% to 100%. Pulse oximeters are most beneficial when evaluating desaturation, such as when the reading drops to below 90%, which corresponds with a PaO_2 that is less than 60mmHg. Pulse oximeters are most accurate within 2% to 6%, and within the 80% to 100 percentile.

Carbon Dioxide

End-tidal carbon dioxide ($ETCO_2$) is the result of expired gases from the alveoli. End-tidal carbon dioxide analysis can be used to help assess acid/base status as well as the adequacy of patient ventilation in a variety of clinical situations. An abrupt decrease in $ETCO_2$ can be an early and reliable indication of an impending cardiovascular collapse or cardiac arrest. Consequently, $ETCO_2$ production can be used to assess the effectiveness of cardio-

pulmonary resuscitation (CPR) techniques since delivery of carbon dioxide from the lungs requires blood flow, cellular metabolism, and alveolar ventilation.

Capnometers and capnographs monitor $ETCO_2$ by evaluating samples of the patient's exhaled gases taken from the anesthetic circuit via an adapter placed on the end of the patient's endotracheal tube. This adapter must be placed precisely at the end of the patient's nose to eliminate excessive dead space and prevent rebreathing of carbon dioxide. Capnometers provide only minimum and maximum $ETCO_2$ values, while capnographs provide a graphic display of exhaled carbon dioxide as each breath is taken. Diagnosing abnormalities in ventilation or anesthetic circuit function are easier using the graphical data provided by a capnograph.

Normal $ETCO_2$ values are 35-45mmHg. Under normal circumstances, $ETCO_2$ typically underestimates the arterial carbon dioxide partial pressure ($PaCO_2$) by a clinically insignificant 2-5mmHg. End tidal carbon dioxide values above 45mmHg indicate inadequate ventilation, necessitating ventilatory assistance via manual or mechanical means. Conversely, by allowing modest increases in $ETCO_2$ (up to 50mmHg) the anesthetist can bolster arterial blood pressure via endogenous catecholamine release. Nonetheless, the highest $ETCO_2$ permissible should be 60mmHg.

There are caveats to $ETCO_2$ monitoring: Esophageal intubation, occlusion of the endotracheal tube, inadequate seal on the endotracheal tube, anesthetic circuit dysfunction/disconnects, moisture within the sampling line, hyperventilation, or respiratory and/or cardiac arrest are all potential causes of failure to detect carbon dioxide. Elevated $ETCO_2$ levels may occur as a result of hypoventilation due to airway obstruction, pneumothorax, body positioning, or lung disease, or during periods of acutely increased metabolism (e.g., thyroid storm, or catecholamine release). Significant disparities between $PaCO_2$ and $ETCO_2$ indicate an inefficiency of gas exchange (e.g., dead space ventilation), which may be secondary to pulmonary embolism, thromboembolism, decreased cardiac output, or perhaps as a result of mechanical ventilation (intermittent positive pressure ventilation.) Explanations for elevated $ETCO_2$ **and** *inspiratory* carbon dioxide may include anesthetic machine malfunction (e.g., malfunctioning valves within the breathing circuit), unsuitable fresh gas flow rates (e.g., non-rebreathing circuits), or exhausted carbon dioxide granules. Therefore, end-tidal carbon dioxide is best analyzed in conjunction with an arterial blood gas sample to yield the most complete status of respiratory function.

Temperature

Hypothermia is not only one of the *most common* anesthetic complications, but also the easiest to document without special equipment. The hypothalamus closely regulates core body temperature. However, this regulation can be impaired in pediatric and geriatric patients, lean breeds, and those with organ failure, large wounds or infections. Almost all anesthetized or sedated patients will lose body heat under general anesthesia. Small patients are at the greatest risk, due in large part due to their small body-surface-to-mass ratio. Hypothermia is exacerbated in prolonged surgical procedures, especially those which expose open body cavities or use cold irrigation solutions. Hypothermia-induced bradycardia is typically non-responsive to anticholinergics. Hypothermia contributes to delayed drug metabolism and decreased hepatic metabolism, resulting in prolonged recovery and potential drug toxicity. Clotting times can be prolonged due to impaired platelet function and hemoconcentration with sludging. Hypothermia also suppresses immune function and may lead to increased infection rates.

Obviously, prevention is key when addressing hypothermia. Aggressive re-warming should be considered when the patient temperature drops to $\leq$ 97.6° F. There are a variety of ways to maintain an envelope of warm air around peri-operative patients. Convection-type warm air devices (e.g., BAIR Huggers®) and electrically conductive fabric warmers such as the HotDogWarmer® (Augustine Biomedical + Design) are the most effective, followed by carbon-based conductive polymers such as PetTherm (Inditherm plc), and circulating warm water blankets. At least 60% of the body surface area must be in contact with the external heat source for re-warming efforts to be most effective. Latex gloves or bottles of warm water, electric heating or hot air blankets, heat lamps and microwaved bags are not recommended. Commercially available wire electric heating-pads and heat lamps have been associated with uneven heating, thermal injury and/or electrocution and should be avoided.

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See also: *National Association of Veterinary Technician in America (NAVTA) Journal*
Anesthetic Monitors – Understanding Their Use and Limitations (Spring 2008)

NOTES:

Who Needs an Anesthetic Plan? YOU DO!

Heidi Reuss-Lamky, LVT, VTS (Anesthesia/Analgesia, Surgery), FFECP

Every cat that enters your hospital is a unique biologic unit. Careful pre-anesthetic assessments are essential to identify physiological, pathological or drug-related factors that may complicate a patient's anesthetic management. The American Society of Anesthesiologists (ASA) offers the following taxonomy to categorize patients with varying levels of anesthetic risk; I- healthy patient, II- mild systemic disease with no functional limitations, III- severe systemic disease with definite functional limitations, IV- severe systemic disease that is a constant threat to life, and V- moribund patient unlikely to survive 24 hours (with or without surgery). Furthermore, an E (for emergency) may be added to any of the above classifications and denotes patients that may face additional inherent risks secondary to the performance of hasty surgical procedures. It is important to consider and assess multiple factors prior to anesthetizing every patient.

History
The value of obtaining an in depth and accurate history cannot be overemphasized. In addition to the presenting complaint, essential components of a thorough history include the patient's name, species and breed, age, sex (unaltered or intact) and breeding/estrus status, current diet and housing conditions (indoors versus outdoors), prior adverse reactions to anesthetic agents or drugs as well as the patient's prior medical history, preventative health status (e.g., date of last vaccine and fecal exam, etc.), and current drug therapy. Routine thyroid screening and Pro BNP testing should be considered for all elderly cats. All abnormalities should be further investigated with particular emphasis provided to geriatric patients with cardiovascular anomalies.[1]

Physical Exam
A good physical exam is an imperative element of the pre-anesthetic assessment. Physical exams should be performed using a routine and systematic method. In addition to documenting the patients overall demeanor, hydration status, weight and body condition (e.g., obese, emaciated), the patient's temperature, pulse, respiratory rate, mentation, mucous membrane color and capillary refill time (CRT) should be obtained. Assessment of the reproductive, cardiovascular and respiratory systems, evaluation of the skin, oral cavity and lymph nodes as well as abdominal palpation should also be performed. Preoperative work-up may consist of blood work, radiographs, or other diagnostic testing will be dependent on the abnormalities uncovered.

Patient Considerations
The age of the patient to be anesthetized can also impact decisions made by the anesthetist. The term **neonate** refers to newborn animals up to 8 weeks of age. The term neonate or pediatric may be used for veterinary patients less than 3 months of age. All major organ systems (e.g., thermoregulatory, cardiovascular and pulmonary, renal and hepatic) are relatively mature by 12 weeks of age. Immature patients less than 3 months old are considered to be at an increased risk when undergoing anesthesia. Small patients are at the greatest risk of developing hypothermia, due in large part due to their small body-surface-to-mass ratio.[2]

A geriatric patient may be defined as attaining 75-80% of their expected life span.[1,2] Many otherwise healthy elderly patients will have decreased blood volumes and blood pressure, reduced cardiac output with an increased circulation time, and vagal tone.[2] Moreover, these patients also benefit from careful physiological monitoring which should always include blood pressure measurement.

The temperament of the patient can affect the selection of anesthetic drugs; fractious patients can prove especially challenging for the anesthetist. Nonetheless, every attempt should be made to minimize stress and avoid the release of catecholamines in the perioperative period.

Managing Systemic Diseases Preoperatively
The severity of pre-existing health problems will guide the anesthetist in the selection of pre-medications, crystalloid fluid type and rate, induction agents, as well as the inhalant and analgesic choice. Various common conditions and ailments that can impact a patient's ability to safely undergo anesthesia may include (but are not limited to)[1]:

Dehydration- Suspect the potential for dehydration may exist whenever the patient has exhibited a recent history of vomiting, diarrhea, anorexia, sepsis, fever, trauma, or whenever diuretic drugs are utilized.[1,5] Dehydration can also occur secondary to fluid losses through draining wounds, respiratory losses, or diseases causing diureses such as diabetes mellitus or chronic renal failure.[5] Consider that a state of dehydration can also predispose the patient to acid-base and electrolyte disturbances as well as decreased tissue perfusion.[1]

Trauma- Polytrauma patients should be assessed for the presence of internal bleeding/blood loss, ruptured urinary bladder and diaphragmatic hernia as well as pulmonary contusions. Internal thoracic pathology such as pulmonary contusions can cause arrhythmias (e.g., ventricular premature contractions) that may not be evident for up to 24-48 hours following trauma.

Cardiac disease- Whenever possible, the nature of cardiac disease should be fully defined *prior to anesthesia*. In general, utilize conservative intravenous fluid rates, and monitor/auscult the patient frequently for the presence of pulmonary edema. Lower drug dosages may be indicated considering that there may be impaired renal and hepatic function. Avoid stress in patients with cardiac disease, as sodium retention and water preservation features may prove problematic during anesthesia.[1]

Pulmonary/thoracic disease- Patients with pulmonary disease may be chronically hypoxic and suffer from blood gas abnormalities. These patients should be stabilized prior to anesthesia. Consider thoracocentesis whenever pleural effusion is present, and utilize light sedation in lieu of a general anesthetic when possible. Pre-oxygenation prior to anesthetic induction can be beneficial for patients with pulmonary disease.

