2026

VMA

CONFERENCE & TRADE SHOW

CANADA'S PREMIER VETERINARY CONFERENCE

JAN 29-31 2026

The Westin Harbour Castle

TORONTO, ON

CONFERENCE PROCEEDINGS

PART TWO

ONTARIO VETERINARY MEDICAL ASSOCIATION

#OVMA2026

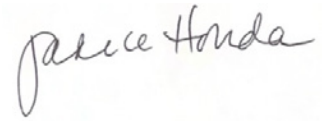
FOREWORD

Thank you for attending the OVMA Conference and Trade Show! We hope you enjoy our continuing education program and learned new ideas and perspectives on trending topics in the veterinary profession.

The following proceedings remain the property of the respective authors, and reproduction without their written consent is prohibited. The authors have condensed their lecture material as reference information for attendees, and these proceedings have been reproduced directly from their submitted materials. Any questions concerning their content should be directed to the authors.

OVMA and its Conference Committee extend a warm thank you to our speakers and sponsors, who have supported the veterinary profession by participating in this year's event. Our sponsors' continued commitment has enabled us to offer you top calibre education at our annual conference.

Thank you again for supporting the OVMA Conference and Trade Show, and the continuing education of veterinary teams.



Janice Honda, DVM
2026 Conference Chair
Ontario Veterinary Medical Association

TABLE OF CONTENTS

PRACTICE MANAGEMENT PROGRAM

INSIDE VETERINARY WELL-BEING

Angie Arora, MSW, RSW

Founder and Veterinary Social Worker, Arora Wellness

MANAGEMENT & FINANCE

Christopher Doherty, DVM, MBA, CBV

Assistant Director, Strategic Business Research and Outreach, American Veterinary Medical Association

TOOLS FOR TEAM LEADERS

Andy Roark, DVM, MS

CEO/Founder, Uncharted Veterinary Conference

TECHNICIAN PROGRAM

TECHNICIAN ESSENTIONS – ACUTE CARE

Megan Brashear, RVT, VTS (ECC)

Senior Manager, Veterinary Nursing, Purdue University Veterinary Hospital, West Lafayette, Indiana

PLENARY SESSIONS – PROCEEDINGS ARE OPTIONAL FOR PLENARY SESSIONS

FRIDAY MORNING PLENARY

Maureen E.C. Anderson, DVM, DVSc, PhD, Dip. ACVIM
Lead Veterinarian, Animal Health and Welfare, Ontario Ministry of Agriculture, Food and Agribusiness

J. Scott Weese, DVM, DVSc, Dip. ACVIM
Professor, Ontario Veterinary College, University of Guelph
Zoonotic Disease/Public Health Microbiologist, Centre for Public Health and Zoonoses, University of Guelph
Chief of Infection Control, Ontario Veterinary College Teaching Hospital

2026 OVMA CONFERENCE – SPEAKER BIOS

SMALL ANIMAL PROGRAM

Dawn Crandell, DVM, DVSc, DACVECC

Veterinary Medical Director, Head of Critical Care, Toronto Animal Health Partners

Dr. Crandell graduated from the Ontario Veterinary College in 1990 and completed an internship in small animal medicine and surgery at UPEI. She worked at a general small animal practice in Thunder Bay for 3 years, then full time work as an emergency veterinarian and practice manager in southern Ontario. She returned to OVC in 2001 to do a 3-year residency in emergency medicine and critical care, obtaining board certification in 2004. Subsequently she worked as a critical care specialist full time in Toronto , and is now is the veterinary medical director at Toronto Animal Health Partners. Her professional special interests outside of critical care are the advancement of recognition and treatment of patient stress and fear in the veterinary clinical environment and promoting an evidence-based approach to veterinary medicine. When not immersed in a veterinary hospital, she loves to be outdoors away from asphalt, concrete and cars, practices and promotes gardening with native plants to help heal our urban environment, and champions safer cycling in Toronto.

Caitlin Grant, DVM, DVSc, Dip ECVCN

Veterinary Specialist, Animal Hospital of Cambridge

Dr. Grant attended the Ontario Veterinary College (OVC) and graduated with honours in 2014. After graduation, she became an associate veterinarian in a private, mixed animal practice. In 2017, she returned to OVC and completed a nutrition residency through the European College of Veterinary and Comparative Nutrition (ECVCN) and earned a Doctor of Veterinary Science (DVSc) degree in September 2020. Dr. Grant then joined OVC as Assistant Professor and held the Nestle Purina Professorship in Companion Animal Nutrition. She was service chief for the OVC-HSC Clinical Nutrition Service and taught nutrition to students in all four phases of the DVM program. She currently works in private practice in Cambridge Ontario providing nutrition consults to pet owners and provides in clinic as well as telemedicine nutrition consultations to pet owners across Ontario and to veterinarians nationwide.

Peter Helmer, DVM, DABVP-Avian Practice

Assistant Professor, Lincoln Memorial University College of Veterinary Medicine

Peter Helmer is a graduate of the Ontario Veterinary College, University of Guelph and a Diplomate of the American Board of Veterinary Practitioners, Avian Practice. After 25 years in private practice he recently joined the faculty at Lincoln Memorial University in Harrogate, TN. He is a frequent speaker at veterinary CE conferences and has authored numerous publications including journal articles and textbook chapters. Dr Helmer is also a consultant for Avian/Exotic pet medicine at Antech Diagnostics.

Lissie Henderson, BVSc (Hons), DipECVS

Small Animal Soft Tissue Surgeon

Dr Lissie Henderson graduated with honours from the University of Bristol in 2011. She went on to complete a rotating Internship at the University of Bristol and subsequently worked as a clinical research assistant at the University of Liverpool. During this time she undertook data collection and the analysis for projects and published in several veterinary scientific journals. Dr Henderson then undertook a surgical internship and residency program in small animal surgery at the University of Edinburgh and became a board-certified Diplomate of the European College of Veterinary Surgeons in 2020. She is passionate about her continued learning and the teaching of veterinary students, interns and residents. Dr Henderson enjoys all aspects of small animal soft tissue surgery and has a particular interest in endocrine surgery and interventional procedures.

Alison Little, DVM, DACVIM (Neurology)

Neurologist, Toronto Animal Health Partners

Dr. Alison Little graduated from the Ontario Veterinary College in 2014. Following graduation, she completed five years of advanced training via a Small Animal Rotating Internship at the Veterinary Emergency Clinic in Toronto, a Specialty Neurology Internship at Southeast Veterinary Neurology in Miami, Florida and a Neurology/Neurosurgery Residency at Mississippi State University. She then returned home to Toronto and joined the Animal Health Partners team in 2020.

Jenna Manacki, DVM, Residency Trained in Clinical Nutrition

Secretary, Canadian Academy of Veterinary Nutrition

Dr. Manacki completed her undergraduate studies at the University of Guelph. She attended Ross University School of Veterinary Medicine on the beautiful island of St. Kitts and completed her clinical training at the University of Saskatchewan. After graduating, Dr. Manacki practiced companion animal medicine in both Arizona and Ontario. After four years in private practice, Dr. Manacki pursued a clinical nutrition residency at the University of Missouri, finishing in 2022. Dr. Manacki currently runs a clinical nutrition service at the Veterinary Emergency Clinic (VEC) in Toronto. Dr. Manacki is a proud member of the Canadian Academy of Veterinary Nutrition.

Connie Mosley, Dr.med.vet., DACVAA, CVA

Veterinary Consultant, Elanco Animal Health

Dr. Conny Mosley is a board-certified anesthesiologist and currently the Veterinary Consultant for Pain & Internal Medicine for Elanco Canada. She is certified in acupuncture, served on the WSAVA Global Pain Council and is the founding director of the Canadian Association of Veterinary Cannabinoid Medicine. Conny has held faculty positions at North Carolina State University, Oregon State University and Ontario Veterinary College and has been an anesthesiologist in a private specialty practice, where she also ran an Integrative Veterinary Pain Clinic. She continues to consult on pain cases. She is a passionate advocate for ethical and practical veterinary care and pain management. Her contributions to the field include publications, lectures, and a deep commitment to both teaching and learning.

Craig Mosley, DVM, MSc, DACVAA

Staff Veterinarian, VCA Canada 404 Veterinary Emergency and Referral Hospital

Dr. Craig Mosley graduated from the Ontario Veterinary College at the University of Guelph where he also completed a residency and Master's of Science program in veterinary anesthesia. Dr. Mosley has been actively involved in many facets of veterinary medicine since graduation including; mixed animal practice, emergency medicine, critical care, teaching, management and of course, anesthesia in both private and academic practices throughout North America. Dr. Mosley's varied experiences have provided him with the foundation for his practical and "real-world" approach to anesthesia and pain management.

Lynne O'Sullivan, DVM, DVSc, DACVIM (Cardiology)

Professor, Department of Companion Animals, Atlantic Veterinary College, University of Prince Edward Island

Dr. Lynne O'Sullivan received her DVM from AVC, UPEI; Cardiology residency training and DVSc degree from OVC, University of Guelph; and board certification in Cardiology from ACVIM in 2003. She was a faculty member at the University of Guelph for 15 years before returning to the east coast to join the faculty at AVC, UPEI. Her research interests have been in dilated cardiomyopathy and imaging, and her passion is teaching both DVM students and residents. She's been the recipient of the Carl J. Norden Distinguished Teacher Award, the Canadian Veterinary Medical Association Teacher of the Year Award, and the Boehringer Ingelheim Clinical Teaching Award. Outside of veterinary medicine, she can be found on the pool deck, side lines, or ski slopes cheering on her active sons, or spending time with her husband and her pets at home.

Karen L. Overall, MA, VMD, PhD, DACVB

Professor, Behavioural Medicine, Department of Biomedical Sciences, Atlantic Veterinary College, UPEI

Dr. Karen L. Overall received her BA, MA and VMD degrees from the University of Pennsylvania and a PhD degree from the University of Wisconsin-Madison. She did her residency training in veterinary behavioural medicine at the University of Pennsylvania and is a Diplomate of the American College of Veterinary Behaviourists (DACVB). Dr. Overall is a Professor of Behavioural Medicine at Atlantic Veterinary College, UPEI where she created the clinical, didactic and research program which trains veterinary students, residents, and graduate students. Dr. Overall lectures at meetings and veterinary schools world-wide and consults internationally with governments, NGOs and working dog and welfare organizations. She is the author of hundreds of scholarly publications, textbook chapters, commentaries, et cetera and the texts Clinical Behavioural Medicine for Small Animals (1997; Elsevier) and Manual of Clinical Behavioural Medicine for Dogs and Cats (2013; Elsevier) and of the DVD, Humane Behavioural Care for Dogs: Problem Prevention and Treatment (2013; Elsevier). She is the editor-in-chief for Journal of Veterinary Behaviour: Clinical Applications and Research (Elsevier). Dr. Overall has been named the North American Veterinary Conference (NAVC) Small Animal Speaker of the Year and was named one of the The Bark's 100 Best and Brightest - Bark Magazine's list of the 100 most influential people in the dog world over the past 25 years. Her research interests include psychopharmacological treatments of anxiety and new drug development, behavioural genetics of anxiety disorders, and effects of early trauma on the behavioural development and later behavioural pathology of kittens and puppies.

Jane Pegg, DVM, MS, DAVDC

Founder & Medical Director, Ascentra Veterinary Dentistry and Oral Surgery

Dr. Pegg is a board-certified vet dentist and founder of Ascentra VDOS and Transcend Vet CE. She's passionate about empowering veterinary teams through hands-on training and advancing pet care through excellence in dentistry and oral surgery.

Charlie Pye, DVM, DVSc, DACVD

Associate Professor Dermatology, Atlantic Veterinary College

Dr Charlie Pye grew up outside of London, England and moved to Prince Edward Island, which she now calls home, at the age of eighteen. There she attended the University of Prince Edward Island where she completed a three-year bachelor of science undergraduate degree majoring in Biology. She went on to receive her Doctorate of Veterinary Medicine from the Atlantic Veterinary College, PEI. She then moved to Saskatoon to complete a one-year rotating internship at the Western College of Veterinary Medicine. Following her internship, she travelled back across the country for a Dermatology Residency at the Ontario Veterinary College. While at OVC, she also completed her Doctorate of Veterinary Science degree specializing in Pseudomonas aeruginosa bacterial biofilms. After completing her residency she began working at Guelph Veterinary Specialty Hospital in Guelph, Ontario. During her time in Guelph she continued to travel back to PEI to teach the veterinary students at the Atlantic Veterinary College a few times a year. As of May 2018 she joined the team at the Atlantic Veterinary College and established the first ever Dermatology service at AVC. She has lectured all over North America and has contributed to multiple journals and textbooks. She is also currently the treasurer for the Canadian Academy of Veterinary Dermatology and an advisor for the Canadian Pre Veterinary Medical Association. In her spare time she enjoys camping, crafting and spending time with her husband, daughter and son. She is also "owned" by two dogs (both of which have allergies!).

Debbie Reynolds, BVSc, BSc, DACVS-SA

Specialist Surgeon, Toronto Animal Health Partners

Dr. Debbie Reynolds completed a Veterinary Degree at the University of Queensland in 1999 at which time she began working as a mixed animal veterinarian in rural Australia. After chasing horses and cattle around the countryside for 3 years, she decided to pursue a small animal surgery specialty. The pursuit of a surgery residency brought her to North America, initially Washington State for a rotating internship which was followed by a research fellowship studying stem cells before being accepted to a surgery residency at Ontario Veterinary College. Following completion of a residency in 2012, she began working in Toronto as specialist surgeon providing both orthopedic and soft tissue surgery. She joinedToronto Animal Health Partners in 2019 and performs both orthopedic and soft tissue surgeon with a special interest in joint replacements (total hip replacement) and minimally invasive surgery.

Dan Riskin, PhD

Renowned evolutionary biologist, award-winning TV presenter, and bestselling author Dr. Riskin has spent over a decade making science accessible, engaging, and fun. Known for co-hosting Discovery Canada's Daily Planet, hosting Animal Planet's Monsters Inside Me, and serving as CTV's Science and Technology Specialist, his passion and curiosity inspire audiences worldwide. An expert on bat biomechanics with a PhD from Cornell, Riskin left academia to focus on science outreach, appearing regularly on television and radio, and leading wildlife tours to destinations like Borneo, the Amazon, and the Galapagos. He has hosted documentaries for National Geographic, CBC, W5, and more, and been interviewed by the likes of Anderson Cooper, Gayle King, and Craig Ferguson—who called him "my favourite scientist." Dr. Riskin is the author of Mother Nature is Trying to Kill You and the children's book Fiona the Fruit Bat, and publishes the popular science newsletter The Bat Signal. With humour, charisma, and boundless enthusiasm, he sparks audiences' curiosity and inspires them to explore, discover, and dream big.

Shoshana Verton-Shaw

RVT, VTS (Nutrition), RLAT

Shoshana graduated from the Veterinary Technology program at University of Guelph, Ridgetown Campus with honors and as the recipient of the Award for Proficiency in Canine and Feline Nutrition in 2007. She became the first Registered Veterinary Technician in Ontario to achieve her Veterinary Technician Specialty in Nutrition in 2015 and has been active with the Academy of Veterinary Nutrition Technicians since. In 2026, furthering her dedication to scientific advancements in veterinary medicine, Shoshana successfully achieved her Registered Laboratory Animal Technician certification with the Canadian Association of Laboratory Animal Science. Joining the Ontario Veterinary College (OVC) Clinical Nutrition and Pet Nutrition Research teams in 2019, supporting the Clinical Nutrition Service, patient care, student learning and research. In 2018, Shoshana also joined Fanshawe College first to develop courses, then as a part-time faculty for their new animal health programs. In 2026, she changed roles at OVC to manage the new Hill's Pet Weight Care Program. Shoshana enjoys sharing and igniting a passion for veterinary nutrition in her peers, with a special interest in canine and feline obesity management and performance dog nutrition.

EQUINE PROGRAM

Jamie Kopper, DVM, PhD, DACVIM-LAIM, DACVECC-LA

Assistant Professor, Equine Medicine, Iowa State University

Dr. Jamie Kopper is board certified in large animal internal medicine and emergency/critical care. She is currently on the equine internal medicine team at Iowa State University and the large animal chief medical officer for the hospital. Clinically, she enjoys treating emergency and critical care patients, particularly those with gastrointestinal disease.

Kyla Ortved, DVM, PhD, DACVS, DACVSMR

Associate Professor of Large Animal Surgery, New Bolton Center, University of Pennsylvania

Dr. Kyla Ortved is an Associate Professor of Large Animal Surgery at New Bolton Center, University of Pennsylvania in Kennett Square, PA. She received her DVM degree from the University of Guelph in 2006 and completed her large animal surgical residency training at Cornell University in 2010. Kyla became boarded with the American College of Veterinary Surgeons in 2011. Following her residency, Kyla went on to obtain a PhD in gene therapy for equine cartilage repair at Cornell. In February 2016, Kyla became boarded with the American College of Veterinary Sports Medicine and Rehabilitation. She joined the large animal surgery faculty at New Bolton Center in 2016 as an equine orthopedic surgeon and was named the Jacques Jenny Endowed Chair of Orthopedic Surgery in 2019. Her research program focuses on understanding the pathophysiology of equine osteoarthritis and developing gene and cell-based therapies to improve cartilage repair and prevent osteoarthritis.

FOCUS ON INFECTION PROGRAM

Maureen Anderson, DVM, DVSc, PhD, DACVIM

Lead Veterinarian – Animal Health & Welfare, OMAFRA

Maureen Anderson is a graduate of the Ontario Veterinary College and is ACVIM board-certified in large animal internal medicine. Her graduate and post-graduate work had a strong focus on infectious disease control and zoonotic diseases in particular. She is currently Lead Veterinarian - Animal Health and Welfare at the Ontario Ministry of Agriculture, Food and Agribusiness, where she continues to work in areas bridging animal and public health, including rabies and antimicrobial stewardship, and co-leads the companion animal Ontario Animal Health Network (OAHN).

Ashley Spencer, DVM, MHSc, DACVIM

Assistant Professor, Ontario Veterinary College, University of Guelph

Dr. Ashley Spencer is a board-certified specialist in Small Animal Internal Medicine with a growing focus on infectious diseases of dogs and cats. She earned her DVM from the Ontario Veterinary College, completed a Master of Health Science in Community Health and Epidemiology at the University of Toronto, and undertook specialty training at North Carolina State University. Her background includes clinical practice, public health, and epidemiology, and she is currently launching research on vector-borne diseases in Ontario dogs. Dr. Spencer is passionate about advancing the understanding of infectious diseases in veterinary medicine and sharing practical, evidence-based approaches.

Scott Weese, DVM, DVSC, DACVIM

Professor, Ontario Veterinary College, University of Guelph

Dr. Weese is a veterinary internist and Professor at the Ontario Veterinary College, University of Guelph, Director of the University of Guelph Centre for Public Health and Zoonoses, Chief of Infection Control at the Ontario Veterinary College Health Sciences Centre, and is Chair of the WHO Advisory Group for Critically Important Antimicrobials in Human Medicine. He runs the infectious disease website WormsAndGermsBlog (http://www.wormsandgermsblog.com

PRACTICE MANAGEMENT PROGRAM:

Angie Arora, MSW, RSW

Founder and Veterinary Social Worker, Arora Wellness

Angie Arora is the founder of Arora Wellness, where she helps animal care organizations and professionals improve professional wellbeing. As a Veterinary Social Worker and Certified Compassion Fatigue Specialist, she provides trauma-informed therapeutic coaching, training, and courses to veterinary hospitals, animal shelters, and wildlife and conservation organizations working in high-stress, trauma-exposed environments. Angie is a member of the World Small Animal Veterinary Association's Professional Wellness Committee and serves as faculty with blendVET, the first DEIB certification program for veterinary professionals. She previously sat on the inaugural Board of Directors for the International Association of Veterinary Social Work and was Governance Chair for the Canadian Collective for Equity in Veterinary Medicine. An international speaker, Angie has presented at leading conferences such as WSAVA, CVMA, OVMA, OAVT, ACVIM, Fetch dvm360, the International Veterinary Social Work Summit, MCVMA Rise, and The UK Vet Congress, where she advocates for trauma-informed approaches to professional wellbeing. She holds a Bachelor of Social Work from Toronto Metropolitan University and a Master of Social Work from York University and is certified in Emotional CPR (National Empowerment Centre), Compassion Fatigue (Traumatology Institute), and has completed ICF coaching training with the Mind Rebel Academy.

Megan Brashear, BS, RVT, VTS (ECC)

Senior Manager, Veterinary Nursing, Purdue University Veterinary Hospital, West Lafayette Indiana

Megan Brashear, BS, RVT, VTS (ECC) graduated in 2000 with a BS in Veterinary Technology and obtained her Veterinary Technician Specialty in Emergency/Critical Care in 2004. She has enjoyed working in emergency and critical care since 2000 and is the Senior Manager of Veterinary Nursing at the Purdue University Veterinary Hospital in West Lafayette, Indiana. Here, Megan truly enjoys the opportunity to work with veterinary nursing supervisors as well as teach and train technicians and students in the hospital. She loves to travel and lecture sharing her knowledge with veterinary technicians and veterinary nurses around the world.

Christopher Doherty, DVM, MBA, CBV

Assistant Director, Strategic Business Research and Outreach, American Veterinary Medical Association

Dr. Chris Doherty is Assistant Director for Strategic Business Research and Outreach at the AVMA. Dr. Doherty obtained his veterinary degree at the Ontario Veterinary College, his MBA at McMaster University's DeGroote School of Business, and is a Chartered Business Valuator. In his role with the AVMA, he analyzes data pertaining to new and early career veterinarians, as well as the overall population of veterinarians, and works in tandem with the rest of the Veterinary Economics Division team to aid in the translation of research findings into tools, resources, and actionable items that veterinarians can utilize and implement in their practices and their careers.

Andy Roark, DVM, MS

CEO/Founder, Uncharted Veterinary Conference

Dr. Andy Roark is a practicing veterinarian in Greenville SC and the founder of the Uncharted Veterinary Conference. He has received the VMX Practice Management Speaker of the Year Award four times, the WVC Practice Management Educator of the Year Award, the Outstanding Young Alumni Award from the University of Florida's College of Veterinary Medicine, and the Veterinarian of the Year Award from the South Carolina Association of Veterinarians.

FOCUS ON INFECTION PROGRAM

ONTARIO VETERINARY MEDICAL ASSOCIATION

10001

SHOW ME WHAT YOU'VE GOT - COMPANION ANIMAL DISEASE SURVEILLANCE IN ONTARIO

FOCUS ON INFECTION PROGRAM

Maureen Anderson, DVM, DVSc, PhD, DACVIM

Accessing good surveillance data of just about any kind is (sadly) not as easy as they make it look on shows like Crime Scene Investigation (CSI), where everything they need is magically accessible at their fingertips on their high-tech screens with a simple search. Especially when it comes to infectious disease data, the collection, cleaning, organization and displaying of data are typically the combined effort of many different individuals, groups and organizations at many different levels, and a surveillance system is only as strong as its weakest link (as they say, garbage in = garbage out, and vice versa!).

Truly robust, efficient, detailed, sustainable disease surveillance systems are few and far between, and even harder to come by for companion animal diseases that do not carry the same health implications as human diseases, or similar food safety or economical impacts as food animal diseases. It is very important to know the limitations of any given system or data set, in order to know what information it can and cannot provide (and also to be wary of what things some may incorrectly infer from the data if not properly informed).

Every disease of interest can't be tracked, as there can be significant resource implications of making any particular disease reportable or notifiable. On the public health sides, every case of a "reportable" disease requires follow up and additional data collection, typically by interview with the patient, patient's family and/or healthcare team, which can take considerable time.

Data management systems at different laboratories or clinics are often incompatible with each other, requiring data on diseases of interest to be exported in a common format and assembled elsewhere on a different platform (be it government, academia or other) or reported separately (which also creates additional work). Every time data is exported / imported or otherwise moved, there is a risk of creating errors (much like copying DNA) which then necessitates a data cleaning or verification step, which typically needs to be done manually (although as AI capabilities continue to improve, it could potentially (theoretically) help with this task). So even data that is "already there" in an electronic format can be a significant challenge to access.

Data organization and visualizations have come a very long way in the last couple of decades, particularly with increased computational power to handle "big data" from very large databases, but they all still require time and skilled labour to develop, and most importantly ongoing maintenance and updating if the system is to be sustainable over time, and ideally available in real time (or as close as possible).

WHAT WE'VE GOT: PROVINCIALLY NOTIFIABLE ANIMAL HAZARD DATA

Notifiable hazards are reported to Ontario Ministry of Agriculture, Food and Agribusiness (OMAFA) by diagnostic labs in Ontario when a sample tests positive. For immediately notifiable (IN) hazards, this notification typically occurs around the same time the submitting veterinarian receives the report, though sometimes there can be a delay. Positive results for periodically notifiable (PN) hazards are submitted to OMAFA once a year. This reporting regulation first came into effect in 2013, and the latest update to the notifiable hazard lists came into effect in February 2023. Veterinarians are only required to notify

OMAFA directly of one of these hazards if it was confirmed by a laboratory outside of Ontario (e.g. sent directly to a laboratory in the US), however those diseases that are also reportable to public health when they occur in animals must be reported directly to the local public health unit by the veterinarian. The notifiable hazards of most relevance to companion animals (listed below) all have significant zoonotic potential. *Indicates a hazard that must be reported directly to public health (see Health Protection and Promotion Act Reg 557 for details):

- Chlamydophila psittaci (IN) *Only reportable to public health when it occurs in captive birds or equids
- Echinococcus multilocularis (IN) *Only reportable to public health when it occurs in dogs or cats (definitive hosts)
- Influenza A virus (any)(IN) *Only avian influenza in captive birds and novel influenza are reportable to public health
- Mycobacterium bovis (IN) *Any MTB complex infection in an animal is reportable to public health (including M. bovis and M. tuberculosis)
- Rabies virus (IN) *Any contact with a mammal that may result in rabies transmission to a person is reportable to public health
- Brucella canis (IN)
- Francisella tularensis (tularemia)(IN)
- Salmonellae (subtyped) (IN)
- SARS-CoV-2 (IN)
- Yersinia pestis (plague)(IN)
- Anaplasma phagocytophilum (PN)
- Blastomyces dermatitidis (PN)
- Borrelia burgdorferi (Lyme disease)(PN)
- Campylobacter jejuni (PN)
- Clostridium spp. (PN)
- Leishmania spp.(PN)
- Leptospira spp. (PN)
- Mycobacterium avium (PN)
- Toxoplasma gondii (PN)

With regard to companion animal testing, the three major Ontario labs that report hazards to OMAFA are IDEXX Laboratories, Antech Diagnostics, and the Animal Health Laboratory.

- Immediately notifiable hazards are monitored as such because individual cases may require a response (which is most often ensuring the veterinarian and owner are appropriately informed of the disease risks and appropriate mitigation measures, but could also include coordinating a response with public health, for example) or sudden changes in disease patterns may warrant a more timely response than would be possible with a periodically notifiable hazard (e.g. acute spike in Salmonella cases of a particular serovar).
- Periodically notifiable hazards are monitored primarily to look at overall disease trends, so that Ontario veterinarians as a group can be notified if there are significant changes to seasonal or annual disease patterns over time.

It is worth noting that the notifiable hazards in the regulation are not listed by species, and are therefore reported when they occur in any species, even if the hazard is not considered significant in some (e.g. Toxoplasma gondii is commonly found in domestic cats, but it is a notifiable hazard due to reproductive disease it causes in small ruminants; Campylobacter jejuni is monitored primarily for changes in prevalence in food animals such as poultry, but is not regularly analyzed for dogs as it often only causes mild or subclinical illness and does not pose a food safety risk in this species).

Unfortunately one major pitfall of the current regulation is that labs are not required to provide denominator data (i.e. number of negative tests) for any of the hazards, which significantly limits data interpretation. Fortunately, at least for some tests, these data may be provided voluntarily, but it is not always consistent. Furthermore, even data from electronic databases can contain discrepancies, and similar tests from different labs may need to be consolidated, and then appropriate visualizations must be developed… all the cleaning and organization of the data can take a considerable amount

of time and effort, primarily on the part of OMAFA's veterinary epidemiologist and the rest of the Animal Health and Welfare Branch team. Analysis of the hazards of greatest interest (in a particular species) is therefore typically prioritized, and other data may be banked for future use, should it be needed.

Data for specific hazards may have additional limitations. Two notifiable hazards of particular interest with regard to data received by OMAFA (in part because there are no other readily available sources) are Blastomyces dermatitidis (PN) and Leptospira spp. (PN).

Blastomycosis is a tricky disease to monitor. It is regionally endemic in Ontario, especially around Georgian Bay, northwestern Ontario and the Ottawa region. In a survey of Ontario practitioners in 2023, 49% of respondents reported diagnosing cases based on some combination of history, clinical signs, radiographs, in-house cytology and urine antigen testing (done by a US lab) – these cases would not be included on OMAFA's notifiable disease summary because they do not involve an Ontario lab. Cases are also reported by the location of the veterinary clinic, which is typically near where the animal lives, but not necessarily where the animal was exposed to the fungus. Most if not all of the cases detected in major urban centres are likely travel-related, particularly in dogs that spend time at cottages or hunting in high-risk areas. (This highlights the importance of taking a good travel history, as some owners may not think of their regular trips to the cottage a few hours away as "travel.")

Leptospirosis is relatively ubiquitous across Ontario due to its many wildlife reservoir species, but cases have a fairly consistent seasonal trend. Similar to blastomycosis, cases that are diagnosed using in clinic / point of care (antibody) tests are not included in the OMAFA notifiable disease summary. Even at the laboratory level, testing for lepto has continued to evolve. Urine culture is effectively never used anymore, having been replaced with molecular PCR testing which is much more sensitive and has very high specificity. Microagglutination titre (MAT) testing is used much less frequently and is the only available test that provides any information on lepto serovars involved, but reported results are not necessarily a representative sample of all cases in Ontario. Antibody tests can also be affected by vaccination, which can further skew the data, and there is no means to adjust for this as no clinical history information is reported with the test results.

OTHER SOURCES OF COMPANION ANIMAL DISEASE SURVEILLANCE DATA (FOR ONTARIO AND BEYOND):

Companion Animal Parasite Council (CAPC) website

Data on a select number of endoparasites, tick-borne diseases and viruses can be found online on the capcvet.org website for both the US and Canada. Advantages to this particular platform include reporting of both positive and negative tests from major reference laboratories, monthly updates (you can also sign up for email alerts when the updates are posted) and mapping by forward sortation area (first three digits of postal code). However, because testing for many of these parasites / pathogens is performed in-house in veterinary clinics, it is estimated that the data represent less than 30% of total testing in the various regions (although this still provides strong representation of local testing activity). Data are mapped by the submitting veterinary clinic, and may not represent the same area where pets were exposed, particularly with regard to tick-borne diseases. Furthermore, data for Canada is currently only provided by IDEXX Laboratories, as data sharing with other laboratories has not yet been established.

Occasionally changes in data sources / reporting may cause significant shifts in test results that are not due to changes in disease trends (e.g. a considerable increase in data reporting occurred in July 2022). Data can also only be viewed month-by-month or for the entire calendar year; graphical visualizations of the Ontario data are provided by the Ontario Animal Health Network, which helps show changes in seasonal and annual trends.

Scientific research publications

Publications provide another source of surveillance information. These are typically driven by academic researchers (e.g. the Canadian Pet Tick Survey), though publications can also be driven by research and development staff from large diagnostic laboratories or pharmaceutical companies, and it is also not uncommon to see collaborations of both (e.g. canine leptospirosis in Canada, Echinococcus multilocularis in Canada). Generally speaking, these studies are time limited (often by the graduate student cycle of 2-4 years) or provide a historical snapshot (i.e. looking at data from a certain period of time) rather than ongoing surveillance. There is often a significant

lag in these studies due to the amount of time it takes to write up the manuscript and pass the peer-review process for most reputable journals.

Syndromic surveillance and larger networks

Syndromic surveillance (e.g. based on disease occurrence by body system / clinical signs) does not have to rely on laboratory data, which can make it cheaper to do, but not necessarily always easier. There are some sources of syndromic data outside of clinics can also be accessed (e.g. insurance claim data). More formal national and provincial surveillance networks that may utilize a variety of formal and informal data sources have continued to develop in recent decades, including companion animal networks under the Canadian Animal Health Surveillance System (CAHSS) and the Ontario Animal Health Network (OAHN). These groups provide a forum for information exchange between practitioners, academia, government and even industry to help flag emerging issues.

Informal communication with colleagues (little networks)

Although it doesn't seem like it, having discussions with colleagues at conferences, local meetings, or even within the same practices can provide information for surveillance. Although in the hierarchy for scientific evidence, anecdotal evidence is somewhere near the bottom, even anecdotes still serve a purpose, and can often spur on more rigorous investigation of a particular issue. In the same way, informal discussion with colleagues is weaker (and prone to lots of bias of different kinds), but is a form of surveillance nonetheless, and more often than not is where things start to be noticed.

5 easy things veterinarians can (need) to do to improve companion animal surveillance

So current disease surveillance in Ontario, particularly when it comes to companion animals, definitely has some significant limitations. What's a lowly veterinarian to do? As with so many things in life, it's the little things we do on a regular basis that collectively add up to make a big difference. Here are five easy things you (and your team) can do to help make disease surveillance in companion animals easier and more effective in the long term:

Keep good records. No one likes doing records, especially when they're stacked up at the end of a long day (or week), but not only are they essentially from a legal standpoint, but in this day and age of electronic medical records they also make it possible to do effective record searches for similar cases or diagnoses. Maybe your medical record system isn't searchable right now, but chances are it will be before too long. Prioritizing good record - keeping habits now may save your bacon in the future, and could provide valuable information for surveillance within your clinic and possibly beyond. Remember that consistency is key, both in how you fill out your own record and how others in your practice fill them out as well. For example, using common key words (and spelling them consistently) in a searchable field can greatly simplify record retrieval.

- The same applies to providing information on laboratory submissions. 50% of companion animal bacteriology samples are submitted without so much as an indication of the sample site. Take an extra 10 seconds to tell the lab where you stuck that "swab" (it might just help you get a better answer from the lab too!). Once you've mastered that, take another 10 seconds to give them some morsel of history about the animal too (particularly when it comes to infectious diseases, things like travel history and other recent exposures are incredibly useful to anyone who might mine the data for answers to questions you'll want to know!).

Talk to your colleagues. It seems so simple, but communication really does make the world go 'round. Talking to fellow veterinary professionals is the most basic grass-roots form of surveillance, and is especially important at the local level – for example, identifying a dog park that may be a hot spot for respiratory disease transmission, or identifying an increase in the local risk of tick borne diseases or leptospirosis. It can be done in person or online, regularly scheduled or totally ad hoc, but the more we share information the more likely it is to travel through our networks and make those connections which help us know when we should be concerned, and when things are pretty status quo.

Fill out the Ontario Animal Health Network clinical impressions survey. This is really just talking to your colleagues taken to the next level. At its heart, OAHN is a

communication hub that allows Ontario veterinarians and RVTs to let each other know what they're worried (and not worried) about, in broad strokes, through a 5 minute (or less!) online survey every 4 months. In return, the network team finds and/or creates resources tailored to those concerns to help inform veterinary staff working at the clinic level. If you haven't already, check out the OAHN website and sign up for free!

Ask your laboratory for information (until they post it). Laboratories have a wealth of information on disease testing, and while that data is sometimes shared through periodic collaborations with researchers and others, there is so much more that could be done to access that data in a timely manner to help keep practitioners more informed of local and time sensitive changes in disease patterns, antimicrobial resistance trends and more. But unless the labs know that there is demand for such data (and which data), then there is little motivation to put in the necessary time and effort to make it accessible. Let your lab know what it is you'd like to see and what you can use, so they know where to put in the effort.

Talk to clients about testing (even if they say no 9 out of 10 times). Everyone is struggling with rising costs these days, clinics and clients alike. Diagnostic testing is not cheap, and sometimes the dollars are better spent on treatment and support if a specific diagnosis is not required. But if no testing is done, there are no data to tell us what is going on, even in the small subset of the population that gets tested. It is always worth asking, and ultimately the test results may benefit more than just the one patient in front of you.

Bonus point: If a reputable researcher asks you to participate in a study… say yes if you can. Tell the researchers what you need to make it manageable, but know that any contribution you can make – even a small one – is important. Front line care is also the front line of surveillance.

Companion animal disease surveillance in Ontario – Summary graphic

REFERENCES

1. *DeWinter S, et al. Infestation patterns of Ixodes scapularis and Dermacentor variabilis on dogs and cats across Canada. PLoS One. 2023 Feb 2;18(2):e0281192. PMID: 36730362.*
2. *Evason MD, et al. Emerging Echinococcus tapeworms: fecal PCR detection of Echinococcus multilocularis in 26 dogs from the United States and Canada (2022-2024). J Am Vet Med Assoc. 2024;263(2):1-5. PMID: 39413817.*
3. *Evason MD, et al. Novel molecular diagnostic (PCR) diagnosis and outcome of intestinal Echinococcus multilocularis in a dog from western Canada. J Am Vet Med Assoc. 2023;261(9):1-3. PMID: 37225160.*
4. *Stull JW, et al. Canine leptospirosis in Canada, test-positive proportion and risk factors (2009 to 2018): A cross-sectional study. PLoS One. 2022;17(6):e0270313. PMID: 35749480.*

10002

ANTIMICROBIAL TREATMENT GUIDELINES UPDATE

FOCUS ON INFECTION PROGRAM

Scott Weese, DVM, DVSC, DACVIM

Antimicrobial treatment guidelines are increasingly being developed in veterinary medicine and represent an important evolution in clinical guidance. Earlier guidelines tended to be expert opinion based guidelines, but recent guidelines have evolved, incorporating structured methodology and evidence synthesis. While more time consuming, these changes, coupled with broader and more diverse guideline panels, have strengthened clinical guidance.

Guidelines are available for a variety of common conditions but do not encompass all possible antimicrobial use scenarios. Guidelines also are not standards. They are meant to provide guidance, not direction, and are designed to cover the majority of patients with a specific disease, realizing that there may be patient, disease or owner related factors that influence the optimal approach.

ISCAID URINARY TRACT GUIDELINES

International Society of Companion Animal Infectious Diseases (ISCAID) urinary guidelines were among the first comprehensive small animal antimicrobial treatment guidelines. First released in 20111, an update was published in 20192 and a comprehensive update is currently underway. The current version involves multiple systematic and scoping reviews, a series of working groups for different topics and a more structured guideline approach. Updates on current discussions and draft changes will be presented during the talk.

ISCAID PYODERMA GUIDELINES

An update to the first (2014)3 guidelines was released in 2025.4 Among the highlights are:

Surface pyoderma

- Topical antimicrobial therapy is the treatment of choice
- Combination therapy of topical antimicrobial therapy with topical glucocorticoids or with a short course (5–7 days) of systemic glucocorticoids at anti-inflammatory doses or antipruritic medication may be helpful
- Antiseptic treatment can be continued proactively on previously affected skin, potentially life-¬ long, where the primary underlying causes cannot be resolved (e.g. skin folds) and the risk of recurrence remains

Superficial bacterial folliculitis

- Topical antimicrobial therapy as the sole antibacterial treatment is the treatment-¬ of-choice
- Systemic antimicrobial therapy should be reserved for cases that have failed to respond to topical antimicrobial therapy alone or if topical therapy is not feasible due to client or patient limitations.
- Culture and cytology should be used whenever possible to guide systemic drug choices.
- An initial 2-¬ week course may be dispensed, and an appointment for re-¬examination should be scheduled before the end of the course to determine whether systemic treatment can be stopped or whether longer treatment is required
- Adjunctive topical antimicrobial therapy is recommended whenever possible
- Clinical resolution of superficial pyoderma can be

assumed, and systemic antimicrobials stopped when primary lesions of pyoderma (papules, pustules and erythematous epidermal collarettes) are no longer found.

- Topical antiseptic treatment can be continued longer than systemic therapy, and is potentially lifelong, where the primary causes cannot be resolved and the risk of recurrence remains.

Deep pyoderma

- Systemic antibacterial therapy is always indicated in deep pyoderma, and the choice of drug should always be based on culture results.
- Adjunctive topical antimicrobial therapy is recommended in every case as soon as the dog is considered pain free
- An initial 3- week course may be dispensed, and an appointment for re-¬ examination by a veterinarian should be scheduled before the end of the course to determine whether systemic treatment can be stopped or whether longer treatment is required.
- If clinical signs are improving but have not resolved, and if cytological evidence of infection is still present, treatment should be continued with re-evaluation every 2 weeks.
- Systemic antimicrobial therapy can be stopped when skin lesions associated with deep infection (draining/fistulous tracts, pus, pustules, crusts) have resolved and there is no cytological evidence of infection.
- At re-examination, if draining/fistulous tracts, pus, pustules, ulcers or crusts remain or if lesions are no longer improving (have plateaued), their bacterial nature should be confirmed again by cytology to differentiate ongoing infection from sterile dis ease processes; if bacteria are seen on cytology, culture may need to be repeated to investigate drug resistance.
- Topical antiseptic treatment can be continued beyond stopping systemic therapy where the primary underlying cause(s) cannot be resolved and the riskof recurrence remains.
- There is no evidence to support extending systemic antimicrobial therapy beyond the resolution of clinical signs; instead, underlying primary causes must be identified and addressed.

ENOVAT CANINE ACUTE DIARRHEA GUIDELINES

The European Network for Optimization of Veterinary Antimicrobial Treatment (ENOVAT) has produced guidelines for acute diarrhea in dogs.5 Based on a systematic review and meta-analysis6 these guidelines focus on antimicrobials for acute diarrhea. They provide guidance after categorizing dogs into three disease severity categories.

Mild disease

This includes the vast majority of dogs with acute diarrhea. Affected dogs are bright, alert and stable. They may or may not have hemorrhagic diarrhea. Antimicrobials are not recommended. Time and supportive care are the main treatments.