Hepatic disease- Patients with hepatic dysfunction may have prolonged drug effects and delayed drug metabolism (e.g., barbiturates) due to hypoalbuminemia. Hypoalbuminemia may lead to pulmonary edema and/or ascites, which can impair respiration. Other potential consequences of hepatic disease include hepatic encephalopathy, hypoglycemia (possibly leading to seizures), electrolyte disturbances, clotting disorders and platelet dysfunction. These patients should be medically stabilized preoperatively, and coagulation defects should be identified and corrected when possible.[1]

Renal disease- Renal failure occurs when ~75% of normal kidney function is lost. Uremia secondary to renal disease can potentiate the effect of anesthetic drugs. Anesthesia related hypotension could result in decreased renal perfusion, thereby exacerbating sub-clinical disease and precipitating clinical renal disease. Chronic renal failure may also result in hypertension as well as decreased tissue perfusion due to anemia. Hyperkalemia may occur in post-renal obstruction (e.g., FLUTD cats) and should be treated prior to performing anesthesia. Perioperative management of patients with renal insufficiency entails maintaining adequate hydration, fluid balance, and normotension while avoiding non-steroidal anti-inflammatory (NSAID) agents.[1]

Endocrine disease- Patients with endocrine dysfunction lack the physiologic ability to respond to stress, which can have an enormous impact on their perioperative management. Examples of endocrine diseases include diabetes mellitus and hyperthyroidism. Minimizing stress is key to managing all patients with endocrine disease.[1]

Monitoring Equipment

A variety of equipment is available to monitor the patient's physiologic parameters, including stethoscopes, blood pressure monitors, electrocardiograph (ECG) tracings, pulse oximeters, end-tidal carbon dioxide monitors, and temperature probes. Let's consider each as a monitoring tool:

Electrocardiography monitoring is commonplace during general anesthesia. It is important to realize that an ECG tracing does not provide information about chamber size, or how efficiently the heart is ejecting blood. Therefore, the ECG should be used strictly for the detection of dysrhythmias during the peri-anesthetic period.[2,7]

Blood Pressure is determined by cardiac output **and** total peripheral resistance. It is important to realize that *all patients* will experience some degree of hypotension during general anesthesia. In fact, the American College of Veterinary Anesthesiologists recommends blood pressure monitoring as a minimum standard for managing the anesthesia care of moderate to severely ill patients.[8] There are two methods to measure blood pressure indirectly – either by using a Doppler or an oscillometric device (e.g., Dinamap, Cardell, petMAP.) Regardless of the method used, selection of the correct sized blood pressure cuff *is imperative* for providing the most accurate results. Although in general the width of the cuff should extend 40% around the circumference of the limb, in cats it is acceptable to use a cuff that is only 30% of the circumference of the limb. The cuff should be snug, but not too tight.[9,10] **Selection of an inappropriate cuff size is the most common source of errors.** Acceptable cuff locations include the forelimb, tail and hindlimbs. The areas proximal to the carpus and tarsus work best. The ventral tail is a good choice in cats and short-legged breeds such as the Dachshund.[10]

Pulse oximeters provide continuous and non-invasive monitoring of pulse and an estimate of arterial hemoglobin saturation (SpO_2). Preoxygenating for $\geq$ 5 minutes increases the reservoir of the lungs and replaces the air with

100% oxygen. Preoxygenation is especially valuable if patient's functional residual capacity is reduced (e.g., pregnant females.)[2]

End-tidal carbon dioxide ($ETCO_2$) is the result of expired gases from the alveoli. End-tidal carbon dioxide analysis can be used to help assess acid/base status as well as the adequacy of patient ventilation in a variety of clinical situations, such as during anesthesia when effects of drugs and inhalants can decrease tidal volumes, or during long-term ventilatory assistance as with the use of a mechanical ventilator. Capnometers and capnographs monitor $ETCO_2$ by evaluating samples of the patient's exhaled gases taken from the anesthetic circuit via an adapter placed on the end of the patient's endotracheal tube. An abrupt decrease in $ETCO_2$ can be an early and reliable indication of an impending cardiovascular collapse or cardiac arrest.[2,11] Consequently, $ETCO_2$ production can be used to assess the effectiveness of cardio-pulmonary-cerebral-resuscitation (CPCR) techniques since delivery of carbon dioxide from the lungs requires blood flow, cellular metabolism, and alveolar ventilation.[9]

Postoperative Considerations

It is imperative to understand that surgical patients can be faced with life-threatening situations during the postoperative period. These patients may already have or develop hypoxia, hypothermia, hypotension, hemorrhage leading to anemia, emergence delirium, vomiting, or cardiac arrhythmias (possibly leading cardiopulmonary arrest), in the minutes and hours following surgery. Furthermore, postoperative patients should be frequently assessed for pain, and additional analgesic medications administered as needed.[12]

References available upon request.

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Purr-Fect Feline Anesthesia

Heidi Reuss-Lamky, LVT, VTS (Anesthesia/Analgesia, Surgery), FFECP

Anesthetizing felines can pose unique challenges for the veterinary technician. In addition to the fact that cats can be difficult to monitor under anesthesia, their small size, interesting metabolism, variable temperament, and propensity towards particular health ailments can also prove problematic. Advanced preparation, skills and knowledge will allow astute technicians to anticipate patient requirements under a variety of circumstances, thereby assuring a successful outcome.

Patient Considerations

Thorough patient assessment is paramount. Patient signalment and history typically include the patient name, species and breed, age, weight, sex (intact/pregnant vs. altered), as well as discovery of recent health issues, current medications and details surrounding the presenting complaint. Other important factors may include diet and housing conditions (indoors vs. outdoors), preventative health status (e.g., date of last vaccine and fecal exam, prior FeLV test, etc.) and prior anesthetic episodes. Whenever possible, a good physical exam is essential; all abnormalities should be further investigated. Pre-operative blood work, radiographs and other diagnostic tests (e.g. blood pressure measurement, ECG rhythm strip, echocardiogram and/or abdominal ultrasound) may be necessary to completely define common feline health problems such as obesity, diabetes, hyperthyroidism, renal insufficiency, hepatic lipidosis, hypertrophic cardiomyopathy (HCM) and asthma.

Fear free handling of felines is recommended by the American Association of Feline Practitioners (AAFP). Although not always easy, every attempt should be made to minimize stress and avoid the release of catecholamines in the perioperative period. The utilization of facial pheromone products (e.g., Feliway diffusers and sprays in the exam room, feline wards and on the employee's hands and clothing), and dedicated feline wards help to create a quiet, warm, clean, stress-free environment.[1] Offer places for the cat to hide can be of the utmost importance by reducing anxiety and promoting food intake.[2] Touch the cat in preferred touch areas, such as between the eyes, ears, cheeks, chin, and along the corner of the mouth. Conversely, minimize stress in aggressive felines by handling them as little as possible. When all else fails, it may become necessary to resort to chemical restraint

Preoperative Considerations

Numerous factors should be considered prior to anesthetizing felines. The severity of pre-existing health problems will guide the anesthetist in the selection of pre-medications, crystalloid fluid type and rate, induction agents, as well as the inhalant and analgesic choice. When multiple major health problems exist, the patient is usually treated for the most clinical or severe problem.

Other preoperative considerations include the type of procedure being performed (elective vs. emergent, short vs. prolonged), possible adverse affects on the patient due to necessary surgical positioning (e.g., large abdominal masses or gross obesity compromising breathing efforts), as well as the expected level of discomfort associated with the procedure.

Monitoring and Equipment Considerations

Ensure that emergency drug dosages have been calculated, surgical supplies are ready and additional trained staff is available to help should a crisis situation arise. Shocky feline patients may present with the following triad: bradycardia, hypothermia and hypotension. Volume overload is more widespread in small patients, and volume-overloaded anesthetized patients may manifest by serous nasal discharge, chemosis, pulmonary crackles and, in severe cases, frothy fluid emanating from the endotracheal (ET) tube.

Patient induction can be achieved via induction chamber, mask, or chemical routes. Mask or induction chamber should be considered only if an injectable agent is not an option. Chamber and mask induction are least desirable for several reasons: 1) difficultly monitoring patients in an induction chamber, 2) exposure to high levels of waste anesthetic gases, 3) excessive stress can be induced by inhalant agents- due to pungent odors and a prolonged induction period and 4) stress-induced cardiac arrhythmias can be severe, causing increased morbidity and mortality. If chamber induction cannot be avoided, provide oxygen while allowing fractious cats to calm prior to starting the inhalant.

Obtain a good light source or laryngoscope to ease visualization of the feline laryngeal area during intubation. *Never force intubation.*

Non-rebreathing circuits (e.g., Bain, Jackson-Reese) should be utilized for the maintenance of anesthesia in small patients (less than 7.0 kg.) This type of circuit is advantageous in small patients by decreasing resistance to breathing. The caveats to non-rebreathing circuits include a dependence on high oxygen flow rates (200-300 ml/kg/min) to prevent rebreathing of carbon dioxide, increased cost of anesthetic agent(s) and oxygen, an accelerated onset of hypothermia due to high oxygen flow rates, and the potential for barotrauma if the pop-off is accidentally left closed.

Pulse palpation is useful in evaluating the heart rate (unless an arrhythmia is present), and is determined by the difference between the systolic and diastolic phase. The normal heart rate for anesthetized cats should range from 100-220. Bradycardia in cats should be avoided, as it can result in reduced cardiac output and hypotension.

Electrocardiography monitoring is commonplace during general anesthesia. It is important to ensure good contact of leads to skin by either using ECG paste or alcohol when placing ECG leads. Avoid wetting large areas of the skin and direct contact with the table.

Bradycardia is commonplace in patients undergoing general anesthesia. Bradycardia is defined as a heart rate of less than 100-120 bpm in cats. Tachycardia is defined as >200 beats per minute in cats. Induction agents (e.g., barbiturates or α_2-agonists) and disease processes (e.g., splenic disease) may predispose patients to cardiac arrhythmias.

Blood pressure is determined by cardiac output **and** total peripheral resistance. Total peripheral resistance (TPR) is defined as the resistance to blood flow created by the peripheral arterial system as well as capillary beds. *Cardiac output* is determined by a combination of the *heart rate* and *stroke volume*. It is important to realize that *all patients* will experience some degree of hypotension during general anesthesia. Normal arterial blood pressure values for cats is systolic 120-170 mmHg, and diastolic 70-120 mmHg.

There are two methods to measure blood pressure indirectly – either by using a Doppler or an oscillometric device (e.g., Dinamap, Cardell, petMAP, etc.) Regardless of the method used, selection of the correct sized blood pressure cuff *is imperative* for providing the most accurate results. Although in general the width of the cuff should extend 40%-60% around the circumference of the limb, in cats it is acceptable to use a cuff that is only 30% of the circumference of the limb. **Selection of an inappropriate cuff size is the most common source of errors.** Acceptable cuff locations include the forelimb, tail and hindlimbs; the areas proximal to the carpus and tarsus work best, but the ventral tail can also work well.

Doppler methods use a 'return-to-flow' principle to detect the systolic blood pressure. Utilizing a Doppler device can prove advantageous to obtain periodic readings in anesthetized cats when oscillometric devices fail to record blood pressure readings in feline patients. In cats it is hypothesized that the resultant reading probably represents the mean arterial pressure (MAP.) As such, a correction factor of 14 mmHg is added to the obtained reading to more accurately reflect the actual feline femoral systolic pressure. Perform several readings in a conscious patient and average the results.

Oscillometric methods detect intracuff changes caused by the pulse wave, and calculate the heart rate, systolic, diastolic and MAP. The author has had good experiences measuring blood pressure in cats while using a petMAP, and satisfactory results with other oscillometric devices by placing the cuff around the proximal tail, or over the distal humeral area, proximal to the elbow. Patient movement, smaller patient size (<5 kg), cold or vasoconstricted patients, or patients with short-legs or excessive skin will all adversely affect results.

Pulse oximeters provide continuous and non-invasive monitoring of pulse and an estimate of arterial hemoglobin saturation (SpO_2). Preoxygenating for $\geq$5 minutes increases the reservoir of the lungs and replaces the air with 100% oxygen. In the event of airway obstruction, difficult intubation, or apnea, preoxygenation permits a lapse of 3-4 minutes before the patient becomes hypoxic, as compared to the 90 seconds it will take a non-preoxygenated patient breathing room air to become hypoxic. Preoxygenation is especially valuable if patient's functional residual capacity is reduced (e.g., pregnant females.)