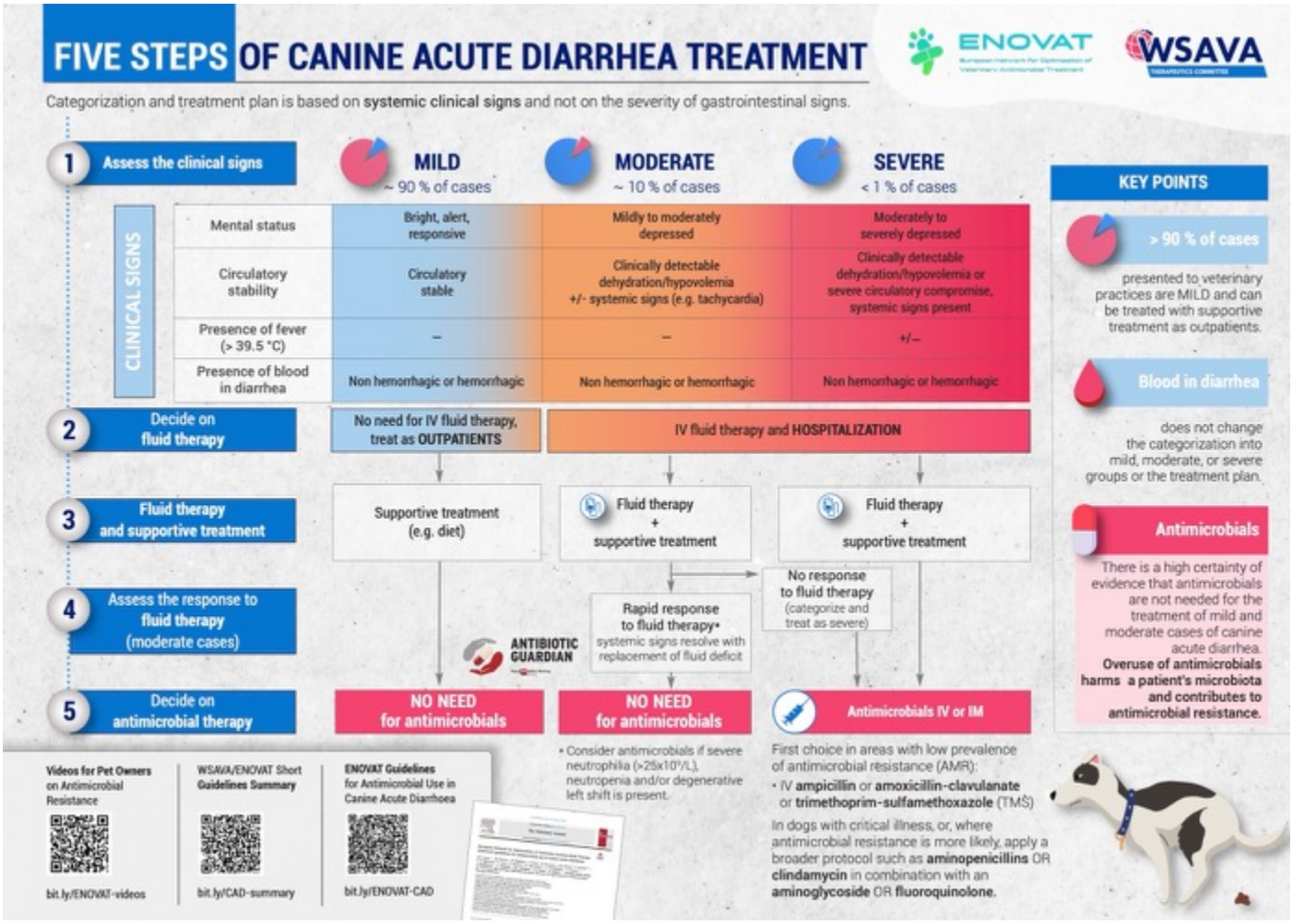
Moderate disease

These dogs have evidence of systemic involvement but where systemic abnormalities might be attributable to dehydration (see figure). Unless there is severe neutropenia with left shift, it is recommended to initiate rehydration. If there is clinical improvement, antimicrobials are not recommended. If systemic signs persist, then antimicrobials are indicated because of the concern for bacterial translocation and sepsis.

Severe disease

When antimicrobials are indicated, these are directed at bacterial translocation and sepsis, not enteric infection. Ampicillin, ampicillin/sulbactam, an injectable 3rd generation cephalosporin (e.g. cefotaxime, ceftriaxone (not cefovecin (ConveniaTM)) or ampicillin plus enrofloxacin are recommended.

It is noteworthy that metronidazole is not recommended as a primary treatment for any category. Evidence of efficacy for metronidazole is lacking and metronidazole can be associated with adverse events and prolonged disruption of the gastrointestinal microbiota. There may be some situations where metronidazole is indicated (or at least not contraindicated), such as when a NetF producing strain of Clostridium perfringens is involved or when there is prolonged diarrhea that is not responding to supportive care. However, it is not recommended as a routine first line agent.



ENOVAT SURGICAL PROPHYLAXIS GUIDELINES

These guidelines were in press at the time of writing and will be presented. A supportive scoping review was performed.7. These guidelines cover peri-operative (administration of antimicrobials 30-60 minutes prior to surgery, redosing during surgery if needed, and stopping after surgery or continuing for no more than 24h) and post-operative (continuation for >24h after surgery) treatment. Among the highlights are:

Strong recommendations against peri-operative antimicrobials were made for:

- Spay/neuter
- Other clean soft tissue procedures (e.g. splenectomy, gastropexy, exploratory laparotomy, dermal mass removal)
- Clean-contaminated procedures not involving the urogenital or gastrointestinal tracts

A conditional (weak) recommendation against peri-operative antimicrobials was made for:

- Clean-contaminated urological procedures
- Clean orthopedic procedures not involving an implant

A conditional (weak) recommendation for peri-operative antimicrobials was made for:

- Clean-contaminated gastrointestinal surgery
- Contaminated gastrointestinal procedures
- Clean orthopedic procedures involving an implant
- TPLO

A conditional (weak) recommendation for post-operative antimicrobials was made for:

- Contaminated gastrointestinal procedures (3-5 days, with daily review and de-escalation when possible based on culture results)

A conditional (weak) recommendation against post-operative antimicrobials was made for:

- TPLO

Strong recommendations against post-operative antimicrobials are not recommended for

- Spay/neuter
- Other clean soft tissue procedures (e.g. splenectomy, gastropexy, exploratory laparotomy, dermal mass removal)
- Clean-contaminated procedures not involving the urogenital or gastrointestinal tracts
- Clean-contaminated urological procedures
- Clean orthopedic procedures not involving an implant
- Clean-contaminated gastrointestinal surgery
- Contaminated gastrointestinal procedures
- Clean orthopedic procedures involving an implant

REFERENCES

1. *Weese JS, Blondeau J, Boothe D, et al. Antimicrobial use guidelines for treatment of urinary tract infections in dogs and cats: antimicrobial guidlines working group of the International Society for Companion Animal Infectious Diseases. Vet Med Int 2011;4:1–9.*
2. *Weese JS, Blondeau J, Boothe D, et al. International Society for Companion Animal Infectious Diseases (ISCAID) guidelines for the diagnosis and management of bacterial urinary tract infections in dogs and cats. Vet J 2019;247:8–25.*
3. *Hillier A, Lloyd DH, Weese JS, et al. Guidelines for the diagnosis and antimicrobial therapy of canine superficial bacterial folliculitis (Antimicrobial Guidelines Working Group of the International Society for Companion Animal Infectious Diseases). Veterinary Dermatology 2014:n/a–n/a.*
4. *Loeffler A, Cain CL, Ferrer L, et al. Antimicrobial use guidelines for canine pyoderma by the International Society for Companion Animal Infectious Diseases (ISCAID). Vet Dermatol 2025;36:234–282.*
5. *Jessen LR, Werner M, Singleton D, et al. European Network for Optimization of Veterinary Antimicrobial Therapy (ENOVAT) guidelines for antimicrobial use in canine acute diarrhoea. Vet J 2024;307:106208.*
6. *Scahill K, Jessen LR, Prior C, et al. Efficacy of antimicrobial and nutraceutical treatment for canine acute diarrhoea: A systematic review and meta-analysis for European Network for Optimization of Antimicrobial Therapy (ENOVAT) guidelines. Vet J 2024;303:106054.*
7. *Sorensen TM, Scahill K, Ruperez JE, et al. Antimicrobial prophylaxis in companion animal surgery: A scoping review for European Network for Optimization of Antimicrobial Therapy (ENOVAT) guidelines. Vet J 2024;304:106101.*

10003

VACCINATION APPROACHES FOR NON-TEXTBOOK SCENARIOS

FOCUS ON INFECTION PROGRAM

Scott Weese, DVM, DVSC, DACVIM

Vaccination is a routine event that is fairly straightforward when patients and their owners follow the 'normal' timing and are of normal health. However, delays, adverse events, vaccine hesitancy and patient health can raise questions or concerns, and impact vaccination approaches.

While those are fairly common scenarios, there is limited guidance. Vaccines are licensed based on specific trials that aim to assess efficacy under limited timeframes. Manufacturers cannot be expected to test a range of time periods and all possible scenarios, and are unlikely to do studies on older, sick or similar populations. Vaccine labels are increasingly vague, providing more flexibility in approach but provided less specific guidance. That leaves veterinarians in limbo in many situations, with lack of clear guidance on how to manage these scenarios. Examples of some of these issues are provided below.

VACCINATION OF SICK ANIMALS

We typically vaccinate 'healthy' animals, but not all animals fit a rather subjective definition of 'healthy'. We focus on healthy pets since they comprise the majority of the pet population. Also, vaccines are typically labelled for use in healthy pets (e.g. "This product is recommended for the vaccination of healthy dogs…"). It does not define healthy nor does it say not to use it in 'unhealthy' pets; it just doesn't give guidance.

Manufacturers are not going to test vaccine effectiveness and safety in animals with a wide range of different health problems. That creates a grey area with little guidance, and often, that means we default to being conservative, avoiding vaccination of 'sick' animals. However, there are many 'unhealthy animals' and some of these need to be vaccinated. In some situations, vaccination of 'unhealthy' animals may be more important than vaccination of healthy animals because unhealthy animals may be at increased risk of severe outcomes.

There are two main issues with vaccination unhealthy animals. One is the potential impact of illness on vaccine response. If the animal's immune system can't respond adequately, the vaccine may not work or may not work as well as desired. The other is the potential for adverse events. There's probably not a much greater likelihood of most sick animals to have an adverse response to a killed vaccine, but there are potential (or at least theoretical) concerns with modified live vaccines.

PATIENTS WITH A HISTORY IMMUNE MEDIATED DISEASE

Links between vaccination and immune mediated disease are weak and poorly investigated. In general, there is no contraindication to vaccination of patients with a history of immune mediated disease unless there is a reasonable suspicion (based on timing) that the disease was triggered by vaccination. The likelihood of vaccination triggering recurrence of immune mediated disease is thought to be very low, but has not been adequately studied.

It is reasonable to assess what vaccines are really needed and which are not as important, and minimize vaccination out of abundance of caution. For example, a dog that has had a DAPP vaccination at 16+ weeks and a year later is likely well protected. Another dose probably adds little and could be avoided if there is concern about risk. In contrast, leptospirosis vaccines do not provide as longterm protection and continuation of annual (or close-

to-annual) re-vaccination would be of greater benefit. It is challenging to balance risks and benefits when neither is well defined. However, it is important to not automatically dismiss future vaccination in animals with a history of immune mediated disease.

PATIENTS ON IMMUNOSUPPRESSIVE MEDICATIONS

As with sick animals, two aspects must be considered, response to vaccination and likelihood of adverse.

Reduced response to vaccination may occur, depending on the vaccine, drug and degree of immunocompromise. However, partial response may be better than no vaccination. Good vaccine response can still occur in immunosuppressed patients.

Therefore, the main concerns are adverse events. This is focused on the risk of disease from modified live vaccines. This is poorly described and the risk is low, but likely variable. One recently authorized prodect (ZenreliaTM) has a label statement that the drug should be discontinued at least 28 days prior to vaccination and shoud not be given within 28 days of vaccination because of a risk of delayed humoral responses and risk of vaccine associated disease from live vaccines. The magnitude of the risk is unclear and it is unclear whether risks are greater with this drug compared to other medications that impact the immune response or whether the specificity of the label statements is because of changes in licensing scrutiny.

When deciding whether or not (or when) to vaccinate animals on immunosuppressive medications, the drug (and label warnings), the need for vaccination (based on vaccine history and disease exposure risk) and the planned duration of immunosuppression (e.g. short vs long term, tapering plans) should be considered. If possible, vaccination should be delayed until after vaccination, or should be done prior to (ideally 28 days prior to) immunosuppression. However, there may be situations where the vaccine is deemed particularly important and vaccination is prioritized, with informed consent of the owner, especially when there is not a clear ending point for immunosuppression.

LATE BOOSTERS

Vaccine labels typically indicate booster intervals. In some situations, vaccine labels now defer to veterinarians about intervals. Vaccine guidelines1,2 provide more guidance for intervals. Yet, these relate to ideal situations. Delays in vaccination are not uncommon because of health, logistical or client compliance issues. How to approach animals that are overdue for vaccines is a common question.

Modified live vaccines are essentially independent vaccine events. They do not rely on previous vaccination for a booster response. They act strongly irrespective of vaccine history. Therefore, if an animal is overdue, a single vaccine can be given and the duration would be that as if it was vaccinated on time (e.g. if dog is 1 year overdue for a 3 year core vaccine, a single dose would still be considered good for at least 3 years).

Rabies vaccine is an excellent vaccine that induces a strong response. Longterm protection and boostability (ability to rapidly produce antibodies in response to subsequent vaccination) are present in humans and likely also in dogs and cats. However, regulatory aspects must be considered. While rabies vaccine labels do not indicate a need to restart vaccination if a booster is overdue, they provide no specific guidance and regulators may have different responses. Often, a 3 month grace period is given. So, if a dog/cat is overdue by < 3 months, a rabies vaccine can still be regarded as good for 3 years (if licensed as a 3 year vaccine). If the animal is more than 3 months overdue, it is prudent to repeat vaccination in a year. Discussion of these with the relevant (provincial, state) regulator in charge of rabies response is important to understand the local approach. It is important to note that if the animal maybe travelling overseas, some countries provide no grace period and being overdue by a day renders the dog unvaccinated.

Leptospirosis vaccines are given yearly. If significantly overdue, restarting a 2 dose series is often done. This is probably excessive as lack of protection from a long interval is not the same as lack of ability to respond to a booster, but data are lacking to support vaccination over long intervals. The European consensus statement on leptospirosis provides a 6 month grace period for late boosters,3 an interval that is reasonable.

DELAYED OR INTERRUPTED PUPPY/KILLEN VACCINE SERIES'

Modified live core vaccines can be started as early as 4 weeks of age in dogs and 6 weeks of age in cats, but most often, pets in households are vaccinated at 8, 12

and 16 weeks, +/- another dose at 20 weeks. That's often interpreted as "we need to make sure they get 3-4 doses of vaccine to be protective'. In reality, it's 'we need to vaccinate them until we're sure they're old enough to respond properly to a vaccine'.

We vaccinate young animals, realizing those initial doses might not work because of lingering maternal antibodies, but we start early to try to get protection as early as we can. We keep vaccinating until we hit an age where we can be confident that maternal antibodies have waned enough that a vaccine will work. Once they hit 16 weeks, we're pretty confident about that. So, we want to make sure they get a dose at 16+ weeks. If it's a higher risk situation (e.g. shelter, dog whose lifestyle means it will be exposed to lots of other dogs), then another dose at 20 weeks provides an extra layer of assurance.

Therefore, it's not that we need a certain number of vaccines, with an initial shot and then a series of boosters to get adequate immunity. A single dose at the right time will do it. Rather, it's a matter of needing a dose to work at some point.

Where it becomes in issue is when we get off schedule (missed dose), when we start late (e.g. don't see the animal until 16 weeks of age) or when we're starting with an adult (e.g. imported dog, dog with no known vaccination history).

In those situations, we don't need a 3 or 4 dose vaccine series, and for young animals, we don't need to see if we can squeeze them back into an 8, 12, 16, +/- 20 week schedule. We just need to get one or two doses of vaccine into them at a time where vaccine will work.

Adult dog with no vaccine history

- One dose will probably be fine, but a second dose is often recommended to provide more confidence

Puppy that starts late

- Missed earlier doses don't matter. If the animal comes it for the first time at 12 weeks, it gets the 12 week, then 16 week +/- 20 week dose. There's no need to 'catch up' on that 8 week dose. It was simply a missed opportunity and we move on.

Puppy that misses a dose

- If it got vaccinated at 8 weeks, and it doesn't come back until 16 weeks, the 12 week dose is just ignored. It would get its 16 week dose and then likely a 20 week dose. We don't care about the time between doses (unlike some of our killed vaccines, where we want a properly spaced initial series.

VACCINATION AT THE TIME OF SURGERY

Typically, we avoid vaccinating at the time of surgery but sometimes surgery may coincide with optimal timing for vaccination or the time of surgery might be one of the few (or only) times an animal is seen by a veterinarian (e.g. trap/neuter/release programs or barn cats, where the time of surgery is quite possibly their only veterinary contact).

In humans, there's no evidence that vaccination at the time of surgery is associated with a poorer vaccine response or increased risk of adverse events. Vaccination around the time of surgery is avoided when possible to avoid the risk of misinterpreting a vaccine reaction (e.g. fever) as an early post-operative complication, which could lead to unnecessary testing and treatment.

In veterinary patients, it's probably better to space out surgery and vaccines if we can, but we don't want to miss an important opportunity to vaccinate. If there's concern that we might not see the animal again (especially for an important vaccine that is needed now), vaccination is indicated. If the owner is committed to bringing the animal in later (e.g. we can vaccinate at the time of suture removal or shortly thereafter), then that's probably ideal. However, we don't want perfect to be the enemy of progress, so we should err on the side of making sure the vaccine gets administered, one way or the other.

VACCINE TITRES

Titres are sometimes considered in lieu of vaccination, often because of client concerns about vaccine safety or following a vaccine reaction. It is important to remember what titres tell us, and what they don't. They tell if a specific antibody is present and the amount of it (or a relative idea of the amount that is present). They don't tell us anything about other parts of the immune system, most importantly cell mediated immunity. They also don't tell us about the boostable response, the ability of the primed immune

system to rapidly produce antibodies after exposure. All of those play roles in disease prevention, along with the innate immune system, but titres on evaluate one.

While some laboratories will reported protective titres, these have not been established. They are laboratory estimates and titres are better as an indicator that there has been a response to vaccination or previous infection, not estimators of clinical protection. For some diseases, titres probably correlate strongly to protection. However at this point, data are lacking to establish good recommendations.

2022 AAHA Canine Vaccination Guidelines state "…, at best, the determination of "protective titers" has been based on limited data. These data were thoroughly reviewed 20 years ago. Nothing more substantive has become available since then. ELISA-based in clinic antibody detection tests have been available for CPV and CDV for more than 20 years. HI and VN tests, respectively, were used as "gold standards" to determine their sensitivity and specificity, as it relates to a "protective titer." Commercial ELISAs have been applied in shelter populations outside of the laboratory and further compared with HI and VN tests. Such applications have provided no further basis for a determination of "protective titers," primarily because the titers or amounts of antibody were not correlated with clinical outcomes. Recognizing these limitations, no values for "protective titers" are indicated in these guidelines, although some commercial laboratories will provide them."

In general, moderate titres against canine distemper virus, canine parvovirus and feline panleukopenia virus likely indicate strong protection. Low titres are harder to interpret as there still may be adequate protection based on cell mediated response and boostable antibody response. Leptospira MAT titres are not thought to correlate to vaccine protection and titre testing cannot be used to determine whether leptospirosis vaccination is required. There is also less confidence in the association of feline herpesvirus and calicivirus titres and protection.

There is an international cutoff for rabies titres (0.5 IU/ml) but that is not a protective titre. It's an indication that there was a response to vaccination. Dogs with lower titres may still be protected, especially if they receive a post-exposure booster as if the standard approach. Dogs with titres above 0.5 IU/ml probably have good immunity. However, titres cannot be used in lieu of vaccination from a regulatory standpoint. If a dog or cat is exposed to a rabid animal, the vaccination history dictates the response (observation vs strict isolation). Titres do not play a role in that assessment.

Titres can be useful in situations where it is important to know if a response to vaccination has occurred. For example, if a puppy had a life-threatening vaccination reaction to DAPP at 12 weeks of age, there would be concern about re-vaccinating but also concern that there might have been poor response at that age because of maternal antibodies. Titres taken at 16 weeks could help as a low/zero titre would suggest the puppy did not response, and either needs to be vaccination with precautions or the owners have to be aware of its high risk of disease. Conversely, titres above the lab's cutoff at that age would support response to vaccination, and the puppy could be considered to have been properly vaccinated (still with a need to re-assess what to do in a year, but removing the need for more 'puppy' DAPP vaccines).

REFERENCES

1. *Ellis J, Marziani E, Aziz C, et al. 2022 AAHA Canine Vaccination Guidelines. J Am Anim Hosp Assoc 2022;58:213–230.*
2. *Squires RA, Crawford C, Marcondes M, et al. 2024 guidelines for the vaccination of dogs and cats - compiled by the Vaccination Guidelines Group (VGG) of the World Small Animal Veterinary Association (WSAVA). J Small Anim Pract 2024.*
3. *Schuller S, Francey T, Hartmann K, et al. European consensus statement on leptospirosis in dogs and cats. J Small Anim Pract 2015;56:159–179.*

10004

VECTOR-BORNE DISEASES IN DOGS: DIAGNOSTIC CHALLENGES AND CLINICAL INSIGHTS

FOCUS ON INFECTION PROGRAM

Ashley J. Spencer, DVM, MHSc, DACVIM (SAIM)

INTRODUCTION

Vector-borne diseases (VBDs) in dogs are increasingly encountered in clinical practice, including in regions such as Ontario, Canada, where they were once considered rare. The northward expansion of ticks, driven by climate change, along with the importation and travel of dogs from endemic regions, have increased exposure to pathogens not historically seen in this area[1-3]. These infections often present with nonspecific clinical signs, such as fever, anemia, or thrombocytopenia, arthropathies that mimic immune-mediated, neoplastic, or inflammatory disease. Because diagnostic tests are imperfect and presentations overlap, VBDs are easily missed or misclassified. Awareness and thoughtful testing are key to accurate diagnosis and appropriate therapy.

WHEN TO SUSPECT VECTOR-BORNE DISEASE

VBDs should be suspected in dogs presenting with anemia, thrombocytopenia, proteinuria, polyarthritis, or unexplained fever. The 'Big 4' syndromes most frequently associated with VBDs include thrombocytopenia, anemia, proteinuria, and polyarthritis. Additional clues include waxing and waning fever, hyperglobulinemia, lymphadenopathy, uveitis, or poor response to immunosuppressive therapy. Dogs with known tick exposure, recent travel, or importation history are at heightened risk. Certain breeds, such as pit bull type dogs, may also be predisposed to infections like Babesia gibsoni.

DIAGNOSTIC TESTING IN PRACTICE

Accurate diagnosis requires a strategic combination of tests. In general practice, the IDEXX SNAP® 4Dx® Plus test remains a valuable first-line screening tool, detecting exposure to Borrelia burgdorferi, Anaplasma spp., Ehrlichia spp., and Dirofilaria immitis. However, it does not detect several key pathogens, including Babesia, Bartonella, Rickettsia, or Leishmania. The use of a single assay may miss cases, especially in early infection or when seroconversion has not yet occurred[4-6]. PCR assays identify active infection and are most useful for confirming disease, though results may be negative if pathogen load is low or infection is sequestered. Ideally, both serology and PCR should be performed in parallel, particularly when an immune-mediated process is suspected.

Globally, studies show that co-infection with multiple vector-borne pathogens is not uncommon, further complicating clinical interpretation. In dogs with suspected immune-mediated hemolytic anemia (IMHA) or thrombocytopenia, failure to test for vector-borne pathogens may lead to inappropriate use of immunosuppressive therapy and poorer outcomes. Conversely, accurate identification of an infectious etiology allows for targeted antimicrobial therapy and more rapid resolution.

CASE EXAMPLE – BABESIA-ASSOCIATED IMHA

A 5-year-old Chihuahua presented with regenerative anemia, mild thrombocytopenia, and a positive slide

agglutination test. The initial SNAP® 4Dx® test was negative; however, PCR testing confirmed Babesia infection. The patient responded well to treatment with atovaquone and azithromycin, and immunosuppressive therapy was safely tapered. This case underscores the importance of screening for infectious triggers prior to immunosuppression and illustrates how targeted therapy can be curative in secondary IMHA cases.

LYME DISEASE UPDATE

According to the 2018 ACVIM Consensus Statement on Lyme borreliosis[7], most seropositive dogs remain subclinical and do not require treatment. Clinical Lyme disease presents as fever, shifting-leg lameness, or, less commonly, protein-losing nephropathy. Diagnosis should be based on compatible clinical signs, a positive serologic test (eg. 4Dx®), and exclusion of other causes. Doxycycline (10 mg/kg PO q24h for a minimum of four weeks) remains the treatment of choice. Preventive measures, including diligent tick control and vaccination of seronegative dogs in endemic regions, are key to disease prevention.

PRACTICAL TESTING STRATEGY AND CLINICAL TAKEAWAYS

When VBD is suspected, combine a 4Dx® screen with broader PCR or IFA testing where possible. Repeat testing after three to four weeks may identify seroconversion in patients initially testing negative. In dogs with suspected immune-mediated disease, testing for vector-borne pathogens should be performed before or concurrent with immunosuppressive treatment. Empiric doxycycline therapy is reasonable in dogs with compatible signs and risk factors when testing is pending or unavailable. Ultimately, integrating clinical suspicion with a stepwise diagnostic approach improves case outcomes and reduces inappropriate immunosuppressive use.

REFERENCES

1. *Ogden NH et al. Distribution of ticks and the risk of tick-borne pathogens in Ontario. *Vector Borne Zoonotic Dis.* 2016.*
2. *DeWinter S et al. Assessing spatial and temporal patterns of Ixodes spp. in Canada. *Ticks Tick Borne Dis.* 2023.*
3. *Anderson MEC et al. Impact of dog transport on high-risk infectious diseases. *Vet Clin North Am Small Anim Pract.* 2019.*
4. *Maggi RG et al. Comparison of serological and molecular panels for VBD diagnosis. *Parasit Vectors.* 2014.*
5. *Kidd L et al. Prevalence of vector-borne pathogens in dogs with immune-mediated disease. *J Vet Intern Med.* 2017.*
6. *Greene CE. *Infectious Diseases of the Dog and Cat.* 5th ed. Elsevier; 2022.*
7. *Littman MP et al. ACVIM Consensus Statement on Lyme Borreliosis in Dogs. *J Vet Intern Med.* 2018;32:887–903.*

10005

FUNGAL INFECTIONS IN DOGS & CATS – DIAGNOSIS, TREATMENT, AND CLINICAL CHALLENGES

FOCUS ON INFECTION PROGRAM

Ashley J. Spencer, DVM, MHSc, DACVIM (SAIM)

INTRODUCTION

Fungal infections in dogs and cats range from localized superficial disease to life-threatening systemic illness. While some, such as dermatophytosis, are routinely recognized in practice, others are underrecognized and complex, leading to delays in diagnosis and treatment. As immunosuppressive therapy becomes more common and our global pet population increasingly mobile, veterinarians must remain alert to these often elusive infections.

WHEN TO SUSPECT FUNGAL DISEASE

Systemic mycoses can mimic many other conditions, including neoplasia, immune-mediated disease, and bacterial infection. Fungal disease should be considered in animals with chronic respiratory signs, persistent nasal discharge, generalized lymphadenopathy, hepatosplenomegaly, ocular inflammation (e.g., chorioretinitis, optic neuritis), lameness with or without bone lesions, or non-healing cutaneous nodules. Unexplained fever and weight loss should also raise suspicion. Travel history, lifestyle, and any form of immunosuppression provide crucial context in clinical decision-making.

CASE 1: SYSTEMIC BLASTOMYCOSIS IN A DOG

A 4-year-old neutered male Labrador Retriever presented with chronic cough, progressive lameness, and weight loss. Thoracic radiographs revealed a diffuse nodular interstitial pattern. Cytology from a draining skin lesion identified broad-based budding yeasts consistent with Blastomyces dermatitidis. The dog was treated with itraconazole for six months with complete clinical resolution. This case underscores the need to consider fungal pneumonia in dogs with non-resolving pulmonary disease, especially in endemic regions.

DIAGNOSTIC TOOLS AND THEIR LIMITATIONS

Cytology and histopathology are rapid and specific when organisms are visible, particularly for Blastomyces, Cryptococcus, and Histoplasma. Culture remains a useful confirmatory tool but is slow and requires biohazard precautions. Antigen detection assays, especially urine antigen testing, offer excellent sensitivity for Blastomyces and Histoplasma, though cross-reactivity can occur. Serology is variably useful; the cryptococcal latex agglutination test remains both sensitive and specific. Advanced imaging can help identify fungal granulomas, osseous lesions, or CNS involvement, guiding sampling and monitoring.

SYSTEMIC FUNGAL INFECTIONS IN IMMUNOSUPPRESSED PATIENTS

Although systemic fungal infections are uncommon in immunocompetent dogs and cats, they may develop in patients receiving immunosuppressive therapy. Clinicians should maintain suspicion when animals treated for immune-mediated conditions exhibit new systemic signs or focal lesions.

CASE 2: SYSTEMIC CANDIDIASIS IN AN IMMUNOSUPPRESSED DOG

A 3-year-old neutered male Goldendoodle with immune thrombocytopenia treated with cyclosporine and corticosteroids re-presented with shifting lameness and uveitis. Imaging revealed lytic lesions in the scapula, and Candida species were isolated from aspirates and enucleation samples. Systemic candidiasis was confirmed by culture, highlighting the risk of opportunistic fungal infection during combination immunosuppression, and in particular cyclosporine.

CASE 3: CRYPTOCOCCOSIS IN A CAT

A 9-year-old neutered male domestic shorthair cat previously treated for immune-mediated hemolytic anemia with prednisolone and cyclosporine developed progressive nasal discharge and facial swelling, particularly over the nasal bridge. Cytology and biopsy of the nasal mass revealed encapsulated budding yeasts consistent with Cryptococcus, and serum antigen testing was positive.

The cat responded initially to fluconazole therapy with improvement in nasal signs, and antigen titers declined over several months. However, recurrence of nasal signs and increasing antigen titers suggested progressive fungal disease despite concurrent azole treatment. Because of concern for antifungal resistance, amphotericin B was trialed but discontinued after azotemia developed. The cat later presented to the emergency service with multi-organ dysfunction, and euthanasia was elected. Post-mortem examination revealed unrelated multicentric lymphoma involving kidneys, lymph nodes, and liver. This case underscores the potential for concurrent or secondary disease in immunosuppressed patients and highlights the possibility of emerging azole resistance.

CYCLOSPORINE AND FUNGAL RISK

Cyclosporine is widely used as a second-line immunosuppressant for immune-mediated disorders such as IMPA, IBD, and IMHA. By inhibiting T-cell activation through calcineurin blockade, cyclosporine compromises cell-mediated immunity. In people, this has been associated with invasive fungal infections, both pathogenic and opportunistic. Similar patterns are increasingly recognized in veterinary medicine, particularly infections due to Candida and Cryptococcus species. These risks are amplified when cyclosporine is used concurrently with corticosteroids or other immunosuppressants, underscoring the importance of close clinical monitoring.

ANTIFUNGAL THERAPIES: CHOOSING WISELY

Drug choice depends on the site of infection, concurrent disease, potential drug interactions, and cost. Treatment typically extends four to six months or longer. Hepatic function monitoring and therapeutic drug level assessment (especially for itraconazole) are recommended. Increasing reports of antifungal resistance, particularly to azole-class drugs, have emerged in both human and veterinary medicine. Resistance may develop following prolonged therapy, subtherapeutic dosing, or incomplete treatment courses. Culture-based susceptibility testing should be considered in refractory cases, and therapeutic drug monitoring helps optimize dosing and reduce resistance risk

ANTIFUNGAL THERAPY SUMMARY

Drug	Class	Route	Clinical Notes
Fluconazole	Azole	PO	Excellent CNS and ocular penetration; possible hepatotoxicity.
Itraconazole	Azole	PO	Effective for systemic mycoses; therapeutic drug monitoring recommended; GI upset possible.
Posaconazole	Azole	PO	Broad-spectrum, useful in refractory infections; expensive.
Voriconazole	Azole	PO/IV	CNS-active; off-label; monitor for hepatic and neurologic effects.
Amphotericin B	Polyene	IV	Reserved for severe or refractory infections; nephrotoxic, requires monitoring.
Terbinafine	Allylamine	PO	Adjunctive option; minimal adverse effects; useful for dermatophytosis.

SINONASAL ASPERGILLOSIS AND SYSTEMIC FORM

Sinonasal aspergillosis is generally a localized infection of the nasal cavity and frontal sinuses, most common in dolichocephalic dogs. It can occur primarily or secondary to structural disruption from neoplasia, foreign bodies, or chronic rhinitis. Systemic aspergillosis, in contrast, involves hematogenous dissemination and may produce multifocal osteomyelitis, renal involvement, or CNS disease. Diagnosis relies on imaging and rhinoscopy with visualization of fungal plaques, supported by cytology or culture. Topical clotrimazole infusion following debridement remains the standard therapy for localized sinonasal disease.

EMERGING CONSIDERATIONS: OOMYCOSIS

Oomycetes such as Pythium insidiosum and Lagenidium species, though not endemic in Ontario, can be encountered due to pet travel, importation, and climate change. These infections can resemble neoplasia and are colloquially termed 'swamp cancer.' Pythiosis often manifests as gastrointestinal or cutaneous granulomatous masses with ulceration, draining tracts, and regional lymphadenopathy. Diagnosis is achieved through histopathology, PCR, or serology. Treatment typically requires aggressive surgical resection combined with antifungal or antifungal-like drugs such as terbinafine, amphotericin B, or mefenoxam. Prognosis remains guarded.

MONITORING AFTER DIAGNOSIS AND DURING TREATMENT

Monitoring fungal disease resolution is challenging. In Blastomyces and Histoplasma infections, urine antigen assays may remain positive long after clinical recovery and should be interpreted alongside patient response. Cryptococcus antigen titers are followed serially until negative. Imaging helps assess lesion resolution, while periodic CBC and biochemistry monitor for adverse drug effects. Recurrence is possible, particularly in immunocompromised patients, and extended therapy or prophylactic dosing may be indicated.

KEY TAKEAWAYS

Fungal infections can mimic numerous other diseases, requiring strong clinical suspicion for timely diagnosis. Immunosuppression increases susceptibility and complicates management. Cytology, histopathology, and antigen detection are cornerstone diagnostics, while appropriate antifungal therapy and diligent monitoring determine outcomes.

REFERENCES

1. *Brown PJ, Helman RG, Ettinger SJ, Vaden SL, Taboada J, Suter PF. Pulmonary blastomycosis in dogs: 125 cases (1980–1997). J Am Vet Med Assoc. 2000;216(3):347–351. PMID: 24495193.*
2. *Sykes JE, Malik R, Anderson G, White JD. Cryptococcosis in dogs and cats: A review. J Small Anim Pract. 2010;51(9):484–494. PMID: 20840121.*
3. *Malik R, Krockenberger MB, O'Brien CR, et al. Cryptococcosis in cats: Clinical and mycological assessment of 59 cases. Med Mycol. 2002;40(6):411–422. PMID: 12462547.*
4. *Legendre AM, Rohrbach BW, Toal RL, et al. Treatment of blastomycosis with itraconazole in 112 dogs. J Vet Intern Med. 1996;10(6):365–371. PMID: 8949980.*
5. *Krecic MR, Harkin KR. Opportunistic fungal infections in dogs receiving immunosuppressive therapy. Vet Clin North Am Small Anim Pract. 2018;48(5):925–940. PMID: 30096983.*
6. *Mavropoulou A, Xenoulis PG, Steiner JM, Lidbury JA, Suchodolski JS. Systemic candidiasis in dogs and cats: A review. J Vet Intern Med. 2023;37(1):31–44. PMID: 11148939.*
7. *Pappas PG, Kauffman CA, Andes DR, et al. Clinical practice guidelines for the management of blastomycosis and histoplasmosis. Clin Infect Dis. 2016;63(6):e1–e60. PMID: 27516381.*
8. *Burrough ER, Garner MM, Bush SJ, et al. Pythiosis and lagenidiosis in domestic animals: Emerging oomycotic infections. Vet Pathol. 2019;56(2):191–208. PMID: 30621538.*
9. *Cohn LA. Fungal diseases of the respiratory tract. Vet Clin North Am Small Anim Pract. 2020;50(2):299–320. PMID: 32035588.*
10. *O'Brien CR, Krockenberger MB, Wigney DI, Martin P, Malik R. Sinonasal and disseminated aspergillosis in dogs: A retrospective study of 90 cases (1990–2003). Aust Vet J. 2006;84(7):235–245. PMID: 16911125.*
11. *Coyne KP, Allen P, Baral R. Antifungal resistance in veterinary medicine: Current challenges and emerging concerns. J Am Vet Med Assoc. 2024;263(11):1458–1467. PMID: 39023101.*
12. *Greene CE, Sykes JE, eds. Infectious Diseases of the Dog and Cat. 5th ed. St. Louis: Elsevier; 2022.*
13. *Sykes JE. Canine and Feline Infectious Diseases. 2nd ed. St. Louis: Elsevier; 2022.*

EQUINE PROGRAM

ONTARIO VETERINARY MEDICAL ASSOCIATION

11001

DIAGNOSTIC TOOLS FOR EQUINE COLIC

EQUINE PROGRAM | DIAGNOSTIC AND TREATMENT STRATEGIES

Jamie Kopper, DVM, PhD, DACVIM-LAIM, DACVECC-LA

For this talk, we will discuss tools to identify horses at risk for having colic that is not amenable to treatment in the field and components of care to use for treatment of a horse in the field for colic. For the purpose of this talk we will use the term colic to specifically refer to or assume we are working with horses with abdominal pain due to primary gastrointestinal disease but remembering that technically colic refers to any cause of abdominal pain and horses cannot readily tell us the difference between intestinal pain vs. renal pain vs. liver pain vs. reproductive pain etc.

COLIC EXAMINATION

The flow of each case is different based on the severity of pain at the time of presentation, the owner's goals and limitations as well as diagnostic findings that are gathered. Below outlines aspects of an exam to consider and information to be gained from each step.

Collect a History: This part is sometimes forgotten in an emergency setting but is something that most of us are adept at collecting. One of my favorite questions to ask is "When was the last time you know your horse was normal?" which is a bit different than "when did your horse start showing signs of colic?". I find that many people will answer the later question with "this morning". However, when asked when they were last normal may disclose that they haven't seen the horse since the day prior at some point thus widening the time for when the horse started showing signs of colic.

Perform a Physical Examination: Certainly, in a thrashing horse this becomes very abbreviated and often after the administration of analgesics and sedation to facilitate everyone's safety. Assuming a complete exam can be performed, this can provide valuable information that may provide clues that this is not a classic uncomplicated intestinal colic or that the horse is sicker than may be initially appreciated. Some key points of this exam include looking for evidence of prior self-trauma (i.e., perhaps the horse is no longer showing active signs of colic but has abrasions over its face from severe unwitnessed colic signs), temperature of distal extremities (ears, distal limbs – evidence of peripheral vasoconstriction), presence of petechia in the ears (evidence of a coagulopathy), mucous membrane color (evidence of systemic compromise), a good thoracic auscultation (many horses with pneumonia present for what the owners perceive to be colic due to reluctance to move in inappetence) and a rectal temperature (horses with a fever likely have something more complex than a straight forward colic).

Pass a Nasogastric Tube: If possible, passing a nasogastric tube provides diagnostic information as well as a route for therapies. For horses with moderate to severe pain and/or a heart rate ⇢ 60 bpm, I will pause to do this prior to completing my physical examination to decrease the risk of gastric rupture while evaluating the horse due to gastric distention. Once passed, if amenable, I will often leave the tube in place until the completion of the examination and a plan has been established so that it can be used therapeutically if indicated. Horses should have < 2 L of gastric reflux at any given time – horses with more than 2 L likely have some form of small intestinal disease. Additionally, when net reflux is present this indicates that enteral fluids cannot be used as a reliable form of treatment for the horse.

Transrectal Palpation: If safe, this can provide information regarding the cause of colic. However, I remind all clients that I can only appreciate about 1/3 of the horse's abdomen

so just because I am unable to palpate an impaction or another abnormality does not mean that there is not an impaction or other problem. To facilitate transrectal palpation several pharmaceutical options can and should be considered. First and foremost is safety of everyone – primarily you. Use of alpha-2 agonists (i.e., xylazine, detomidine) should be employed as needed. However, some horses are still prone to unpredictable behavior (i.e., kicking, biting) with alpha-2 agonists despite otherwise appearing sedate. Adding butorphanol helps eliminate kicking in many of these horses. To decrease straining (by the horse) N-butylscopolammonium bromide (Buscopan®) can be added. This drug will essentially paralyze the intestinal smooth muscle for approximately 20 minutes which also has anti-spasmotic effects and may provide mild analgesia. While there is some concern with decreasing intestinal motility in horses with intestinal disease, in the author's opinion this has not had appreciable deleterious effects on outcome. However, a similarly effective alternative is to apply ~60 mL of 2% lidocaine (for an ~ 500 kg horse) topically per rectum. This is done after evacuating the manure in the distal rectum, drawing up 60 mL of 2% lidocaine in a 60 mL syringe and attaching it to a 30 inch extension set (tear off the end so that it is smooth and you can slide off any clamps etc.). This provides local analgesia so that the horse strains less and can similarly facilitate transrectal palpation but does not have the same anti-spasmotic effects. Due to the cardiovascular effects of Buscopan®, I will use this in horses with notable cardiac murmurs or moderate to severe tachycardia. Rather than focusing on the exact diagnosis, big questions that I try to answer are: (1) Is the palpation normal or abnormal, (2) do I think that there is evidence of small intestinal disease (i.e., distended amotile small intestine) or large colon disease (i.e., gas distention, colonic bands, an impaction) or small colon disease (careful palpation can differentiate small colon from other bowel based on size and appreciating the anti-mesenteric tenia).

PERITONEAL FLUID ASSESSMENT:

Collection of peritoneal fluid is a relatively easy diagnostic that can give you a window into the health of the abdominal contents. Below is a step-by-step guide to collecting peritoneal fluid.

Peritoneal paracentesis:

1. Choosing a location: A typically "safe" location for collection of peritoneal fluid is just to the right of midline and just caudal to the pectoral muscles. Using the ventral midline and pectoral muscles you can make two sides of a triangle and your "sweet spot" is right in that triangle. This location will usually allow you to avoid the spleen and bowel. Alternatively, if you have an ultrasound available you can confirm that the spleen is absent from your intended location and/or look for a specific pocket of fluid. However, even if you do not see fluid you can usually collect a sample from this location.
2. The site you choose should be clipped and aseptically prepared.
3. One of several instruments can be utilized including an 18-gauge 1.5 inch needle, teat cannula, female (metal) urinary catheter, or spinal needle. If using a needle (18-gauge 1.5 inch or spinal) you can skip the next 4-10 steps and move on to step 11.
4. Infiltrate a small volume of 2% lidocaine or other local anesthetic where you intend to insert your collection device in the subcutaneous tissue and underlying muscle.
5. Using a #15 blade make a stab incision through the skin, subcutaneous tissue and partial thickness into the underlying muscle.
6. Advance the teat canula or female urinary catheter through a sterile gauze sponge (4 x 4) – this will help collect/absorb blood associated with the skin incision that could contaminate your peritoneal fluid sample.
7. Insert the end of the teat canula or female urinary catheter through your stab incision and apply steady pressure. With firm pressure you should feel two "pops" - one through the rest of the muscle and one through the peritoneum. The horse may mildly react as you puncture the peritoneum - this is not blocked by your local analgesia.
8. Now, slowly advance your teat cannula while someone holds a collection tube under it. Do not pass through a third "pop" - this is typically the intestine.
9. You've taken a lot of time to get here, so I will spend some time hunting for a fluid sample if it is not readily produced. This can include gradually advancing the instrument unless I feel resistance, turning it clockwise and counter clockwise and redirect cranially and caudally.

10. If you still have not obtained fluid make sure that you keep your collection device under the teat cannula or female urinary catheter as you remove it – the majority of the time you will be able to collect a small amount of fluid that had collected in the lumen of the collection device.

11. If you chose to use a needle, slowly advance the needle. Local anesthesia can be utilized as described in step 4 but is not necessary for most patients.

12. Have a collection device under your needle as you advance ready to collect the fluid.

13. If you feel a grating sensation over the tip of your needle STOP and back up – this is the colon.

Complications associated with peritoneal paracentesis are rare, but the most common complication is inadvertent enterocentesis. This is obvious based on the presence of intestinal contents in a patient a that does not have clinical signs consistent with intestinal rupture. These horses do quite well with a short course of prophylactic antimicrobials.

Occasionally, you will not achieve peritoneal fluid. I usually consider this to be a "good" sign in a colic evaluation – typically horses with surgical disease have an excess of free peritoneal fluid.

Normal peritoneal fluid should be clear to clear and slightly yellow in color. As a crude test, you should be able to read print through the fluid. The total protein should be less than 2.5 g/dL, the USG should be less than 1.012 and the peritoneal fluid lactate should be commiserate with venous lactate.

Intestinal rupture may result in obtaining peritoneal fluid with frank fecal material present and is typically malodorous. Definitive diagnosis requires the identification of intracellular bacteria and plant material, but this is typically not practical in an emergent field setting. The primary rule out for obtaining frank fecal matter on peritoneal paracentesis is an accidental enterocentesis. These differentials have very different outcomes (rupture being very poor, enterocentesis being typically good) and thus effort should be made to confirm the etiology. Physical exam findings for a horse with an intestinal rupture are typically pronounced and include severe tachycardia (often upwards of 100 beats per minute), toxic appearing mucus membranes, prolonged capillary refill time, severe hemoconcentration (often upwards of 60%), sweating and muscle fasciculations. With corresponding physical exam findings, I will often repeat an abdominocentesis in a separate location to confirm the findings in two locations for both myself and the owner. If you obtain fecal material from an otherwise stable appearing horse, I would assume that it was an enterocentesis until proven otherwise.

Horses with peritonitis will typically have turbid orange to yellow colored peritoneal fluid. Several "guidelines" for peritoneal glucose measurements consistent with sepsis have been proposed which include peritoneal fluid glucose less than 50% of the venous glucose, a venous and peritoneal glucose difference of greater than 50 mg/dL or a peritoneal fluid glucose that is less than 50 mg/dL. Cytological evaluation should reveal a cell count of greater than 10,000 cells/µl and > 90% neutrophils. Observing bacteria on cytology is not required for diagnosis of septic peritonitis, but is confirmative. Whether peritonitis is managed medically versus surgically is largely dependent upon the overall clinical picture. Samples suspicious for peritonitis should be submitted for culture to determine an etiologic agent and confirm that empirical antimicrobial choices are supported by sensitivity testing.

The holy grail of peritoneal fluid analyses questions is … does this horse have surgical (ischemic) lesion? In a perfect world, we would always be correct – we would never delay referral or surgery for a horse with an ischemic lesion and we would never take a horse to surgery that doesn't have a surgical or ischemic lesion … unfortunately we don't live in a perfect world. However, we can use several diagnostic tools to help increase our chances of correctly identifying such lesions.

Peritoneal fluid color: Perhaps one of the hardest differentiations to make is horses with small intestinal strangulating disease versus those with enteritis. In a study by Shearer and colleagues (1) their major finding was that peritoneal fluid color matters. In other words, abnormal colored peritoneal fluid (red, pink, etc.) was more predictive of horses having a lesion requiring surgery than peritoneal fluid lactate or other variables evaluated.

Peritoneal fluid L-lactate: Even though I just told you that color was more predictive in that retrospective study, lactate can also be helpful. Typically, we compare peritoneal fluid lactate to venous lactate and when the peritoneal lactate is 2 times (or more) greater than the

venous lactate, we consider that consistent with ischemic intestine. Unfortunately, not all lactate meters are created equal. A study by Nieto and colleagues (2) found that only the Lactate Pro ® meter had acceptable agreement at high lactate concentrations.

Peritoneal fluid creatinine kinase (CK): This may be another indicator to assist with colic decision making. Kilcoyne and colleagues evaluated blood and peritoneal CK comparing normal horses, to those with colic and those with colic requiring surgical intervention (3). They found that peritoneal and blood CK were elevated in horses with colic compared to normal horses and that those horses with strangulating or ischemic lesions had increased blood and peritoneal CK vs. those with non-strangulating or ischemic lesions.

At the end of the day there are horses that clearly need referral and/or surgery, horses that clearly do not and those that are in "the grey zone" which make up the "art" of veterinary medicine and why it's referred to as practicing medicine. We do the best that we can, in the situation that we are in, with the information that we have, to make an informed recommendation but the answer is not black or white. The above are provided as tools to assist in decision making, but horses unfortunately do not always play by our rules and should be reassessed as clinical signs progress.

REFERENCES

1. *Shearer T, Norby B, Carr E. Peritoneal fluid lactate evaluation in horses with non-strangulating versus strangulating small intestinal disease. J Equine Vet Sci. 2018. 61: 18-21*
2. *Nieto JE, Dechant JE, le jeune SS, Snyder JR. Evaluation of 3 handheld portable analyzers for measurement of L-Lactate Concentrations in Blood and Peritoneal Fluid of Horses with Colic. Vet Surg. 2015;44: 366-372.*
3. *Kilcoyne I, Nieto JE, Dechant JE. Predictive value of plasma and peritoneal creatinine kinase in horses with strangulating intestinal lesions. Vet Surg. 2018.;48:152-158.*

11002

THORACIC AND ABDOMINAL ULTRASOUND OF THE HORSE

EQUINE PROGRAM | DIAGNOSTIC AND TREATMENT STRATEGIES

Jamie Kopper, DVM, PhD, DACVIM-LAIM, DACVECC-LA

There are two types of thoracic and abdominal ultrasound – an abbreviated version that is most commonly employed in horses demonstrating acute signs of colic, often referred to as the FLASH (fast localized abdominal sonographic assessment of the horse) and a through approach that evaluates the horse rib space by rib space. For the purposes of this talk, we will review both as each have a place and time when evaluating horses for colic or other thoracic or abdominal disease.

FAST LOCALIZED ABDOMINAL SONOGRAPHY OF THE HORSE (FLASH)

FLASH is designed to be a brief (several minute) ultrasonographic assessments that can be utilized to try and identify findings consistent with significant abdominal disease in horses with acute colic (1). Although these examinations are best performed with a 3.5 MHz macro convex probe, in many instances a rectal probe can also provide diagnostically useful information. Several FLASH protocols exist; one of the commonly utilized protocols is provided below. This protocol should be performed in less than 10 minutes (hence the F for fast). It is not meant to replace a systematic thorough transcutaneous abdominal ultrasound but rather aide in rapid decision making for horses with significant acute colic.

Ventral Abdomen: Assess for the presence of increased peritoneal fluid, and if present the character of the fluid (hypo vs. hyperechoic).

Left side of the horse:

Location 1: Stomach. The stomach is found on the left side of the horse and in a normal horse should be gas filled and should not be present beyond the 10th intercostal space (ICS). Identifying fluid within the stomach or the stomach beyond the 12th ICS is consistent with gastric distention. These findings warrant prompt placement of a nasogastric tube and is suggestive of a proximal intestinal obstruction.

Location 2: Left Kidney/Spleen. Normally, the left kidney is found deep to the spleen in the left 17th ICS. Horses with a nephrosplenic entrapment (NE)will have gas filled large colon which obliterates this view of the left kidney. It is important to note though, that while not identifying the left kidney can indicate that the horse has a NE, it is not diagnostic for a NE. However, adequately visualizing the left kidney effectively rules out this differential.

Location 3,4: Left, right inguinal area. This is a prime location to evaluate for the presence of distended amotile small intestine, which would be consistent with a small intestinal obstruction (functional or physical).

Right side of the horse:

Location 5: Right 14-15th ICS. This location allows you to visualize the liver, duodenum, and right dorsal colon. Horses with gastric distention will commonly have distention of the duodenum as well. Identifying an amotile duodenum should prompt you the pass a nasogastric tube to assess for gastric distention if that has not already been performed. The large colon wall should be less than 0.3 cm in thickness. Thickening of the large colon can be concerning for colitis, right dorsal colitis or a large colon volvulus.

Location 6: Right middle third of the abdomen. This location is used to both assess the large colon for wall thickness as well as the presence of colonic vessels. The presence of mesenteric vessels and/or increased wall thickness are concerning for a large colon displacement that may have progressed to a large colon volvulus.

Location 7: Cranioventral thorax just caudal to the triceps to assess for the presence of free fluid or abdominal contents within the thoracic cavity. This is an often overlooked location but important one as many horses with pleural pneumonia are presented due to concerns of colic due to vague clinical signs and a limited ability for horses to tell us that their chest hurts versus their abdomen.

COMPLETE THORACIC AND ABDOMINAL ULTRASOUND

A complete abdominal and thoracic ultrasound requires a systematic approach and involves assessing the horse rib space by rib space, dorsally to ventrally. A practical tip, particularly if not clipping the horse, is to only wet a few rib spaces at a time with alcohol, as once the alcohol dries, even when re-applied you do not obtain as high quality of an image. Clipping and the use of acoustic gel can be beneficial, particularly in overweight horses, or those that are grey or black in color and do not image as well as other counterparts.

Thorax:

Within the thorax, normal lung should appear as a smooth, crisp hyperechoic line that slides ("glides") back and forth as the horse breathes. The lung surface should be evaluated for the presence of "comet tails" or "b-lines" which would indicate irregularities on the pleural surface. The nature of these irregularities cannot be inferred from ultrasound alone, but rather in taking into consideration the entire clinical picture – common causes include inflammation, fibrosis, inflammation or neoplasia. The lung surface should also be evaluated for areas of consolidation which can be measured based on location and depth. A full cardiac evaluation is beyond the scope of this discussion, but the heart can briefly be assessed for pericardial effusion. The thorax can also be assessed for the presence of free fluid (which would appear anechoic or hypoechoic) or a pneumothorax – which would appear similar to aerated lung, except the hyperechoic line does not move/glide back and forth as the horse breathes, as it is free air within the thorax rather than contained within the pleura. The diaphragm can also be traced to ensure continuity.

Abdomen:

You should develop your own system for evaluating the abdomen – the order by which you evaluate it is not important, however it is important to try and approach it the same each time so that you do not accidentally miss part of the picture. The author prefers to start on the right side of the horse working cranially to caudal, and then move to the left side working cranially to caudal. However, it would be equally correct to start on the left side or to start caudally and work cranially.

Left side:

The major organs one would expect to see on the left side of the horse are the stomach, spleen, a small view of the liver in the cranioventral abdomen in juxtaposition to the spleen, the left kidney and (small) colon. Depending on the horse or the nature of the horse's problem there may also be small intestine visible.

Stomach: The stomach should not extend past the 12th intercostal space and should have a gas cap precluding the visualizing or fluid or other material within the stomach. Identifying fluid within the stomach should prompt passage of a nasogastric tube, if one has not already been passed. Similarly, if a nasogastric tube is indwelling it may be visualized within the stomach. The stomach can be distinguished from the colon, which should also have a similar appearing gas interface by noting the layering of the stomach wall and/or appreciating the gastrosplenic vein within the spleen – when the gastrosplenic vein, spleen and gas filled viscous are visible, this confirms that you are visualizing the stomach. Unfortunately, gastric ulcers cannot be visualized ultrasonographically.

Spleen: The spleen should be homogenous in echotexture and relatively hyperechoic to the liver. It can extend over the better part of the left side of the horse. Failure to visualize the spleen due to gas filled viscous may indicate a large colon displacement resulting in colon being positioned between the spleen and the body wall.

Left Kidney: The left kidney should be visualized deep to the spleen, often just cranial to the paralumbar fossa. Due to needing to penetrate deeper, some detail of the left kidney is lost in comparison to evaluation of the right kidney. Failure to identify the left kidney due to the presence of a gas filled viscous may indicate that the horse has a nephrosplenic entrapment. The kidney should be assessed for the presence of nephroliths (hyperechoic foci with an acoustic shadow), dilation of the renal pelvis and/or ureter and corticomedullary distinction.

Colon: Normal colon should always have a gas-fecal interface precluding visualizing of anything (impaction etc.) beyond the colon wall. Normal colon wall should be 5 mm or less in diameter.

Small Intestine: Normal small intestine should be difficult to find as it is typically collapsed and mobile. Often, you may get a brief impression of it contracting between segments of colon. Small intestine that is motile but easy to identify may be hypomotile. Amotile small intestine is concerning for an obstruction – occasionally, you may find two populations, one with a thickened wall and one without. This is most concerning for a strangulating lesion, as the thickened wall intestine is the portion entrapped and the portion without the thickened wall is the oral portion. However, not identifying two populations of wall thickness does not rule out a small intestinal strangulation. Normal small intestinal wall thickness should be less than or equal to 3 mm.

Liver: The majority of the liver is evaluated on the right side of the horse and will be discussed there, however on the left side of the horse you may see a small (1-2 rib spaces) amount of the liver next to the spleen cranial to the stomach. Here, this allows you to compare the echotexture of the liver to the spleen, where it should be hypoechoic compared to the spleen.

Right Side:

The major organs one would expect to see on the right side of the horse include the liver, right kidney, large colon and specifically the right dorsal colon, the cecum, the duodenum and other small intestine.

Liver: The liver is present in variable rib spaces, depending on the age of the horse (the liver atrophies with age) and the position of the colon. The liver should be homogenous in echotexture with the exception of anechoic bile ducts. In the majority of horses the portal vein should not be visualized, unless the horse has portal vein hypertension. Choleliths appear as hyperechoic foci with acoustic shadowing. The liver should come to a crisp point and should not have rounded edges or extend to or past the level of the right kidney.

Right dorsal colon: Assuming that the colon is sitting in the correct anatomic location, the right dorsal colon sites adjacent to the liver in the cranioventral abdomen. Focal wall thickening of this area is concerning for right dorsal colitis.

Colon: The large colon is readily visualized on the right side of the abdomen, however the presence of colonic vessels on the right mid abdomen is concerning for a large colon displacement and possible volvulus. Similarly, thickened large colon in the area of the mid right abdomen is concerning for edema secondary to venous congestion associated with a large colon volvulus.

Duodenum: The duodenum can specifically be visualized between the liver and right dorsal colon and at the cranial aspect of the right kidney. With patience, it should be observed to contract but should not be readily found distended and amotile – such a finding would be concerning for gastric distention and should prompt passing a nasogastric tube if one has not already been passed. The remainder of the small intestine within the abdomen cannot be identified based on segment (i.e., jejunum, ileum).

Right Kidney: The right kidney is more readily visualized than the left kidney with better detail. However, the assessment remains similar - the kidney should be assessed for the presence of nephroliths (hyperechoic foci with an acoustic shadow), dilation of the renal pelvis and/or ureter and corticomedullary distinction.

Cecum: Assuming everything is in the correct anatomic location, the cecum should be located in the right paralumbar fossa and appears very similar to the colon. Like the colon it should be gas filled with a wall thickness of less than or equal to 5 mm.

Ventrum:

The ventrum and inquinal areas should be scanned for free fluid and the presence of amotile small intestine or other abnormalities. Normally, the ventrum should primarily contain large colon. The presence of a small amount of anechoic free peritoneal fluid is not abnormal in the horse. However, large volumes and/or echogenic peritoneal fluid should prompt peritoneal paracentesis for fluid assessment.

REFERENCES:

1. *Busoni V, De Busscher V, Lopez D, Verwilghen D, Cassart D. Evaluation of a protocol for fast localised abdominal sonography of horses (FLASH) admitted for colic. Vet J. 2011 Apr;188(1):77-82. doi: 10.1016/j.tvjl.2010.02.017. Epub 2010 Mar 26. PMID: 20347357.*
2. *le Jeune S, Whitcomb MB. Ultrasound of the equine acute abdomen. Vet Clin North Am Equine Pract. 2014 Aug;30(2):353-81, viii. doi: 10.1016/j.cveq.2014.04.011. Epub 2014 Jun 10. PMID: 25016496.*

11003

PRACTICAL FLUID THERAPY: A CASE-BASED DISCUSSION

EQUINE PROGRAM | DIAGNOSTIC AND TREATMENT STRATEGIES

Jamie Kopper, DVM, PhD, DACVIM-LAIM, DACVECC-LA

INTRODUCTION

Intravenous (IV) fluid therapy can be a crucial component of treatment for the critically ill horse. IV fluids are an effective tool at restoring and maintaining intravascular volume in horses with severe hypovoluemia[1,2] and may be the only mechanism by which to do so in horses that are unable to take enteral fluids. However, there are several important limitations to commercially available IV fluid formulations that practitioners may need to take into consideration including supply challenges[3] and the electrolyte composition which may put patients at risk of developing risks a hyperchloremic metabolic acidosis.[4-7] To the author's knowledge, the association between the use of IV fluids, hyperchloremic metabolic acidosis, morbidity and mortality has not been reported for veterinary species. Direct extrapolation of human studies to veterinary patients should be done with caution. However, until veterinary data has been generated and reported it is prudent to at least critically evaluate this literature. The most common cause of human patients developing a hyperchloremic metabolic acidosis is iatrogenic – i.e. administration of IV fluids with supraphysiologic concentrations of chloride. And although the subsequent development of a hyperchloremic metabolic acidosis was once thought to be benign and self-limiting[8] physicians now realize that this is no longer the case. Other points of consideration with commercially available IV fluids are sub-physiologic concentrations of potassium which may result in additional cost with IV supplementation and potential safety concerns, sub-physiologic supplementation with calcium and magnesium and limited cost-effective means for meaningful nutritional supplementation. So what are alternative options and potential benefits or risks associated with their use?

IN-HOSPITAL PREPARED IV FLUIDS

In particular, recent fluid shortages lead to some practitioners pursuing alternative means for administering IV fluids to patients including the use of non-sterile in-hospital prepared IV fluid formulas. These fluids are commonly prepared using 5-gallon commercial distilled water jugs with the custom addition of electrolytes. This has the added benefit of allowing veterinarians to better custom create formulas according to their patient's individual needs. However, largely owning to the non-sterile nature, there are several potential concerns worth considering. The first is a report from 1986 indicating that the administration of non-sterile IV fluids to healthy horses resulted in leukopenia and clinical signs consistent with endotoxemia.[9] A more recent study by Magnusson and colleagues reported that there is a high rate of bacterial contamination in non-sterile in-hospital prepared IV fluids.[10] In this study there was a much lower rate of contamination with endotoxin and those with endotoxin contamination were not at concentrations considered to be physiologically relevant to the adult horse. However, in this study the clinical relevance of the bacterial and endotoxin contamination was not investigated. In a subsequent study, horses that received non-sterile IV fluids were found to have an increased risk of jugular vein thrombosis or thrombophlebitis but there was no effect on survival to discharge or other types of morbidity when compared to horses that received commercially prepared IV fluids.[11] Of note, formulas and patient monitoring should be carefully considered so as to avoid hyperchloremia. Table 1 shows several formulas for 5 gallon volumes provided courtesy of Dr. Harold Schott (Michigan State University)

TABLE 1: IN-HOSPITAL IV FLUID FORMULAS PER 5 GALLONS OF DISTILLED WATER

	NaCl (g)	KCl (g)	KHCO3- (g)	Na+ (mEq/L)	Cl- (mEq/L)	K+ (mEq/L)	HCO3- (mEq/L)	mOsm/L
0.9% NaCl	170	-	-	153	153	-	-	306
Rehydration-1	136	42	-	122	152	30	-	304
Maintenance-1	102	84	-	92	152	59	-	303
Rehydration-2*	136	-	56.4	122	122	30	30	304
Maintenance-2*	102	-	112.8	92	92	60	60	304

**Due to the use of KHCO3- these formulas are not compatible with calcium or blood product additives.*

ENTERAL FLUID THERAPY

Enteral fluids, when feasible, are an efficacious means for providing both fluid therapy and aiding in the resolution of uncomplicated obstructive disease of the large colon. Lester and colleagues compared the effects of enteral versus IV rehydration in horses.[12] They found that when administered an 8 L bolus of fluids via nasogastric tube, 90% of the fluids had left the stomach within 15 minutes and had reached the cecum by 1-2 hours resulting in increased intestinal and fecal water compared to horses that received IV fluids.[12] Furthermore, horses that received IV fluids were more likely to undergo a period of rebound dehydration after discontinuing IV fluid therapy compared to horses receiving enteral fluids. Marlin and colleagues explored using an oral rehydration solution (ORS) as a means to increase the efficacy of enteral fluid therapy.[13] ORS consists of a balanced glucose and electrolyte mixture and were originally designed by the World Health Organization to aide in the rehydration of diarrhea stricken individuals while treating cholera in third world countries without routine access to IV fluids. Adding glucose to the solution facilitates sodium absorption and thus absorption of water from the small intestine via the SGLT-1 transporter protein. Marlin and colleagues found that by adding balanced glucose and electrolytes to the enteral fluids they were able to effectively restore euvolemia within 2 hours with minimal electrolyte disturbances in dehydrated horses.[13] An ORS can be easily created for horses by adding ~8 ounces of infant rice cereal to an isotonic electrolyte formula for 6 liters of water. Additional benefits of enteral fluid therapy include the ease and cost effectiveness with which nutritional support can also be provided.

RECTAL FLUID THERAPY

Rectal fluid therapy is employed in human patients in several settings including emergency departments and palliative care settings where intravenous access is not attainable or desirable. Khan and colleagues described effectively using rectal fluid therapy in horses, a technique that is gaining popularity in equine patients.[14] Here, the authors reported that rectal administration of up to 5 ml/kg/hour of tap water was well tolerated by horses and resulted in hemodilution comparable to nasogastric and intravenous fluid administration. Rectal fluids can be administered by inserting a lubricated stallion catheter into the horse's rectum, attaching it to the horse's tail and connecting the line to non-sterile fluid administration sets that can be utilized with carboys or refilled (nonsterile) intravenous fluid bags. In the author's experience this technique is generally well tolerated but does require careful monitoring and re-insertion of the fluid line after defection. Several potential advantages to this means for fluid administration include means for delivering non-salt rich fluids to horses including those that are not amenable to enteral fluids due to ileus, cost savings compared in intravenous fluids, ability to allow the horse to eat and receive fluid therapy compared to use of enteral fluids and lower complication rates as compared to intravenous and enteral fluid therapy.

In summary, there are several potential limitations of commercially available IV fluids which should be considered. When feasible alternatives including the use of enteral fluids or custom-made IV fluids are viable options and in some cases may have superior attributes.

REFERENCES

1. *Fielding L. Crystalloid and colloid therapy. Vet Clin North Am Equine Pract 2014;30:415-425, viii-ix.*
2. *Muir WW, Ueyama Y, Noel-Morgan J, et al. A Systematic Review of the Quality of IV Fluid Therapy in Veterinary Medicine. Front Vet Sci 2017;4:127.*
3. *Food and Drug Administration CfVM. Large Volume Intravenous (IV) Solution Shortage. http://wwwfdagov/AnimalVeterinary/SafetyHealth/ProductSafetyInformation/ucm440393htm?source=govdelivery&utm_medium=email&utm_source=govdeliveryAccess 2015*
4. *Yunos NM, Bellomo R, Hegarty C, et al. Association between a chloride-liberal vs chloride-restrictive intravenous fluid administration strategy and kidney injury in critically ill adults. Jama 2012;308:1566-1572.*
5. *Boniatti MM, Cardoso PR, Castilho RK, et al. Is hyperchloremia associated with mortality in critically ill patients? A prospective cohort study. J Crit Care 2011;26:175-179.*
6. *Silva Junior JM, Neves EF, Santana TC, et al. The importance of intraoperative hyperchloremia. Rev Bras Anestesiol 2009;59:304-313.*
7. *Young JB, Utter GH, Schermer CR, et al. Saline versus Plasma-Lyte A in initial resuscitation of trauma patients: a randomized trial. Ann Surg 2014;259:255-262.*
8. *Prough DS, Bidani A. Hyperchloremic metabolic acidosis is a predictable consequence of intraoperative infusion of 0.9% saline. Anesthesiology 1999;90:1247-1249.*
9. *Denkhaus M, Van Amstel S. Adverse effects following intravenous fluid therapy in the horse using non-commercial fluids: preliminary findings. J S Afr Vet Assoc 1986;57:105-107.*
10. *Magnusson CB, Poulsen KP, Budde JA, et al. Quality Control of Compounded Crystalloid Fluids for Intravenous Delivery to Horses. J Vet Intern Med 2018;32:469-473.*
11. *Kopper JJ, Bolger ME, Kogan CJ, Schott HC. Outcome and complications in horses administered sterile or non-sterile fluids intravenously. J Vet Intern Med. 2019;33:2739-2745.*
12. *Lester GD, Merritt AM, Kuck HV, et al. Systemic, renal, and colonic effects of intravenous and enteral rehydration in horses. J Vet Intern Med 2013;27:554-566.*
13. *Marlin DJ, Scott CM, Mills PC, et al. Rehydration following exercise: effects of administration of water versus an isotonic oral rehydration solution (ORS). Vet J 1998;156:41-49.*
14. *Khan A, Hallowell GD, Underwood C, van Eps AW. Continuous fluid infusion per rectum compared with intravenous and nasogastric fluid administration in horses. Equine Vet J. 2019;51:767-773.*

11004

TREATING COLIC IN THE FIELD

EQUINE PROGRAM | DIAGNOSTIC AND TREATMENT STRATEGIES

Jamie Kopper, DVM, PhD, DACVIM-LAIM, DACVECC-LA

Medical treatment of colic involves taking into consideration several possible treatment modalities including analgesia, fluid therapy, nutrition and tactics to improve hydration of intestinal contents and improve intestinal motility.

Analgesia: Analgesia can be multi-modal and include a non-steroidal anti-inflammatory drugs (commonly flunixin meglumine, phenylbutazone or firocoxib), alpha-2 agonist (i.e., xylazine or detomidine), opioid (i.e., butorphanol or morphine) and in some instances an NMDA receptor antagonist (i.e., Ketamine). Whenever reaching for more than one dose of detomidine or butorphanol to facilitate pain control or Ketamine, I ask myself if I think that I am masking pain associated with a surgical lesion, carefully reassess the patient and discuss options with the owner. Table 1 provides doses and routes for these medications. For horses with colic, I try to avoid oral administration when possible as the functionality of the intestinal tract is in question.

TABLE 1 – ANALGESICS FOR TREATMENT OF COLIC

NSAIDS			
Drug	**Dose**	**Route(s)**	**Frequency or Duration of action**
Flunixin meglumine	1.1 mg/kg	IV, PO	Q12h
Phenylbutazone	2.2-4.4 mg/kg	IV, PO	Q12-24h
Firocoxib	0.27 mg/kg loading dose, then 0.09 mg/kg	IV, PO	Q24h
OPIOIDS			
Butorphanol	0.01-0.04 mg/kg	IV, IM, SQ	Typically lasts 20-30 minutes with IV dosing, likely prolonged with IM and SQ routes
Morphine	0.1 mg/kg	IV, IM	Typically lasts 1-4 hours
ALPHA 2 AGONISTS			
Xylazine	0.2-1 mg/kg	IV, IM	Typically lasts 20-30 minutes
Detomidine	0.01-0.02	IV, IM, Sublingual	Typically lasts 1 hour
NMDA ANTAGONIST			
Ketamine	0.1-0.5 mg/kg	IM	Q6h

Fluid Therapy: Fluid therapy is important for several reasons. First, many horses with colic have some degree of dehydration that is primary or secondary to their colic. Second, hydrating intestinal contents helps improve motility and, if an impaction is present, can help soften it to ease movement through the intestinal tract. Fluid therapy can be accomplished enterally (i.e., nasogastric fluids), rectally or intravenously. For horses that are producing gastric reflux and/or hypovolemic intravenous fluids are the route of choice. For many horses this initiates referral to a hospital where administration is more practical than in the field. Enteral fluids can be accomplished as intermittent boluses (4-10L for a 500 kg horse). In a normal horse, fluids administered via nasogastric tube should pass from the stomach in ~ 30 minutes. Many horses with colic do not have normal intestinal motility, but for some it is feasible to give 1-3 nasogastric boluses during the initial visit. Additionally, depending on the owner and farm set up, a small-bore nasogastric tube can be left in dwelling for continual enteral fluid administration. Rectal fluids are another option – horses can receive up to 5 ml/kg/hour and plain water (no electrolytes) are best tolerated. These are often set up by passing a mare or stallion urinary catheter per rectum that is attached to an old STAT IV set (non-sterile) and attached to a 5-gallon carboy or previously used IV fluid bags that you have filled with plain non-sterile water. This is discussed in detail elsewhere in this conference.

Nutrition: Many horses with colic will be held off feed during their initial treatment to decrease additional bulk that is added to a potential impaction which is entirely appropriate. For patients at risk for hyperlipidemia (i.e., ponies, donkeys, mules, obese horses), it is worth considering being more proactive about their nutritional intake, as hyperlipemia can occur in as short periods of fasting (i.e., 24 hours). For these animals, I will consider adding a powdered caloric support (such as Purina Wellgel®) to their enteral fluids per label dosing, dextrose to their fluids (if tolerated based on blood glucose level) or small amounts of easy to digest low bulk feed (i.e., green grass or soaked senior pellets). Grass is 80-90% water, thus when possible, can make a nice early feeding substrate as it is also palatable to most horses.

Improving Intestinal Motility: Many horses with colic that can be treated medically have decreased intestinal motility. There are several aspects of the aforementioned treatments that we can use to our advantage when treating patients including:

1. Gastrocolic reflex – In all animals, when the stomach fills it stimulates the colon to contract. Thus, when they are tolerated by administering enteral fluids this is also improving intestinal motility.

2. Early enteral nutrition – When tolerated, small frequent low-bulk meals can be advantageous to both improve enterocyte health as well as stimulate intestinal motility. I generally consider the following principles when deciding on early enteral feeding:

    a. Never give more than you can easily "recall" via a nasogastric tube if feeding fails

    b. If it can introduce water into the horse's intestinal tract even better (i.e., grass, soaked feed etc.)

    c. Assume that the intestinal tract is not working at 100% capacity, feed accordingly (i.e., small frequent meals) and gradually increase the amount as the horse "proves itself".

3. Analgesia – while many of the medications we consider for horses with colic decrease motility in normal horses (i.e., alpha-2 receptor agonists, opioids, N-butylscopolammonium bromide) pain also decreases intestinal motility. Thus, use the medications that you need to control pain and constantly question whether the next dose is needed rather than routinely scheduling it.

Encouraging water consumption: Once your nasogastric tube has been removed, encouraging continued water consumption can be a challenge. One simple yet practical way of encouraging horses to drink is to provide them with a salt slurry containing table salt (0.5 g/kg of regular table salt) up to every 6 hours (1). Although commercial electrolyte pastes can be purchased, they frequently have a larger amount of sugar, less salt and are more expensive than using simple table salt purchased from your regular grocery store. If hypokalemia is a concern in a horse that has been off feed for several days, "lite" table salt (marketed for people with hypertension) can be substituted in part as it is 50% KCl and 50% NaCl, thus providing potassium to the diet as well. Additionally, many owners like to offer their horses flavored water buckets.

Each horse is individual – and while this can be effective in some horses, for many it is not (2). Thus, it is important to always have clean regular water available, as some horses will actively avoid the flavored options.

Percutaneous (cecal) trocharization: In horses that are markedly gas distended, especially on the right, upon transrectal palpation this can be a helpful technique to reduce gas distention and thus improve pain giving medical management a better chance at being successful. After adequate sedation, auscultation or percussion of the paralumbar fossa area will identify an area of gas accumulation. The skin should be clipped and asceptically prepared followed by instilling 3-5 mL of local anesthetic (this can be performed aseptically or followed by a final aseptic preparation). A 14 ga 5.25 intravenous catheter attached to a 30 inch extension set, is then inserted with confidence through the local anesthetic and into the cecum (tentative insertion may "push" the cecum away rather than puncture it). The end of the 30 inch extension set is then placed into a small cup of water – as long as the water us bubbling the catheter is seated into the cecum and releasing gas. If the gas bubbles slow or stop the catheter may be advanced (the cecum may pull away from the catheter as it deflates) or removed. Some users instill several mL of an aminoglycoside as they remove the catheter through the body wall due to possible fecal contamination and risk of a local cellulitis or abscess formation. This procedure is rarely performed on the left side of the horse due to the presence of the spleen.

REFERENCES:

1. *Schott HC 2nd, Axiak SM, Woody KA, Eberhart SW. Effect of oral administration of electrolyte pastes on rehydration of horses. Am J Vet Res. 2002 Jan;63(1):19-27. doi: 10.2460/ajvr.2002.63.19. PMID: 16206775.*
2. *Van Diest TJ, Kogan CJ, Kopper JJ. The Effect of Water Flavor on Voluntary Water Intake in Hospitalized Horses. J Equine Vet Sci. 2021 Mar;98:103361. doi: 10.1016/j.jevs.2020.103361. Epub 2020 Dec 24. PMID: 33663710.*
3. *Schroeder EL, Gardner AK, Mudge MC. How to perform a percutaneous cecal or colonic trocarization in horses with severe abdominal tympany. J Vet Emerg Crit Care (San Antonio). 2022 Jan;32(S1):57-62. doi: 10.1111/vec.13123. PMID: 35044068.*

11005

MANAGEMENT OF THE POST-OPERATIVE COLIC PATIENT

EQUINE PROGRAM | DIAGNOSTIC AND TREATMENT STRATEGIES

Jamie Kopper, DVM, PhD, DACVIM-LAIM, DACVECC-LA

Understanding principle of managing the post operative colic patient is important, even if you are not at a practice that routinely performs exploratory celiotomies. First, your clients often have a better relationship with you than with referral centers and thus will rely on you for reassurances guidance and second, with changes in economic pressures patients that have undergone an exploratory celiotomy may be discharged for continued care at home sooner than desirable for cost savings. Finally, the majority of incisional infection management is done on farm rather than at the referral hospital.

We will discuss several considerations for the post operative colic patient including: analgesia, fluid balance, antimicrobials and nutrition followed two common post operative complications: ileus and incisional infections.

ANALGESIA

My approach to analgesia is to ensure that we are providing the horse with adequate pain control without taking unnecessary risks due to undesirable side-effect profiles. Unlike small animal medicine, the use of non-steroidal anti-inflammatory drugs (NSAIDs) remains pivotal in the management of horses immediately following an exploratory celiotomy. Although firocoxib has been explored as an alternative to flunixin meglumine due to it's potentially lower side-effect profile, it's use is currently limited due to the lack of injectable options. If employed, it is important to recall that it requires a 0.27 mg/kg loading dose otherwise it takes approximately 5 days to reach steady-state therapeutic concentrations. A continuous rate infusion of lidocaine (1.3 mg/kg loading dose followed by 0.05 mg/kg/min) can make a nice adjunctive analgesic and in one study helped reduce the adverse effects of flunixin meglumine on mucosal healing in horses with jejunojejunostomies. If the patient develops post operative colic that is refractory to NSAIDs and a lidocaine CRI, additional analgesia can be considered including a butorphanol continuous rate infusion (18 µg/kg bolus followed by 13-24 µg/kg/hour). Although opioids are often avoided due to the concern for ileus, in the author's opinion while this may be true pain also causes ileus, so it becomes a moot point in the painful post operative patient. If further analgesia is required, a repeat exploratory celiotomy should be strongly considered. Analgesia is often continued for 3-5 days post operatively depending on the patient, procedure and if post operative complications were encountered. If the patient is taking medications by mouth, acetaminophen can also be considered as an adjunctive analgesic at 30 mg/kg PO q12h.

FLUID BALANCE

Fluid therapy is discussed in detail elsewhere. However, a there are a few considerations for the post operative patient. In general, if the patient is eating and not having significant losses (i.e., reflux, diarrhea) they can drink. Thus, intravenous fluids may be indicated in the immediate post operative patient for some cases, many can be discontinued within 12-24 hours unless ileus develops. Special attention should be paid to sodium levels in patient with profound gastric reflux and requiring large volumes of intravenous fluids, as it is important to remember that all 3 and 5 L bags of commercial intravenous fluids are replacement formulas,

not maintenance formulas and thus relatively sodium rich. Similarly, in patients that remain off feed for an extended period of time serum potassium should be noted, as the majority of potassium is stored intra-cellularly, meaning that by the time the serum potassium is low the patient is whole body depleted.

ANTIMICROBIALS

As a profession, and particularly with post operative patients we are getting better at being more restrictive with our antimicrobial use. In general, for most patients, three days of broad spectrum prophylactic coverage was not found to be inferior to 5 days and subsequently many individuals are reducing their antimicrobial use accordingly. Similarly, if an enterotomy or resection was not performed many people are further restricting their anti-microbial use to 24 hours. In addition to good antimicrobial stewardship, this also reduces the use of nephrotoxic medications (i.e., aminoglycosides) in a patient that is already at risk for acquiring an acute kidney injury. In the author's opinion, if aminoglycosides are to be continued for greater than 3 days, a renal profile or urine specific gravity should be assessed to help monitor renal function.

NUTRITION

Similarly, as a profession we are moving towards starting earlier enteral nutrition in patients after an exploratory celiotomy. In the author's hands most horses will start back on some form of nutrition (even if small volume and low bulk) within 12 hours of recovery from general anesthesia. Enterocytes benefit from nutrition to heal and they best receive this nutrition via absorption from the lumen (i.e., feeding) versus parenterally. Horses that had an uncomplicated large colon disease (i.e., large colon displacement, large colon impaction) are frequently fed back quicker than those with small intestinal or small colon disease. For horses with small intestinal disease, while the author is proactive in refeeding them she similarly anticipates some degree of intestinal ileus, so the refeeding plan is more gradual with small frequent meals particularly for the first 72 hours. Additionally, there is anticipation that whatever was fed may need to be removed via nasogastric intubation if clinically significant ileus results. In rare instances there have been reports of impactions of the anastomosis. Similarly, although ileus is rarely a complication of small colon impactions they are at higher risk of re-impaction in the immediate post operative (3-5 days) periods. Thus, a low bulk diet (grass, complete feed pellets) may help reduce the risk until the associated edema and swelling of the small colon has resolved.

POST OPERATIVE ILEUS (POI)

Post operative ileus is the nightmare of post operative colic management, as it can be costly to manage with no definitive treatment and may result in the need for a repeat exploratory celiotomy. Post operative ileus most commonly develops in patients that underwent a small intestinal resection and anastomosis or otherwise had an inflammatory lesion of the small intestine. Intra-operatively, POI is limited by limited tissue handling and good anastomotic technique. Post operatively, POI may be improved by the use of a lidocaine continuous rate infusion to limit neutrophil migration and thus promote intestinal homeostasis (of note, lidocaine is not a true prokinetic) however these results have not been uniformly accepted. I often explain to clients that I expect all horses with small intestinal disease to have some degree of ileus, thus we refeed them gradually because if you are working at 25% capacity and we give you 100% of your work to do (i.e., feed) you will fail (i.e., develop clinical post operative reflux) but perhaps if we only give you 25% of your daily feed you will pass for the day. Post operative reflux is most challenging to manage because for every liter of fluid loss via the nasogastric tube it must be replaced intravenously in addition to the horse's maintenance requirements. Given that a standard 500 kg horse makes 80-100 L of saliva and gastric secretions per day, which are meant to travel aborally – this is why horses may reflux upwards of 80-100 L per day and require that volume in fluid replacement. This is both costly to treat as well as physically challenging to meet the demands of when it persists. In general, if POI is persisting at high volumes for > 72 hours and/or is accompanied by signs of colic the author will frequently speak to the clients about the feasibility of a repeat exploratory celiotomy. Sometimes, after recovery a mesenteric vessel thrombosed leading to anastomotic failure or there is another functional problem with the anastomosis. In other horses, physically decompressing the intestine seems to reset the motility and they recover without incidence. Metaclopramide can be considered as a true prokinetic agent as well in horses

with POI, although recent pharmacokinetic data suggests that it should be given as a continuous rate infusion (2). Of note, some horses develop extra-pyramidal side effects and can develop aggressive and dangerous behavior that resolves with cessation of the medication.