End-tidal carbon dioxide ($ETCO_2$) is the result of expired gases from the alveoli. An abrupt decrease in $ETCO_2$ can be an early and reliable indication of an impending cardiovascular collapse or cardiac arrest. Consequently, $ETCO_2$ production can be used to assess the effectiveness of cardio-pulmonary-cerebral-resuscitation (CPCR) techniques since delivery of carbon dioxide from the lungs requires blood flow, cellular metabolism, and alveolar ventilation. It is advantageous to eliminate excessive dead space for smaller patients with side-stream $ETCO_2$ collection adapters by utilizing a special $ETCO_2$ adapter, Normal $ETCO_2$ values are maintained between 35-45 mmHg. It is prudent to avoid hyperventilation (<20-25 mmHg), which can result in decreased cerebral blood flow and oxygen delivery to the brain.

Hypothermia is one of the *most common* anesthetic complications. Almost all anesthetized or sedated patients will lose body heat under general anesthesia, but small patients are at the greatest risk, due in large part due to their small body-surface-to-mass ratio. There are a variety of ways to maintain an envelope of warm air around perioperative patients. Convection-type warm air devices (e.g., BAIR Huggers®) and electrically conductive fabric warmers such as the HotDogWarmer® (Augustine Biomedical + Design) are the most effective, followed by other warming units such as carbon-based conductive polymers by PetTherm (Inditherm plc), and circulating warm water blankets. Commercially available wire electric heating-pads and heat lamps have been associated with uneven heating, thermal injury and/or electrocution and should be avoided.

Analgesic Options
Although somewhat historically controversial, pure μ-agonist opioid analgesics have been used with great success in cats. Paradoxical excitement (typically observed at higher opioid doses) can be averted by the addition of a sedative agent such as acepromazine. Pure μ-agonists opioids (e.g., morphine, oxymorphone, hydromorphone, and fentanyl) provide the most reliable forms of analgesia for severe pain in cats. Mild to moderate pain may be treated with butorphanol or, preferably, buprenorphine. Alternately, low doses of α_2–adrenergic agonists (e.g., medetomidine) may combined with opioids in otherwise healthy patients. Ketamine (an NMDA receptor antagonist) may be administered via continuous infusions in conjunction with opioids for adjunctive analgesic effects, however lidocaine CRI's were not shown to be advantageous in cats.

Local anesthetics such as lidocaine, bupivacaine, and Nocita® may be employed for local and incisional blocks. Epidural analgesia as well as transdermal fentanyl and lidocaine are other pain management techniques that can be utilized in the periop period.

It is important to realize that pain management may be indicated after the patient has been discharged from the hospital. Due to the pH of the feline oral cavity, buprenorphine can be absorbed sublingually in cats, making it a good analgesic choice for acute or long-term use. Non-steroidal anti-inflammatory drugs (NSAID's) such as Onsior are another excellent analgesic option for cats.

Although anesthetizing cats can be somewhat difficult and challenging, it *can be* a very rewarding experience with a positive outcome!

References available upon request.

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Anesthesia Mistakes Awareness

Heidi Reuss-Lamky, LVT, VTS (Anesthesia/Analgesia, Surgery), FFECP

The pressures facing anesthetists today are great; the anesthetist must fully understand physiology, pathophysiology, pharmacology, anesthesia equipment, and monitoring devices as well as recognize their limitations. Although the goal is to assure a successful surgical or procedural outcome while ensuring the patient receives the finest possible anesthetic care, *mistakes **can*** and ***do** happen*.

Patient Considerations

Careful pre-anesthetic assessments are essential to identify physiological, pathological or drug-related factors that may complicate a patient's anesthetic management. Components of a thorough history include the patient's name, species and breed, age, sex (altered vs. intact) and breeding/estrus status, current diet and housing conditions (indoors versus outdoors), preventative health, as well as the patient's prior medical history, current medications, and prior adverse reactions to anesthetic agents or drugs. Additionally, preoperative bloodwork consisting of a complete blood count and age-appropriate chemistries should also be performed.

A good physical exam is also an imperative element of the pre-anesthetic assessment. In addition to documenting the patients overall demeanor, hydration status, weight and body condition (e.g., obese, emaciated), the patient's temperature, pulse, respiratory rate, mentation, mucous membrane color and capillary refill time should be obtained. Assessment of the reproductive, cardiovascular and respiratory systems, evaluation of the skin, oral cavity and lymph nodes as well as abdominal palpation should also be performed.

Potential Patient-Related Areas of Concern:

- Undiagnosed underlying disease
  - (e.g., renal or cardiac disease; feline hyperthyroidism; diabetes)
- Mismanaged pre-existing conditions
  - (e.g., overhydrating patient with unstable cardiac disease; renal disease patient not provided with adequate fluid therapy perioperatively)
- Inadequate preoperative stabilization of patient's condition or disease
  - (e.g., shocky patient still dehydrated at time of surgery; persistent arrhythmias ignored resulting in negative impact on blood pressure; pneumothorax patient anesthetized before condition resolved)
- Significant clinical pathology abnormalities that have been ignored, untreated, or undiagnosed
  - (e.g., hyperkalemia; azotemia; hypercalcemia)
- Emergent situation- Not enough time to assess organs and systems
- Fractious/feral patient (and subsequent limitations)
- Other patient-related human errors
  - (e.g., incorrect weight recorded- lbs vs kg; using obese vs lean body weight; different patient medicated; inadequate history; missed abnormalities on physical exam)

Pharmacology Considerations

Ideal drug choices and dosing should be selected based on each patient's history, temperament and physical health status as well as the procedure being performed.

Potential Drug-Related Sources of Errors:

- Drug overdose/overdose
- Incorrect drug calculations; decimal point errors
- Used wrong/different drug than intended
- Adverse drug interaction with current medications
- Assuming drugs used for anesthesia and analgesia are interchangeable
- Blood transfusion reactions under anesthesia
- Human errors
  - Charting errors
  - Allergies, current medications not properly documented

Before administering ANY drug to EVERY patient, please consider the following:
The 6 'Rights' of Patient Medication Administration. Do you have the Right___?:

1. Patient

2. Drug
3. Dose
4. Route
5. Time/frequency
6. Documentation

Anesthesia and Monitoring Equipment Considerations
Intra-operative monitoring documentation is imperative for optimizing all anesthetic procedures. In addition to allowing informed, flexible and well-timed responses to changes in the patient's status, it can also serve as a database for comparison prior to subsequent anesthetic episodes. A variety of equipment is available to monitor the patient's physiologic parameters, including but not limited to stethoscopes, blood pressure monitors (using either indirect or direct methods), electrocardiograph (ECG) tracings, pulse oximeters, end-tidal carbon dioxide monitors, and temperature probes. Each monitoring device certainly has its own distinct set of advantages and disadvantages, and every anesthetist should be familiar with them.

Several studies have indicated that between 60-93% of anesthetic complications can be detected by an electronic monitor before a trained anesthetist; therefore, alarms should never be ignored (or silenced as being 'annoying'.) The data assimilated from anesthetic monitors can provide invaluable information on the anesthetized patient's status, but only if used prudently.

It is also important to use a 'hands-on' approach during every anesthetic procedure. Technicians can gather a lot of information from the anesthetized patient simply by consistently palpating pulses, assessing mucous membrane color and capillary refill times, feeling jaw tone, and tracking palpebral and withdrawal reflexes. Regularly evaluating these parameters can also help to alert the anesthetist of an impending problem before some monitors will sound an alarm. Any concerns about a patient's status during the anesthetic period should always be brought to the veterinarian's attention.

All anesthetic equipment should be kept well maintained and serviced at regular intervals. Any malfunctions should be promptly addressed or repaired. Maintain records for all anesthetic machines.

Potential Errors Posed by Monitoring and Anesthetic Equipment Issues:

- Data provided by monitors not accurate
    - (e.g., incorrect blood pressure cuff size selected, ECG leads double-counting)
- Incorrect monitoring devices used for patient's condition or procedure
- Patient's abnormality not accurately reflected by monitor
    - (e.g., arrhythmias not detected by pulse oximeter)
- Relying too heavily on monitors
- Accurate data provided by monitor but ignored/alarms silenced
- Unidentified anesthesia machine malfunction
    - System leak 'somewhere'…
    - Vaporizer out of calibration
- Improper flow rates (nitrous oxide/oxygen)
- Human errors
    - Incorrect use of anesthetic machine or equipment
        - (e.g., closed pop-off valve resulting in barotraumas; training deficiencies; incorrect use of syringe pumps)
    - Breathing and ventilation concerns
        - Improperly intubated
            - (e.g., cuff over- or under-inflated; endotracheal tube too long or short)
        - Premature tracheal extubation complications)
            - (e.g., hypoventilation; apnea; obstructive breathing)
        - Immediate postoperative hypoventilation
            - (e.g., due to opioid effects; incomplete reversal of neuromuscular blockade; presence of redundant oral tissues [BAS])
    - Substandard patient monitoring
        - Unrecognized patient deterioration
        - 'Reactive' vs 'proactive' approach
        - Patient's deterioration left untreated/ignored
        - Anesthetist over-worked or stretched too thin (e.g., dual role as circulating nurse) to properly monitor patient
        - Inattentive / distracted anesthetist

- (e.g., checking electronic devices, overly engaged in casual conversation)

It is also imperative to remember that diligent care of the anesthetized patient should not end once the procedure is finished: even though it is at this point where many anesthetists tend to let their guard down. The magnitude of this problem was identified in the 2008 article entitled, *The Risk of Death: the Confidential Enquiry into Small Animal Perioperative Fatalities,* published in Veterinary Anaesthetics and Analgesia (Brodbelt, et.al.) "The postoperative period was the most common time for dogs, cats and rabbits to die usually within 3 hours of surgery…greater patient monitoring and management during this time period is recommended."

As it turns out, patients in this stage of recovery can be subject to life threatening problems such as hypothermia, hemorrhage, hypoxia, hypotension, post-anesthetic vomiting, emergence delirium, cardiac arrhythmias, or cardiopulmonary arrest. Furthermore, these patients will need to be regularly assessed for pain. Only experienced personnel should continuously monitor these patients in a designated recovery area. The recovery area should be stocked with necessary drugs and equipment to treat common post-anesthetic emergencies.

The Anesthetist "Too (sic) Err is Human"
When mistakes inevitably do occur, maintain integrity. Fess up. Correct the problem, and objectively identify solutions to prevent the same mistakes from occurring again in the future. To quote Paul Bear Bryant, "When you make a mistake there are only 3 things you should ever do about it: admit it, learn from it, and don't repeat it."

> **"There are no safe anesthetic agents; there are no safe anesthetic procedures; there are only safe anesthetists." Robert Smith, MD**

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Pain Scoring for Dummies

Heidi Reuss-Lamky, LVT, VTS (Anesthesia/Analgesia, Surgery), FFECP

Pain can be defined as an adverse sensory and emotional experience.[1] Negative sequela resulting from pain may include immobility, inappetance, insomnia, catecholamine release, decreased pulmonary function and increased myocardial oxygen consumption. Additionally, cats may become mildly pyrexic.[2] As such, it is essential to be able to identify signs of acute and chronic pain in non-verbal species.