INCISIONAL INFECTIONS

Depending on the surgical center, there is a reported 10-50% incisional infection rate in horses that have undergone an exploratory celiotomy. Risk factors are numerous and vary between studies but in general horses undergoing a repeat exploratory celiotomy are at the highest risk. Other potential risk factors include duration of general anesthesia, undergoing a large colon resection and/or a pelvic flexure enterotomy. The first clinical signs of an incisional infection are often a low-grade fever followed by incisional drainage. Unfortunately, until the suture has fully dissolved (which we do not want to expedite, as it is also what prevents development of a hernia or catastrophic incisional breakdown) the infection is unlikely to full resolve as there is foreign material present. Thus, treatment is frequently local but may employ the use of systemic antimicrobials to decrease the severity of the infection to prevent early suture break down. Local treatment often includes establishing drainage if needed (i.e., removing a stable or skin suture depending on the closure utilized), local treatment (such as medical grade honey, lavage with dilute betadine, topical antimicrobials) and use of an abdominal compression bandage to try and reduce the risk of hernia formation. Incisional cultures may be obtained to help guide antimicrobial selection if deemed necessary and often produce organisms with multi-drug resistance profiles. Often, horses that develop incisional infections will need to remain on stall rest until drainage stops before carrying on with the rest of their prescribed rest/turn out program. This is done to reduce the strain on the incision and thus hopefully reduce the risk of hernia formation.

REFERENCES

1. *Cook VL, Jones Shults J, McDowell M, Campbell NB, Davis JL, Blikslager AT. Attenuation of ischaemic injury in the equine jejunum by administration of systemic lidocaine. Equine Vet J. 2008 Jun;40(4):353-7. doi: 10.2746/042516408X293574. PMID: 18321812.*
2. *Brandon AM, Williams JM, Davis JL, Martin EG, Capper AM, Crabtree NE. Evaluation of pharmacokinetics of metoclopramide administered via subcutaneous bolus and intravenous constant rate infusion to adult horses. Vet Surg. 2024 Aug;53(6):1111-1122. doi: 10.1111/vsu.14128. Epub 2024 Jun 24. PMID: 38925540.*

12001

OVERVIEW OF ORTHOBIOLOGICS IN THE HORSE

EQUINE PROGRAM | ORTHOBIOLOGICS & SPORTS MEDICINE

Kyla Ortved, DVM, PhD, DACVS, DACVSMR

PennVet New Bolton Center
University of Pennsylvania

Overview of Orthobiologics in the Horse

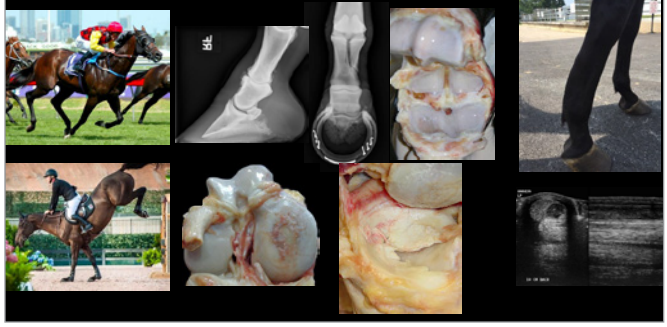
Kyla Ortved, DVM, PhD, DACVS, DACVSMR
Associate Professor of Large Animal Surgery
New Bolton Center, University of Pennsylvania

1

Horses are elite athletes prone to injury

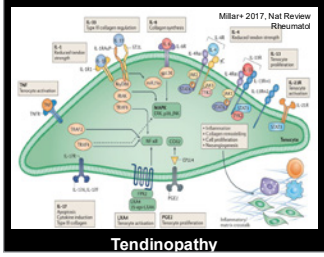
2

Musculoskeletal injuries heal poorly



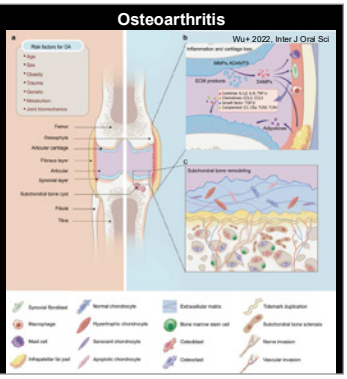
3

Inflammatory pathways drive degeneration & limit healing



Tendinopathy

Osteoarthritis



4

Goal of Regenerative Medicine

- Immunomodulation + decreased inflammatory response
- Improve quality of repair tissue
- Decrease re-injury rates

Does not decrease need for appropriate rehabilitation or speed return to high intensity work

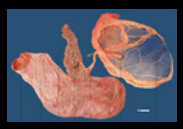
5

Orthobiologics

Stem Cells

Exosomes

Amnion

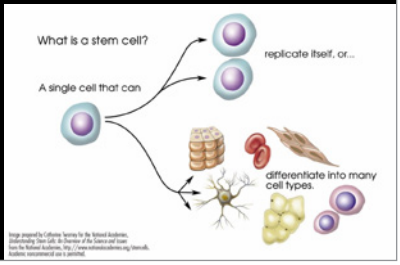


Autologous Blood Products
Platelet-rich plasma (PRP)
Autologous conditioned serum (ACS)
Autologous protein solution (APS)
Alpha-2-macroglobulin (A2M)

6

Stem Cell Therapy

- Undifferentiated cell that has 2 properties:
  1) Self-renewal
  2) Potency

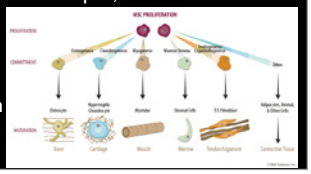


7

Stem Cell Potency

- **Pluripotent:** can differentiate into any of the 3 germ layers (endoderm, mesoderm, ectoderm)
  - Embryonic stem cells (ESC)
  - Induced pluripotent stem cells (iPSC)
- **Multipotent:** can differentiate into multiple, but limited cell types
  - Hematopoietic
  - Mesenchymal

MSC Differentiation



8

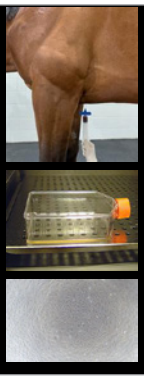
How do MSCs work?

Immunomodulatory + inhibition of pro-inflammatory pathways

- Home to areas of inflammation
- Paracrine effects
- Effects increased in inflamed environments

Recruit endogenous progenitor cells

Promote tissue repair

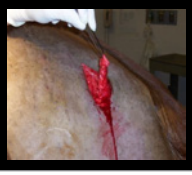
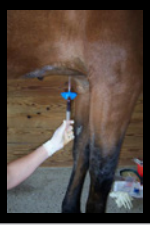


9

Mesenchymal Stem Cells (MSCs)

Adult

- Bone marrow
- Adipose

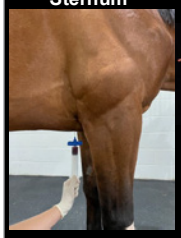
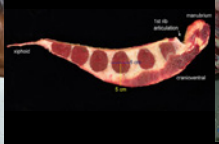
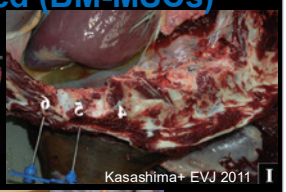
Fetal

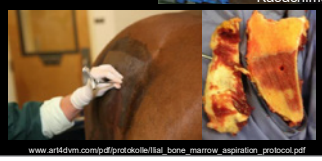
- Umbilical cord blood / tissue
- Amniotic membrane

10

Bone Marrow-derived (BM-MSCs)

Sternum



Tuber Coxae

www.art4dvm.com/pdf/protokolle/lilial_bone_marrow_aspiration_protocol.pdf

11

MSC Processing

Density Centrifugation

- Bone marrow aspirate concentrate (BMAC)
- Adipose-derived stromal vascular fraction (AD-SVF)



Culture Expansion

2-4 week culture period

- Exponential increase in cell number
- Cells can be primed to enhance properties

12

Materials Needed for Bone Marrow Aspiration

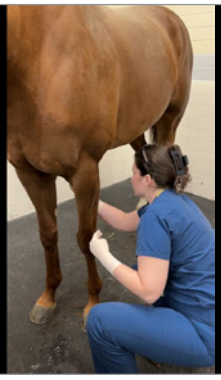
Sedation and **local anesthetic**

60ml syringe

Anticoagulant
Heparin
ACD

Jamshidi bone marrow biopsy needle

13

14

MSCs for Soft Tissue Injuries

Mainly ultrasound-guided intralesional injections

Fewer studies have demonstrated homing of MSCs to sites of injury following RLP
(Sole+ EVJ 2013; Becerra+ JOR 2013)

Several studies show improved outcomes + reduced re-injury rates using BM-MSCs
(Godwin+ EVJ 2012; Smith+ PLoS One 2013; Salz+ EVJ 2023)

AD-MSCs have less promising results
(Romero+ Vet J 2017; Salz+ EVJ 2023)

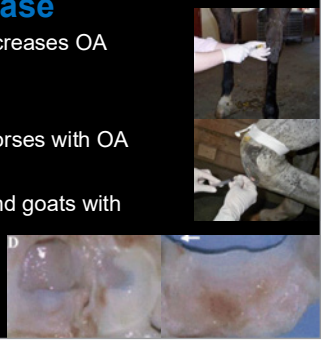
15

MSCs for Joint Disease

Improves cartilage healing + decreases OA progression
(McIlwraith+ Arthroscopy 2011; Delco+ AJSM 2020)

Improves clinical outcomes in horses with OA
(Magri+ PLoS One 2019; Luque+ EVJ 2025)

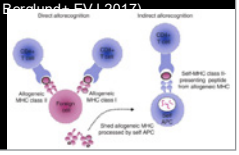
Improves outcomes in horses and goats with meniscal injury
(Ferris+ Vet Surg 2014; Murphy+ Arthritis Rheum 2003)



16

Allogeneic Stem Cells

- Available “off-the-shelf”
- Can be standardized + manipulated to improve therapeutic qualities
- Stem cells are not immune-privileged
- Allogeneic cells can elicit host immune response leading to cell death (Pezzanite+ Stem Cell Res Ther 2015; Berglund+ EVJ 2017)
- Increased response with subsequent injections



Whitelegg+ Tissue Antigens 2004

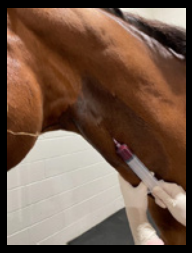
17

Allogeneic Stem Cells

18

Autologous Blood Products

Platelet rich plasma (PRP)
Autologous conditioned serum (ACS)
Autologous protein solution(APS)
Alpha-2-macroglobulin (A2M)



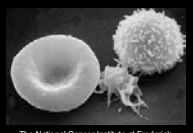
19

Platelet Rich Plasma (PRP)

Any volume of plasma with a platelet count above that of whole blood

Platelets contain high concentration of growth factors
- **PDGF**, **TGF-β**, FGF, VEGF, EGF

Promotes healing by:
- Cell migration, proliferation, differentiation
- Matrix synthesis
- Angiogenesis



The National Cancer Institute at Frederick

20

Many different systems with variable platelet & WBC concentrations

21

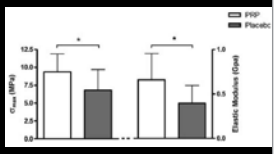
Leukocytes in PRP

- Leukocyte-poor or reduced vs. leukocyte-rich
- Conflicting evidence on which is superior
- Leukocyte-poor may be better for acutely injured joints
- Leukocyte-rich may have better pain relief effects

22

PRP for Soft Tissue Injuries

Improved histologic + biomechanical properties in experimentally induced SDFT lesions
(Bosch+ JOR 2010)



Earlier lameness reduction, improved ultrasonographic appearance, improved return to performance in PRP treated naturally-occurring SDFT lesions compared to saline
(Geburek+ BMC Vet Res 2016)

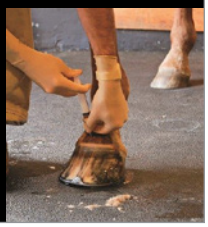
23

PRP for Joint Disease

Patient-side use for acute joint injuries

Safe for injection into equine joints
(Textor+ Vet J 2013)

Improves lameness scores in horses with fetlock arthritis
(Broeckx+ Stem Cells Dev 2014)



24

EVIDENCE REVIEW

Equine Veterinary Journal WILEY

A systematic review and meta-analysis of the efficacy of platelet-rich plasma products for treatment of equine joint disease

Cong Peng[1] | Luo Yang[1] | Raphael Labens[2] | Yu Gao[3] | Yiping Zhu[1] | Jing Li[1,4]

2023

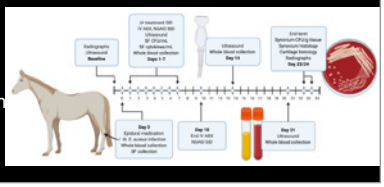
- PRISMA guidelines with randomised controlled trials, non-randomised trials and controlled laboratory studies included
- 21 publications in the systematic review; 5 included in the meta-analysis.
- Significant improvement with PRP treatment (OR: 15.32;95% CI: 3.00–78.15; $p < 0.05$)
- Significant improvement in clinical performance (OR: 36.64; 95% CI: 3.69–364.30; $p < 0.05$)

25

frontiers | Frontiers in Cellular and Infection Microbiology

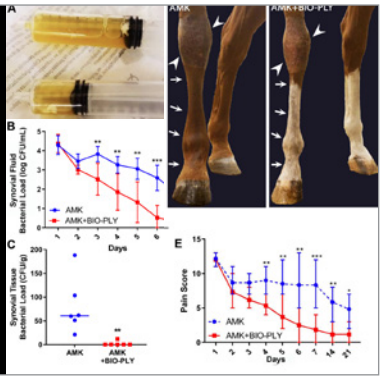
A Platelet-Rich Plasma-Derived Biologic Clears *Staphylococcus aureus* Biofilms While Mitigating Cartilage Degeneration and Joint Inflammation in a Clinically Relevant Large Animal Infectious Arthritis Model

Staph aureus infection treated with amikacin (AMK) or AMK + **BIO**active fraction of **P**latelet-rich plasma **LY**sate (BIO-PLY)



26

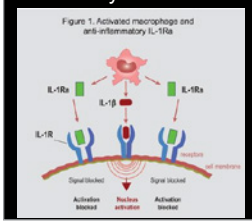
- AMK+BIO-PLY decreased bacterial concentrations
- 5/6 horses treated with AMK+BIO-PLY had complete bacterial clearance
- AMK+BIO-PLY had decreased pain scores



27

Autologous Conditioned Serum (ACS)

- Whole blood processed with WBCs releasing cytokines
- Serum-based product that contains increased IL-1Ra and other cytokines



28

ACS for Soft Tissue Injuries

Limited evidence in soft tissue injuries

Improved ultrasonographic appearance + histologic tissue organization following single ACS injection in horses with naturally-occurring tendinopathies
(Geburek+ Stem Cell Res Ther 2015)

Improved clinical outcomes in horses with naturally-occurring SDFT, DDFT, SL injuries
(Tomassa+ Open Vet J 2025)

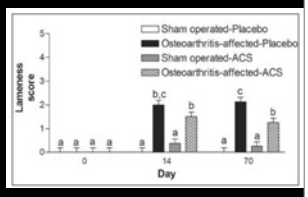
29

ACS for Joint Disease

ACS improves lameness in horses with induced carpal OA
(Frisbie+ AJVR 2007)

IA injection every 7 days for 4 treatments

Limited clinical evidence



30

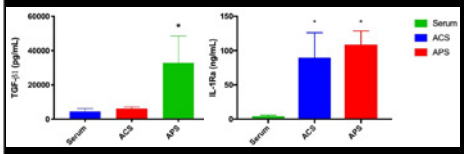
Autologous Protein Solution (Pro-Stride®)

Two-step patient-side centrifugation

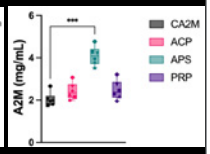
- 1) Separator that concentrates WBCs and platelets
- 2) Concentrator that activates WBCs
- Yields small volume (3mL from 60mL blood)

31

- Contains increased anti-inflammatory cytokines + growth factors
  - IL-1Ra, sTNFR
  - TGF-β1
  - A2M

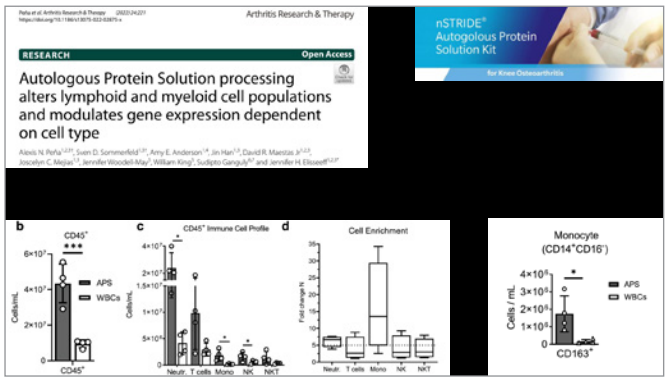


Linardi+ Front Vet Sci 2019; Barot+



Barot+ AJVR 2025

32

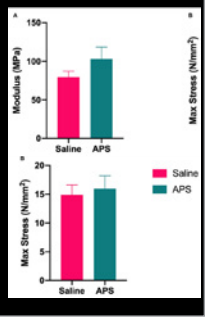


33

APS for Soft Tissue Injuries

Limited evidence in the horse

Improved biomechanical properties in experimentally-induced SDFT lesions
(Gaesser+ Front Vet Sci 2021)

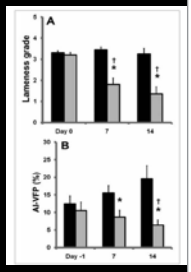


34

APS for Joint Disease

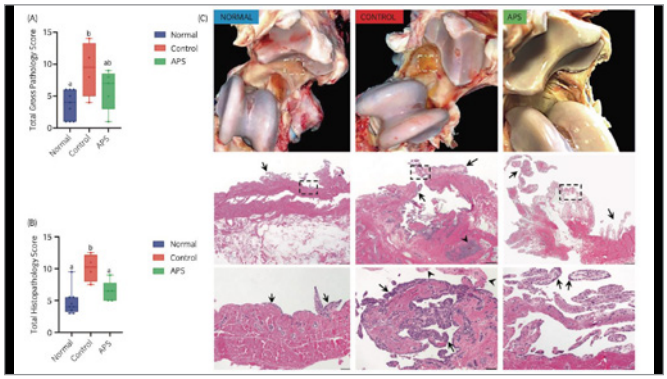
Improved lameness scores in horses with osteoarthritis following single injection

Improved gross + histologic appearance following single injection in horses with induced TCJ synovitis
(Usimaki+ EVJ 2025)



Bertone+ AJVR 2014

35



36

AJVR | AVMA

Single-dose nonsteroidal anti-inflammatory drugs in horses have no impact on concentrations of cytokines or growth factors in autologous protein solution and platelet-rich plasma 2024

Kara A. Brown, VMD, DACVSMR[1]; Elizabeth N. Gregorio, BA[1]; Dhvani Barot, BVSc[1]; Alexandra Usimaki, DVM[1]; Renata L. Linardi, DVM, PhD[2]; Jaclyn R. Missanelli, BS[2]; Youwen You, PhD[2]; Mary A. Robinson, VMD, PhD, DACVP[1]; Kyla F. Ortved, DVM, PhD, DACVS, DACVSMR[1]

AJVR | AVMA

Prolonged administration of oral phenylbutazone and firocoxib in horses has no impact on selected cytokine and growth factor concentrations in platelet-rich plasma and autologous protein solution 2024

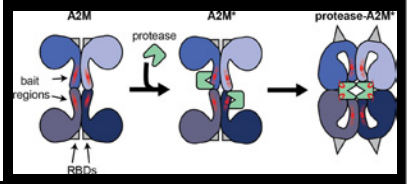
Kara A. Brown, VMD, DACVSMR[1]*; Elizabeth N. Gregorio, BA[1]; Dhvani Barot, BVSc[1]; Alexandra Usimaki, DVM[1]; Renata L. Linardi, DVM, PhD[2]; Jaclyn R. Missanelli, BS[2]; Youwen You, PhD[2]; Mary A. Robinson, VMD, PhD, DACVP[1]; Kyla F. Ortved, DVM, PhD, DACVS, DACVSMR[1]

No effect of IV administration of xylazine or detomidine 5 minutes before blood collection

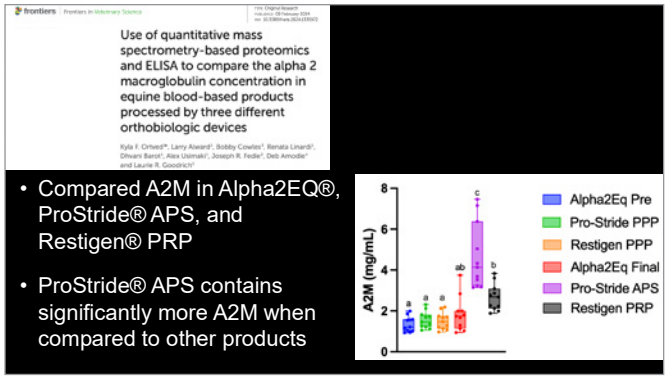
37

Alpha-2-macroglobulin (A2M)

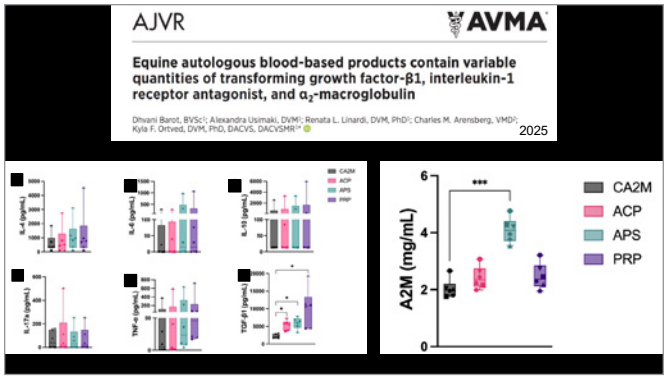
- Protease inhibitor
- Activity against collagenases & aggrecanases



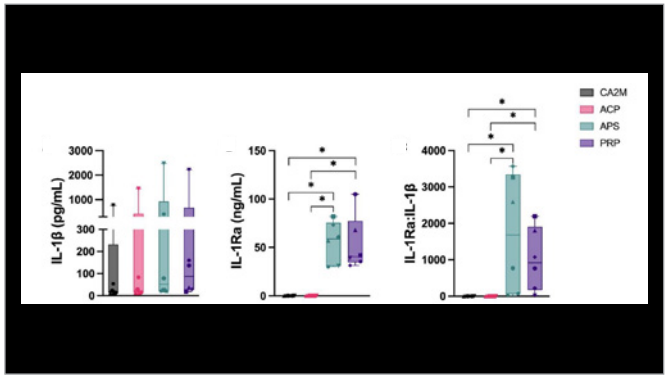
38



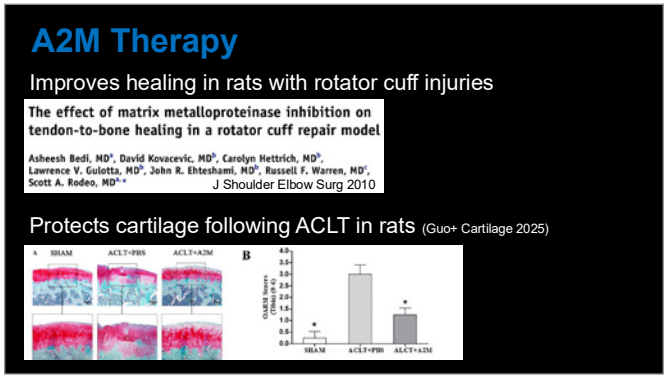
39



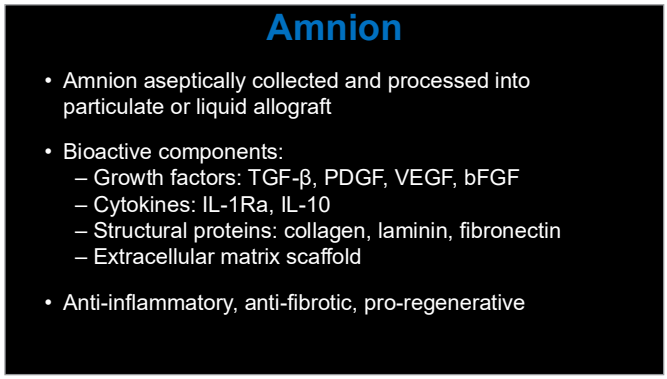
40



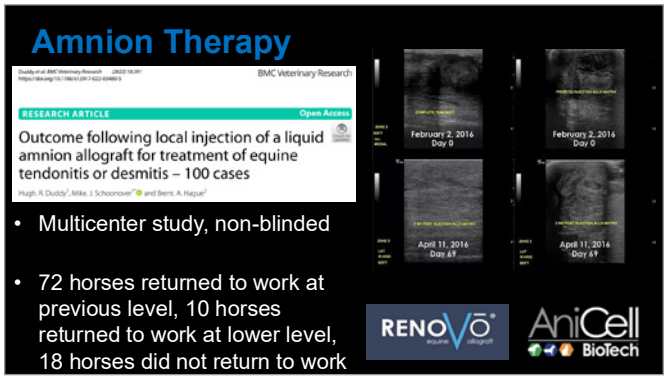
41



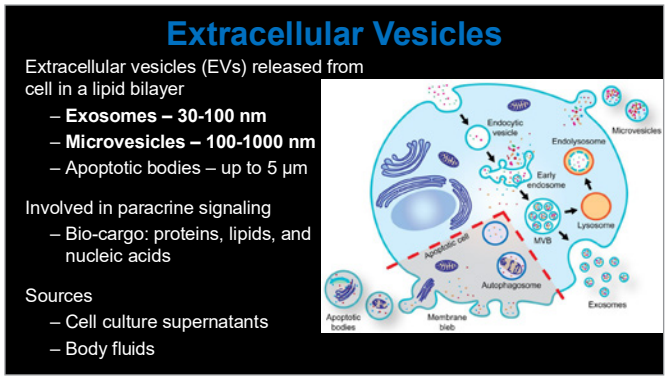
42



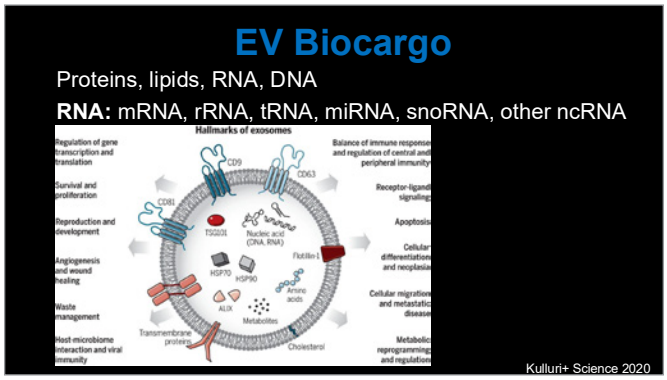
43



44



45

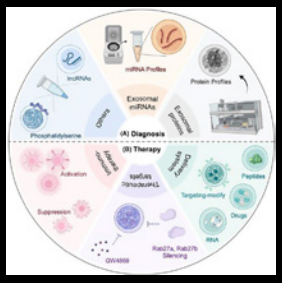


46

Extracellular Vesicles

Diagnostic potential
- Biomarkers of disease

Therapeutic potential
- Immunomodulation
- Tissue regeneration
- Immunotherapy
- Delivery systems



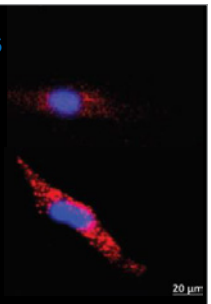
47

EVs for Soft Tissue Injuries

In vitro evidence only in the horse

Equine Amniotic Microvesicles and Their Anti-Inflammatory Potential in a Tenocyte Model In Vitro

Recent systematic review in Achilles tendon injury in small animal models suggest EV efficacy
(Kasula+ Biomedicines 2024)

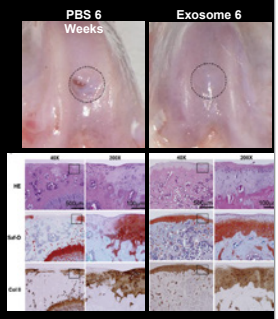


48

EVs for Joint Disease

MSC-EVs inhibit adverse effects of inflammation on chondrocytes *in vitro*
(Vonk+ Theranostics 2018)

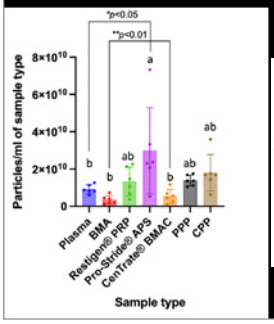
MCS-EVs promote cartilage regeneration in rats
(Zhang+ Osteoarthr Cartil 2016)

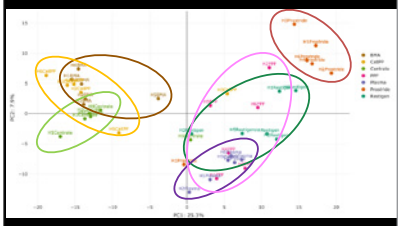


Zhang+ Osteoarthr Cartil 2016

49

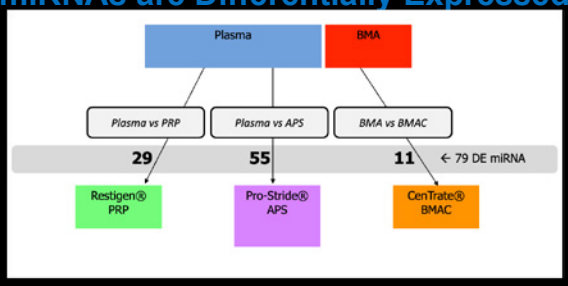
EVs in Orthobiologics





50

miRNAs are Differentially Expressed



Upregulation of anti-inflammatory + regenerative miRNAs in PRP and APS

51

Commercial Products

hilltop bio

No published studies

52

Summary

- Many orthobiologics available
- Current pre-clinical and clinical data is promising especially in naturally-occurring disease
- Need for more randomized, placebo-controlled, double-blind clinical trials
- Avoid commercial products with no peer-reviewed studies

53

54

12002

STATE-OF-THE-ART IN REGENERATIVE MEDICINE FOR SOFT TISSUE DISORDERS

EQUINE PROGRAM | **ORTHOBIOLOGICS & SPORTS MEDICINE**

Kyla Ortved, DVM, PhD, DACVS, DACVSMR

PennVet New Bolton Center
University of Pennsylvania

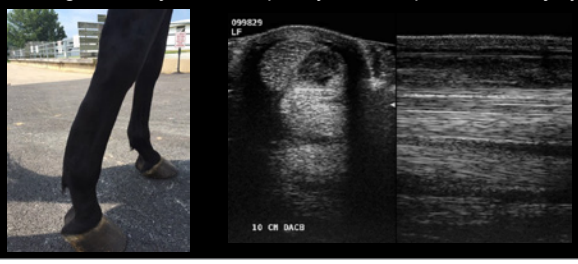
State-of-the-Art in Regenerative Medicine for Soft Tissue Disorders

Kyla Ortved, DVM, PhD, DACVS, DACVSMR
Associate Professor of Large Animal Surgery
New Bolton Center, University of Pennsylvania

1

Why do we need musculoskeletal regenerative medicine?

Tendon & ligament injuries heal poorly and are prone to re-injury



2

Goal of Regenerative Medicine

- Immunomodulation + decreased inflammatory response
- Improve quality of repair tissue
- Decrease re-injury rates

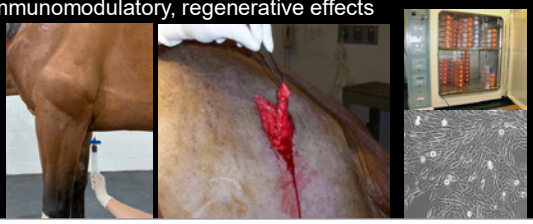
Does not decrease need for appropriate rehabilitation or speed return to high intensity work

3

Mesenchymal Stem Cells (MSC)

- Most studies support bone marrow-derived MSCs over adipose-derived
- Early studies of umbilical cord-derived MSCs
- Immunomodulatory, regenerative effects

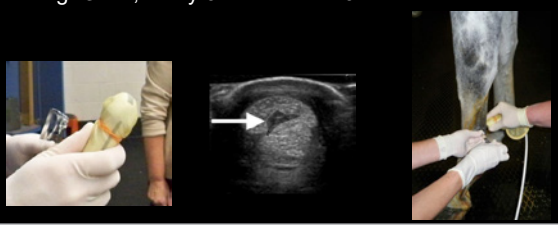
eQcell



4

Intra-lesional Injections

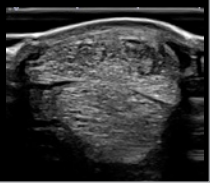
- Intralesional injection under ultrasound guidance
- Dose: 10-50 million cells
- Dosing: Once; every 3-4 weeks for 3-4 treatments



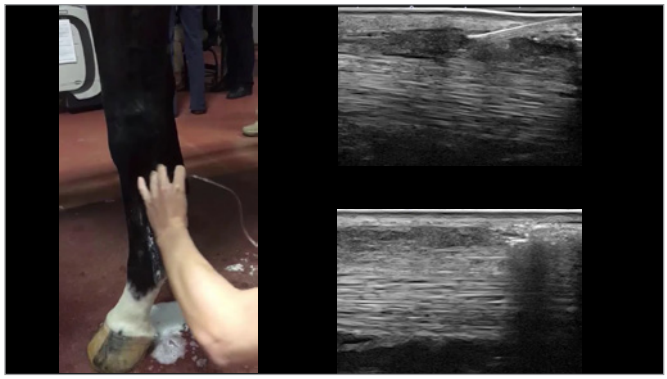
5

Ultrasound-guided Intralesional Injections

- Sterile prep on limb, sterile glove on ultrasound probe
- Local block
- 20-23g needle to minimize damage to tendon + cells
- Needle parallel to probe + within plane of ultrasound beam
- Watch needle enter lesion
- "Fill" core lesions, don't "overfill"
  - Diffusion vs. multiple sites of injection
- +/- NSAIDs

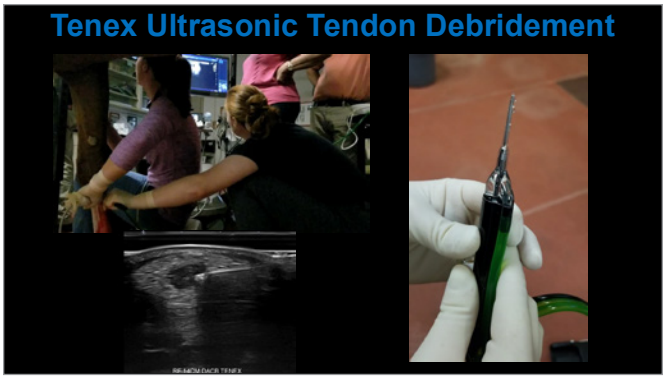


6



7

Tenex Ultrasonic Tendon Debridement



8

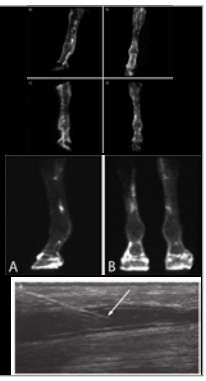
Regional Limb Perfusion

Good MSC migration with IV or IA perfusion under GA
(Sole+ EVJ 2012)

Limited MSC migration with IV perfusion in normal standing horses
(Spriet+ Vet Surg 2015)

Intra-arterial MSC injection of allogeneic cells in standing horse (Espinosa+ Vet Surg 2016)

- Good distribution but some venous thrombosis

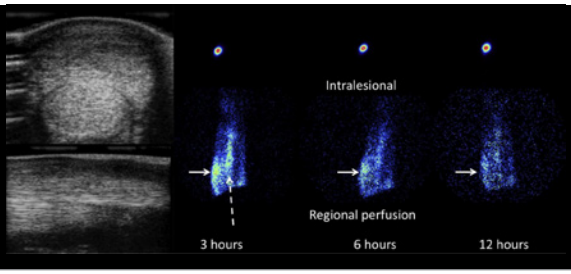


9

Distribution of Injected Technetium^{99m}-Labeled Mesenchymal Stem Cells in Horses with Naturally Occurring Tendinopathy

Patricia Becerra,[1] Miguel A. Valdés Vázquez,[1] Jayesh Dudhia,[2] Andrew R. Fiske-Jackson,[2] Francisco Neves,[1] Neil G. Hartman,[3] Roger K.W. Smith[2]

JOR 2013



10

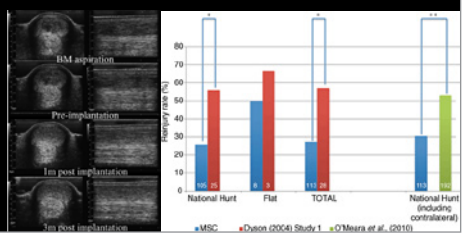
Equine Veterinary Journal

Implantation of bone marrow-derived mesenchymal stem cells demonstrates improved outcome in horses with overstrain injury of the superficial digital flexor tendon

E. E. GODWIN, N. J. YOUNG, J. DUDHIA, I. C. BEAMISH and R. K. W. SMITH*

2012

- Intralesional injection of 10x10^6 autologous MCSs one time (n=141)
- 2-year follow-up
- Significant reduction in re-injury rate



11

ORIGINAL ARTICLE — Equine Veterinary Journal — WILEY

Treatment of racehorse superficial digital flexor tendonitis: A comparison of stem cell treatments to controlled exercise rehabilitation in 213 cases

Rachel O. Salz[1] | Christopher R. B. Elliott[2] | Tomas Zuffa[3] | Euan D. Bennet[4] | Benjamin J. Ahern[3]

- SDFT lesions treated with controlled exercise & rehabilitation program (**CERP**), autologous **BM-MSCs + CERP**, or allogeneic **A-MSCs + CERP**
- BM-MSC treatment was associated with 3 x increased likelihood of racing and 2.6 x increased likelihood of C5+ races post-injury
- A-MSC treatment did not improve outcome compared to CERP alone

12

ORIGINAL ARTICLE — Equine Veterinary Journal — WILEY

Racing performance of Thoroughbred racehorses with suspensory ligament branch desmitis treated with mesenchymal stem cells (2010–2019)

Stefanie H. Hansen[1] | Lawrence R. Bramlage[2] | George E. Moore[3]

2024

- Horses treated with allogeneic umbilical cord MSCs (20x10^6) at diagnosis
- Followed with 3-4 injections of autologous MSCs (20x10^6)
- 69 horses treated
  - 71% raced
  - No difference in earnings in 18 horses that raced pre- and post-injury

13

Allogeneic Stem Cells

ORIGINAL ARTICLE — Equine Veterinary Journal — WILEY

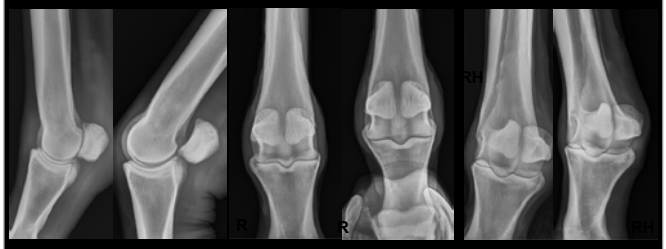
Equine allogeneic tenogenic primed mesenchymal stem cells: A clinical field study in horses suffering from naturally occurring superficial digital flexor tendon and suspensory ligament injuries

2023

EXPLORATORY EVALUATION OF EFFICACY AND SAFETY OF HORSTEM (EQUINE UMBILICAL CORD MESENCHYMAL STEM CELLS) IN NATURALLY OCCURING TENDON AND LIGAMENT EQUINE INJURIES

14

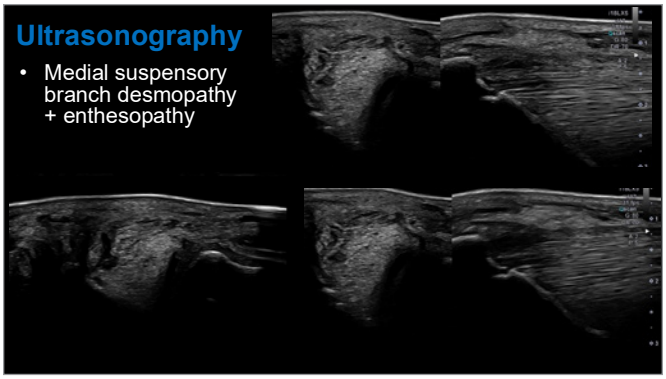
5yo TB mare with RH lameness



15

Ultrasonography

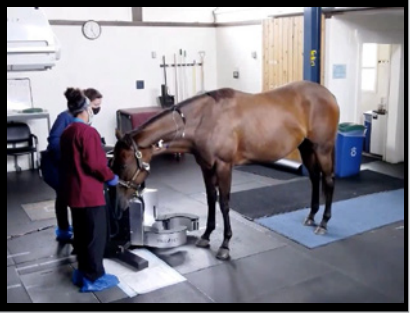
- Medial suspensory branch desmopathy + enthesopathy



16

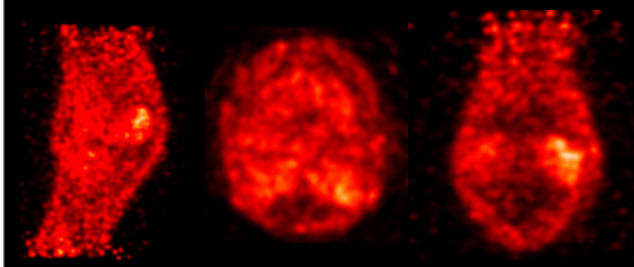
Positron Emission Tomography

- ^{18}F-NaF bone radiotracer
- ^{18}F-FDG soft tissue radiotracer



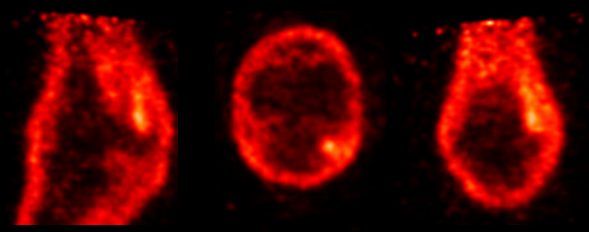
17

^{18}F- NaF PET



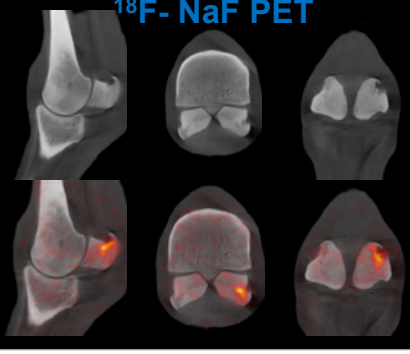
18

^{18}F- FDG PET



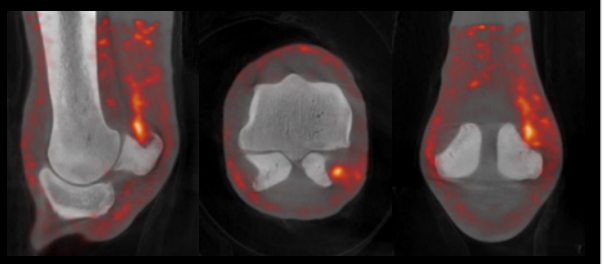
19

^{18}F- NaF PET



20

^{18}F- FDG PET



21

Treatment

- **April 2024:**
  - Intralesional ultrasound-guided injection with PRP
  - Collection of bone marrow from the sternum for culture expansion of MSCs
- **Starting May 2024:**
  - 3 x intralesional ultrasound-guided injection with 50 million autologous MSCs
- Controlled exercise with water treadmill work

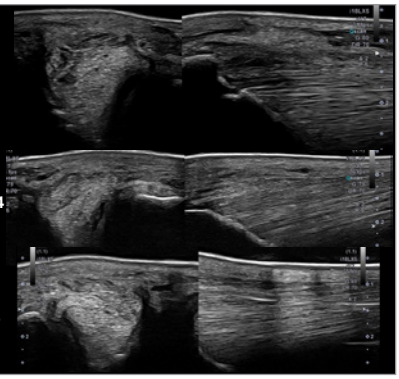
22

Ultrasonography

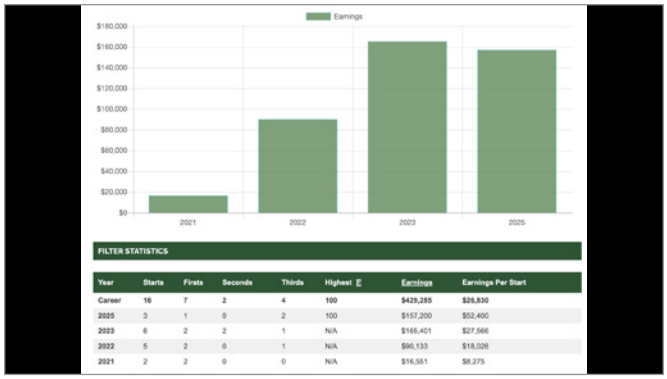
April 2024

September 2024

November 2024



23



24

Clinical Outcome After Intra-Articular Administration of Bone Marrow Derived Mesenchymal Stem Cells in 33 Horses With Stifle Injury

Dora J. Ferris[1], DVM, David D. Frisbie[1], DVM, PhD, Diplomate ACVS, John D. Kisiday[1], PhD, C. Wayne McIlwraith[1], BVSc, PhD, DSc, Diplomate ACVS, Brent A. Hague[2], DVM, MS, Diplomate ACVS & ABVP, Michael D. Major[2], DVM, MS, Diplomate ACVS, Robert K. Schneider[3], DVM, MS, Diplomate ACVS, Chad J. Zubrod[2], DVM, MS, Diplomate ACVS, Christopher E. Kawcak[1], DVM, PhD, Diplomate ACVS, and Laurie R. Goodrich[1], DVM, PhD, Diplomate ACVS

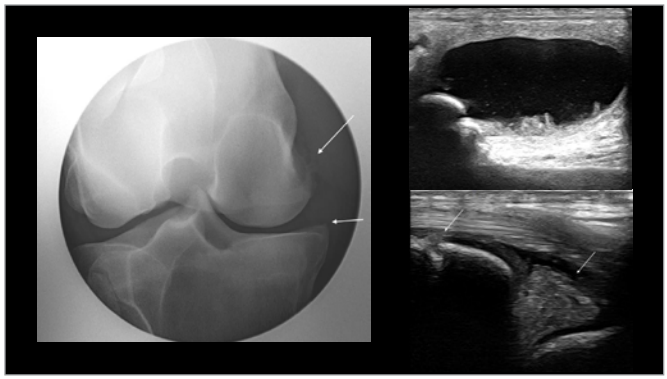
- BM-MSCs intra-articular post-arthroscopy
- 75% of horses with meniscal tears treated with MSCs returned to work compared to 60% without

25

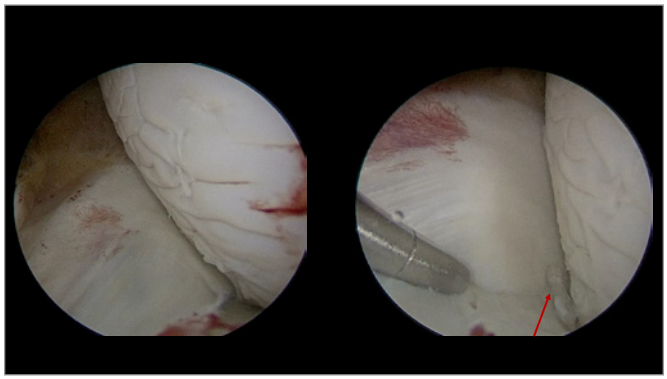
8yo Warmblood mare

- Recent LH lameness that began after impact injury to the left stifle going over a jump several weeks ago
- Marked effusion of the left femoropatellar and medial femorotibial joint
- Grade 3/5 LH lameness localized to stifle with IA anesthesia

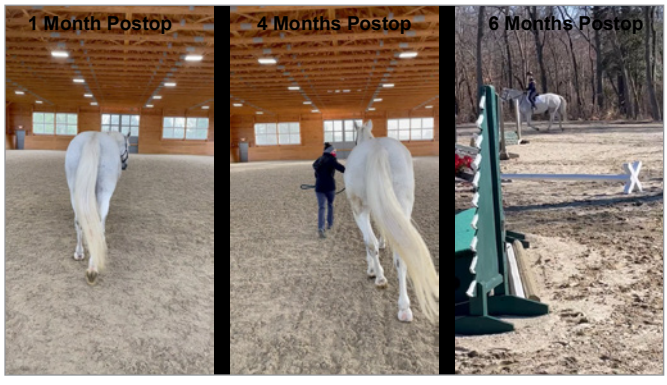
26



27



28



29

Autologous Blood Products

Platelet rich plasma (PRP)
Autologous conditioned serum (ACS)
Autologous protein solution(APS)
Alpha-2-macroglobulin (A2M)

30

Platelet Rich Plasma (PRP)

Any volume of plasma with a platelet count above that of whole blood

- Significant variability in platelet and leukocyte concentration

Platelets contain high concentration of growth factors

- **PDGF**, **TGF-β1**, FGF, VEGF, EGF

Patient-side so can be used in acute or subacute injuries

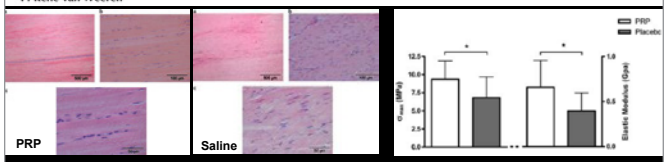
Intra-lesional injections every 3-4 weeks until lesion filling in with fibers

31

Effects of Platelet-Rich Plasma on the Quality of Repair of Mechanically Induced Core Lesions in Equine Superficial Digital Flexor Tendons: A Placebo-Controlled Experimental Study

JOR 2010

Gerco Bosch,[1] Hans T. M. van Schie,[1,2] Mark W. de Groot,[3] Jennifer A. Cadby,[1,2] Chris H. A. van de Lest,[1,4] Ab Barneveld,[1] P. René van Weeren[1]



Tendons treated with PRP:

- Improved histologic appearance
- Increased stress at rupture
- Increased elastic modulus

32

Intralesional injection of platelet-rich plasma followed by controlled exercise for treatment of midbody suspensory ligament desmitis in Standardbred racehorses

Martin Waselau, Dr med vet, MS; W. Wesley Sutter, DVM, MS, DACVS; Ronald L. Genovese, VMD; Alicia L. Bertone, DVM, PhD, DACVS

JAVMA 2008

- 9 Standardbreds
- 3-year follow-up
- All horses returned to racing with no re-injury

J. Vet. Sci. (2000), 1(2), 173-175
DOI: 10.4142/jvs.2010.11.2.173

JOURNAL OF Veterinary Science

Case Report

Autologous conditioned plasma as therapy of tendon and ligament lesions in seven horses

Rindermann Georg[1], Cislakova Maria[1], Arndt Gisela[2], Carstanjen Bianca[1,3,*]

- 7 Warmbloods
- 10-13 month follow-up
- All horses returned to work with no re-injury

33

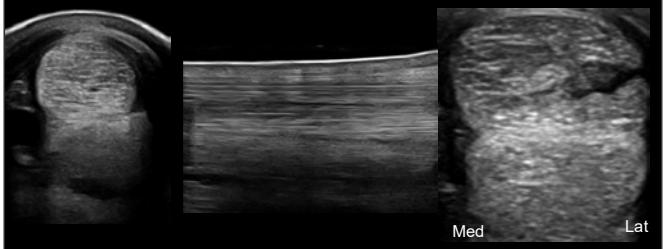
13 yo Oldenburg Mare

- Dressage (4th level)
- Chronic LF lameness due to SDF tendonitis
- SDF tendonitis diagnosed 9 months prior to admission
- Treated with autologous MSC intralesional injection 2 months after injury
- Persistent lameness grade 2/5 exacerbated on circle to the left
- Lameness resolves with high-4 nerve block

34

35

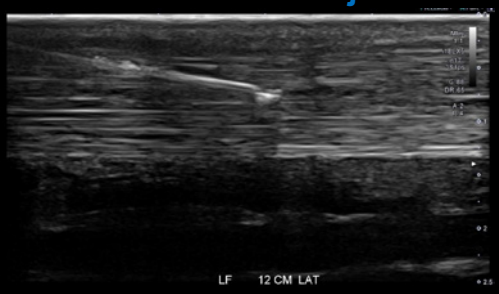
Ultrasonography



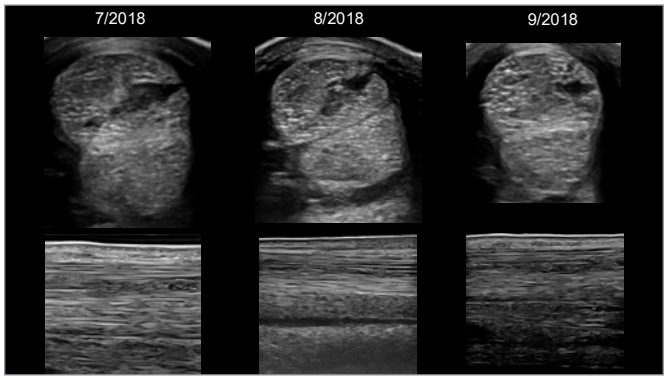
Superficial digital flexor tendonitis 8-14cm DACB

36

PRP Intralesional Injection



37



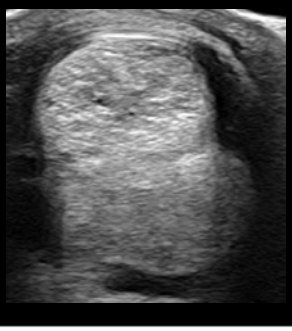
38

Case Progression

- Horse in controlled exercise program over next 10 months
- Trotting and light canter under saddle
- Increased lameness & re-evaluated 5/2019
- Adequate healing of original lesion with evidence of diffuse SDF tendonitis distally

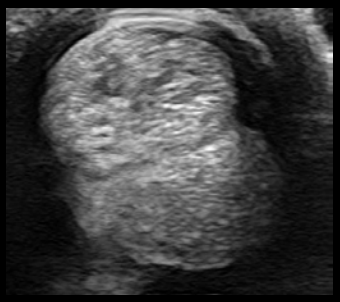
39

Proximal



40

Distal



41

Case Progression

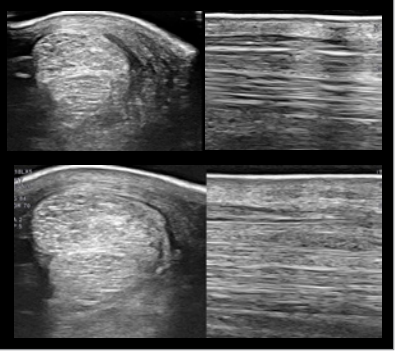
- Superior check ligament desmotomy performed
- Horse returned to controlled exercise program

42

12cm DACB

6 Months Post Superior Check Ligament Desmotomy

16cm DACB

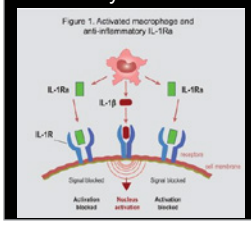


43

44

Autologous Conditioned Serum (ACS)

- Whole blood processed with WBCs releasing cytokines
- Serum-based product that contains increased IL-1Ra and other cytokines



45

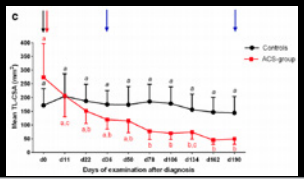
Effect of a single injection of autologous conditioned serum (ACS) on tendon healing in equine naturally occurring tendinopathies

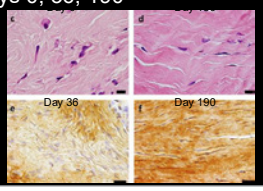
2015

Florian Geburek[1*], Maren Lietzau[1], Andreas Beineke[2], Karl Rohn[3] and Peter M. Stadler[1]

stem cell research & therapy

- 17 horses with SDF tendinitis
- Treated with single intralesional injection (10 ACS; 7 control)
- Biopsy of lesion performed on days 0, 36, 190



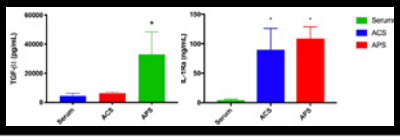


46

Autologous Protein Solution (Pro-Stride®)

Two-step patient-side centrifugation

- 1) Separator that concentrates WBCs and platelets
- 2) Concentrator that activates WBCs
- Yields small volume (3mL from 60mL blood)



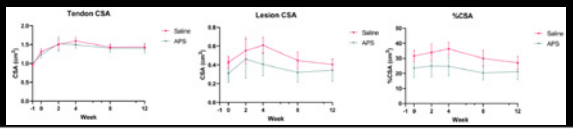
47

Evaluation of Autologous Protein Solution Injection for Treatment of Superficial Digital Flexor Tendonitis in an Equine Model

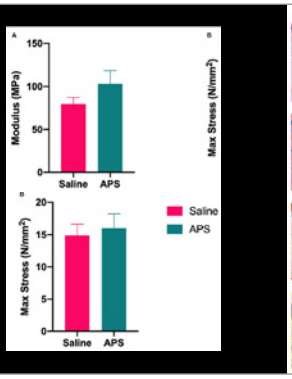
frontiers in Veterinary Science

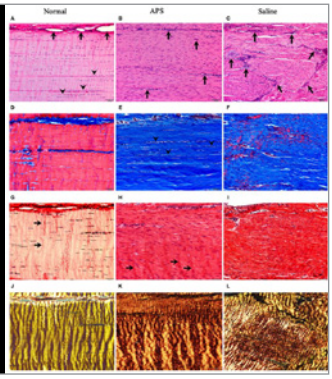
ORIGINAL RESEARCH
published: 05 July 2021
doi: 10.3389/fvets.2021.697551

- 8 horses with collagenase-induced SDF tendonitis
- Treated with APS (Pro-Stride®) 1 week after induction
- Serial ultrasonography up to 12 weeks
- Histology, biomechanical testing, gene expression analysis



48

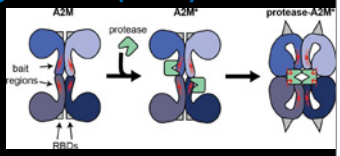




49

Alpha-2-macroglobulin (A2M)

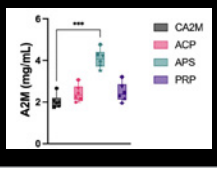
- Protease inhibitor
- MMP inhibition in soft tissue injuries



The effect of matrix metalloproteinase inhibition on tendon-to-bone healing in a rotator cuff repair model

Asheesh Bedi, MD*, David Kovacevic, MD*, Carolyn Hettrich, MD*, Lawrence V. Gulotta, MD*, John R. Ehteshami, MD*, Russell F. Warren, MD*, Scott A. Rodeo, MD*,†

APS contains highest amounts of A2M compared to Alpha2EQ (CA2M) and PRP



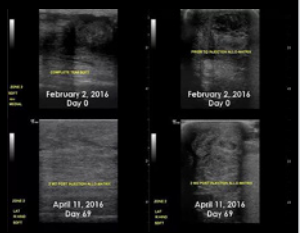
50

Amnion

Outcome following local injection of a liquid amnion allograft for treatment of equine tendonitis or desmitis – 100 cases

BMC Veterinary Research

RESEARCH ARTICLE Open Access



- Multicenter study, non-blinded
- 72 horses returned to work at previous level, 10 horses returned to work at lower level, 18 horses did not return to work

RENOVO equine allograft

AniCell BioTech

51

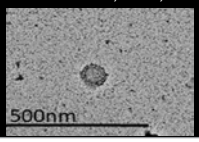
Extracellular Vesicles

Extracellular vesicles (EVs) release from cells in lipid bilayer containing biocargo

- Small RNAs, proteins, lipids
- Exosomes (30-100nm)

Collected from cell culture supernatants and body fluids

- Present in PRP, APS, blood



hilltop bio

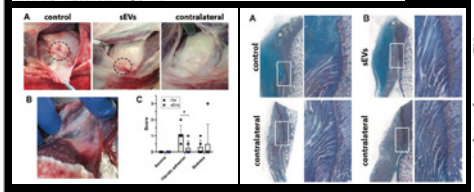
52

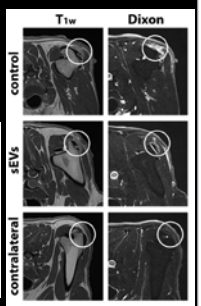
Exosome Therapy

Evaluation of the Potential of Umbilical Cord Mesenchymal Stromal Cell–Derived Small Extracellular Vesicles to Improve Rotator Cuff Healing

A Pilot Ovine Study

The American Journal of Sports Medicine





53

Summary

- Regenerative medicine used to improve quality of repair tissue
- Stem cells have repeatedly been shown to reduce re-injury rates in naturally-occurring disease
- Intra-lesional or RLP administration
- Individualized rehabilitation programs still key to recovery

54

55

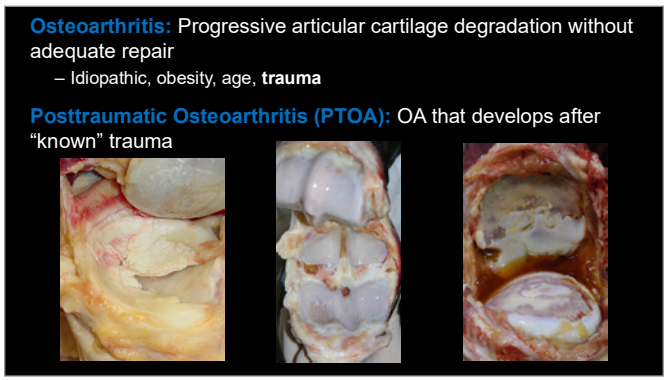
12003

ADVANCES IN THE MANAGEMENT OF JOINT DISEASES

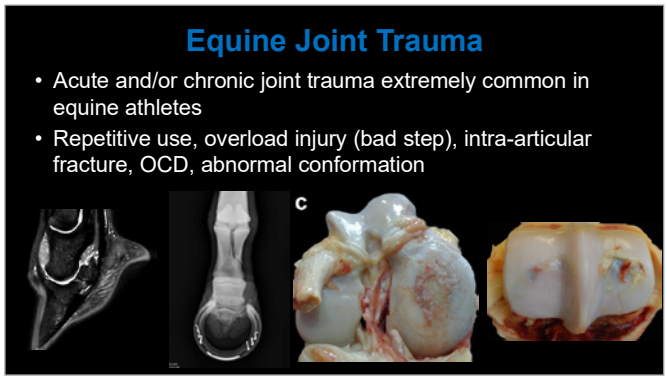
EQUINE PROGRAM | ORTHOBIOLOGICS & SPORTS MEDICINE

Kyla Ortved, DVM, PhD, DACVS, DACVSMR

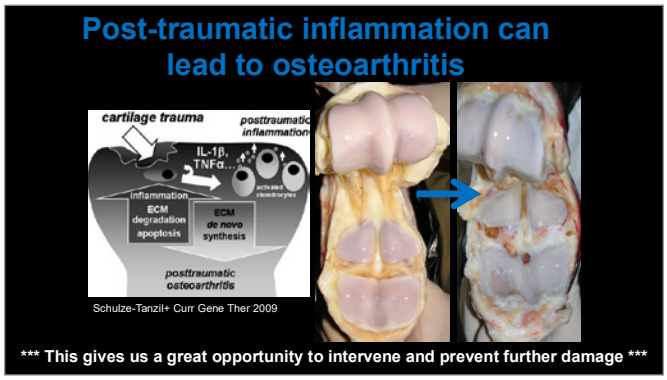
1



2

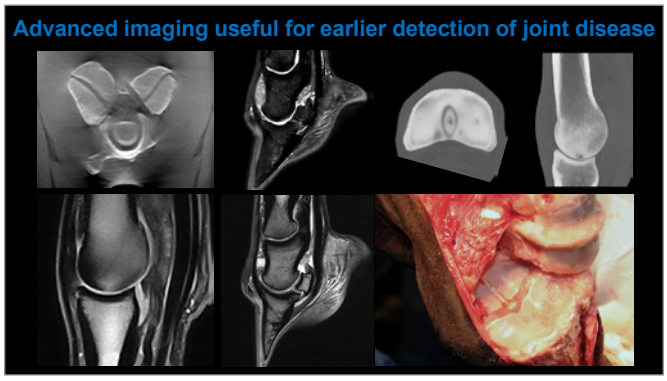


3



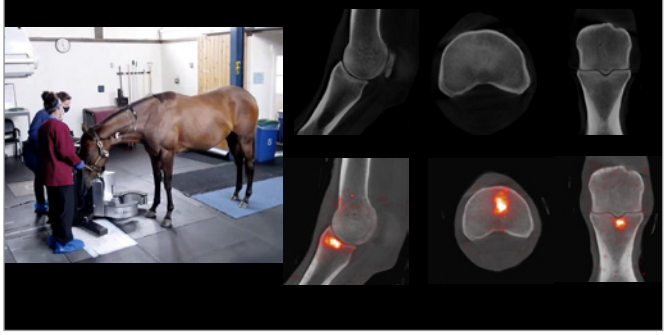
4

5



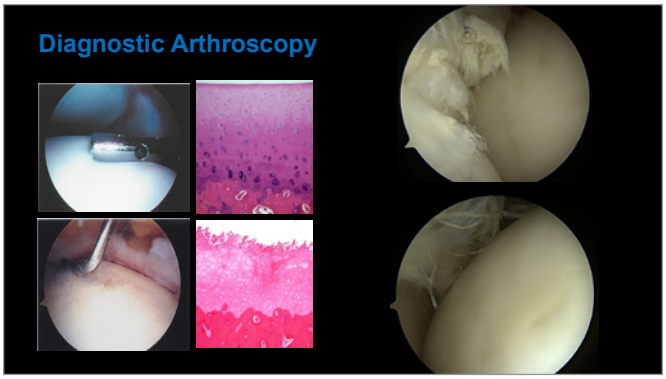
6

Positron Emission Tomography



7

Diagnostic Arthroscopy



8

Therapeutic Goals

- Decrease inflammation
- Repair articular surface
- Prevent further joint injury
- Lubricate joint
- Restore homeostasis

9

Treatment Options

Conservative Management

- Physical therapy
- Systemic medications
- Intra-articular injections

Surgical Management

10

Intra-articular Injections

Synthetics

- Corticosteroids
- Hyaluronic acid
- PSGAGs
- Polyacrylamide hydrogels

Orthobiologics

- Autologous blood-based products
  - Platelet rich plasma (PRP)
  - Autologous conditioned serum (ACS)
  - Autologous protein solution (APS)
  - Alpha-2-macroglobulin (A2M)
- Mesenchymal stem cells
- Amnion

11

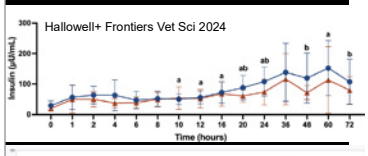
Corticosteroids

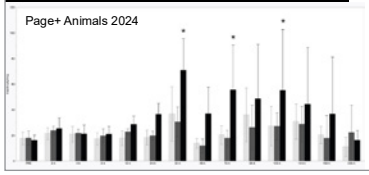
Powerful, fast-acting anti-inflammatories but must consider:

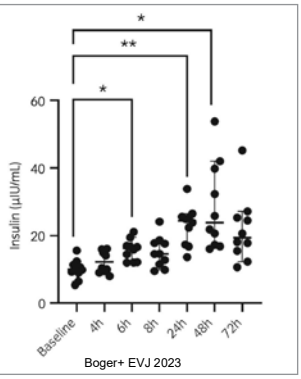
- Total dose administered
- Long-term effects on joints
  - Methylprednisolone can be chondrotoxic (Trotter+ AJVR 1991)
- Withdrawal times
- Risk of laminitis?
  - Review of 2000 horses found 3/2000 (0.15%) developed laminitis (Bathe EVJ 2007)
- Use in horses with endocrine disorders
  - PPID (Equine Cushing's)
  - Insulin resistance (IR)

12

Effects on Insulin





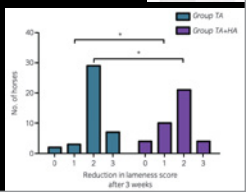


Boger+ EVJ 2023

13

Hyaluronic Acid (HA)

- Integral component of synovial fluid and articular cartilage
- IA administration results in increased synthesis of endogenous HA
- Inherent anti-inflammatory properties
  - Inhibits PGE2 & free radicals
  - Inhibits inflammatory cell migration
- Conflicting evidence of efficacy in humans & horses (de Grauw+ EVJ 2016)



14

Polyacrylamides Hydrogels (PAAGs)

2.5% Polyacrylamide hydrogel (ArthramidVet®)

- Target tissue is synovium
- Synovial tissue integration and modification of synovial membrane

4% Polyacrylamide hydrogel (NoltrexVet®)

- Target tissue is cartilage
- Viscoelastic supplementation to reduce friction

15

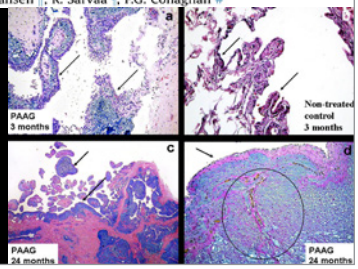
Osteoarthritis and Cartilage 24 (2016) 1999–2002

Brief Report

Synovial incorporation of polyacrylamide hydrogel after injection into normal and osteoarthritic animal joints

L. Christensen †*, L. Camitz ‡, K.E. Illigen §, M. Hansen ||, R. Sarvaa ¶, P.G. Conaghan #

- 10 normal rabbit knees
- 13 equine OA joints (7 horses) including coffin, fetlock, carpus
- Incorporated into synovial membrane
- Synoviocyte proliferation, vessel ingrowth
- Persisted up to 2 years



16

Journal of Equine Veterinary Science

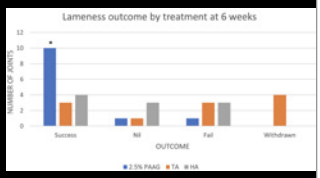
journal homepage: www.j-evs.com

A Double-Blinded Positive Control Study Comparing the Relative Efficacy of 2.5% Polyacrylamide Hydrogel (PAAG) Against Triamcinolone Acetonide (TA) And Sodium Hyaluronate (HA) in the Management of Middle Carpal Joint Lameness in Racing Thoroughbreds

Leigh Travis de Clifford[a], Jason Nicholas Lowe[b], Campbell Duirs McKellar[c], Catherine McGowan[d], Florent David[a,b,e]

2021

- 26 Thoroughbred racehorses with 33 MCJs
- Randomly assigned to treatment group
- Lameness assessed at 6 weeks
- 83.3% PAAG horses sound at 6 and 12 weeks



17

JAVMA

AVMA

Histologic and cytologic changes in normal equine joints after injection with 2.5% injectable polyacrylamide hydrogel reveal low-level macrophage-driven foreign body response

Jason Lowe, BVSc[1*]; Leigh de Clifford, BVSc[2]; Alan Julian, DACVP[3]; Marc Koene, DVM[4]

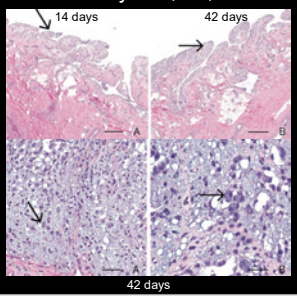
2024

- 10 Healthy Thoroughbred horses (3-5yo)
- Administered 2mL (50mg) or 4mL (100mg) ArthramidVet® into fetlock and/or MCJ
- Assessed at 0, 14, 42 and 90 days post-injection
  - Clinical exam, synoviocentesis, gross pathology, synovial histology, scanning electron microscopy

18

- No adverse events at either dose
- Synovial fluid NCC and TP were WNL at days 14, 42, and 90
- Normal gross pathology

Synovial histology showed macrophage infiltration, villus hyperplasia & increased vascularity



19

Journal of Equine Veterinary Science

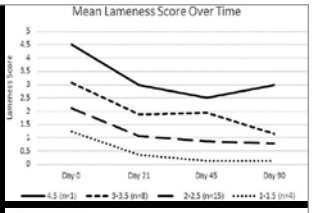
journal homepage: www.j-evs.com

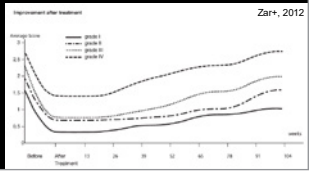
Short Communication

A Preliminary Field Trial Evaluating the Efficacy of 4% Polyacrylamide Hydrogel in Horses With Osteoarthritis

Scott R. McClure[a,*], Chong Wang[b,c,d]

- 28 horses with naturally-occurring OA
  - Carpus, fetlock, and hock
- 23/28 (82%) of horses improved





20

Journal of Equine Veterinary Science

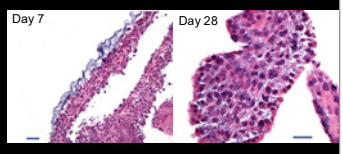
journal homepage: www.j-evs.com

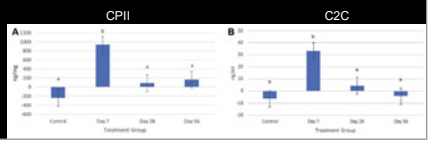
Original Research

Clinical and Histologic Evaluation of Polyacrylamide Gel in Normal Equine Metacarpal /Metatarsal-Phalangeal Joints

Scott R. McClure[a,*], Michael Yaeger[b], Chong Wang[c,d,e]

- 6 horses with normal fetlock joints
- Treatment groups
  1) untreated control
  2) day 7 PAHG
  3) day 28 PAHG
  4) day 56 PAHG



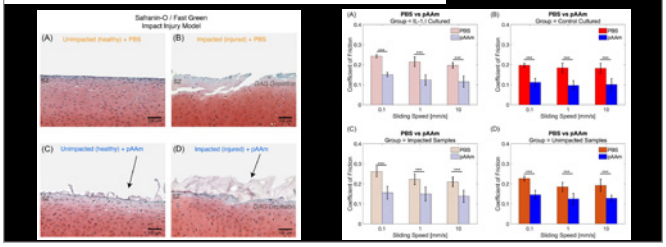


21

RESEARCH ARTICLE

Polyacrylamide hydrogel lubricates cartilage after biochemical degradation and mechanical injury

Karan Vishwanath[1] | Scott R. McClure[2] | Lawrence J. Bonassar[3,4]



22

Orthobiologics

Autologous Blood-Based Products

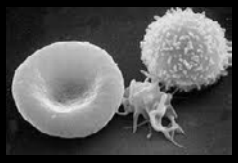
- Platelet rich plasma (PRP)
- Autologous conditioned serum (ACS)
  - IRAP
- Autologous protein solution (APS)
  - Pro-Stride®: ACS + PRP
- Alpha-2-macroglobulin (A2M)

Mesenchymal Stem Cells

23

Platelet Rich Plasma (PRP)

- Platelets contain high concentration of growth factors
- Decreases MMP and aggrecanase activity, increases GAG in OA joints (Perrone+ J Eq Vet Sci 2020)
- Improves clinical lameness (Perrone+ J Eq Vet Sci 2020; Broeckx+ PLoS One 2014)



The National Cancer Institute at Frederick

24

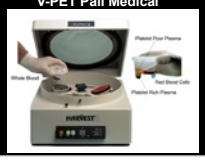
Platelet Rich Plasma

Osteokine® Dechra

V-PET Pall Medical

Arthrex Angel System

Manual Techniques



25

Autologous Conditioned Serum

- Incubated blood releases **interleukin-1 antagonist protein (IRAP)** + other growth factors and cytokines
- **IRAP =** Competitive antagonism of IL-1
- Intra-articular anti-inflammatory (Frisbie+ AJVR 2007; Lasarzik+ J Eq Vet Sci 2018)
- 2-4 injections, 7-14 days apart
  - Can freeze aliquots

26

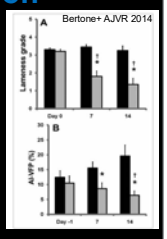
Autologous Protein Solution

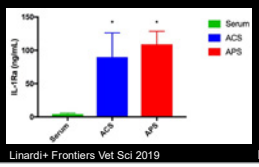
- Pro-Stride®
- Two-step centrifugation to concentrate platelets (PRP) + IRAP
- Patient-side
- 3mL/60mL blood
- Single treatment

27

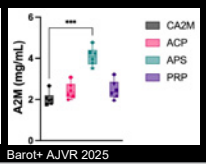
Autologous Protein Solution

- Improved lameness scores following single injection in horses with naturally-occurring OA
- Contains high levels of IL-1Ra, TGF-β1, sTNFR, A2M



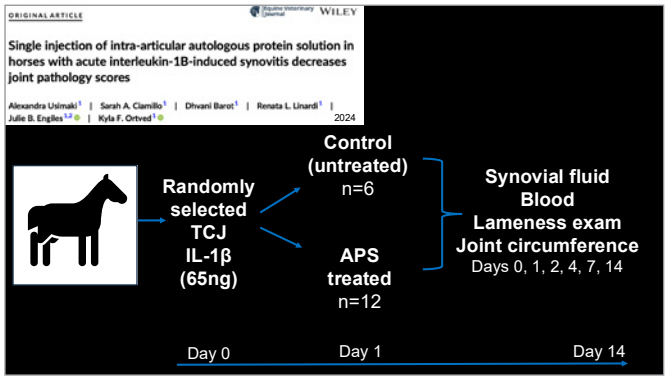


Linardi+ Frontiers Vet Sci 2019

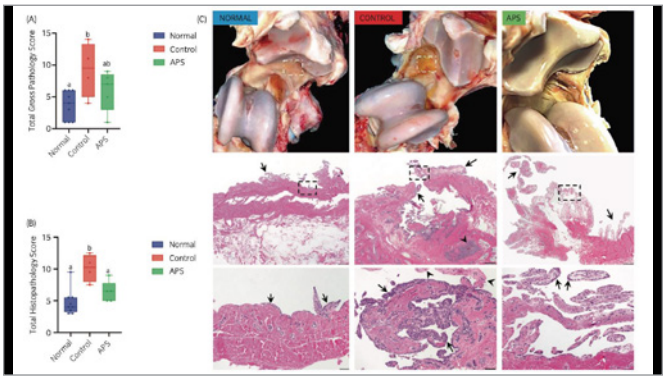


Barot+ AJVR 2025

28



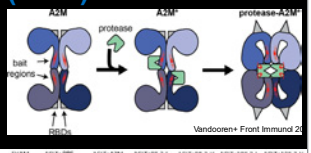
29



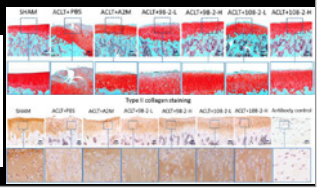
30

Alpha-2-macroglobulin (A2M)

- Protease inhibitor
- Activity against collagenases & aggrecanases
- May protect ECM from degradation



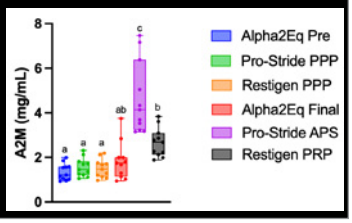
Targeted designed variants of alpha-2-macroglobulin (A2M) attenuate cartilage degeneration in a rat model of osteoarthritis induced by anterior cruciate ligament transection Arthritis Research & Therapy



31

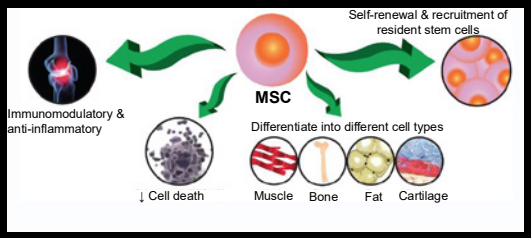
Commercially available product reported to contain concentrated A2M

Use of quantitative mass spectrometry-based proteomics and ELISA to compare the alpha 2 macroglobulin concentration in equine blood-based products processed by three different orthobiologic devices



32

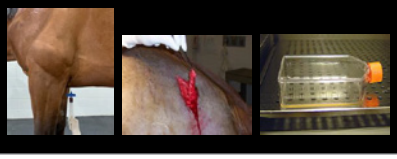
Mesenchymal Stem Cells

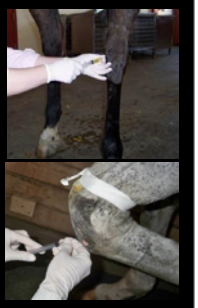


33

Mesenchymal Stem Cells

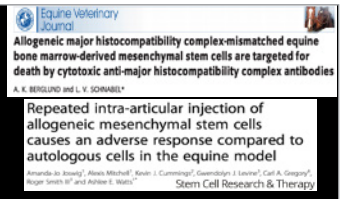
- Improves outcome in horses with meniscal tears (Ferris+ Vet Surg 2013)
- Improves cartilage healing (McIlwraith+ Arthroscopy 2011)
- Many different sources of cells with significant variability



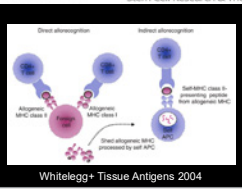


34

Allogeneic Stem Cells



- Horses produce cytotoxic antibodies to allogeneic cells
- May limit effectiveness of cell therapy
- May cause adverse effects on repeat injection



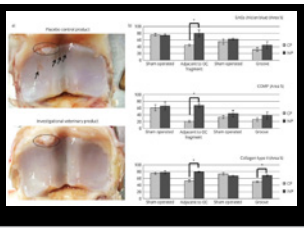
Whitelegg+ Tissue Antigens 2004

35

Allogeneic Stem Cells

The use of equine chondrogenic-induced mesenchymal stem cells as a treatment for osteoarthritis: A randomised, double-blinded, placebo-controlled proof-of-concept study

EVJ 2019



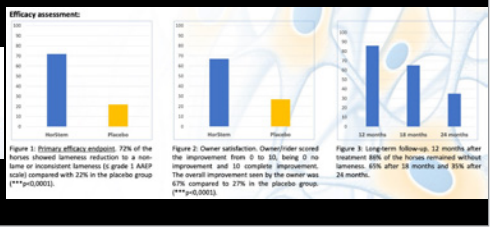
36

Allogeneic Stem Cells

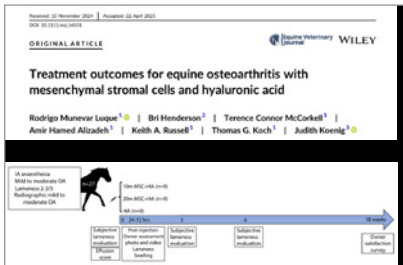
EFFICACY AND SAFETY STUDY OF HORSTEM® FOR THE TREATMENT OF CLINICAL SYMPTOMATOLOGY ASSOCIATED WITH MILD TO MODERATE OSTEOARTHRITIS IN HORSES UNDER FIELD CONDITIONS

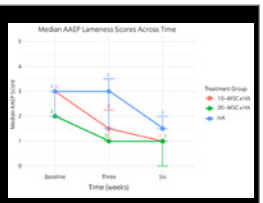
Pradera A¹.

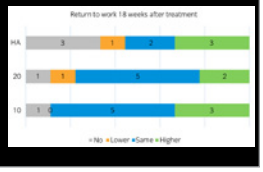
¹EquiCord, Loeches 1030, 28925, Alcorcón, Madrid. Telf. 655179210, apradera@equicord.com



37



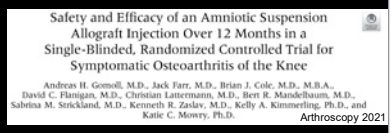




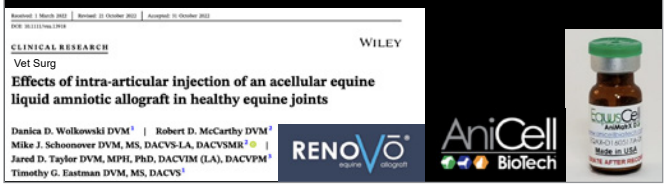
38

Amnion

- Concentrated growth factors, cytokines, + ECM from placental tissues
- Limited preclinical + clinical date in any species


Safety and Efficacy of an Amniotic Suspension Allograft Injection Over 12 Months in a Single-Blinded, Randomized Controlled Trial for Symptomatic Osteoarthritis of the Knee

Arthroscopy 2021


CLINICAL RESEARCH

WILEY

Vet Surg

Effects of intra-articular injection of an acellular equine liquid amniotic allograft in healthy equine joints

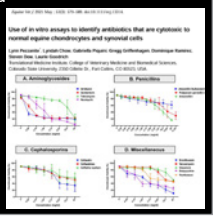
RENOVO equine allograft

AniCell BioTech

39

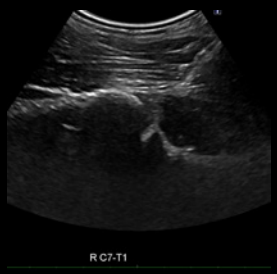
Considerations for Joint Injections

- **Indication?**
- Do not need to clip unless indicated (excessive hair / dirt)
- Do not need to add antibiotic unless indicated
  - Antibiotics are chondrotoxic
- Rest for 48-72 hours post-injection
  - Decreases turnover of synovial fluid
- Ultrasound-guided?