The pain pathway occurs during tissue damage when stimulated nociceptors release inflammatory mediators, which are subsequently encoded (transduced) into electrical activity, and transmitted along afferent nerve fibers to the dorsal horn of the spinal cord (modulation), before being projected to the brain (perception).[3] Acute pain may be the result of trauma, surgery, medical conditions, infection or inflammation.[4] Chronic pain in veterinary patients may be best described as pain extending beyond the anticipated healing period, with lasting neurophysical or psychological manifestations. [5]

Evaluation for pain should be part of every physical exam. Ideal pain scoring scales would create minimal inter-observer variations, and incorporate factors such as the type and duration of surgery, severity of pain associated with the procedure, hospitalization, age and concurrent diseases as well as individual variability.[6]

Pain Scales
Validated scales for assessing acute pain in companion animals include the Glasgow Composite Pain Scale, Melbourne Pain Scale and the Colorado Acute Pain Scale (see Figures below).[5]

Fear Free Patient Handling
The concept of Five Freedoms surrounding the welfare of livestock animals was developed by the United Kingdom (UK) Government in December 1965, and subsequently formalized by the UK Farm Animal Welfare Council in 1979.[2] Dubbed the Brambell Report, it outlined the importance of five key aspects of animal welfare under human control, including 1) access to fresh water and food, 2) adequate shelter and bedding, 3) pain, injury or disease prevention, including rapid diagnosis and treatments, 4) sufficient space, proper facilities and the company of other animals, and 5) conditions and treatment to avoid mental suffering. Comprehensive veterinary patient knowledge extending beyond mere anatomy and physiology has prompted some training programs to add behavioral medicine into the curriculum for future veterinarians and veterinary nurses.

The Fear Free Certification Program was launched by the American Animal Hospital Association (AAHA) in March 2016, based on Dr. Marty Becker's belief that providing a Fear Free patient experience leads to more accurate physical exams and laboratory testing, while resulting in less stress (including immune suppression, vomiting and diarrhea) for veterinary patients, and ultimately leading to more pleasurable interactions with the veterinary staff.

According to a 2014 Bayer Veterinary Healthcare Usage Study, 58% of cat owners reported that their pet hated going to the veterinarian, necessitating that Fear Free initiatives begin with travel desensitization at home.[3] Perhaps the biggest impact on the physical and emotional well-being of all veterinary patients entails the ability to identify the signs of anxiety by interpreting body language, employing gentle handling methods, and using sedation before fearful or stressed patients reach critical thresholds.[4]

Other Fear Free handling strategies may incorporate the use of pheromones (e.g., Feliway®, MultiCat, Adaptil® available through CEVA Animal Health) on clothing, carriers and toys, the availability of soft, warm bedding, a constant flow of tasty treats, soothing music (e.g., iCalmCat®) and the use of non-harsh, odorless chemicals for cleaning between patients. Fear Free concepts in hospital design may entail quiet, slip resistant flooring and separate dog and cat triage and housing areas. Dr. Becker's mantra-- "Take the pet out of petrified and put pets back into your practice"—succinctly describes how Fear Free veterinary practices of tomorrow will experience increases in patient visits while strengthening the client-veterinarian team-patient bond.[3, 5]

Pain Assessments in Cats
Pain assessments in cats pose unique challenges, and are often based on subjective behavioral changes. Physiological parameters such as heart and respiratory rate and pupil size are not consistently linked to acute pain symptoms in this species, while factors such as patient temperament and environmental context can further confound interpretation. The only pain assessment scale validated in cats (following ovariohysterectomy) is the UNESP-Botucatu Multidimensional Composite Pain Scale (MCPS) (www.animalpain.com.br/en-us/avaliacao-da-

dorem-gatos.php), although it is time consuming and may not be applicable for other types of surgical procedures or pre-existing health condition variables. Alternatively, the Glasgow Feline Pain Scale (CMPS-F) is an easier to utilize option.[6,7]

Pain assessments for cats should include both undisturbed cage observations and reactions associated with gentle handling techniques and wound palpation. Behavioral markers associated with discomfort may include a hunched posture or splinting of the abdomen, anorexia, lowered head position, growling, closed eyes, hiding or reaction to palpation, but facial expression changes such as furrowed brow, squinted eyes, whisker positioning or ear tip distance are currently under investigation. Cats in severe pain are usually depressed, motionless, and silent. [4,6]

Colorado Acute Pain Scale for Cats **Colorado State University**

Pain Score	Example	Psychological & Behavioral	Response to Palpation	Body Tension
0		☐ **Content and quiet** when unattended ☐ **Comfortable** when resting ☐ Interested in or **curious** about surroundings	☐ **Not bothered** by palpation of wound or surgery site, or to palpation elsewhere	Minimal
1		☐ **Signs are often subtle and not easily detected in the hospital setting**; more likely to be detected by the owner(s) at home ☐ Earliest signs at home may be withdrawal from surroundings or change in normal routine ☐ In the hospital, may be content or slightly unsettled ☐ **Less interested** in surroundings but will look around to see what is going on	☐ May or may not react to palpation of wound or surgery site	Mild
2		☐ **Decreased responsiveness, seeks solitude** ☐ **Quiet**, loss of brightness in eyes ☐ **Lays curled up or sits tucked up** (all four feet under body, shoulders hunched, head held slightly lower than shoulders, tail curled tightly around body) with eyes partially or mostly closed ☐ **Hair coat appears rough** or fluffed up ☐ May intensively groom an area that is painful or irritating ☐ **Decreased appetite, not interested in food**	☐ **Responds aggressively or tries to escape** if painful area is palpated or approached ☐ Tolerates attention, may even perk up when petted as long as painful area is avoided	Mild to Moderate **Reassess analgesic plan**
3		☐ **Constantly yowling, growling, or hissing** when unattended ☐ May bite or chew at wound, but unlikely to move if left alone	☐ **Growls or hisses at non-painful palpation** (may be experiencing allodynia, wind-up, or fearful that pain could be made worse) ☐ **Reacts aggressively** to palpation, **adamantly pulls away to avoid** any contact	Moderate **Reassess analgesic plan**
4		☐ Prostrate ☐ Potentially unresponsive to or unaware of surroundings, difficult to distract from pain ☐ Receptive to care (even mean or wild cats will be more tolerant of contact)	☐ **May not respond to palpation** ☐ **May be rigid to avoid painful movement**	Moderate to Severe **May be rigid to avoid painful movement** **Reassess analgesic plan**

New resources and checklists from Zoetis in 2020; feline chronic pain assessments for pet owners are also available at: https://www.zoetisus.com/oa-pain/first-time-resolution.aspx/

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Detecting Feline Chronic Pain

Alison Gottlieb, BS, CVT, VTS (ECC)

Feline veterinary enthusiasts love a challenge; it is largely why we are cat people. Because cats are often not willing participants, significant creativity is needed to care for them. One of the greatest challenges in treating feline pain is *recognizing* their pain. Overcoming this obstacle is crucial to providing the best patient care. Understanding painful conditions and signals will empower nurses to better advocate for their feline patients.

There are a range of pain states and classifications; however, the scope of this session will focus on recognition and causes of generalized chronic pain. Chronic feline pain is the ultimate challenge, significantly more problematic to identify than the acute version. Acute pain is severe, short in duration and alleviated once the body has healed. Acute pain can originate from medical, surgical, or trauma-related incidents and provide more obvious, visual or measurable cues. These pain cues provide increased opportunities for analgesia or other interventions that are vital for optimal patient care.

Chronic pain, alternately, has a more wide-ranging, fluid definition. Chronic pain, according to the WASAVA, is a disease state because it 'persists beyond healing'. Like all diseases, chronic pain should be considered detrimental and significant, and treated with the same importance as any other disease. This type of pain is often not visible and provides the first challenge to diagnosing chronic pain.

Pain recognition in any non-verbal patient provides a substantial universal hurdle. But with feline patients their complicated makeup and sensitivities is the ultimate impediment to diagnosing their pain. Animals typically hide pain due to their genetic predator/prey instinct. Cats are incredibly adept at this, and their mastery is another a diagnostic barrier. With their instinct to hide pain, cats then have fewer cues to display their pain. Spending most of their time sleeping, cats provide only a small window for observing behaviors to provide pain information, and when they are active cats typically do not go for walks, jump in cars or run as a dog might. Those are helpful opportunities for dog owners to recognize changes in behavior, enthusiasm or gait. Cats adaptation to pain make the cues more gradual and therefore even more difficult to identify. Behaviorally, felines in veterinary settings have increased stress and anxiety which cause them to further hide pain.[2]

On physical exam cats often do not react to painful or non-painful palpation which further adds to the litany of difficulties in detection. This becomes increasingly detrimental when trying to diagnose osteoarthritis (OA). In the veterinary setting cats are reluctant to show gait; they cannot be viewed walking a straight line, or through an exam room on a lead. Instead, feline patients will likely be found looking to hide or escape.[3] Cats are proven unlikely to present or display overt lameness. Several studies have confirmed that a notably low ratio of cats diagnosed with osteoarthritis (via radiograph) had presented lameness. A 2005 study reported as low as 16% of these cats had changes in gait prior to diagnosis. [4] There are a lot of roadblocks to diagnosing and treating chronic feline pain. There are limited research models and pharmacological options which contribute to this difficulty, but a combination of veterinary and owner education can counter some of these impediments.

Cat owners, and even veterinary professionals, inadvertently attribute behavior changes to typical or common age-related issues, instead of investigating the possibility of chronic pain. Signs of chronic pain can include decreased grooming resulting in greasy or matted hair, or overgrooming. Pain should be considered in areas of overgrooming – though is often assumed to be stress related. Animals often lick or chew at areas that are painful, hence the Elizabethan collar. With some cases analgesia may even prevent the need for the dreaded collar. Reluctance to jump/stretch is another sign of pain, and weight loss can be a symptom if food is kept on high surfaces. In many mixed dog and cat homes owners tend to provide cat food on high surfaces to prevent the family dog from eating it. Inappropriate urination/defecation is often attributed to behavior and thus overlooked as a pain related.[5] Weight loss or a reluctance to eat dry food can be a sign of oral pain.

Some less obvious signs of pain include changes in sleep patterns, hiding, shaking a paw, overgrown nails (not scratching), behavioral issues, a decrease in appetite, and objections to being brushed. Painful limbs will inhibit normal scratching behavior. Some arthritic cats will shake a front leg when getting up from a resting positioning before placing it on the floor, a subtle sign of possible pain. Feline behavior varies in response to pain, so ALL feline behavior changes should be investigated as pain.

I observed a profound response to chronic feline pain in my own cat. George was a castrated male, domestic short hair (DSH) feline. He showed small signs of urinary pain,(overgrooming only of the penis) and eventually developed a urinary blockage. Several months before his overt urinary signs I rescued a cat, Waffles, from my backyard. Waffles was timid, from a feral colony and twice the size of George. George was incredibly aggressive towards only Waffles. George seemed to give any new animal (dog or cat) that came into the house with a hazing period which lasted only a few days. Following this hazing period George would bond for life. This was different and was ongoing despite behavioral and pharmacological interventions. I was considering re-homing Waffles; simultaneously George had his urinary obstruction and I eventually decided to do periurethrostomy (P/U) surgery on him. There were several reasons that contributed to this decision, urinary pain was a primary reason.

George returned home after surgery without any aggression toward Waffles, in fact they became incredibly bonded. George not only accepted Waffles but loved him deeply, they were inseparable from that point on. This was a clear lesson for me; George conveyed his pain with aggression, once his pain was corrected, he was able to embrace Waffles and enjoy a relationship with him, no interventions were ever needed again. This was a life changing lesson for me, which should not have been. Humans often become "cranky" or snap at loved ones when suffering from pain, George demonstrated this to a tee.