40

Ultrasound-guided Injections



41

Complications of Joint Injections

Joint Flare

- Acute inflammatory response (8-24hrs)
- Heat, pain, swelling, effusion, lameness
- Usually milder clinical signs than infection
- Usually resolve with conservative tx
  - NSAIDs
  - Stall rest

42

Complications of Joint Injections

Joint Infection

- Uncommon (<0.1%)
- Several days to weeks post-injection
  - Delayed clinical signs of infection post-steroid
- Moderate-severe lameness
- Synovial fluid analysis
  - NCC > 30,000cells/uL
  - TP > 4.0g/dl
  - >80% PMN cells
- Aggressive tx required
  - Joint lavage
  - Systemic and local antibiotics

ALWAYS SAMPLE THE JOINT IF YOU HAVE ANY CONCERNS OF INFECTION

43

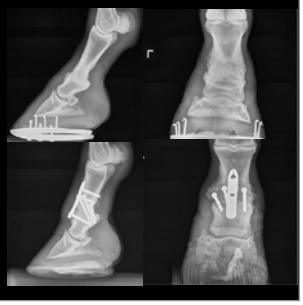
Failure to Respond

Joint disease is too severe

- Some horses require > 1 injection to control pain at first
- Consider other types of IA injection
- Consider other types of treatment including surgery

Incorrect diagnosis

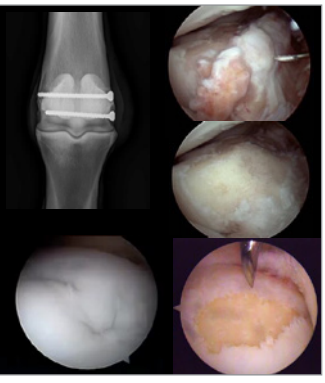
- Re-evaluate lameness with diagnostic analgesia
- Advanced imaging



44

Surgical Therapies

- Stabilize intra-articular fractures
- Remove osteochondral fragments
- Debride / repair cartilage defects
- Cell-based cartilage grafting
  - Chondrocyte or MSC
- Facilitated ankylosis or arthrodesis



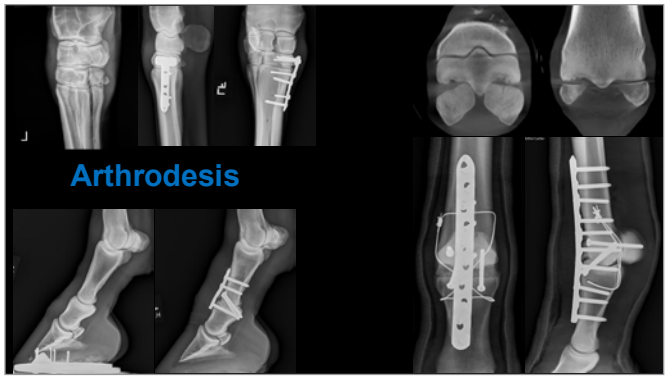
45

Facilitated Ankylosis

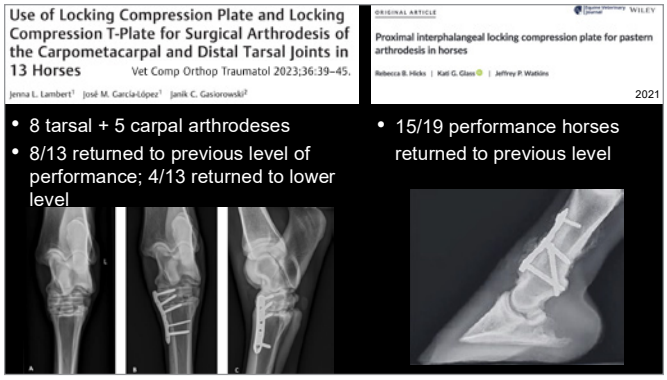
- Chemical
  - Monoiodoacetate (MIA), 70% ethyl alcohol
- Laser
- Transarticular drilling


Alcohol-facilitated ankylosis of the distal intertarsal and tarsometatarsal joints in horses with osteoarthritis

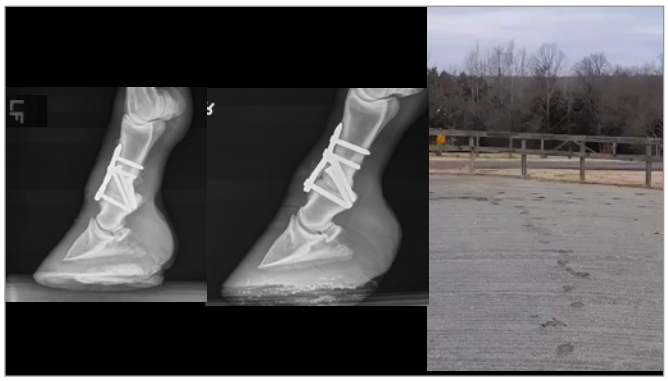
46


Arthrodesis

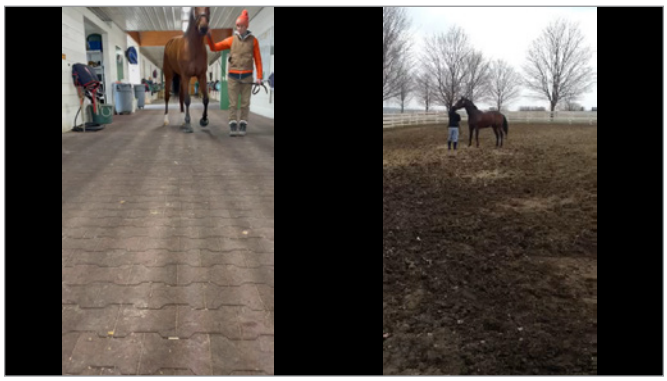
47


Use of Locking Compression Plate and Locking Compression T-Plate for Surgical Arthrodesis of the Carpometacarpal and Distal Tarsal Joints in 13 Horses
Vet Comp Orthop Traumatol 2023;36:39–45.
Proximal interphalangeal locking compression plate for pastern arthrodesis in horses
2021
• 8 tarsal + 5 carpal arthrodeses
• 8/13 returned to previous level of performance; 4/13 returned to lower level
• 15/19 performance horses returned to previous level

48



49



50


Questions?
PennVet
New Bolton Center

51

12004

THE CLINICAL APPLICATION OF ADVANCED IMAGING FOR SPORT HORSES

EQUINE PROGRAM | ORTHOBIOLOGICS & SPORTS MEDICINE

Kyla Ortved, DVM, PhD, DACVS, DACVSMR

PennVet New Bolton Center
University of Pennsylvania

The Clinical Application of Advanced Imaging for Sport Horses

Kyla Ortved, DVM, PhD, DACVS, DACVSMR
Associate Professor of Large Animal Surgery
New Bolton Center, University of Pennsylvania

1

Equine Diagnostic Imaging

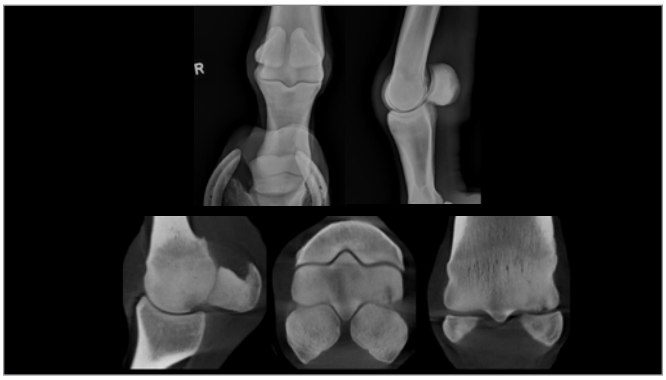
- Major advances in the past two decades
- Cross-sectional imaging has greatly increased our understanding of musculoskeletal injury
- ↑Understanding = ↑Treatment = ↑Outcomes

2

Radiography

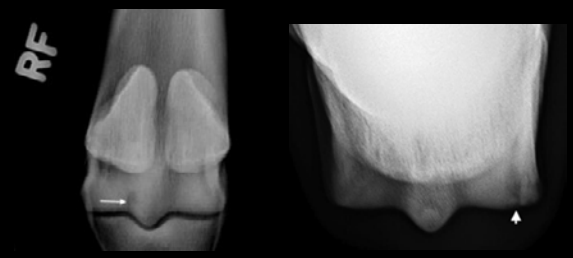
- Mainstay of equine diagnostic imaging
- Affordable, portable, rapid
- **Limitations:** Superimposition, complex anatomy, relatively large degree of bone change required before lesion visualization

3



4

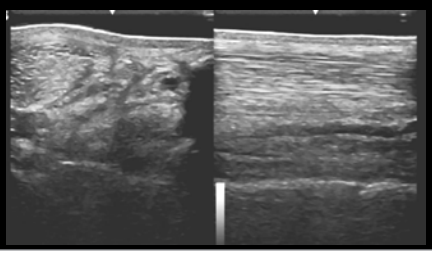
Non-standard projections may increase lesion visualization



5

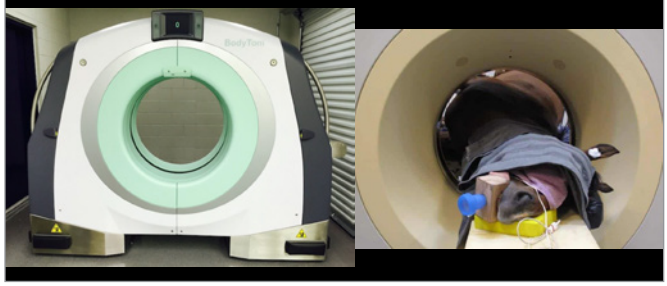
Ultrasonography

- Affordable, portable, no radiation safety concerns
- Limited by location, contrast resolution



6

Computed Tomography

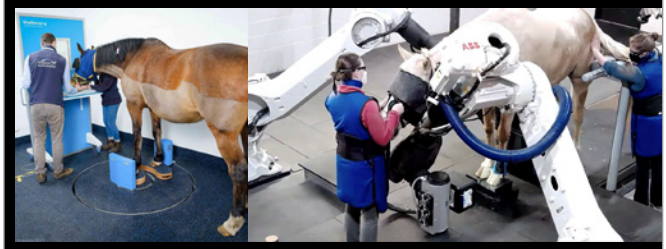


7

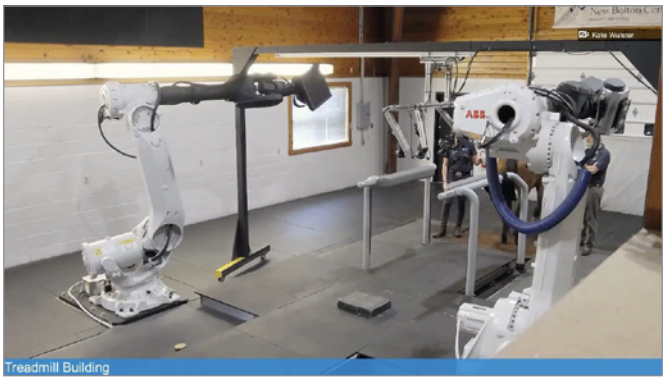
Standing CT – Fan Beam

8

Standing CT – Cone Beam

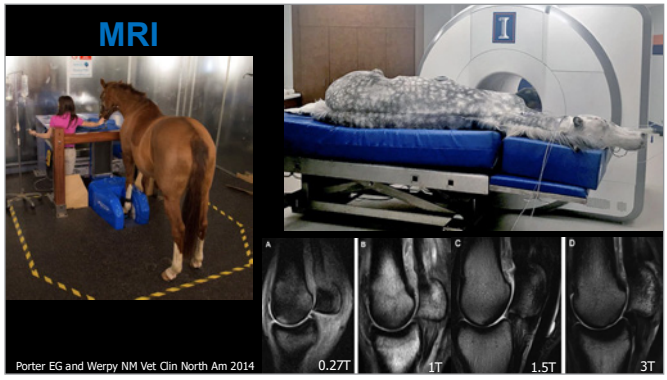


9

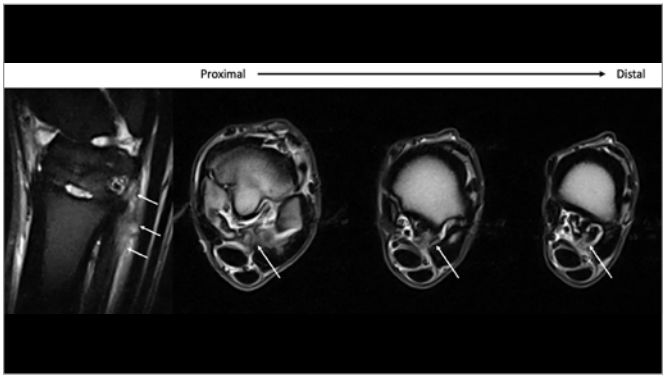


10

MRI



11



12

Positron Emission Tomography (PET)

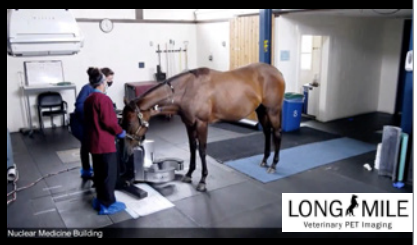
Functional, cross-sectional imaging of metabolic processes

Two Key Radiotracers

- **^{18}F–Sodium fluoride (NaF)**: exchanges with hydroxyl groups in hydroxyapatite crystals, forming fluorapatite in areas of active bone remodeling
- **^{18}F–Fluorodeoxyglucose (FDG)**: glucose analog taken up by metabolically active cells via glucose transporters

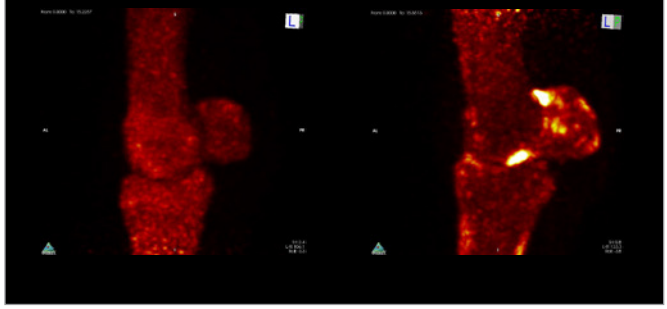
13

- ^{18}F-NaF bone radiotracer
- ^{18}F-FDG soft tissue radiotracer
- Scan site(s) of interest 45 minutes later
- Horse cleared ~8 hours later



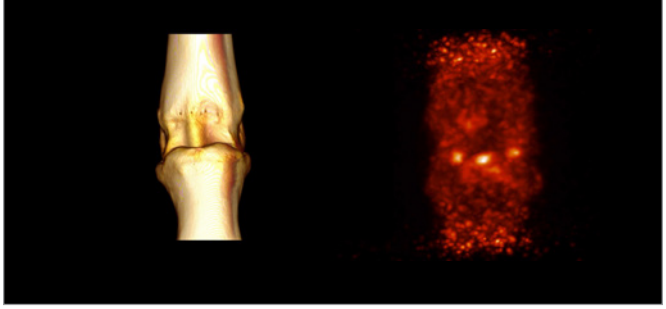
14

Standing Fetlock PET



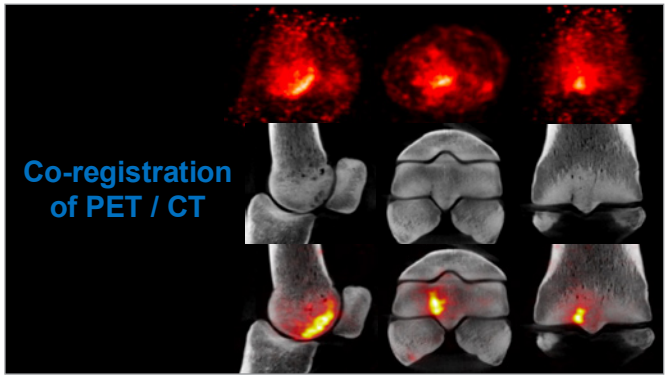
15

Morphologic vs. Functional



16

Co-registration of PET / CT



17

Clinical Application of Imaging

Establish an accurate diagnosis
- E.g. DDFT tear, stress-induced bone injury

Evaluate anatomical sites with complex anatomy
- E.g. Cervical spine, skull

Visualize and target areas with lack of direct exposure
- E.g. Structures within the hoof

**** Targeted treatments to improve outcomes ****

18

Navicular Syndrome / Podotrochlosis

- Horses with lameness isolated to the foot with palmar digital anesthesia
- Radiography alone has poor sensitivity
- MRI has allowed more accurate diagnoses & targeted treatment

19

NEW ZEALAND VETERINARY JOURNAL
2020, VOL. 68, NO. 5, 283–288
https://doi.org/10.1080/00480169.2020.1750499

Taylor & Francis

SCIENTIFIC ARTICLE

Comparison of lameness outcomes in horses with acute or chronic digital lameness that underwent magnetic resonance imaging

DW Koch[a], MF Barrett[b], BR Jackman[c], D MacDonald[c] and LR Goodrich[a]

- Acute < 12 weeks vs. chronic > 12 weeks
- Horses that underwent early MRI had significantly improved outcomes
- Accurate diagnosis & targeted treatment

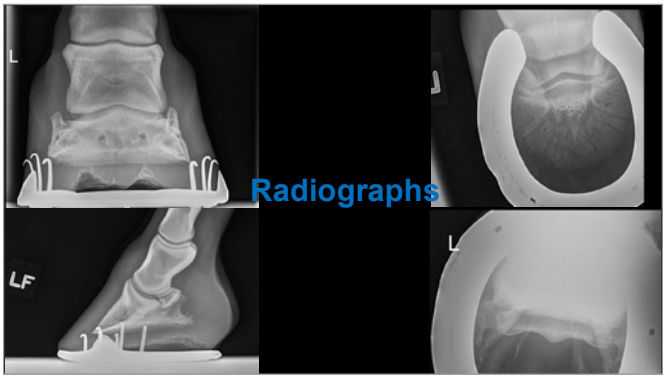
20

11yo Warmblood mare

- Dressage horse
- 3 Week history of LF lameness localized to the foot with both PD and distal interphalangeal analgesia

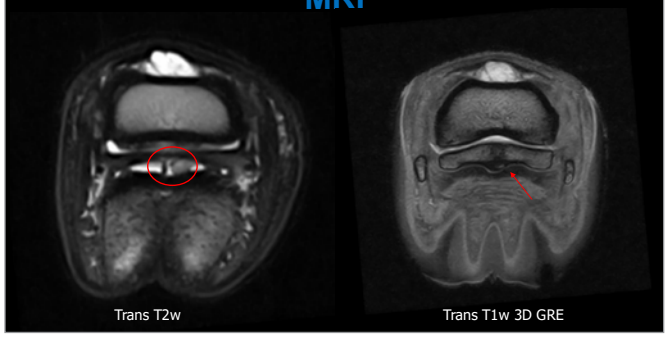
21

Radiographs



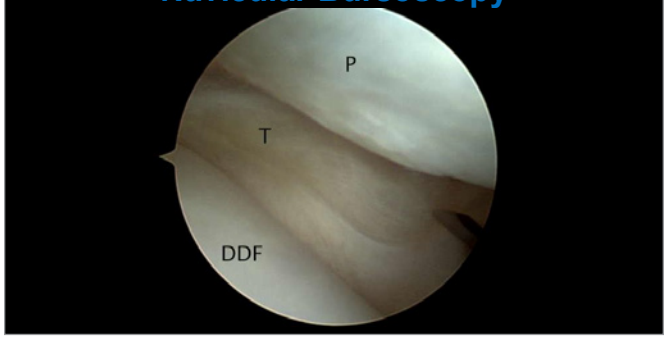
22

MRI



23

Navicular Bursoscopy



24

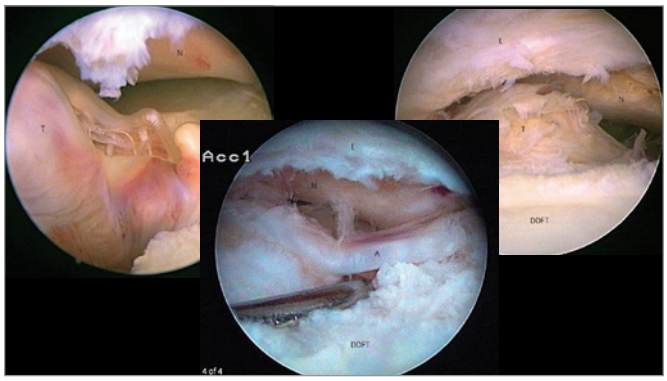
Equine Veterinary Journal

Endoscopic evaluation of the navicular bursa: Observations, treatment and outcome in 92 cases with identified pathology

M. R. W. SMITH* and I. M. WRIGHT

- 61% sound, 42% returned to previous level
- Extensive tearing + combination injuries had worse outcomes
- Cartilaginous lesions of NB + adhesions uncommon endoscopically
- Advanced imaging paramount in case selection

25



26

ORIGINAL ARTICLE

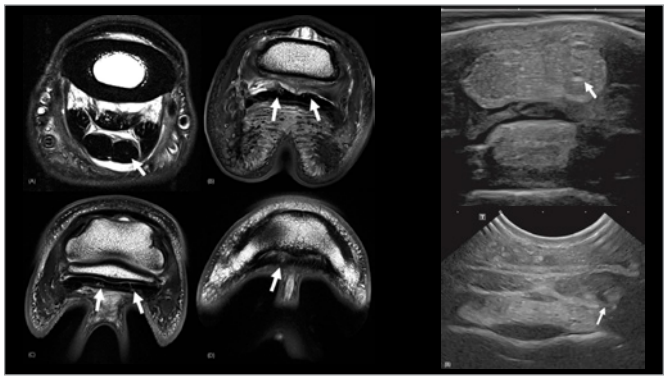
Equine Veterinary Journal WILEY

Deep digital flexor tendon lesions in the pastern are associated with the presence of distal tendinopathy

Elizabeth V. Acutt | Erin K. Contino | David D. Frisbie | Myra F. Barrett 2021

- 75% with DDF tendinopathy in pastern had distal lesions
- Significant association with presence of core DDFT pastern lesion and more distal lesions
  - 38/39 horses with core lesions had distal lesions
  - 28/49 horses with dorsal border tears or paramedian splits had distal lesions

27



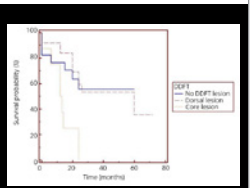
28

Equine Veterinary Journal

Outcome of palmar/plantar digital neurectomy in horses with foot pain evaluated with magnetic resonance imaging: 50 cases (2005–2011)

S. D. GUTIERREZ-NIBEYRO*†, N. M. WERPY‡, N. A. WHITE II§, M. A. MITCHELL†, R. B. EDWARDS III#, R. D. MITCHELL#, S. J. GOLD† and A. K. ALLEN¥

- Core or linear lesions of the DDFT experience residual lameness or early recurrent lameness after surgery



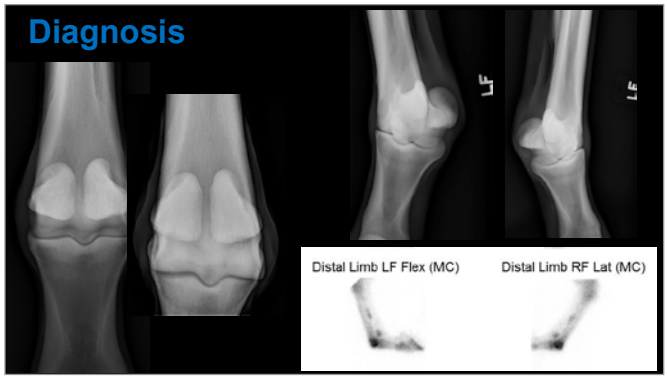
29

Stress-Induced Bone Injury

- Early diagnosis is difficult but key to prevention of catastrophic injuries + successful treatment
- Very common in racehorses but becoming more commonly diagnosed in sport horses

30

Diagnosis



31

Standing CT

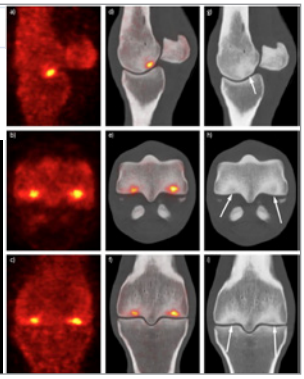
32

Equine Veterinary Journal

^{18}F-sodium fluoride positron emission tomography of the racing Thoroughbred fetlock: Validation and comparison with other imaging modalities in nine horses

M. SPRIET*, P. ESPINOSA-MUR, D. D. CISSELL, K. L. PHILLIPS, G. ARINO-ESTRADA, D. BEYLIN, P. STEPANOV, S. A. KATZMAN, L. D. GALUPPO, T. GARCIA-NOLEN, B. MURPHY and S. M. STOVER

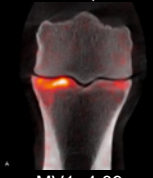
- Cross-sectional imaging + information about bone metabolism
- Early detection + possible prevention of catastrophic injuries



33

Quantification

SUVmax: 16.4
Bgd: 4.2
Ratio: 4.0 (Grade 3)



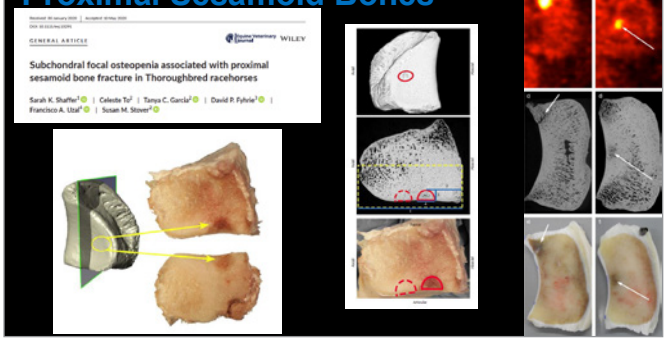
MV1: 4.39
MV2: 2.93
MV3: 1.08

Grading
- Normal < 1
- Mild = 1-2
- Moderate > 2-3
- Marked > 3

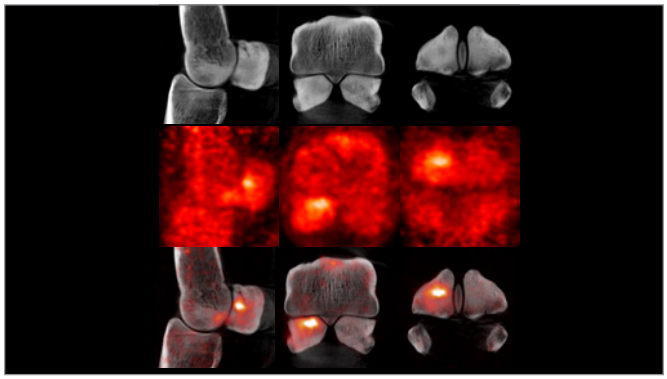
Metabolic volume (MV) of the lesion (cm^3):
- MV1: 1-2x background
  - How much of the lesion is "mild"
- MV2: 2-3x background
  - How much of the lesion is "moderate"
- MV3: 3+x background
  - How much of the lesion is "marked"

34

Proximal Sesamoid Bones

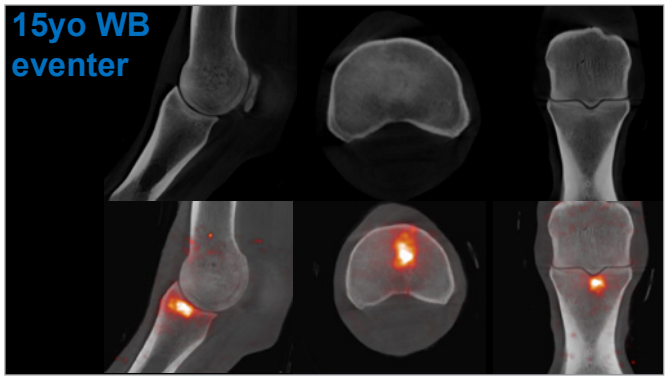


35



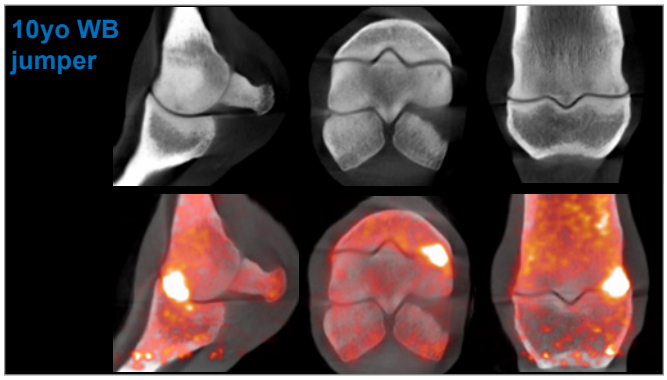
36

15yo WB eventer

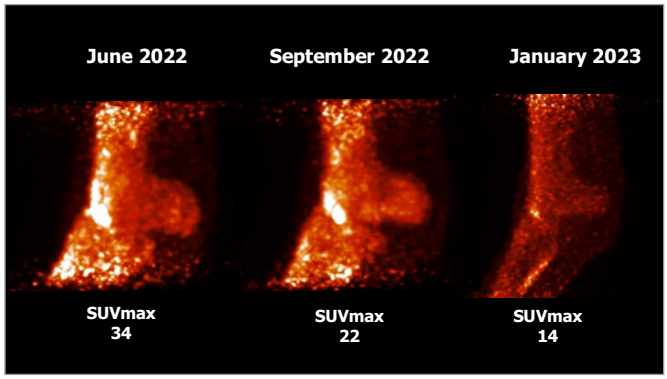


37

10yo WB jumper



38



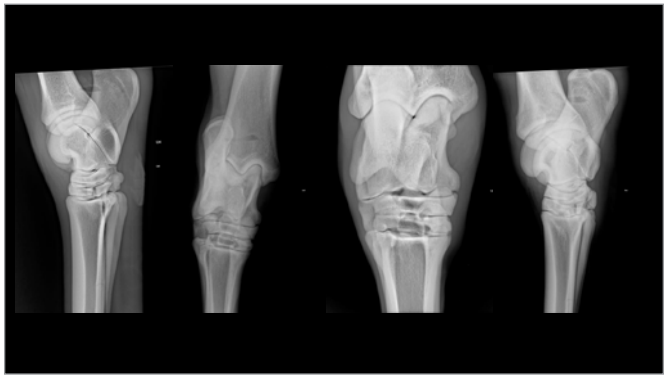
39

8yo WB gelding

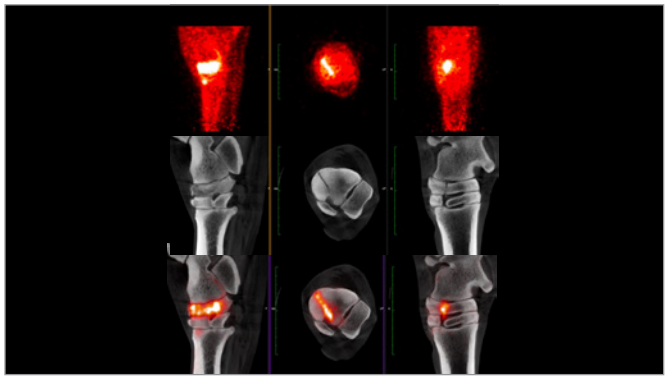
- Moderate-severe 3/5 LH lameness
- Localized to proximal MT3 / distal tarsal region with diagnostic analgesia
- Ultrasonography of proximal suspensory ligament + tarsal radiographs were unremarkable

40

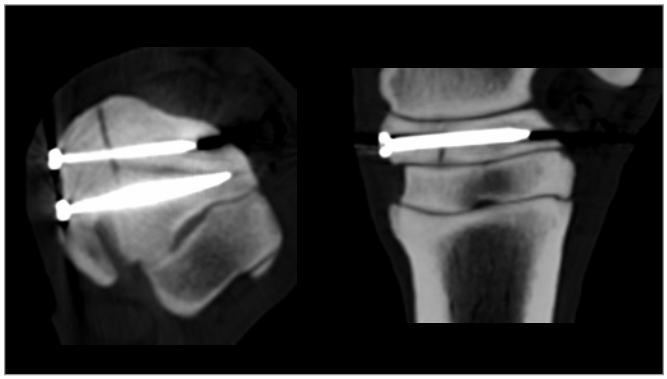
41



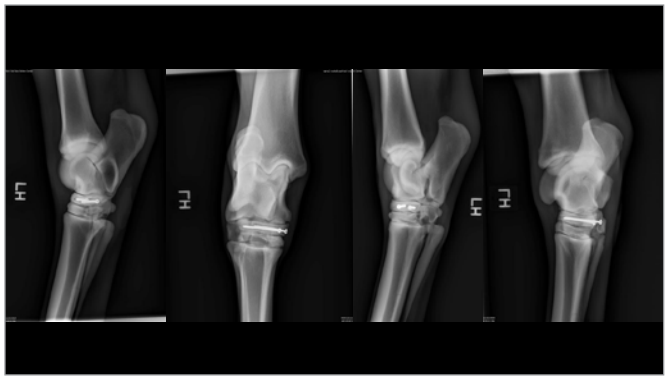
42



43



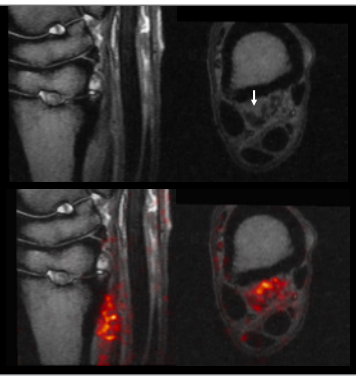
44



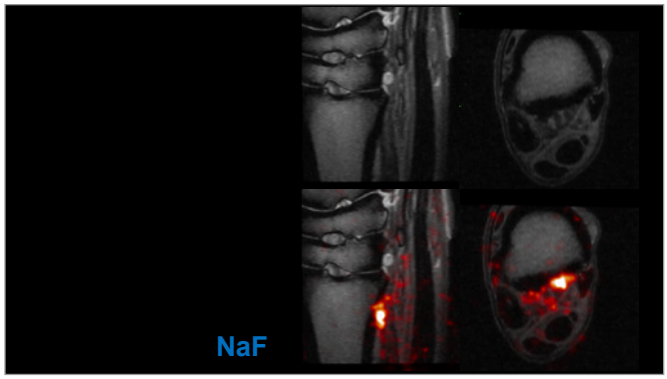
45

9yo WB gelding

Grade 3-4/5 RH lameness improves with subtarsal nerve block



46

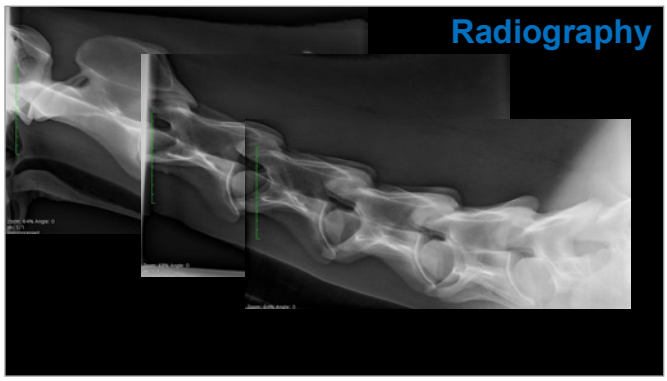


47

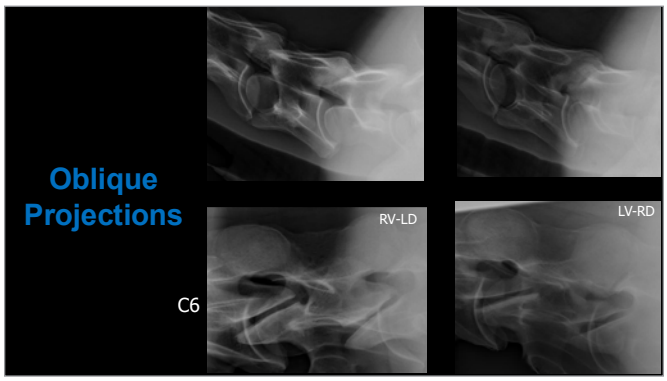
Cervical Spine

- Increasingly common site of pathology
  - Ataxia, neck pain, lameness, poor performance
- Cervical vertebral stenotic myelopathy (CVSM)
  - Type 1: Vertebral malformation and/or malarticulation
  - Type 2: Cervical APJ osteoarthritis
- Cervical APJ osteoarthritis
  - Ataxia, cervical radiculopathy, pain

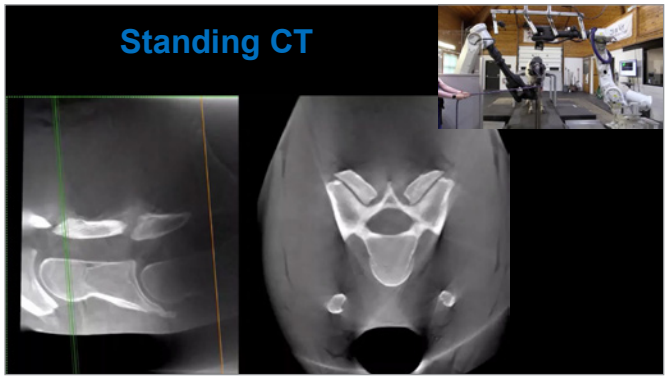
48



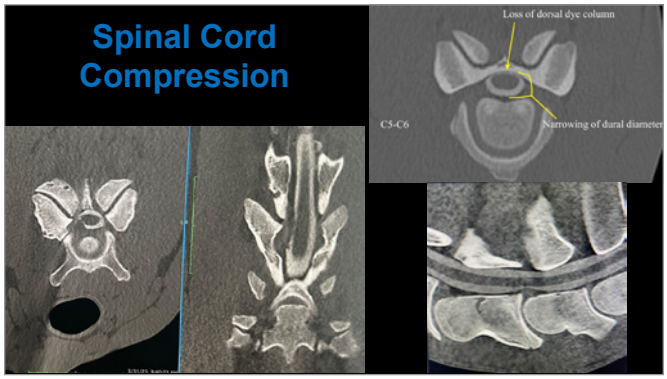
49



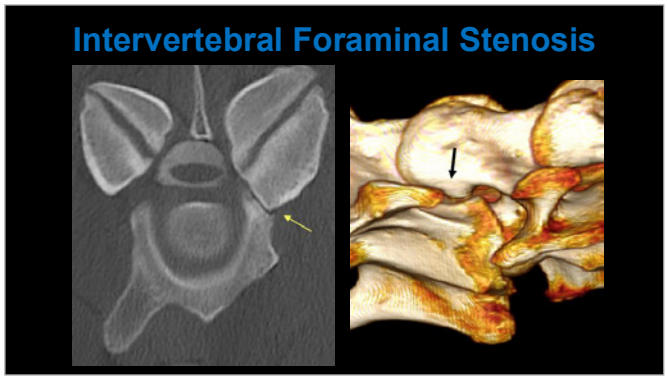
50



51



52



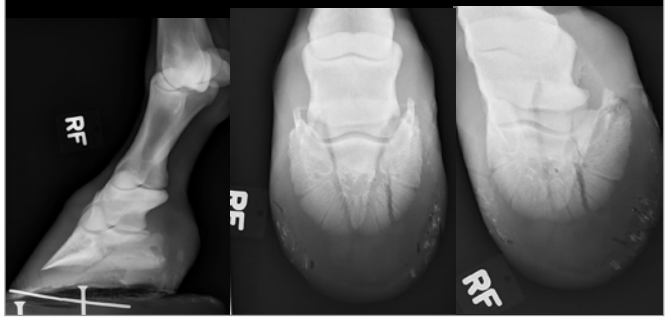
53

P3 Fractures

- Common in racehorses and sport horses
- Often managed conservatively with shoeing or casting to support hoof
- Articular fractures ideal for screw fixation but location of P3 in hoof creates major challenges

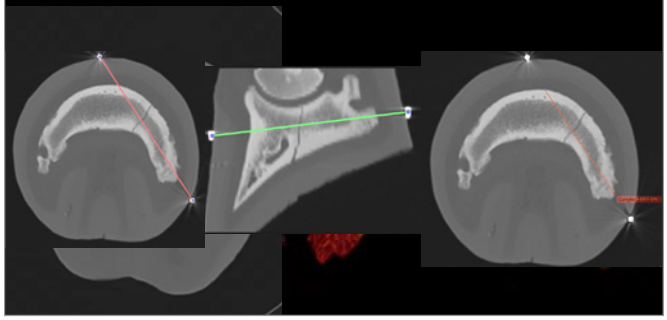
54

2yo Standardbred filly

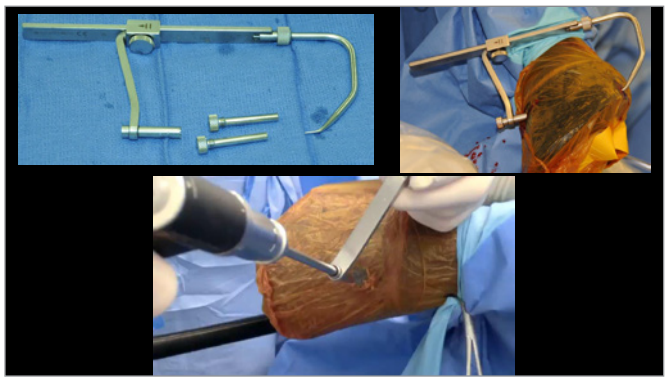


55

Preoperative CT

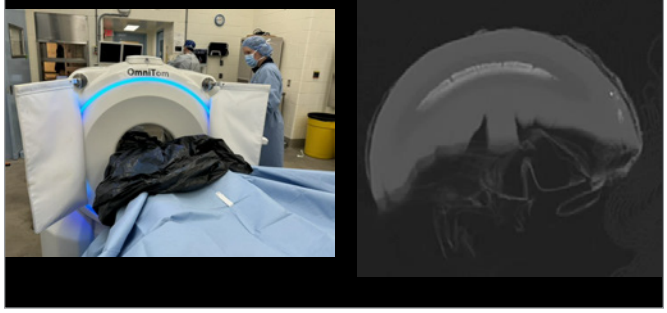


56



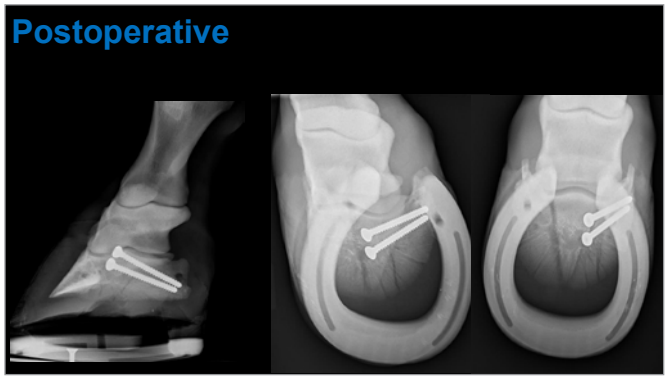
57

Intraoperative CT



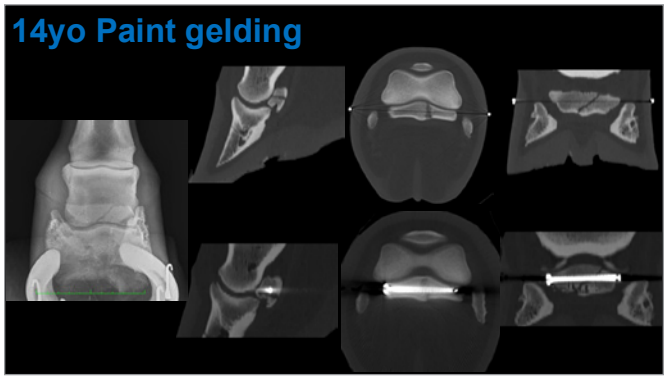
58

Postoperative



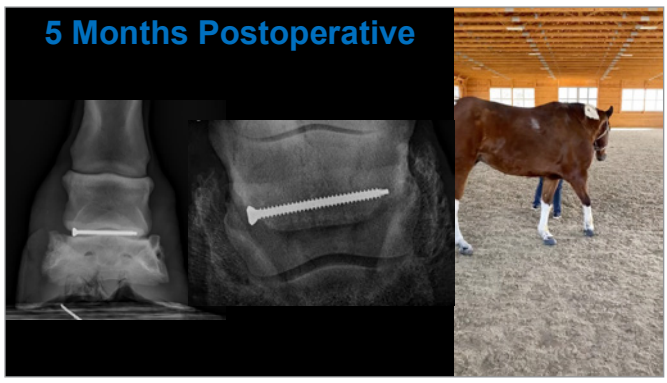
59

14yo Paint gelding



60

5 Months Postoperative



61

Summary

- Major advances in equine imaging in past 20 years
- Improved diagnostic capabilities, therapeutic approaches + outcomes
- Technological advancements require careful evaluation and implementation

62

63

12005

MANAGEMENT OF CERVICAL SPINE DISEASE IN THE EQUINE ATHLETE

EQUINE PROGRAM | ORTHOBIOLOGICS & SPORTS MEDICINE

Kyla Ortved, DVM, PhD, DACVS, DACVSMR

PennVet New Bolton Center
University of Pennsylvania

Management of Cervical Spine Disease in the Equine Athlete

Kyla Ortved, DVM, PhD, DACVS, DACVSMR
Associate Professor of Large Animal Surgery
New Bolton Center, University of Pennsylvania

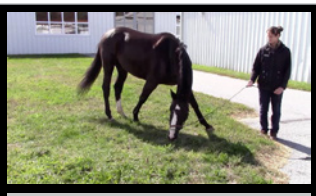
1

Cervical Disease / Dysfunction

Common cause of poor performance:

- Generalized stiffness or neck pain
- Unwillingness to work in a frame or bend
- Ataxia
- Change in attitude
- Forelimb lameness or gait abnormality

2

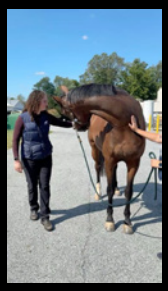


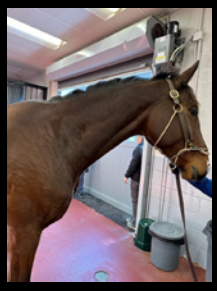
3

Clinical Evaluation

Physical Exam

- Pain, decreased ROM, patchy sweating, atrophy



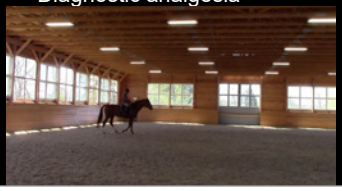


4

Clinical Evaluation

Lameness exam

- Forelimb lameness often with short cranial phase & low arc
- "Hopping" forelimb gait
- Diagnostic analgesia



5

Clinical Evaluation

Neurologic Exam

Grade	Description
0	No neurological deficits
1	Neurological deficits just detected at normal gait, worsened by backing, turning, neck extension
2	Neurological deficits easily detected at the walk and exaggerated by backing, turning, neck extension
3	Neurological deficits prominent at the walk with a tendency to buckle or fall with backing, turning, or neck extension; Postural deficits noted at rest
4	Stumbling, tripping, and falling spontaneously at a normal gait
5	Horse recumbent

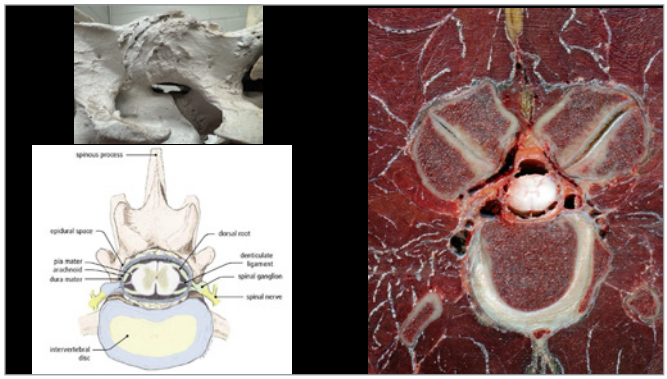
6

Anatomy

7

Anatomy

8



9

Biomechanics

Cranial vertebrae: stress in flexion
Caudal vertebrae: stress in extension

10

Causes of Cervical Pain & Dysfunction

Cervical vertebral stenotic myelopathy (CVSM)
- Type 1: Vertebral malformation and/or malarticulation
- Type 2: Cervical APJ osteoarthritis

Cervical APJ osteoarthritis
- Ataxia, IVF stenosis +/- cervical radiculopathy, pain

Equine Cervical Vertebral Malformation (ECVM)?

OCD

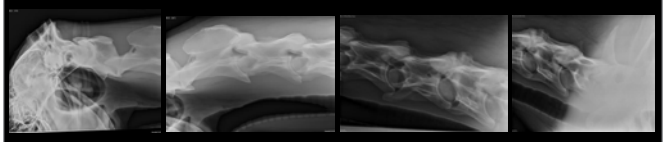
Trauma
- Fracture, subluxation

Intervertebral disc degeneration

Discospondylitis

11

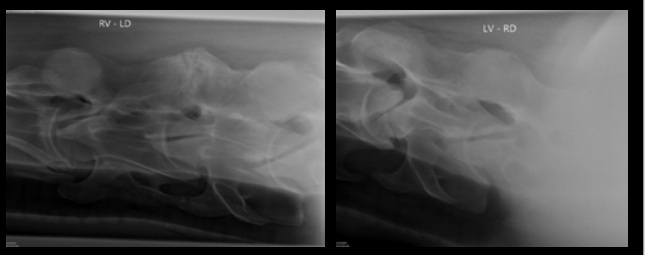
Radiography



Need for oblique projections and/or CT?

12

Oblique Projections



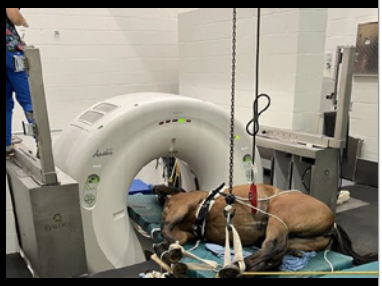
13

CT – Cone Beam

14

CT – Fan Beam

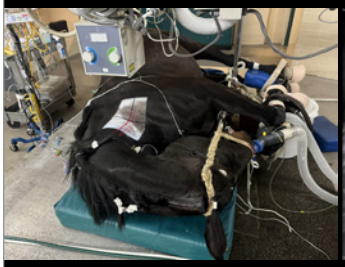
Courtesy of Dr. Gabriel Manso-Diaz

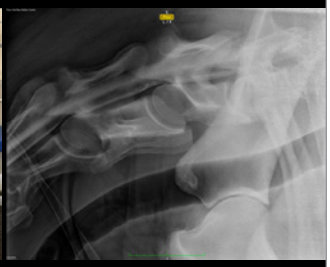


Courtesy of Dr. Travis Tull

15

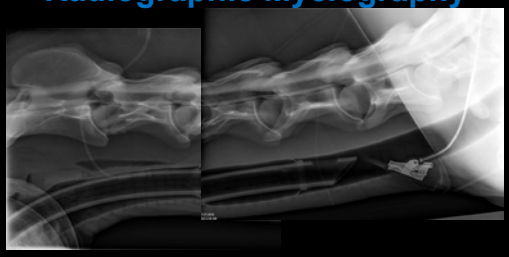
Radiographic Myelogram





16

Radiographic Myelography

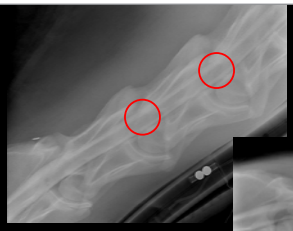


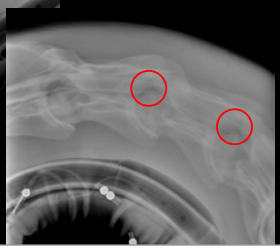
Sites of compression and in which position
Degree of certainty
Need for CT

17

Myelography

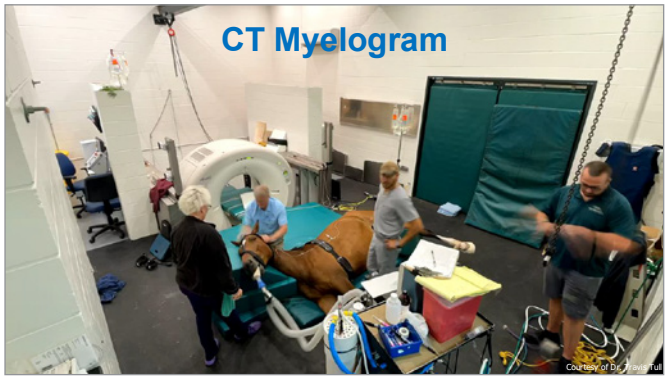
Effect of position





18

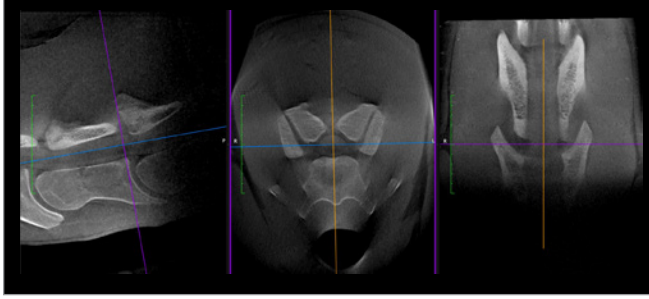
CT Myelogram



Courtesy of Dr. Travis Tull

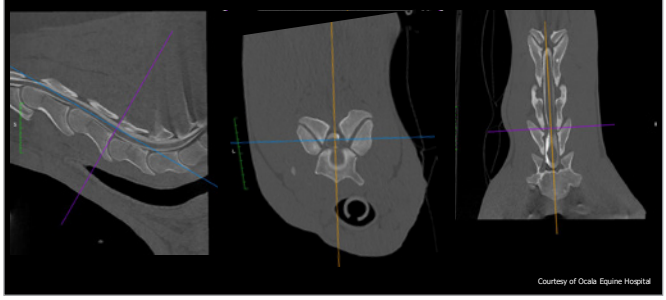
19

CT Myelogram – Standing Cone Beam



20

CT Myelogram – Fan Beam

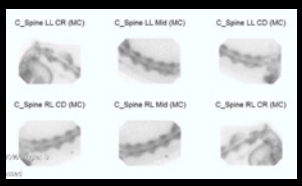


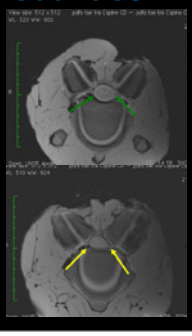
Courtesy of Ocala Equine Hospital

21

Other Imaging Modalities

- Ultrasonography of APJs
- Nuclear scintigraphy
- MRI

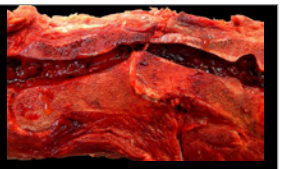


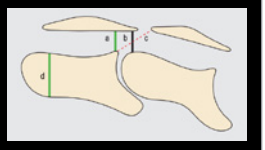


22

CVSM

- **Type 1:** Vertebral malformation and/or malarticulation
- Young horses
- Often dynamic compression
- Assessment of plain radiographs
  - Intervertebral or intravertebral sagittal diameters
  - Subluxation
- Spinal cord compression on myelography





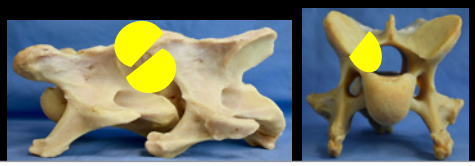
Intra-vertebral & inter-vertebral minimal sagittal diameter

Hahn et al. 2008

23

Cervical APJ Osteoarthritis

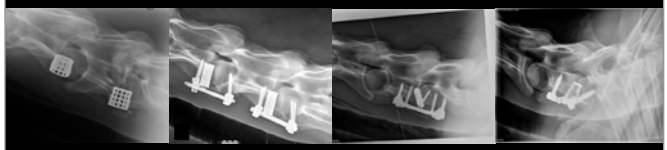
- 2º to developmental orthopedic disease or trauma
- Clinical signs depend largely on location of proliferative soft tissue + bone
  - Dorsal = Pain & stiffness
  - Ventral = Intervertebral foraminal stenosis + cervical radiculopathy
  - Axial = Neurological deficits / Type 2 CVSM
- Many horses with caudal cervical APJ enlargement have no clinical signs (Down+ EVJ 2009)



24

Treatment for CVSM

- Conservative management
  - Controlled exercise + physical therapy, restricted diet, corticosteroids, vitamin E
- Ventral cervical stabilization
  - Several surgical options available



25

Ventral Cervical Stabilization

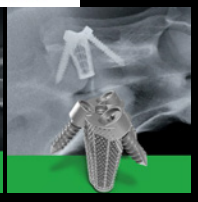
- Relieves dynamic instability immediately
- Improves static compression over time
  - Can induce remodeling of APJs, decreased soft tissue swelling
- Major considerations
  - Number of sites of compression (usually no > 2 sites)
  - Type of compression
  - Severity + duration C/S
  - Temperament + intended use of horse
- Outcomes
  - 6-12 months rehab
  - 85-90% horses improve by 1 grade
  - ~ 60-85% horses return to work

Moore+ JAVMA 1993; Kuhnle+ VCOT 2018' Pezzanite+ EVJ 2022

26

Ventral Cervical Stabilization

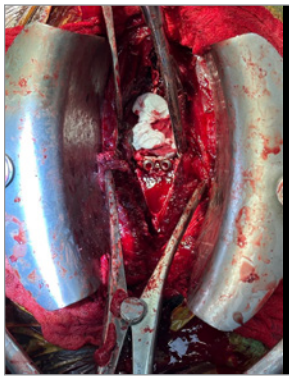
3D HORSE

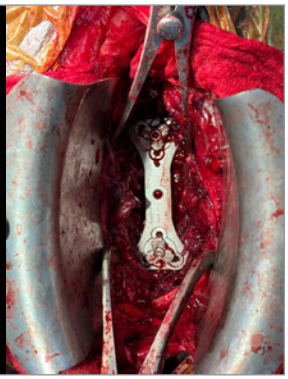


3D printed titanium intervertebral spacer and plate

3D printed titanium intervertebral spacer with screws

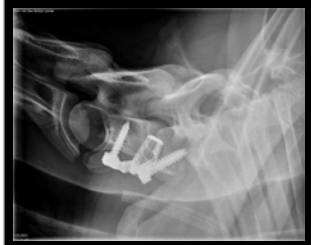
27



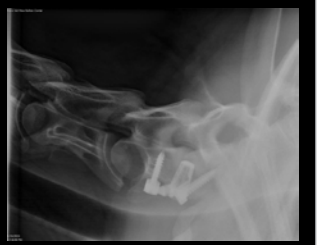


28

Postoperative



Immediate

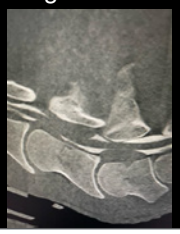


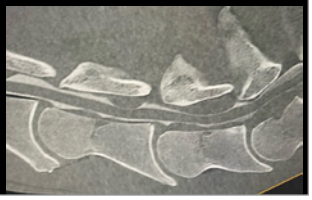
6 Months

29

Uncommon Types of Spinal Cord Compression

- Meningeal cysts
- Synovial enlargement
- Neoplasia

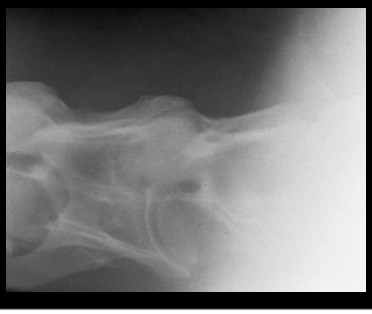




30

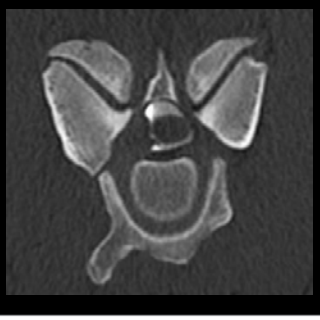
5yo Warmblood gelding

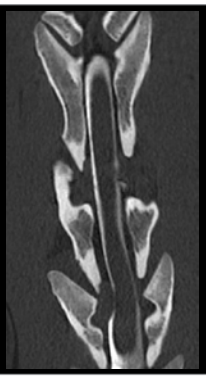
- Grade 2.5/5 hind limb and 2/5 front limb ataxia
- Radiographs showed enlarged APJ C6-7



31

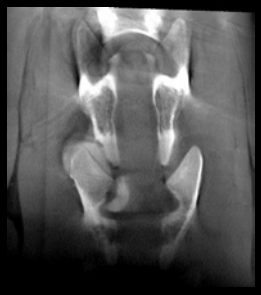
CT Myelogram

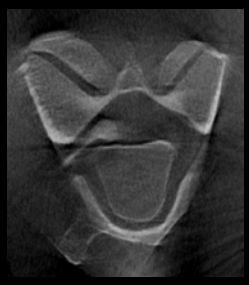




32

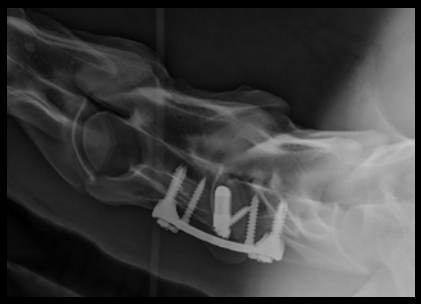
CT Arthrogram – C6-7





33

Ventral Cervical Stabilization

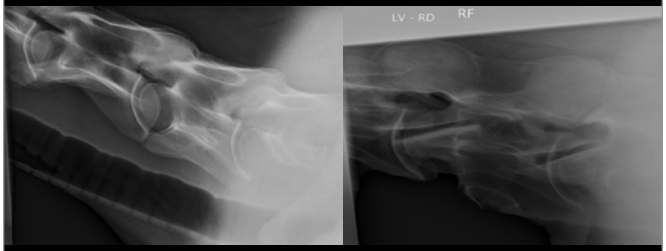


34

Intervertebral Foraminal Stenosis

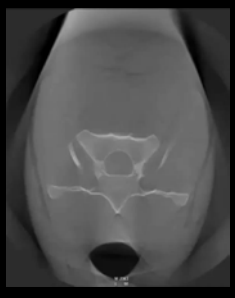
35

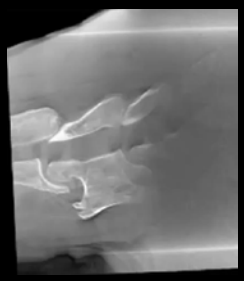
Radiographs



36

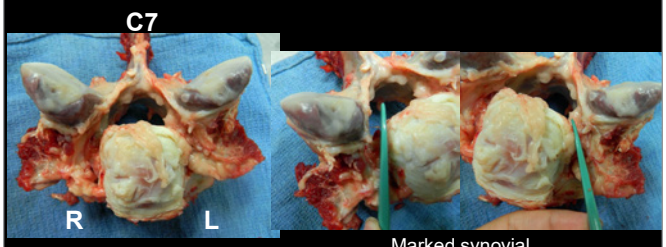
Standing CT





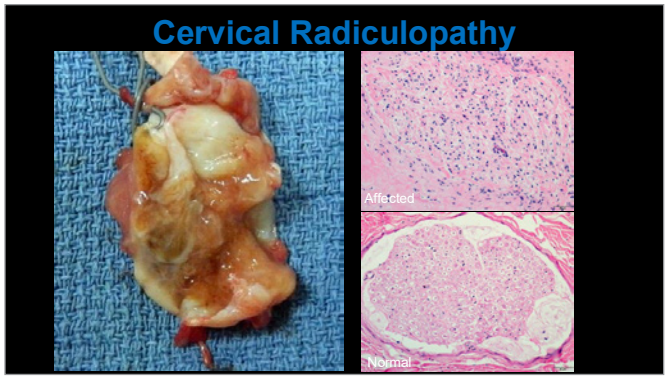
37

Post-mortem

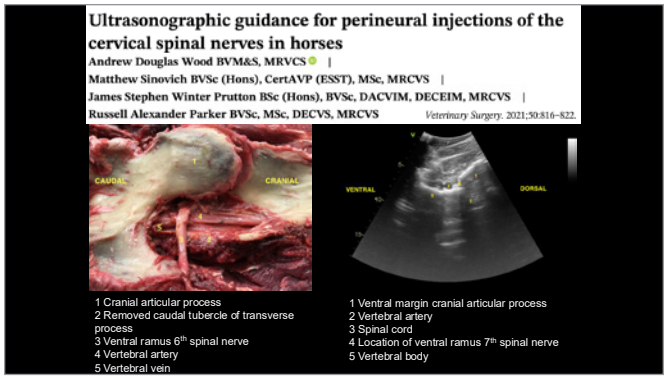


Marked synovial hyperplasia & proliferation

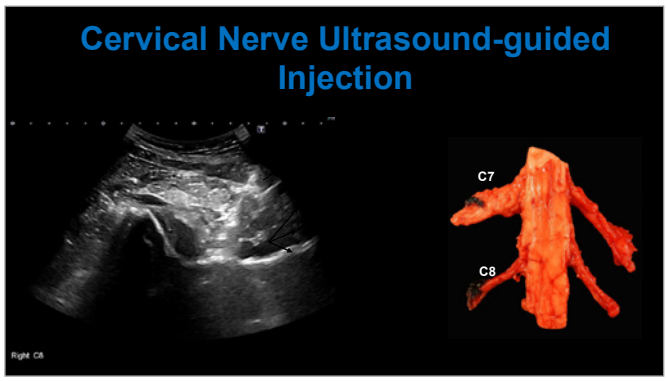
38



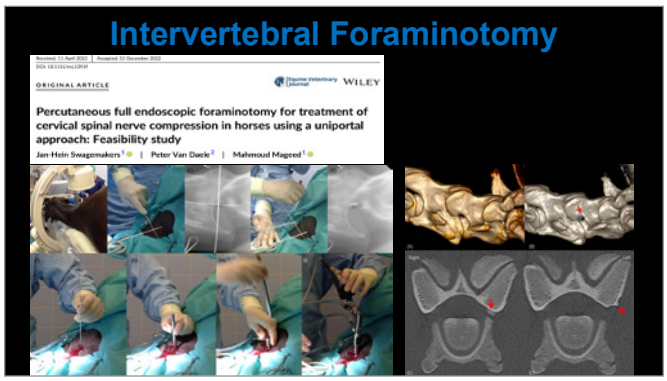
39



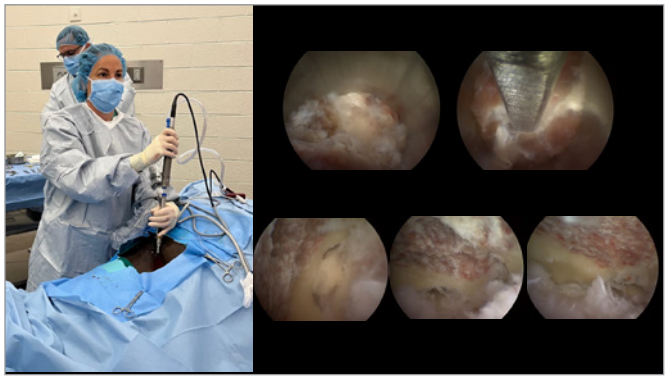
40



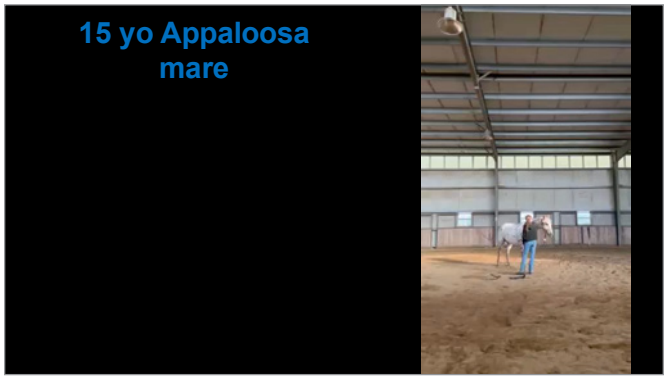
41



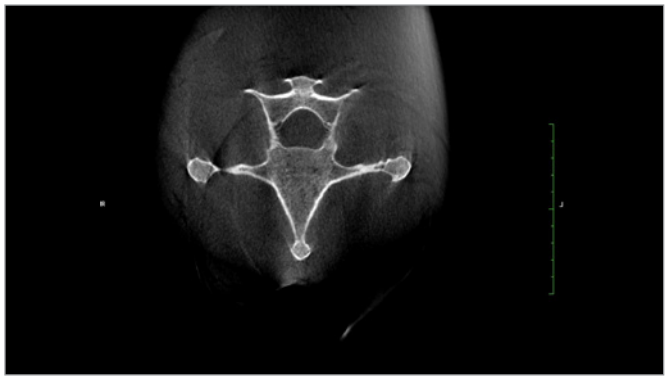
42



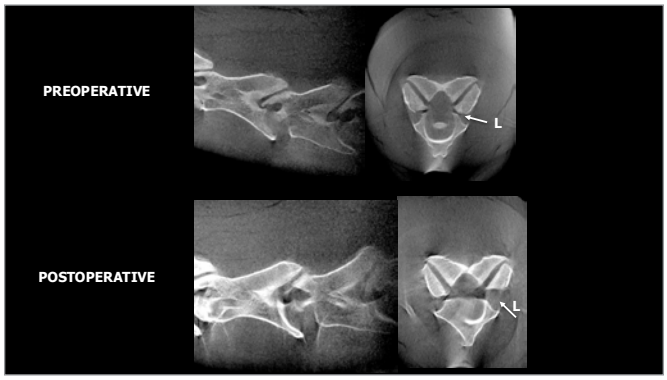
43



44



45



46

Postoperative Management



47

Equine Cervical Vertebral Malformation (ECVM)

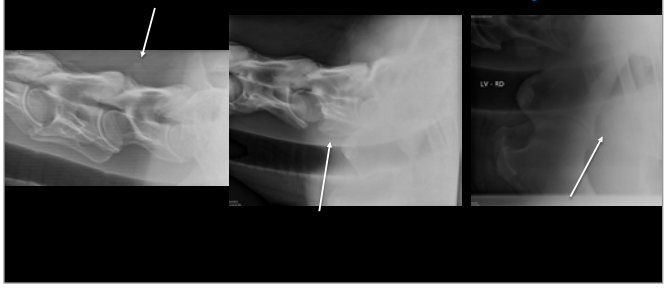
- Developmental variation of the caudal cervical vertebrae
- Prevalence ~ 20-25%
- Most common variation is unilateral left absence of ventral lamina of C6
- Early study suggested association with clinical signs[1] with more recent evidence indicating ECVM is an incidental congenital variant[2,3]
- ECVM variants can affect clinical and/or surgical decision making

[1]Beccati+ EVJ 2021; [2]Dyson+ EVJ 2024; [3]Dyson+ VRU 2024

48

ECVM

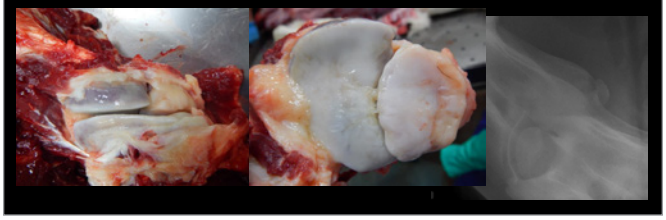
Cervico-thoracobrachial Syndrome



49

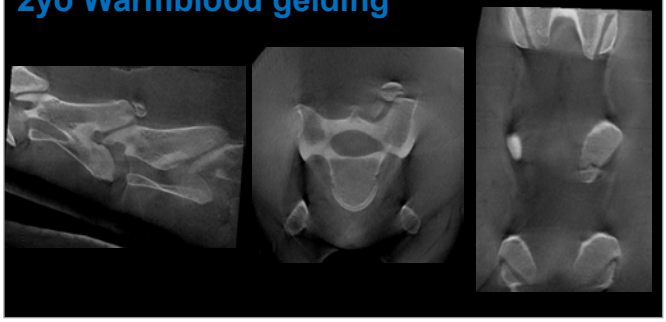
OCD

- Common in the articular process joints
- May be appropriate to remove in younger, less affected joints

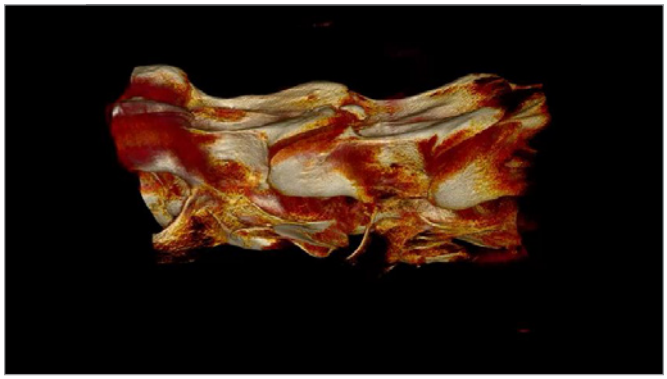


50

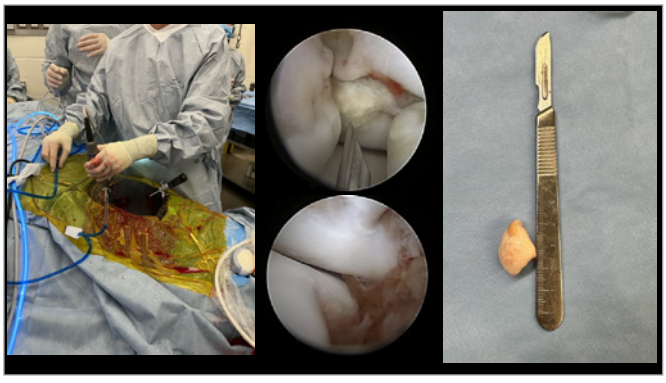
2yo Warmblood gelding



51



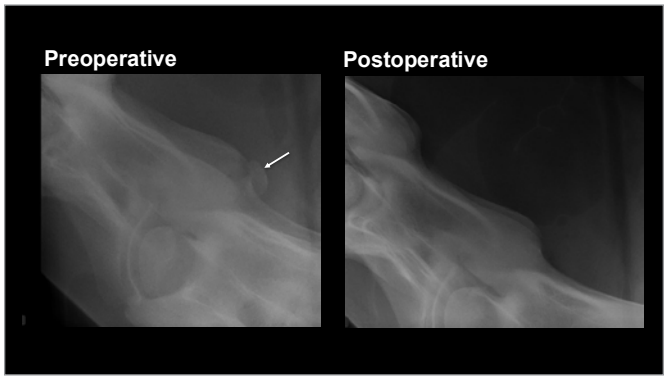
52



53

Preoperative

Postoperative



54

Trauma

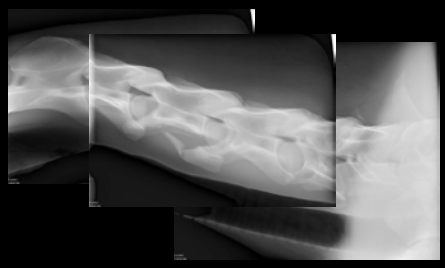
- Subluxations and fractures
- More common in younger horses
- Swelling, pain, variable neurological deficits
- Spinal cord compression
  - Bony
  - Acute hemorrhage & soft tissue swelling
- Conservative treatment common; surgical treatment in few

55

7 TB gelding

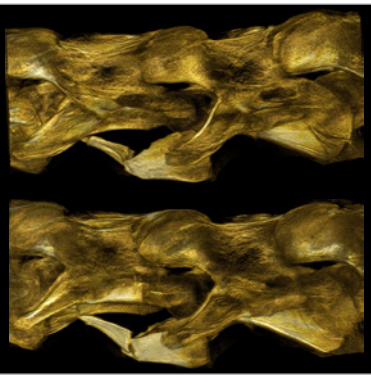
56

Radiography

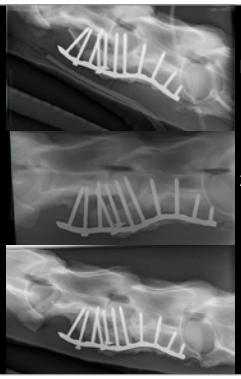


57

Standing CT



58



Post-op

2 mos post-op

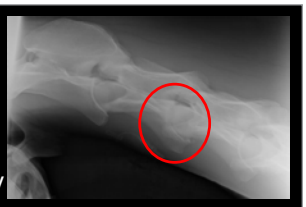
1 yr post-op

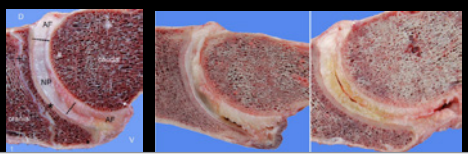
Cervical Ventral Stabilization

59

Intervertebral Disc Disease

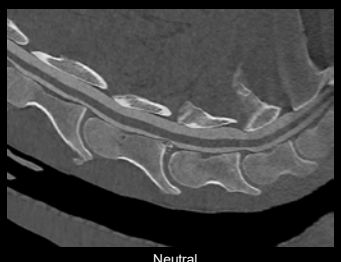
- Uncommon compared to other spp.
- Stiffness of equine disc may play a role



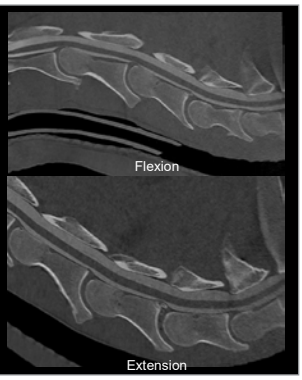


60

IVD Pathology



Neutral



Flexion

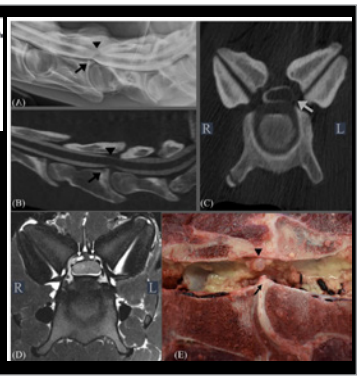
Extension

Courtesy of Dr. Travis Tull

61

Equine intervertebral disc disease with dorsal protrusion and spinal cord compression: A computed tomography, myelography, MRI, and histopathologic case study

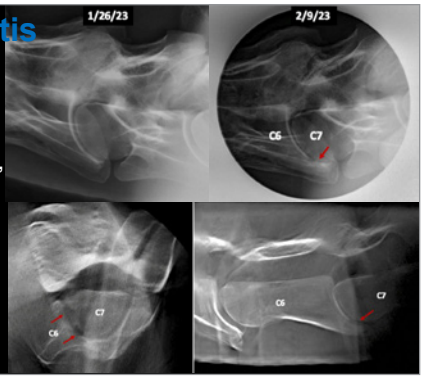
- Difficult to identify radiographically
- CT tends to underestimate
- Caudal cervical spine more commonly affected
- Extension will often worsen



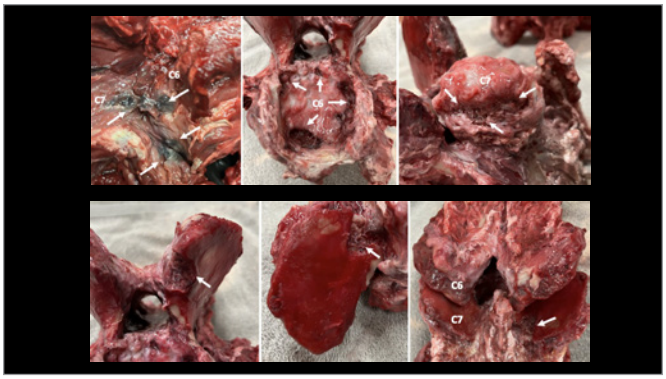
62

Discospondylitis

- 16yo WB gelding
- Severe neck pain, fever, ↑ SAA & fibrinogen 2 weeks after APJ injection



63



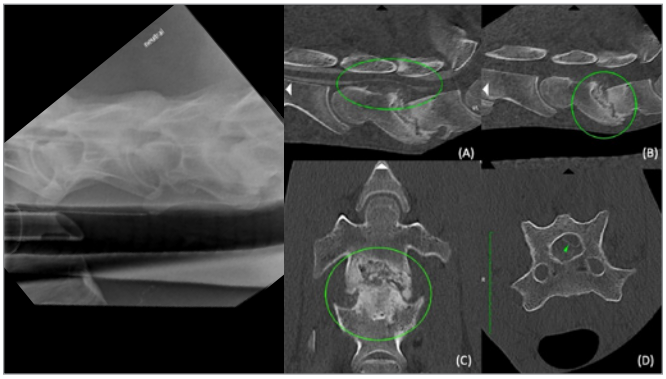
64

4yo Warmblood gelding

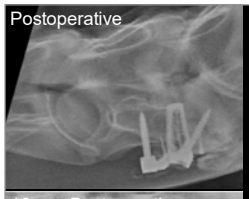
- 14 month history of progressive ataxia
- Neck pain and ↓ ROM

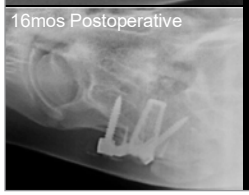
3D-printed titanium cervical integrated spacer for C6–C7 fusion in a horse with discospondylitis

65



66





67

Summary

- Cervical spine pathology common
- Many more treatment options available
- Advanced imaging can be critical in correct diagnosis, guiding treatment, + evaluating outcomes

68

69

PRACTICE MANAGEMENT PROGRAM

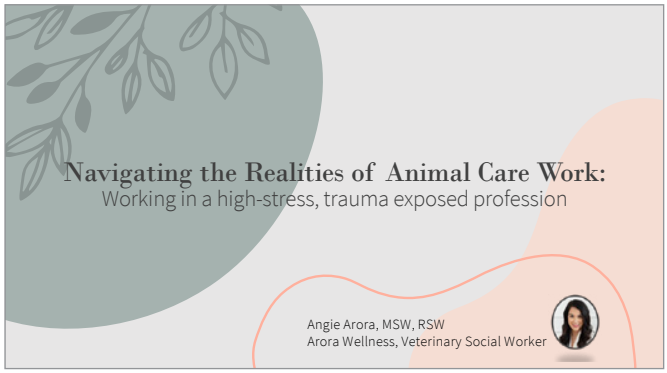
ONTARIO VETERINARY MEDICAL ASSOCIATION

13001

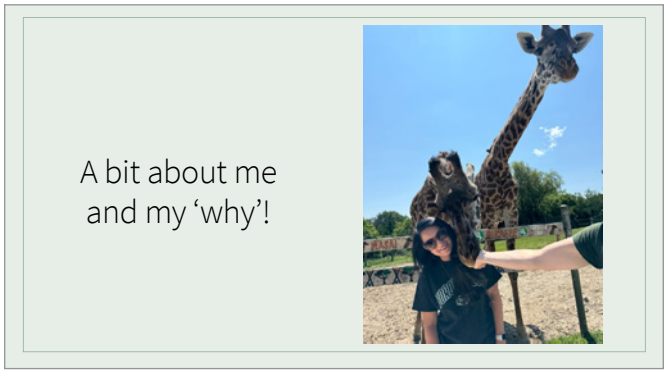
NAVIGATING THE REALITIES OF ANIMAL CARE WORK