Cats have numerous circumstances that would cause them chronic pain. While feline joint disease has not been widely studied, early research on initial findings are impressive. In one study, 100 cats at a clinic for unrelated, varied issues had appendicular skeleton radiographs**.** Results showed that 61% of the cats had osteoarthritis in at least one joint and 48% had more than one joint affected. The prevalence increased exponentially with age: with cats over 14 years, 82% at least one joint was affected by this painful condition. The most commonly affected were shoulders, elbows, hips and tarsal joints.[6] A U.S. study of 100 cats between 6 months and 20 years of age undergoing orthopedic radiography revealed that 91% had damage in at least one joint. [7] Osteoarthritis in cats is more prevalent than is diagnosed. There are numerous reasons for this which include a lack of radiographs obtained as well as many of the reasons addressed above.

Feline orofacial pain syndrome (FOPS) is 'oral discomfort and mutilation without obvious cause'. A recent study found declawing cats increases the risk of pain, including back and neuropathic pain. The researchers established that there is simply no "painless" declaw. [8]

Additional causes of feline chronic pain include; gastrointestinal disease, urinary issues or renal diseases, neoplasia, oral pain, diabetic neuropathy, skin issues, burns, declaw related chronic pain and emotional pain. Other causes of chronic pain exist and continue be discovered as our veterinary community continues to increase the dialogue and education among each other and cat owners of these basic facts of feline chronic pain. Liken your feline patient's pain a scale equivalent to a human's pain scale; a condition that humans describe as painful should also be considered painful for cats.

Neoplasia itself as well as diagnosis and treatment is commonly painful. Pain is related to; the tumor itself, inflammation or infection related to the tumor as well as potential nerve involvement/compression. Diagnostic tests do not come without pain as well, this may include a biopsy, venipuncture and any other testing which may contribute to pain. If treatment is elected, pain should be assumed. Surgical treatment, chemotherapy and radiation therapy all come with various levels of discomfort for these patients. Chronic gastrointestinal disease should be considered a source of pain in felines as well. This includes; constipation, megacolon and any inflammatory bowel disease. Pancreatitis and cholangiohepatitis will contribute as well. Commonly cats suffer from periodontal disease. This is often not an area owners regularly evaluate and many cats will not allow for proper evaluation at the time of physical exam. Often dental disease and pain are not recognized until the patient has stopped eating or is literally pawing at their face.

It is fair to assume pain is present, cats should not have to prove it is present to have it addressed. A paper written by Professor Davis provides a profound statement on analgesia in veterinary medicine which this author has found life changing: "Animal Pain One of the psychological curiosities of therapeutic decision-making is the withholding of analgesic drugs, because the clinician is not absolutely certain that the animal is experiencing pain. Yet the same individual will administer antibiotics without documenting the presence of a bacterial infection. [9]" As feline advocates we are responsible to advocate and educate, and this complex subject requires patience, calculating for clinic-based physical and behavioral changes, and a lot of questioning and investigating with owners and an understanding of the genetic and inherent difficulties of feline pain diagnosis.

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Treatment of Chronic Pain

Alison Gottlieb, BS, CVT, VTS (ECC)

"*If we keep these animals to give and receive love, as members of our families, we have an insurmountable obligation not to let them suffer*." Dr. Bernard E. Rollin

Analgesia in veterinary medicine has made great strides in recent history. Highly regarded veterinary textbooks published as recently as 1972 had no mention whatsoever of feline analgesia. The veterinary paradigm has shifted in the past few decades from "*do they feel pain*?" to recognizing and treating pain for animals. There have been several important catalysts to this change. The most distinct of these include Federal legislation for research, strong position statements from prestigious corporations and organizations (including the American Animal Hospital Association and the Association of American Feline Practitioners), and patient advocates - including veterinary technicians and pet owners.

While there have been significant constructive strides in veterinary analgesia in general, one area has lagged behind; chronic feline pain. There are a variety of reasons for this and barriers for treatment. Some of the obstacles for treating this specific feline pain include difficult recognition, their unique metabolism, difficult drug delivery, fear of adverse effects, and ultimately a lack of data on the analgesic options for felines. Additionally, cats are living longer and older ages increase the need for appropriate and varied treatment options for painful cats.

Treating Pain Involves Multimodal Intervention

Cats are private about displaying chronic pain. Often, initiating treatment measures can be a trustworthy method to solidify a diagnosis. Profound improvement after a given treatment can positively confirm that pain had been present. Treatment of chronic pain in cats should be multimodal. To that end, treatment courses can consist of a combination of environmental and lifestyle changes, pharmacologic interventions, and alternative therapies.
For example, a cat with musculoskeletal or arthritic pain can benefit from a combination of treatment and lifestyle changes, where employing only one form of treatment may not result in significant relief.

Pain is a complex process which affects the entire wellbeing of the cat. Due to the complex origin and consequences the treatment plan must encompass all perspectives of pain, called multimodal. Multimodal treatment which consists of a combination of environmental and lifestyle changes, pharmacologic interventions, and alternative therapies. [1] Combining therapies increases success of alleviating pain.

Cats with arthritic pain benefit from combining medical and lifestyle changes. Using both modalities together provide the greatest improvement in quality of life. Many of these cats have a high body condition score as well as arthritic pain. Weight loss substantially reduces arthritic pain in two ways; decreasing stress on joints and increasing mobility. Using a low-calorie diet, controlling calorie intake and educating owners on the ideal weight for their pet are ideal ways to decrease weight in these cats.[2] Incorporating activity will not only facilitate weight loss it will also keep muscles and joints active. Using small amounts of controlled activity are ideal. Playing with their favorite toys, leash walks and fetching food are a few options to keep cats moving. Food motivated cats will run down a long hall or play in an empty bathtub to fetch treats. Getting creative will not only improve mobility but is also a wonderful way to bond with a cat.

Other lifestyle changes should focus on improving comfort and accessibility. Providing steps or ramps for cats to get to their favorite high spots or food that may be offered on counters away from canine housemates. Any elevated surface; including beds, couches and windows that require any type of jumping up or down should have accessible options. Providing padded beds helps cushion joints and adding a heating pad and plenty of options will help encourage them to use them. Placing catnip on ramps, steps and bedding is a great way to encourage cats to use these new additions. Nail care may need to be with increased frequency. Scratching behavior may cause pain in these cats, allowing nails to overgrow and cause additional painful situations.

Making small changes to the litter pans will increase comfort and may help with inappropriate elimination. Pans with a low entry point eliminate discomfort that may be associated with getting into a higher pan. A pan with a large circumference and soft/fine litter are helpful for arthritic pain as well as declaw related chronic pain. Storage boxes designed for under beds often work well. Often a flight of stairs are involved in cats getting to the pan, eliminate the discomfort stairs may bring by placing a pan on each floor.

Other modalities depend upon the temperament of the cat. Massage, range of motion and heat therapy are often tolerated well by cats. The Assisi Loop® is simply placed on the affected area for 15-minute intervals. Mats are also available if area is widespread. This therapy uses small amounts of electricity to reduce inflammation and pain. Other therapies require more from both the owner and the feline include; acupuncture and physical therapy with an underwater treadmill. These may all aid in decreasing chronic pain, barring they do not stress these patients.

Specific commercially available diets are available to help with joint support. These diets often have specific additives as well as decreased calories to promote weight loss. Often supplementation may still be needed based on doses provided in the diets. The potential joint targeted supplements that may be added are; omega 3 fatty acids, glucosamine and chondroitin and green lipped muscle extract.

Nutraceuticals are a popular option for cat caretakers; due to the ease of availability and low incidence of side effects. High levels of fatty acids have shown to be beneficial for pain relief as well as disease modulation in canine studies. Fish based fatty acids, particularly docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) are likely to be beneficial.[3] The supplements glucosamine and chondroitin are involved in the metabolism of cartilage proteins and their use may help cartilage repair or slow down its degradation in the osteoarthritic joint. Studies on humans and canines is conflicting on the efficacy of this supplement. Dogs have shown positive results from the addition of Green lipped mussel extract (GLME) and the combination of all five of these supplements have anecdotally shown improvement in mobility when combined.[4] . This exemplifies the void in feline supplement research.

Another nutraceutical becoming gaining popularity in veterinary medicine is derived from milk protein concentrate from hyperimmunized cows. Microlactin (Duralactin, Veterinary Products Laboratories) impedes inflammation and is helpful regardless of the cause of inflammation.

Polysulfated glycosaminoglycan (PSGAG), an injectable chondroprotectant, has been shown to increase range of motion and decrease lameness and pain in dogs; however, the product is not labeled for use in cats.[5] Adequan® (American Regent); is actually a disease modifier; inhibiting enzymes that break down cartilage. A loading dose of twice weekly followed by monthly injections. This is a wonderful option for cats that have food allergies and may not be able to tolerate supplements/diet and cats that will not willingly take supplements/diet. Injections are labeled for intramuscular administration in dogs, however off label subcutaneous and feline administration have been shown to decrease signs of pain.[6] Some suggested regimens call for once weekly injections for 4 weeks followed by once monthly administration. Research on Adequan has not provided concrete evidence that it provides a beneficial effect, but anecdotal information suggests improvement can be seen after a few injections.[7]

Gabapentin (Neurontin) is another treatment option and is widely available (as of now) and inexpensive. Originally developed as an antiepileptic drug it was eventually found to have a significant effect on many forms of pain. It is thought to interrupt the calcium channels on which pain travels, alleviating the severity and presence of certain types of pain. Gabapentin can be found as a liquid elixir or can be compounded, making it desirable for cats to ingest. Of note, however: some human formulations of Gabapentin contain xylitol, which can be toxic to cats, and some lethargy may be seen at higher doses.

One feline study found that with the introduction of Gabapentin the affected cat displayed a decrease in pain associated behaviors; aggression, avoiding human interaction and loss of appetite. This same study also reported cat owners found it easy to administer and minimal side effects.[8] This being said, there is not a wealth of true evidence true analgesia is being provided in all cases. It has been known to reduce anxiety in cats which may fool us into believing pain has been addressed. The recommended dose starts at 2-10mg/kg PO (for both canines and felines), BID-TID, and may be increased to 50mg/kg PO, TID. Patients should be re-evaluated for potential dose increase every 5-7days as needed.[9]

Tricyclic antidepressants (TCA's) have been used with success as part of a multimodal treatment plan. Amitriptyline (a TCA) is generally very well tolerated as well as safe and has the potential to be used for many pain states. Amitriptyline blocks norepinephrine and serotonin reuptake which inhibits the pain pathway. The off-label veterinary dose ranges from 0.5 to 2 mg/kg PO q24h.. TCA,s have been used for behavioral as well as pain disorders and often both combined. Due to the difficulty of detecting feline chronic pain as well as behavioral manifestations of pain; Amytriptyline may be an top option. This treatment has been ideal for overgroomers, inappropriate urinators as well as feline idiopathic cystitis (FIC) which all have the potential to be pain related rather than behavioral.

N-methyl-D-aspartate (NMDA) inhibitors have shown promise in improving long term pain. NMDA receptors may change with chronic pain, using these inhibitors has shown to improve several types of pain in humans. Amantadine (as well as ketamine) acts centrally and is thought to decrease pain sensitization. Canine studies and anecdotal evidence are promising, but to date there are no studies published investigating its use in cats. One study showed

that administering amantadine with an NSAID significantly decreased clinical signs in dogs with osteoarthritis. .[11] An off-label dose of 2 to 5 mg/kg PO q24h has been suggested for cats. [12]

Tramadol is an atypical opioid drug that weakly binds to mu receptors. Studies in humans demonstrate a specific metabolite, O-desmethyl (M1), is necessary for tramadol to be effective as an analgesic. It was believed this was also the case for dogs, but research has recently shown the M1 metabolite in canines falls short of producing analgesia with Tramadol[13] Humans and cats produce enough M1 to generate opioid-like analgesia. Research is still needed for Tramadol with chronic feline pain. Tramadol has a bitter taste that may make administering it to cats difficult and compounding often does not mask the severe bitterness. Drug interaction and dysphoria are other potential problems associated with using tramadol; both may be related to serotonin syndrome. Combining tramadol with selective serotonin reuptake inhibitors (SSRI), monoamine oxidase inhibitors (MAOI), and tricyclic antidepressants should be avoided. Tramadol may lower the seizure threshold and therefore should be used cautiously in animals prone to seizures, such as patients with epilepsy.

Long-term use of nonsteroidal anti-inflammatory drugs (NSAIDs) in cats has been controversial. There are many factors that contribute to this, however with this particular class of drugs it is related to metabolism. Cats have individual and variable metabolism of NSAIDS which can make repeat dosing complicated. NSAID labeling for cats varies in different countries further defining the ambivalence surrounding chronic NSAID use in cats. On top of regional differences information is constantly changing. Inflammation of degenerating joint is the center of arthritic pain, using an anti-inflammatory drug is paramount for promoting comfort in these patients. However, quality of life needs to be the paramount consideration when treating feline pain. Meloxicam (Metam, Boehringer Ingelheim Vetmedica) has been approved for cats in the United States as a single-dose administration. Daily administration of the oral formulation is approved in other countries, but such use remains off-label in the United States.

Robenacoxib is another NSAID currently approved only for 3-day use in the US and 6 days in Europe. A study on long-term Onsior (Elanco Animal Health) proved it was well tolerated, with no evidence of injury to the gastrointestinal tract, kidney, or liver, when administered daily for 1 month in cats with osteoarthritis, including cats with evidence of chronic kidney disease. [14] As this handout is being prepared more promising information on long term use of Onsior in cats is being published. An study with 450 cats was just published that found when Onsior was given for 4-12 weeks to cats with OA there were no more adverse events than placebo.

Buprenorphine is a partial mu opioid agonist which binds to mu receptors but has only partial clinical effects, making it appropriate for mild to moderate pain, but not severe pain. Buprenorphine was thought to have a ceiling effect, this is when a medication has reached its greatest effects, increasing the dose does not enhance the effectiveness. The pH of buprenorphine is very similar to that of the saliva of cats. This makes the drug effective when the injectable formulation is delivered oral transmucosal (OTM) in felines, therefore increasing the ability to send the medication home with the painful feline patient. Chronic daily use is only recommended for end of life pain.

Emerging Therapies

Cannabis is another option in the cadre of feline chronic pain treatment modalities. Cannabis has been used with success for its medicinal properties in the US since the 1800's. In 1970, it was classified as a schedule 1 drug, akin to LSD and Heroin with no legal option for medical use. This reclassification limits usage but likewise limits the ability to perform research. (Ironically much human research regarding medicinal uses of Cannabis was done on lab animals). Cannabis is currently prescribed to humans for a wide variety of afflictions including pain, inflammation, anxiety, seizures, nausea, inappetence, neurosis and spasticity in spinal cord injuries. Research proved that low doses enhance morphine in humans, making it a valuable instrument in multi-modal analgesia (22). Research is limited in this area, however with laws changing research will follow.

Stem cell therapy is currently being used in canines with osteoarthritis with promising results. Studies and the authors experience with her own arthritic dog have demonstrated increased mobility as well as a decrease in lameness in these patients. The cells are harvested from the animals own adipose tissue and delivered back to the patient via intravenous and/or intraarticular injections. One clinical trial performed at the University of California Davis proved employing fresh, autologous, adipose-derived stem cell therapy was safe and effective for a naturally occurring, chronic inflammatory disease in cat. This particular study was performed on cats with severe gingivostomatitis but has the potential to be applied to any chronic inflammatory process.

Anti-NGF monoclonal antibodies (mAbs) are being developed as treatments for several pain conditions in multiple species. Solensia contains frunevetmab, a monoclonal antibody produced by Zoetis said neutralizes nerve growth factor. This product has gained approval in Europe and the research is impressive. 76% of cat owners reported

sustained improvement in signs of pain when their cats were given Solensia. Nerve growth factor plays a vital role in pain, inflammation and sensitization, this treatment targets them at the cellular level which also decreases renal, hepatic and GI side effects. Delivered as a subcutaneous injection also increases owner and cat compliance.

The Role of Veterinary Technicians

Veterinary technicians are patient's advocates; this includes client educators, doctor translators and persistent reminders. Because feline pain is so elusive and well disguised it is often overlooked. it is the technician that responds, "maybe it's pain" or "how about pain meds" consistently. Detecting chronic feline pain is a collaborative effort which begins with client education. Because most behaviors associated with chronic pain occur at home the pet owner must be educated on possible pain cues.

Veterinary technicians need to be aware of all the options that the veterinarian may discuss with an owner so they can reinforce that information and better educate the client on following the recommended multimodal approach to feline chronic pain. Because most of the pain medications are used off-label in cats, clients need to be reminded to look for adverse events and to immediately report any to the veterinarian.

Sometimes chronic pain does not become obvious until the cat has become so debilitated that no treatment can restore an acceptable quality of life. When that happens, it is necessary to discuss euthanasia for humane reasons. As recommended by the ethicist Dr. Bernard Rollin, "letting them [cats] live in unalleviated pain is the worst thing we can do to them." Therefore, if chronic pain interferes with quality of life, the staff needs to serve as the patient's guardian and bring up this difficult topic.

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Feline Chronic Pain: Getting Cat Owners on Board

Alison Gottlieb, BS, CVT, VTS (ECC)

Until cat people take over, status quo is what we deal with. Things are changing; however, it remains a dog's world. This may work in cats favor when it comes to the discussion of chronic pain with owners. The veterinary profession has been hard at work educating dog owners on osteoarthritis and other painful conditions, there is some work already done. It is all uphill from here so celebrate the positive.

We not only have to educate ourselves on cat pain, but practice also what we have learned and consider pain with every patient; we then must educate cat owners. This is followed by asking cats to comply. These tasks seem insurmountable some days, your hard work will pay off. There is no shortage of challenges, patience, and baby steps work wonders.

Recognition is something veterinary professionals struggle with as well. There are several reasons for this: cats are amazing at hiding pain, they certainly will not show it in the clinic, fewer cues they are usually not limping like dogs. Cats are professionals when it comes to hiding pain, even when we are looking for it. This is something we hear constantly, he was fine yesterday, it happened so fast. This is followed by our explanation of the disease process was going on for some time and they did not want you to know. This is not only true for end of life or critical care patient this also applies to chronic pain and disease. Cats hide pain from the owners, so it then falls to us to recognize chronic pain or subtle changes. When the cats are brought into the clinic, they are reluctant to walk up and down the hall, hop on 3 legs, lift the afflicted leg or point politely to where it hurts. The combination of a comprehensive orthopedic/physical exam, detailed history and educated owners will result in improved feline quality of life.

Cats with joint disease are not likely to be lame. One study found 16% of cats with radiographic evidence of joint disease were lame. [1] Making detection even more difficult. Working in an ER there are several triages for limping dogs each day and rarely for a limping cat; and if it is trauma is often associated. This additionally makes them less likely to see a vet due to plan.

The first step to getting owners on board is getting the team on board. Taking on chronic pain is a team sport. Everyone should have the same information and each different role that need to come together. It needs to be a judgment free but dedicated team and creative (as always when working with cats). It is important to deliver education and suggestions the entire family approves of. The question then becomes which cats are on our chronic pain radar? When we think about possible causes and demographics the list winds up consisting of all cats and therefore all cat owners. We know feline osteoarthritis is present in a huge (one study puts it at 90% over 12) population of cats. There are also cats with chronic abdominal pain from IBD or pancreatitis, declaw related, oral pain, other skeletal pain, cystitis, etc. and this is if these are diagnosed, many are not.

The next steps are educating owners is teaching recognition as it pertains to their cat. This can be done in several ways; active, passive, formal or informal. Passive education on chronic pain can either be on their own time or the time they spend waiting for us. One easy way to educate is to provide brochures of reliable and relevant information. AAFP has one targeting feline joint disease and another on detecting pain. Keeping them well stocked can help owners remember the information provided by the team and share it with their family. Exam rooms are the perfect place for posters, web sites and any detailed information they can absorb while waiting. One tool that can help with the conversation is having a checklist for cat owners to fill out either in the waiting room or any time at home. Zoetis currently has one on their site that is easy to use and digital. The digital version can be filled out prior to the visit and e-mailed in. This list evaluates behavioral as well as physical changes that may be occurring with chronic pain. It is also ideal for follow-up to track progress and have it all stored in their file. One can also be created by the clinic with questions referring to pain behaviors.

Educating owners on how to obtain optimal video of their cats at home can aid us in the diagnosis as well. Odd behaviors, gait, jumping, positioning and general motions give us the ability to see what we may not be seeing in the hospital environment. Lighting and long hallways are ideal spots, steps and jumping as well.

Signs of chronic pain can include decreased grooming resulting in greasy or matted hair, or overgrooming. Pain should be considered in areas of overgrooming – though is often assumed to be stress related. Reluctance to jump/stretch is another sign of pain, and weight loss can be a symptom if food is kept on high surfaces. In many mixed dog and cat homes owners tend to provide cat food on high surfaces to prevent the family dog from eating it.

Inappropriate urination/defecation is often attributed to behavior and thus overlooked as a pain related.[2] Weight loss or a reluctance to eat dry food can be a sign of oral pain.

Some less obvious signs of pain include changes in sleep patterns, hiding, shaking a paw, overgrown nails (not scratching), behavioral issues, a decrease in appetite, and objections to being brushed. Painful limbs will inhibit normal scratching behavior. Some arthritic cats will shake a front leg when getting up from a resting positioning before placing it on the floor, a subtle sign of possible pain. Feline behavior varies in response to pain, so ALL feline behavior changes should be investigated as pain. Particularly inter-cat aggression as was the case in my home. I observed a profound response to chronic feline pain in my own cat. George was a castrated male, domestic short hair (DSH) feline. He showed small signs of urinary pain,(overgrooming only of the penis) and eventually developed a urinary blockage. Several months before his overt urinary signs I rescued a cat, Waffles, from my backyard. Waffles was timid, from a feral colony and twice the size of George. George was incredibly aggressive towards only Waffles. George seemed to give any new animal (dog or cat) that came into the house with a hazing period which lasted only a few days. Following this hazing period George would bond for life. This was different and was ongoing despite behavioral and pharmacological interventions. I was considering re-homing Waffles; simultaneously George had his urinary obstruction and I eventually decided to do periurethrostomy (P/U) surgery on him. There were several reasons that contributed to this decision, urinary pain was a primary reason.

George returned home after surgery without any aggression toward Waffles, in fact they became incredibly bonded. George not only accepted Waffles but loved him deeply, they were inseparable from that point on. This was a clear lesson for me; George conveyed his pain with aggression, once his pain was corrected, he was able to embrace Waffles and enjoy a relationship with him, no interventions were ever needed again. This was a life changing lesson for me, which should not have been. Humans often become “cranky” or snap at loved ones when suffering from pain, George demonstrated this to a tee.

Using personal stories can often help break the ice with these discussions as well. It is important to express to cat owners how detrimental chronic pain can be to the quality of life of their family member. Put it in self terms, fortunately most have had some sort of pain. I find planting a seed often reaps big rewards. Some owners may appear to not hear you but remember the seed has been planted. Also keep in mind these owners in general do not want to see their cats suffer, they are just becoming aware of the signs you have shared with them in addition to the finances and possible work (or trauma depending on the cat) they may have to do. This is where our feline creativity comes in.

Some low cost/free options that do not require a willing feline participant involve environmental changes. These should focus on improving comfort and accessibility. Providing steps or ramps for cats to get to their favorite high spots or food that may be offered on counters away from canine housemates. Any elevated surface; including beds, couches and windows that require any type of jumping up or down should have accessible options. Providing padded beds helps cushion joints and adding a heating pad and plenty of options will help encourage them to use them. Placing catnip on ramps, steps and bedding is a great way to encourage cats to use these new additions. Nail care may need to be with increased frequency. Scratching behavior may cause pain in these cats, allowing nails to overgrow and cause additional painful situations.

Making small changes to the litter pans will increase comfort and may help with inappropriate elimination. Pans with a low entry point eliminate discomfort that may be associated with getting into a higher pan. A pan with a large circumference and soft/fine litter are helpful for arthritic pain as well as declaw related chronic pain. Storage boxes designed for under beds often work well. Often a flight of stairs are involved in cats getting to the pan, eliminate the discomfort stairs may bring by placing a pan on each floor.

Weight loss can also be discussed with owners, low to no cost and does not involve handling. Teach owners about decreasing calorie content, body condition scores, food puzzles and throwing kibble down the hallway. Cats with arthritic pain benefit from combining medical and lifestyle changes. Many of these cats have a high body condition score as well as arthritic pain. Weight loss substantially reduces arthritic pain in two ways; decreasing stress on joints and increasing mobility. Using a low-calorie diet, controlling calorie intake and educating owners on the ideal weight for their pet are ideal ways to decrease weight in these cats. Incorporating activity will not only facilitate weight loss it will also keep muscles and joints active. Using small amounts of controlled activity are ideal. Playing with their favorite toys, leash walks and fetching food are a few options to keep cats moving. Food motivated cats will run down a long hall or play in an empty bathtub to fetch treats. Getting creative will not only improve mobility but is also a wonderful way to bond with a cat.

These are several ways to engage the cat client in recognizing and treating chronic pain. Once it has been established and a treatment plan proposed follow-up becomes vital. How well are the treatments being tolerated and

providing analgesia, do they need to be altered or added to? The Zoetis feline check list or a hospital one used at diagnosis should be repeated. This will give quantitative information as to progress.

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Feline Nursing Care for the Hospitalized Patient

Alison Gottlieb, BS, CVT, VTS (ECC)

There is no such thing as a bad cat; just a good cat having a bad day…..

Working with cats can be a pleasure or it can be miserable, this all depends on techniques and attitudes of veterinary personnel. Cats are incredibly special creatures, closer to wild than we like to imagine. Most of them never leave the house, this is their day out and they do not like it. The day starts with being stuffed in a box from the garage covered in cobwebs and urine smells from the last time. Then put in the car and brought into a waiting room full of barking dogs. Then you get pulled out of the box, stretched, scruffed, covered in alcohol, poked and prodded. And then we wonder why they are not happy. Using low-stress and feline friendly techniques along with pharmacologic intervention will change everyone's perspective and quality of life. [1]

Admitting the feline patient to the hospital should only be done when home care is not an option; all attempts should be made to keep the feline patient at home. Stress levels, personality, and finances must be weighed into every aspect of decision making. Once the decision to admit to the hospital has been made, three very different treatment philosophies come into play. The doctor will often want significant hands-on nursing care, the patient wants to be at home and as nurses we play referee between the two. A delicate balance between patient care, stress and monitoring.

Stress is a vague and subjective word. It can be benign, or life threatening and should always be taken seriously. Hospitalizing the feline patient will inevitably lead to stress in some form or another; on the owner and the patient. If we consider the fact that cats do not necessarily understand that hospitalization is in their best interest and temporary. For an animal that lives in the moment this is a foreign concept and one that would cause stress in any species.

Stress is incredibly detrimental to health and well-being. This is evident with our own stressors. It not only complicates disease but conceives afflictions as well as behavior changes. The stress response has pathways that become stimulated and lead to physiologic and behavioral changes. The sympathoadrenal system releases epinephrine and norepinephrine, the catecholamines responsible for the classic "fight, flight, or freeze" responses. These hormones increase heart rate and respiratory rate. Epinephrine stimulates glycolysis, gluconeogenesis, and lipolysis, necessary to supply energy for fight or flight. The hypothalamic-pituitary-adrenal response stimulates various changes, some of which have catabolic and immunosuppressive effects.

Hospital related stress is long acting as well. Depending on how long the cat needs to be in the hospital high levels of stress will follow. The effects of this are seen in many aspects of their health. Diseases like feline herpes, cystitis, hepatic lipidosis, DKA and behavior issues can all result or be hastened by stress. Anesthetic drugs are less reliable under high stress environments. Hospital induced UTI's can also result if the cat will not urinate in the hospital which can result in a return visit and additional medication.

Cats are territorial and regimented in general. When we consider the healthy cat at home this is evident when they are presented with change. Often visitors, new furniture, changes to routine and minor environmental changes stress a cat on a good day. A hospitalized cat is often not having a good day. Everything is unfamiliar; people, smells, sights, sounds, habitat and diets have all been abruptly changed in addition to whatever ailment caused hospitalization.

Territory is of the utmost importance to cats. They mark their areas with pheromones, scratching and urine to arrange their territory at home. This is a lot of work and vital to everyday comfort. The cage is a foreign place for a cat, no markers or familiar smells. Using pheromones (feliway) and bringing bedding from home may make a significant difference in their stress levels. It is incredibly important to clean cages thoroughly in between patients as well, using a disinfectant that removes pheromones from other patients. Additionally, changing bedding that is not soiled also creates stress in cats. They have marked and have adapted to the bedding placed with them and changing it will cause the process to start again. The other downfall is often cage size, cat cages are often too small to provide proper hosing. Cat cages should have enough room for bedding as well as a place to hide/perch, a true litter pan (not a tray), food and water. We educate owners to avoid placing food and litter together (like eating in the bathroom) at home and often this becomes the case in the hospital. Top cages are ideal for cats, cages on the floor can lead to additional stress from dogs walking by and can potentially facilitate escape. Providing cats with a simple cardboard box or a privacy curtain over the cage door can decrease stress levels. Cats in general tend to prefer a

quiet environment which is often not the case in the hospital. Dogs, phones, pages and voices can be unrelenting and significant in the hospital. Moving cats away from barking dogs is a must to decrease stress levels. Playing cat friendly music has also been found to decrease stress levels and improve the hospitalized cat's quality of life. .[2] Another stressor can be lights, often bright and never off. Dimming them of having set times they are off is helpful. Keep in mind certain opioids can have lasting effects on feline vision and light sensitivity.

Tools such as towels, e-collars, pheromones, cat nip and food are all staples to handling cats. Using feline friendly techniques alters the entire visit/relationship.[1] In addition to these valuable techniques giving Gabapentin is a wonderful anti-anxiolytic for cats. Ideally it should be given pre-visit, however are it is incredibly helpful when given at any time. In the authors experience giving a hospitalized cat 50mg (100mg pre visit) of gabapentin PO q8-12 will decrease stress significantly and often lead to eating. If needed additionally 50mg of Trazadone PO can also be used in addition. No cat should ever be gassed down in a box! EVER!. There are numerous cocktails of injectable drugs that can be given. This is safer and less traumatic for the staff and patients.

Speaking of E-collars……..a necessary evil? We have all seen them break a cats spirit, mobility and appetite. Do they really need them or is it just a habit? IV catheters can be lightly covered with no-chew type wrap, lines too if needed. Perhaps stockinette or a t-shirt will cover an incision and often great analgesia is the best collar of all. If it is necessary, try a soft one and please remove it for feeding.

Monitoring is a balancing act between information and stress. For most feline patients the constant checking of vital signs adds undue stress and they are often skewed by the hospital itself. A 2011 study supported the idea that stress may result in elevated physiologic parameters for cats in the hospital environment.[4] Additionally a 2005 study showed heart rate and rhythm recorded in unfamiliar circumstances like the clinic may inadequately represent the true resting state.[5]

Respiratory rate and effort are easily evaluated from outside of the cage, BP cuffs can be applied and cage door closed if using multi parameter telemetry. Electro pads should be used if EKG is being continuously monitored, this is often done involving feet and tape which most cats do not care for. When approaching a feline patient with a list of treatments often consider temperament, importance, patient stability, stress and the true value of the information obtained. For example: a pulse ox measurement on a cat that is not under anesthesia, should you obtain a random number, will that change the treatment of the patient? If the patient is having respiratory signs it should be supplied oxygen (without stress) and treated for the cause of the tachypnea. Does every cardiac cat truly need an IV catheter or is it to make us feel better. This refers to the cat that comes to the hospital and does not need IV cardiac meds. Often when they present dyspenic the stress of an IV makes matters worse. Most of these cats are treated with thoracocentesis, oxygen supplementation and Lasix which can be given IM. In my experience they often eat post thoracocentesis making oral medication easily delivered.

Frequent blood draws increase patient stress as well. Grouping them together when possible is often the first thing I do when I approach a treatment sheet. When that is not possible a sampling catheter should be placed.

Pain should be evaluated in every patient, often. Pain scores and palpation should be performed at the very least q8. The most accurate way to assess pain is not to assess it at all, but to assume it exists. Anthropomorphism is the concept of applying human characteristics to animals and for the most part is a desirable ideology. For several reasons this philosophy is not only applicable but imperative in the area of animal analgesia. The assumption should be made that any injury, disease, or procedure that causes discomfort to a human would have a similar effect on an animal.

In the emergency room and critical care unit, pain is most commonly of the acute nature. This encompasses acute illness, sudden trauma, and post-operative surgical pain. Often many of the things we do in attempting to care for our patients such as taking radiographs of broken bones, using a firm ultrasound probe on a painful abdomen, performing simple restraint, abdominal and thoracic drainage, passing various catheters into various orifices, and venipuncture can worsen the patient's existing pain. **Multimodal analgesia** is the concept of using various medications and techniques that address pain through different angles to provide effective pain relief. There are several advantages to using this concept. One obvious benefit is that by using drugs that work on different parts of the pain pathway the caregiver has added assurance that the pain pathway is being broken. Another theoretical benefit to multimodal analgesic therapy is that lower drug doses, which may lessen side effect and improve safety in these critical patients, can be used. This is because many analgesic choices have synergistic effects with each other thus providing superior analgesia at decreased individual doses. **Pre-emptive analgesia** is a concept that employs providing analgesia before a painful stimulus occurs whenever possible. While this is feasible in the case of acute post-surgical pain it is often impossible for acute illness and sudden trauma. Recently the effectiveness of pre-emptive analgesia has been questioned in human medicine. The concept of pre-emptive analgesia has now evolved

into the concept of preventative analgesia. **Preventative analgesia** is the concept of providing analgesia with the focus on reducing postoperative pain and targeting the prevention of chronic pain.

Behavioral changes are not always present or clear in animals; severe debilitation, injury, neurologic damage, cages and bandages may interfere with clearly observing pain behaviors. Even though the majority of our patients are domesticated (perhaps with the exclusion of feral cats) they are not far removed from their wild instincts. They are conditioned (if physically able) to conceal signs of pain to protect themselves as prey which may skew recognition.

Cats tend to reduce their and limit their activity or hide, not even using the litter pan or by displaying flight behavior (thrashing or climbing the cage). They may purr as a self-soothing mechanism which can help us recognize the need for analgesia or additional analgesia. Decreased appetite, shaking, guarding a painful location, hiding, the inability to sleep, inappropriate urination and defecation, self-mutilation, over grooming and temperament changes are indicators of potential pain.

Physiologic changes in response to pain may include; tachycardia, tachypnea, hypertension and dilated pupils. There are several flaws however with using physiologic changes to assess pain. For example, re-evaluation after opioid administration which may lower heart rate may introduce bias. The heart rate may simply be decreased from the opioid itself not necessarily as a result of appropriate analgesia. Additionally, many things may cause a rise in vital signs beyond simply pain. Anxiety, stress, shock, medications and normal responses to a primary problem can all create increases in vital signs. Tachypnea may be related to acid based abnormalities or a full bladder for example as well as pain. In general, increased physiologic parameters such as tachycardia and hypertension are very unreliable indications of pain in both humans and animals. Palpation of the area in question conversely is one of the more trustworthy indicators of pain.

Opioids are the most widely used and effective drugs for the treatment of acute pain. Interesting they are poorly effective in the treatment of established chronic pain. Opioids work by mimicking the actions of endogenous opioids peptides (e.g. endorphins, enkephalins, dynorphins) at mu, kappa, or delta receptors located throughout the central nervous system and periphery (e.g. eyes, synovial and pleural membranes, etc.). In the veterinary emergency and critical care setting, the most frequently used mu agonist opioids include fentanyl, remifentanil, oxymorphone, hydromorphone, and methadone. These drugs are efficacious in treating mild to severe pain. The partial mu agonist opioid buprenorphine and the mu antagonist/kappa agonist drugs butorphanol and nalbuphine are also utilized frequently for less intense more mild pain. All of the drugs described can be administered via intermittent bolus administration or as a constant rate infusion. Opioids that have very short duration of effect, including remifentanil, fentanyl, and butorphanol, almost always require constant infusion to be of clinical benefit. Besides providing excellent analgesia, opioids are generally safe drugs in even the most unstable patients. Potential side effects include sedation, nausea and vomiting, respiratory depression, hyperthermia, dysphoria, and increased vagal tone with bradycardia. If objectionable side effects are observed, the opioid antagonist naloxone is available as an opioid reversal agent. Analgesia will also be reversed in the face of naloxone. Large doses of naloxone ranging from 0.02-0.04mg/kg can be used to completely reverse the effect of most opioids. Much lower doses of naloxone (e.g. 0.001-0.005mg/kg IV) are very useful to rouse overly sedated patients and reduce respiratory depression while leaving analgesia intact.

The term **locoregional** is used to define any analgesic technique that is restricted to a localized region as contrasted by a technique that is administered to the whole body. Sodium channel blockers such as lidocaine, bupivacaine, and ropivicaine are local anesthetics agents that easily lend themselves to locoregional analgesic techniques. In general, 2% lidocaine is believed to have an approximate onset time of 5 minutes and a 60-90-minute duration. Bupivicaine may have a longer onset time up 20 minutes but a duration of 180-360 minutes.

The injection of local anesthetics themselves can be painful due to the low drug pH, especially in awake patients. Adding a very small amount of sodium bicarbonate to the local anesthetic will increase the pH and in turn decrease the pain on injection as well as increasing efficacy by creating a pH which improves absorption. One type of locoregional anesthetic technique is the use of local anesthetics topically. Depending on the preparation, they can potentially be absorbed by mucous membranes (conjunctiva, nose, mouth, larynx) as well as through the skin and open wounds. Proparacaine 0.5% or tetracaine 1% ophthalmic drops can be applied directly on the surface of the eye for corneal and conjunctival desensitization with a duration of anesthetic action of 15 minutes and 25 minutes respectively. Lidocaine 2% and bupivacaine 0.5% can also be utilized for much longer effect if needed. Proparacaine 0.5%, tetracaine 1%, or lidocaine 10% spray can be administered in nares for placing nasal oxygen and feeding tubes. Sterile vicious lidocaine 2% jelly may help facilitate the placement of urinary catheters and effectively block other mucous membrane surfaces.

Intact skin is very difficult for local anesthetics to penetrate. Simply applying lidocaine 2% or bupivacaine 0.5% to intact skin will have minimal to no effect. The most effective topical local anesthetic drug preparation to penetrate intact skin is a cream formulation of 2.5% lidocaine and 2.5% prilocaine (EMLA© cream). A recently published study was done on Emla cream for jugular venipuncture in cats and found significantly decreased stress levels after Emla cream sat for 30 minutes. "The jugular venepuncture was defined as easy in 1/9 cats that received the placebo and in 8/9 cats in the EMLA group". [3] To use this product, the patient's fur is clipped over the intended site to be numbed and a thick layer of the cream applied. The site is then covered with a non-porus occlusive dressing. The cream achieves deep tissue desensitization but full efficacy takes approximately 45 minutes for effect. When time allows the desensitization of intact skin prior to peripheral or central intravenous catheter or venipuncture can dramatically ease this process for both the patient and veterinary technician. Potentially spray on products like Cetacaine® Topical Anesthetic Spray(Benzocaine 14.0 %, Butamben 2.0 %, Tetracaine Hydrochloride 2.0 %) **can be used for SQ injections, with a 30 second onset.**

Feeding the hospitalized cat is an incredibly rewarding challenge. Nausea must be considered before feeding. Drooling, vomiting, lip smacking and refusal of food may all be due to nausea in these patients. Anti-emetics (Zofran, Cerenia) should be considered. Appetite stimulants, a quiet box, catnip, and sometimes sitting and talking to them when you offer food can all be helpful for getting these patients eating. Make sure pain is being adequately managed; this tends to be a frequent cause of anorexia. Force feeding is highly discouraged, this often leads to increased stress and food aversion, neither helpful when treating the feline patient. Aside from the fact that they tend to be finicky eaters, hepatic lipidosis is a very real secondary problem to feline illness and must be addressed. Pre-hospital anorexia should also be considered when a nutritional plan is being devised.

Even healthy cats can be finicky eaters, add illness and you may likely wind up with an anorexic cat. Healthy cats will stop eating when brought in to a strange environment regardless of the state of their health. Some cats prefer a dish to a bowl, or they only eat at night, imagine what hospitalization does to them. As far as comfort goes we do have the ability to make a huge difference, we need to take advantage of this. Sometimes something as simple as a box to hide in or covering their cage with a towel will help them feel comfortable enough to eat. Occasionally heating up canned food helps, as well as using a fishy smelling variety of food. Often the more inexpensive the cat food is the higher the probability that the cat will eat it. Some cats prefer dry food to canned, or the semi-moist varieties. Canned tuna fish or store bought lunchmeat can also be offered. Freeze dried liver used for dog training treats can be crumbled over food, cats can't resist the smell. Temporarily removing an e-collar may also entice them to nibble. Adding a probiotic (forti flora, Purina) or a tube variety (Churu) may stimulate appetite. Ham baby food and A/D (Hills) are great options as well.

Additional interventions include pharmaceuticals. Cyproheptadine (2-4 mg per cat PO; SID or BID) can be given 30 minutes before food is offered. This is an antihistamine which has a side effect of an increased appetite. Diazepam (0.05-0.4 mg/kg IV, IM or PO) works like magic when used as a feline appetite stimulant. When given IV, will cause a cat to lunge forward into a bowl of food. Onset is rapid and the effects are short term, so be prepared with several varieties of food available as soon as injection is given. Mirtazapine (remeron) is a human antidepressant which has proven to show profound increase in appetite in cats. They are usually made in 15mg tabs and cat doses were ¼ tab PO (3.75mg) per cat every three days. The results of this dose produced increased mania (presumably due to serotonin) and an increased appetite for 1-2 days. The recommended dose has since been amended to 1.8mg/cat EOD PO. This dose has resulted in less mania and more reliable and consistent appetite stimulation. Transdermal options are also available and an option for cats that will not readily take pills. Cats are also susceptible to developing food aversion. This occurs when food is left in the cage for extended periods of time with a sick anorexic cat. Think about it if you were not feeling well would you want to sit next to an old cold meal. Force feeding is not recommended for this reason as well as the threat of aspiration and undo stress.

If none of these treatments stimulate the patients appetite and sending them home is not an option it is time to place a tube. What type of tube depends on the disease process and the clinician. This procedure is done to administer short-term nutritional support to a patient when they are not eating enough nutrition to meet its daily caloric needs. There are two forms of feeding tubes that can be placed which allow the patient to continue to eat and drink. The types are; nasoesophageal (NE) tube and nasogastric (NG) tube. These tubes can be kept in place from several days to weeks; however they are contradicted in patients predisposed to aspiration, esophageal dysfunction and patients that are actively vomiting. They are also contradicted in patients that have injuries to the head and neck or surgical procedures of the nasal cavity, pharynx or esophagus. NG tubes are narrow, therefore liquid diets only can be placed in them and cats usually need an e-collar placed to prevent them from removing the tube.

Feedings may be done as a constant rate infusion (CRI) or as bolus feedings. It is all dependent on the patient's condition and the doctor's recommendations. For bolus feeding, Always offer the patient food or water first, unless instructed otherwise by the doctor. Complete any other treatments the patient may need before giving anything

through the feeding tube. The patient should not be stressed or excited after the feeding, because that may cause them to vomit. Flush the feeding tube with 5 mls of water, wait to make sure the cat does not gag, cough or vomit. If you are administering a feeding make sure that you have measured out the amount you are giving and let it warm to room temperature and refrigerate unused portions. Administer prescribed medication or feeding (only liquefied medications should be administered through these tubes, otherwise they can become clogged). If the tube becomes clogged, try pushing a small amount of a carbonated beverage through it. Flush the tube with 10 mls of water and place cap on the end. If the patient vomits after its' treatment, skip the next feeding, and then resume feedings at a slower rate of administration. Feeding via CRI is helpful for animals that have not eaten for two or more days, it allows the stomach to slowly return to normal function. Using either a liquid diet or electrolyte solution the gastrointestinal tract slowly begins to move again. As this is tolerated the feeding is increased to meet the caloric requirements of the patient.

The ethical triangle between the patient, owner and veterinary care team is unique as well. As nurses we tend to have the most contact with the patient, conversely with the least control over the situation. This can lead to burnout of the staff which negatively affects patient care; there are ways to prevent this from occurring. Effective communication between all aspects of the triangle helps all involved. As nurses we need to take advantage of the ability to build a relationship with the client to help express the needs of the patient. Communication is the key.

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