PRACTICE MANAGEMENT PROGRAM | INSIDE VETERINARY WELL-BEINGE

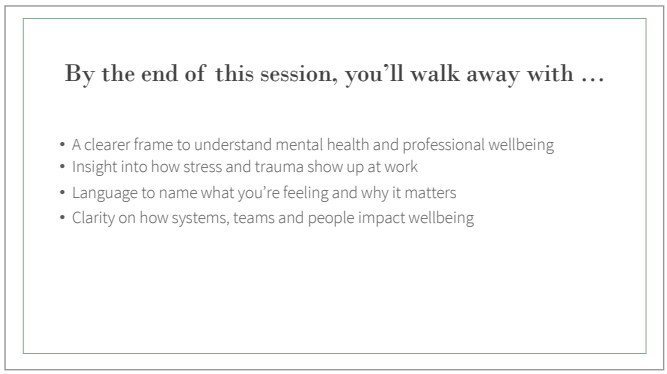
Angie Arora, MSW, RSW



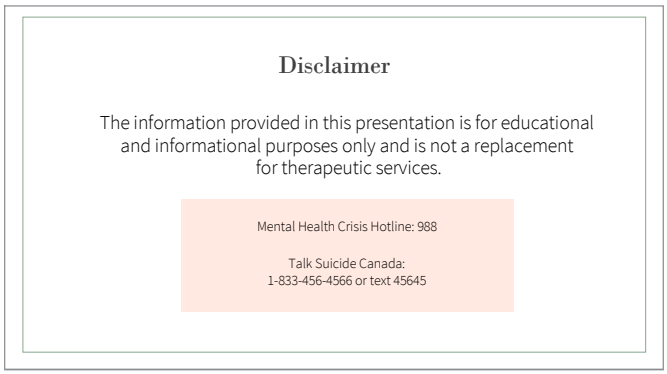
1



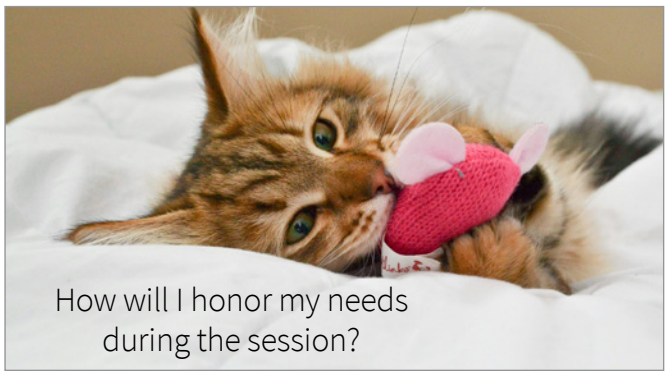
2



3



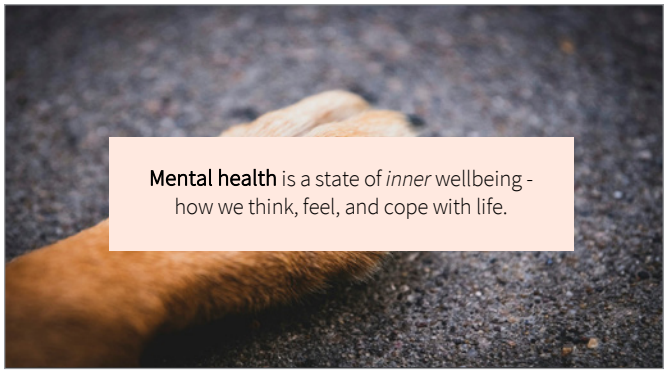
4



5

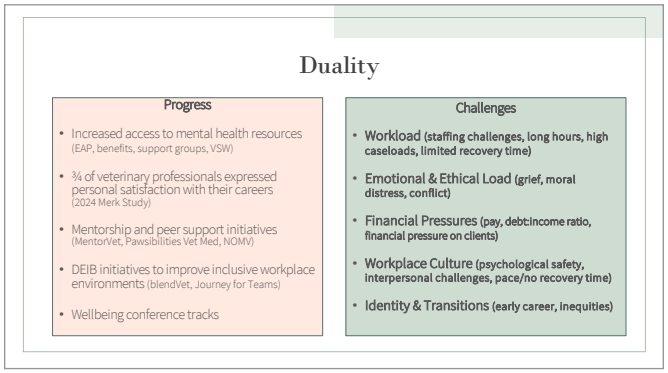
6

7

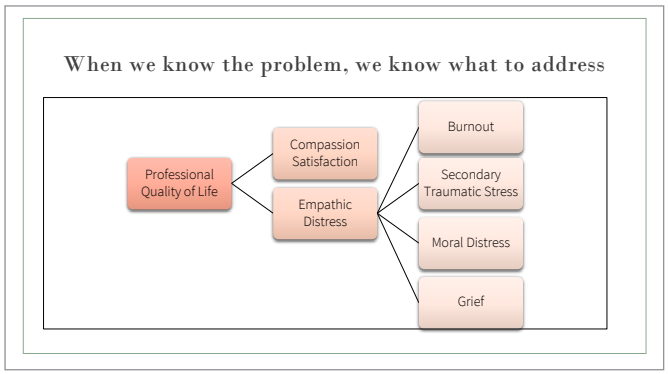


8

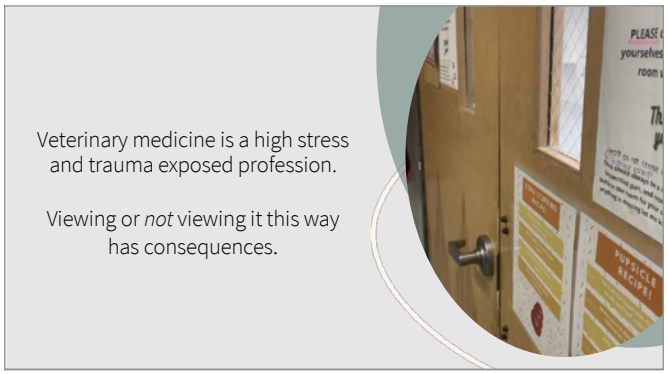
9



10

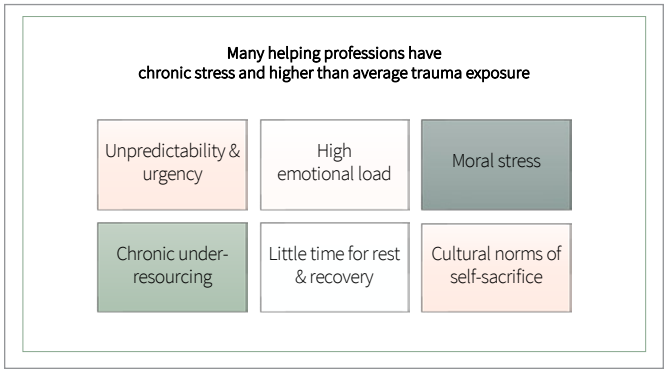


11



12

13

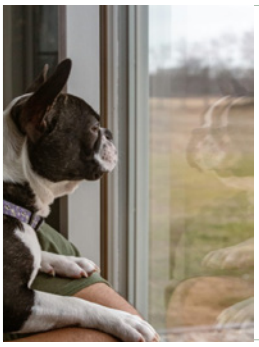


14

I Came for the Animals …

… and much of the stress comes from interactions and relationships with humans

15



We need to co-create systems-care, team-care & self-care

16

Impacts of High-Stress, Trauma Exposed Work

17

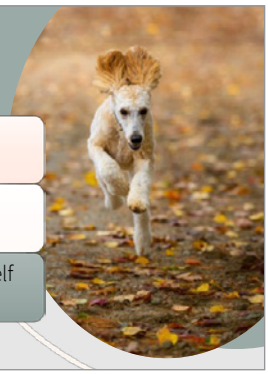
Disconnection

- Emotionally (numbness, irritability)
- Physically (tension, fatigue, pain)
- Relationally (withdrawal, conflict)
- Professionally (dread, resentment)

18

"Overconnection"

- Unable to shut off the 'thinking' mind
- Empathy may become overstretched
- Barriers to impact impacts sense of self worth



19

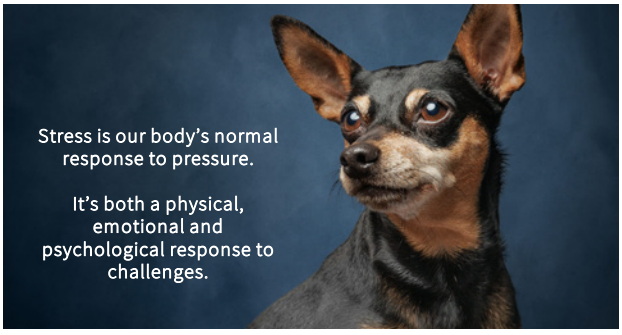
Survival stress becomes the baseline

20

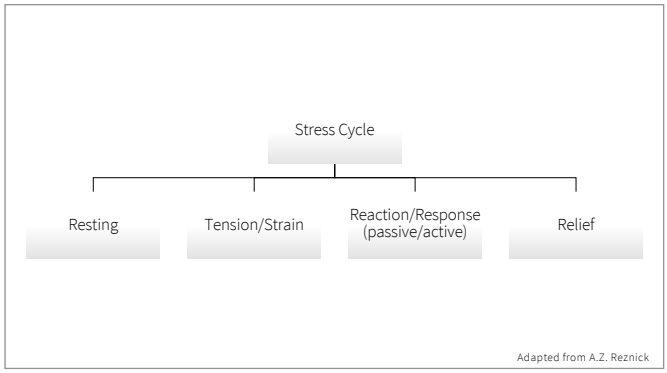
Types of Stress

Acute (short-term)	Eustress	energizing or motivating (e.g. successful CPR)
	Distress	intense or upsetting, but still manageable (e.g. upset client)
	Traumatic	high-intensity that overwhelms capacity to cope (e.g. patient death by error)
Chronic (prolonged, cumulative)	Eustress	long-term challenge that remains engaging and manageable with adequate support (rare)
	Distress	ongoing stress without adequate recovery that contributes to burnout (e.g. chronic understaffing, emotional labour without breaks)
	Traumatic	Repeated trauma exposure without time, tools, or support to process it (e.g., ongoing exposure to moral injury leading to feelings of powerlessness)

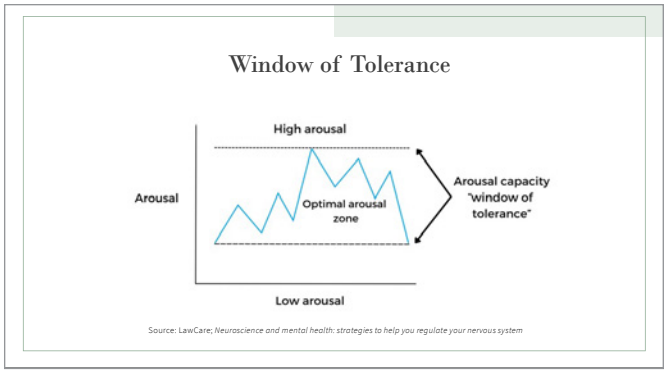
21



22



23

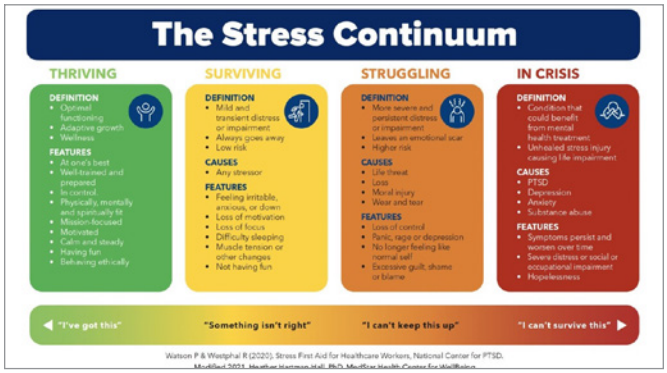


24

Chronic Stress

Physical	Emotional	Psychological
Sleep disturbances (insomnia, poor quality, excessive fatigue)	Irritability and anger (short temper)	Memory impairment (short-term recall and concentration impacted)
Reduced immune function (high susceptibility to infections)	Mood swings (frequent, unpredictable shifts in emotional state)	Poor decision making (impulsive or overly cautious)
Cardiovascular issues (increased risk for high blood pressure, heart disease, stroke)	Chronic anxiety (persistent worry, fear unrelated to immediate threats)	Rumination (loop of repeated negative thoughts)
Gastrointestinal Problems (stomach pain, nausea, IBS)	Emotional numbness (detached, checked out as a protective mechanism)	Intrusive thoughts (common in trauma-exposed fields)
Musculoskeletal Pain (chronic tension – headaches, back pain)		Perceived loss of control (feeling powerless or stuck in the face of challenges)

25



26

Impacts on Teams & Organizations

- Dysregulated behaviours
- Inability to repair conflict
- Lack of psychological safety (blame culture, voices silenced)
- Presentism
- Decreased quality of care
- Missed opportunities for learning and growth
- Absenteeism
- Turnover
- Reputational harm

27

Responding is a shared responsibility

28

Because workplace settings like veterinary medicine can be high-stress and trauma-exposed, we must understand how this impacts people and respond accordingly.

29

Organization	Psychological Health & Safety Trauma-Informed Culture & Care
Team	Debriefing Pathways Grounded Conversations Psychological Safety Interpersonal Effectiveness Conflict Repair
Person	Stress Management Nervous System Health Emotional Regulation Personal Identity Development Healthy Boundaries Moral Assurance & Repair

30


How are you already contributing?
What more can you do?
What's your next best step?

31


@VETERINARYWELLBEINGCOACH
Angie Arora, MSW, RSW
Arora Wellness
Veterinary Social Worker
angie@arorawellness.ca
www.arorawellness.ca

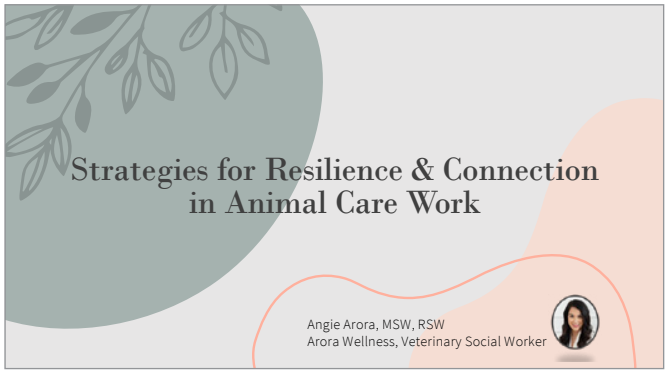
32

13002

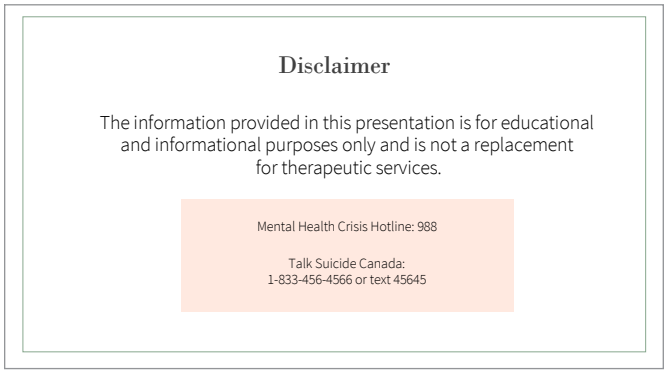
STRATEGIES FOR RESILIENCE AND CONNECTION IN ANIMAL CARE WORK

PRACTICE MANAGEMENT PROGRAM | INSIDE VETERINARY WELL-BEINGE

Angie Arora, MSW, RSW



1

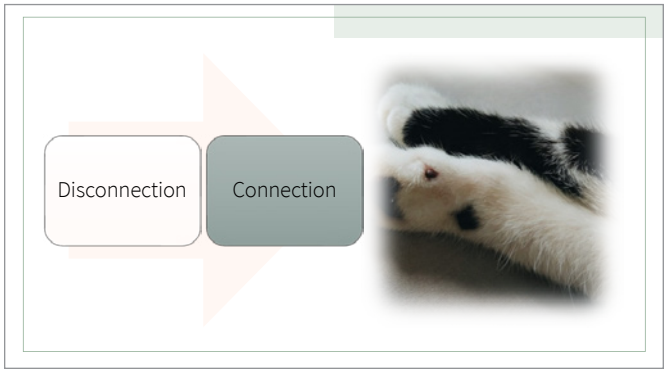


2

3

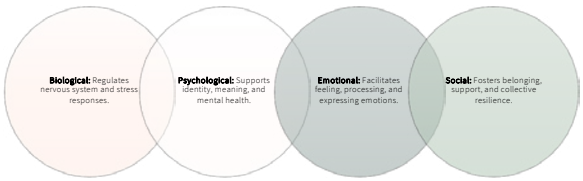
4

5



6

Connection:
A need – not a nice to have



7

Defining Connection

Connection exists **within us** and **between us.**

How we connect with ourselves
Our sense of belonging with others
Feeling aligned with work, purpose, nature, community

8

Introducing a Trifocal Approach to Professional Wellbeing

9

Organization	Psychological Health & Safety Trauma-Informed Culture & Care
Team	Debriefing Pathways Grounded Conversations Psychological Safety Interpersonal Effectiveness Conflict Repair
Person	Stress Management Nervous System Health Emotional Regulation Personal Identity Development Healthy Boundaries Moral Assurance & Repair

10

Organizational Responsibilities

11

Psychological Health & Safety

A psychologically healthy and safe workplace is one that "**promotes** workers' psychological well-being and actively works to **prevent** harm to worker psychological health, including neglect, reckless, or intentional ways."

-Mental Health Commission of Canada

12

PPE is needed in *any* workplace where stress and trauma exposure is high

13

Holistic Safety

Physical Safety
Psychological Safety
Psychological Competencies

14

15

16

Resources

Hidden Struggles of Veterinary Professionals (Podcast)
https://www.youtube.com/watch?v=mcY3dTkPORI

Tracking the Perfect Legal Storm
https://www.mentalhealthcommission.ca/wp-content/uploads/drupal/document_tracking_the_Perfect_Legal_Storm_ENG_0_1.pdf

Mental Health Commission of Canada's National Standards on Psychological Health & Safety
https://mentalhealthcommission.ca/national-standard/
https://mentalhealthcommission.ca/implementing-the-standard/

Workplace Strategies for Mental Health
https://www.workplacestrategiesformentalhealth.com/

Psychologically Safe Leader Assessment
https://psychologicallysafeleader.com/

17

Trauma-Informed Workplace

Understands the widespread impact of trauma and how it impacts people
+
Responds by integrating knowledge about trauma into policies, procedures and practices

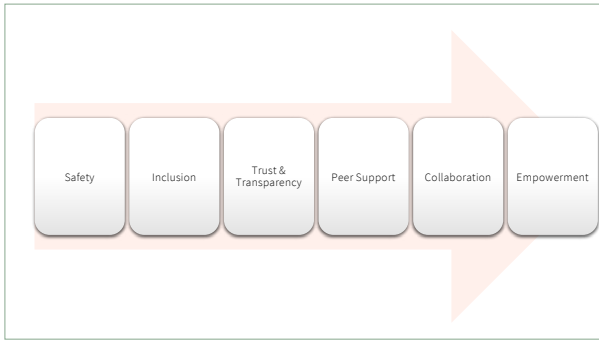
Adopted from Substance Abuse and Mental Health Services (SAMHSA)

18

Veterinary trauma exposure
is often not about one big event.

It's the accumulation of daily moral distress, emotional strain, and high-stakes caregiving – without the buffer of time, space, or support to recover.

19



20

Resources

SAMHSA:
https://library.samhsa.gov/product/samhsas-concept-trauma-andguidance-trauma-informed-approach/sma14-4884

Vancouver Humane Society:
https://vancouverhumanesociety.bc.ca/trauma-informed-training/

NOMV/Angie Arora Trauma-Informed Care:
https://nomv.org/2023/06/07/trauma-informed-care-in-vet-med/

21

Team Responsibilities

22

Debriefing & Grounded Conversations

Psychological Safety

Interpersonal Effectiveness

Conflict Repair

23

Psychological Safety

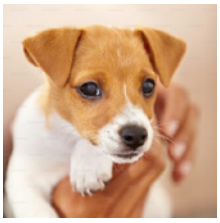
Inclusion Safety	I can show up to work as my full self and feel accepted
Learner Safety	No question is perceived or treated as 'dumb' Full, safe exploration of ideas is possible
Contributor Safety	I feel empowered with autonomy, guidance and encouragement so I can contribute to my workplace
Challenger Safety	The status quo can be challenged for the sake of improvement. Constructive feedback is part of the culture, is provided effectively and received safely.

Begin by addressing how mistakes are handled and how feedback is given and received

24

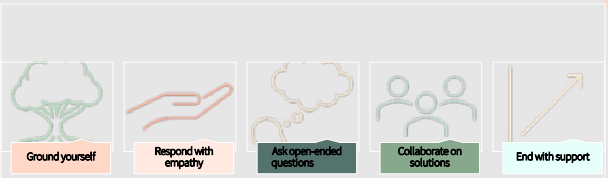
How have I been treated when I've made mistakes ….

- Growing up
- School
- Previous places of employment
- At work



25

Low-Impact Mistakes: GRACE



Arora Wellness ©

26

High-Impact Mistakes

A team or organizational process is required, and should include either debriefing, and more specifically a CISD if traumatic in nature

27

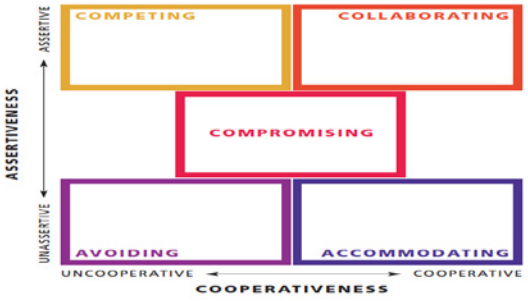
Conflict

Personality Conflicts	Most common Hard to avoid
Task-Based Conflicts	When things don't go perfectly across the cross-functional processes within the workplace
Style-Based Conflicts	We each have different styles of working and they don't always align
Leadership-Style Conflicts	Mismatch of leadership style to learning/growth needs

Source: Wrike

28

Thomas-Kilmann Conflict Mode Instrument



29

"Relational integrity is the commitment to show up in relationship in a way that honors your own values and the humanity of the other person – even when things are hard, uncomfortable, or unclear. It's built one moment, one rupture at a time through consistent practice"

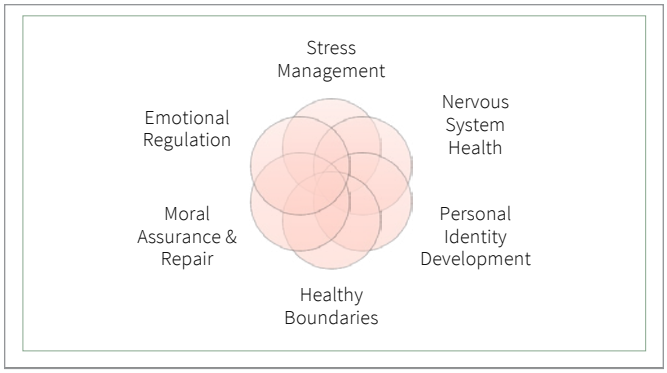
–Lindsey Lockett

https://lindseylockett.com/product/guide-to-rupture-repair/

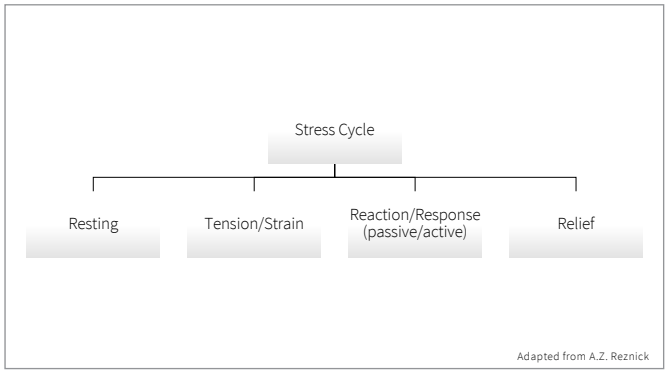
30

Individual Responsibilities

31



32



33

Micro Moments of Recovery

Ventral Vagal	Maintenance Practices: Mindful sensory experiencing, Self-soothing, Breath awareness, Light movement
Fight	Releasing Excess Energy: Intense movement, Double-breath, Cooling strategies, Sour candy, Physical pressure
Flight	Grounding & Slowing: 5-4-3-2-1/Colors of the rainbow, Longer exhale, Feet on ground, Easeful movement
Freeze	Small, Gentle Activations: Light movement, sensory stimulation Releasing Excess Energy
Dorsal Vagal/ Shutdown	Reconnection Practices: Nature, Gentle movement, Warm physical pressure, Humming, Visualization

34

Resources

Irene Lyon
https://irenelyon.com/

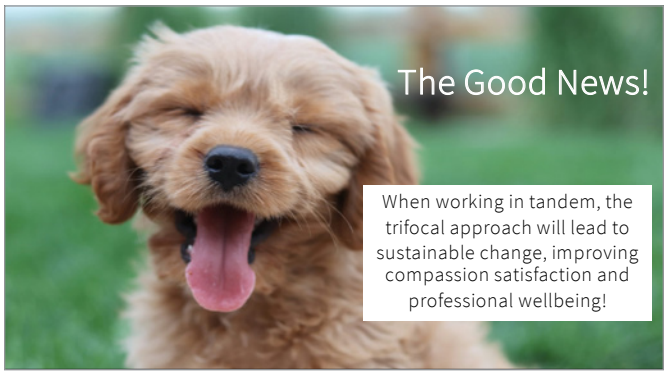
Jessica Maguire
https://www.jessicamaguire.com/

Lexy Florentina
https://lexyflorentina.com/

Somatic Experiencing
https://traumahealing.org/

SomaShare
https://www.somashare.com/

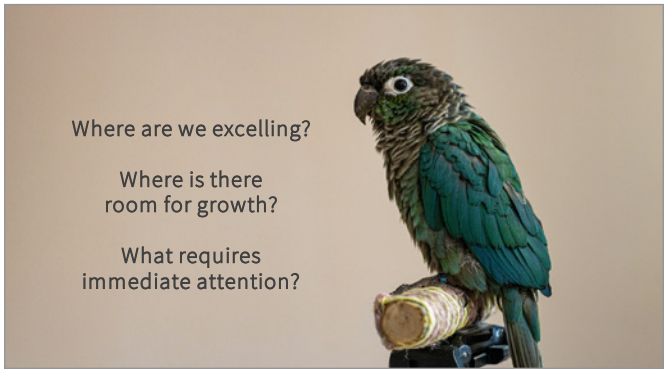
35



36

Organization	Psychological Health & Safety Trauma-Informed Culture & Care
Team	Debriefing Pathways Grounded Conversations Psychological Safety Interpersonal Effectiveness Conflict Repair
Person	Stress Management Nervous System Health Emotional Regulation Personal Identity Development Healthy Boundaries Moral Assurance & Repair

37



38


@VETERINARYWELLBEINGCOACH
Angie Arora, MSW, RSW
Arora Wellness
Veterinary Social Worker
angie@angiearora.com
www.angiearora.com

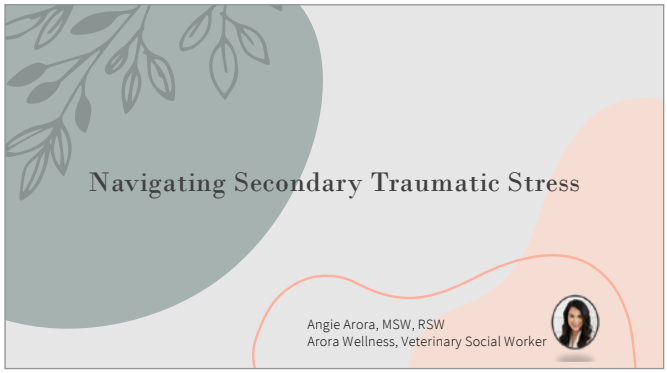
39

13003

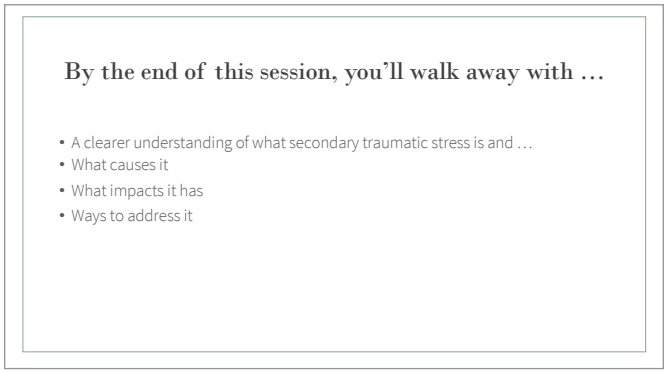
NAVIGATING SECONDARY TRAUMATIC STRESS

PRACTICE MANAGEMENT PROGRAM | INSIDE VETERINARY WELL-BEINGE

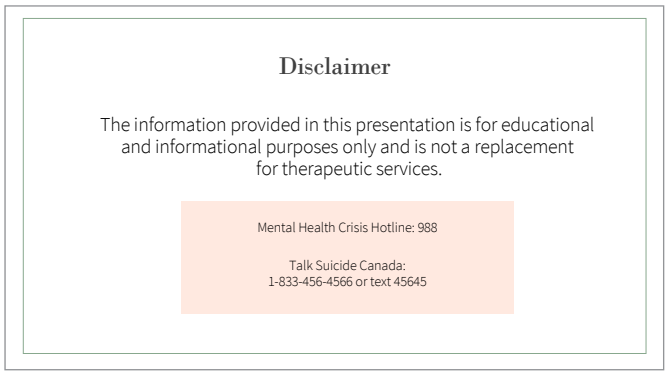
Angie Arora, MSW, RSW



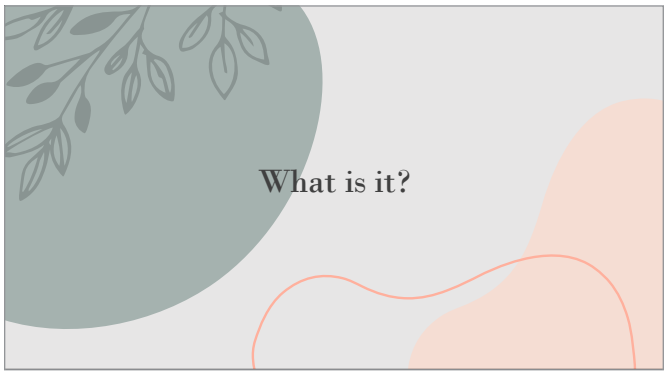
1



2

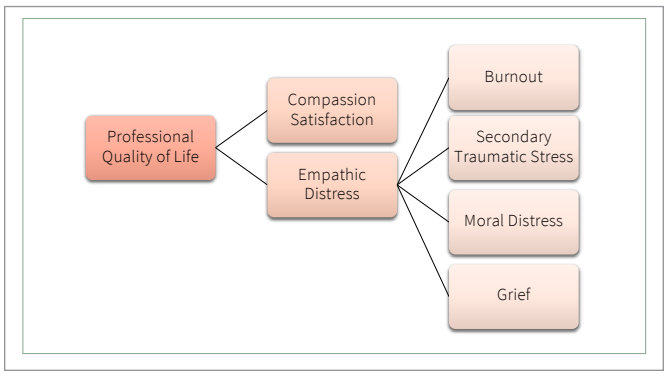


3



4

5



6

Secondary Traumatic Stress

Indirect exposure to difficult, disturbing and/or traumatic information of the suffering of others – humans, animals, communities, the ecosystem – and the way that it might impact us as individuals and professionals

7

A Personal Story

8

Examples of Exposure

- Animal cruelty & human suffering (direct witnessing, hearing stories, seeing surveillance)
- Environmental suffering
- Traumatic deaths (animals, humans)
- Euthanasia (under conditions of moral distress; dysthanasias)
- Discrimination & oppression

9

What causes it?

10

Risk Factors

- COMPLEX TRAUMA
- SOCIAL ISOLATION
- EMOTIONAL SUPPRESSION
- INEFFECTIVE SUPERVISION
- LACK OF APPROPRIATE TEAM SUPPORT

11

Until we recognize it as an occupational stressor, it will continue to be an *unmanaged* factor impacting people's mental health and professional wellbeing

12

What are its impacts?

13

Impacts on Professionals

Emotional	Physical	Cognitive
Nervous system dysregulation (adaptive survival patterns)	Somatization	Cognitive distortions
Hypervigilance, Avoidance, Numbing, Withdrawal	Sleep disturbances (nightmares)	Intrusive thoughts/rumination/ flashbacks
	Fatigue	Shifts in worldviews

https://www.ncbi.nlm.nih.gov/books/NBK207201/

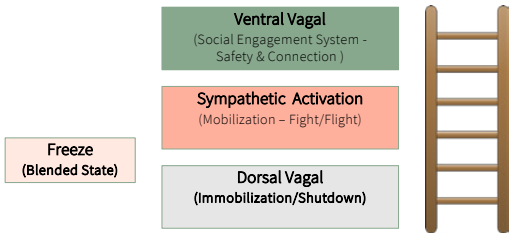
14

Impacts of Chronic Stress & Trauma

Corticolimbic System:
Part of the central nervous system, it's the brain's stress and emotion hub
(detects danger, remembers context, and helps us regulate our response)

15

The Nervous System

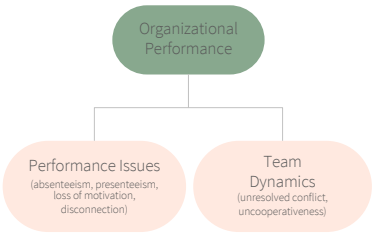


16

This can lead to decontextualized behaviours which impact teams

17

Impacts on Teams



18

So how do we address it?

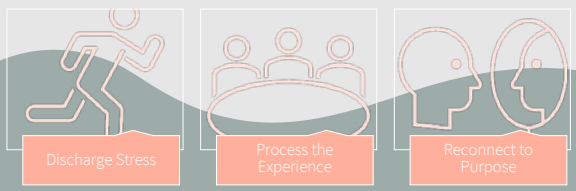
19

An Integrated Healing Formula

Level	Focus	Core Practices
Body	Discharge stress	Grounding practices & micro recovery
Mind	Process the experience	Reflective debriefs, effective supervision
Relationship	Restore connection	Peer support, psychologically safe culture
System	Create conditions for sustainability	Workload management, policies, trauma-informed leadership
Spirit	Reconnect to purpose	Values alignment, gratitude, meaning-making

20

My Top 3



21

Discharge Stress

Body & Breath	Quick stretch or body scan Mindful drinking/eating Conscious breathwork
Senses & Presence	Sensory rest Grounding techniques (use senses)
Movement & Release	Easeful (stretch, slow walk, sway) Releasing (shake, dance, brisk movement, psychological sigh)
Connection & Regulation	Self-sooth (self touch, humming, singing, warmth) Co-regulate Nature breaks
Mind & Energy Shifts	Switch task or environment Acknowledge something that's going well Transitional moments

22

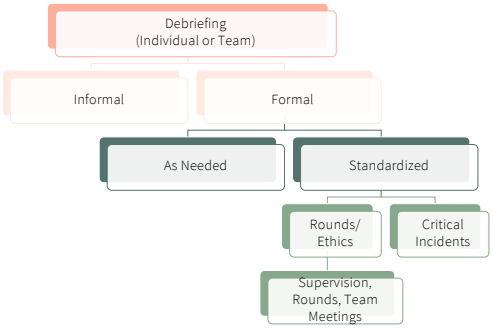
Process the Experience

Venting	Sliming	Debriefing
Expressing oneself without seeking solutions or feedback	Sharing traumatic or graphic details without warning or permission, leaving the listener feeling burdened and/or overwhelmed (TEND Academy)	Structured process where individuals or teams discuss and process stressful or traumatic events in a supportive environment to foster growth and wellbeing

23

- Am I seeking consent?
- How much time do we have?
- How regulated am I?
- Do I want to Share or Solution?
- What's my bandwidth to receive
- Set a time limit
- Check-in with self after

24



Arora Wellness ©

25

Reconnect to Purpose

26

What's your greatest takeaway?

What's your next best step(s)?

27

Nervous System Health Resources

Irene Lyon
https://irenelyon.com/

Jessica Maguire
https://www.jessicamaguire.com/

Lexy Florentina
https://lexyflorentina.com/

Somatic Experiencing
https://traumahealing.org/

SomaShare
https://www.somashare.com/

28

Resources

Low Impact Debriefing
https://tendtoolkit.com/low-impact-debriefing-strategy/

Critical Incident Debriefing
https://www.betterhelp.com/advice/stress/the-7-steps-of-critical-incident-stress-debriefing-and-how-they-support-trauma-recovery/

https://wcb.ab.ca/assets/pdfs/employers/EES_Critical_incidents_management_and_stress_debriefing.pdf

29

@VETERINARYWELLBEINGCOACH

Angie Arora, MSW, RSW
Arora Wellness
Veterinary Social Worker
angie@angiearora.com
www.angiearora.com

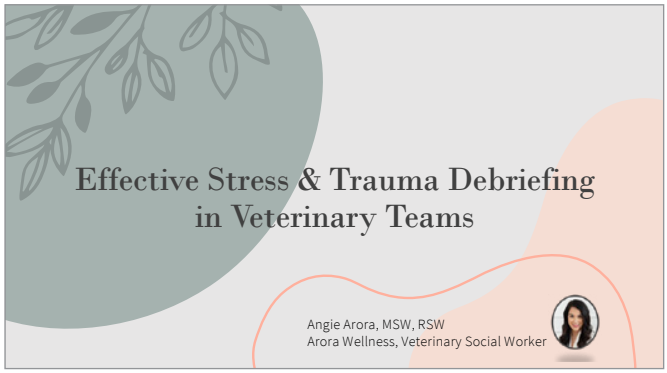
30

13004

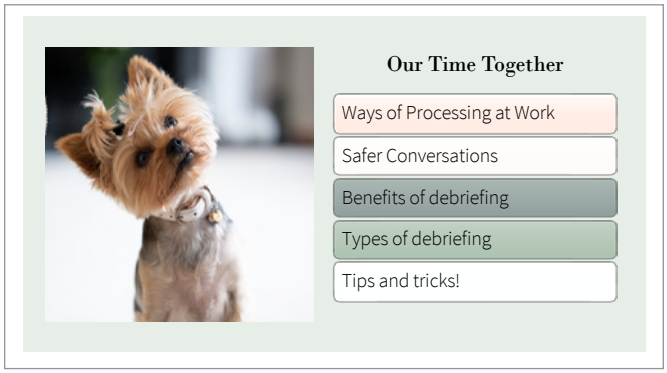
EFFECTIVE STRESS & TRAUMA DEBRIEFING IN VETERINARY TEAMS

PRACTICE MANAGEMENT PROGRAM | INSIDE VETERINARY WELL-BEINGE

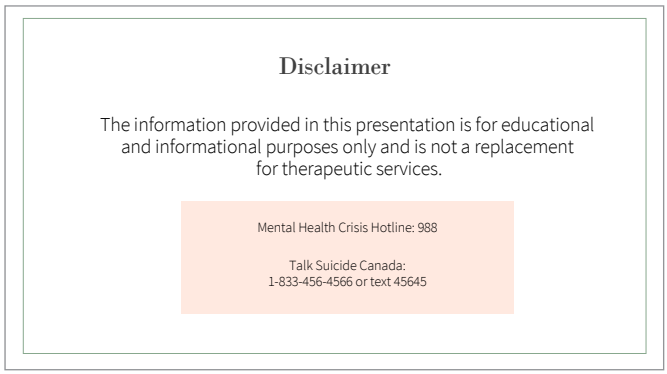
Angie Arora, MSW, RSW



1



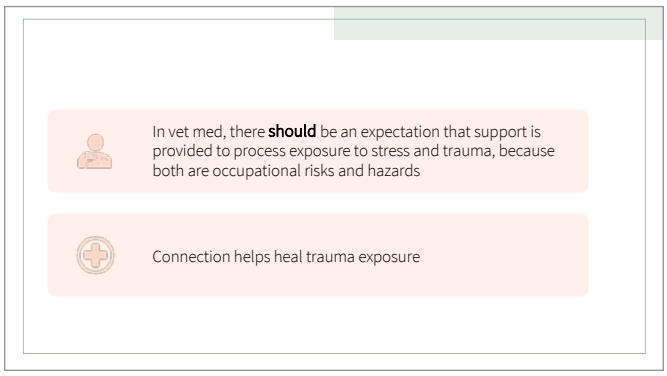
2



3

4

5



6

Impacts of Chronic Stress & Trauma

Corticolimbic System:
Part of the central nervous system, it's the brain's stress and emotion hub (detects danger, remembers context, and helps us regulate our response)

Memory Saver
Hippocampus

Security Guard
Amygdala

Wise Leader
Pre-frontal cortex

7

The Nervous System

Ventral Vagal
(Social Engagement System - Safety & Connection)

Sympathetic Activation
(Mobilization – Fight/Flight)

Freeze
(Blended State)

Dorsal Vagal
(Immobilization/Shutdown)

8

Processing Supports Recovery After Stress & Trauma

Integrates the experience
- Moves memory from implicit (felt) to explicit (processed) memory
- Reduces rumination

Validates emotional responses
- Normalizes stress reactions
- Reduces isolation and shame

Fosters connection and safety
- Rebuilds a sense of belonging
- Encourages collective meaning making

9

Ways of Processing at Work: Venting, Sliming, Debriefing

10

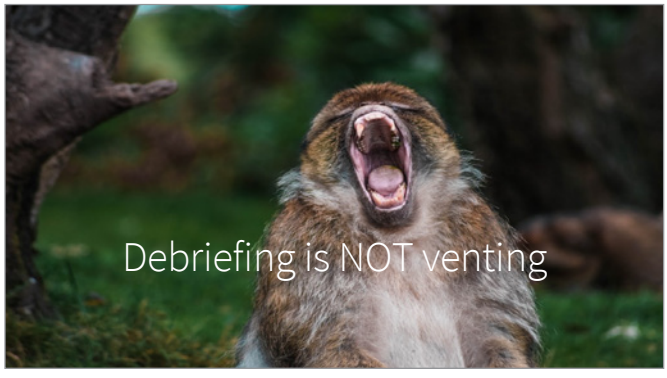
Venting	Sliming	Debriefing
Expressing oneself without seeking solutions or feedback	Sharing traumatic or graphic details without warning or permission, leaving the listener feeling burdened and/or overwhelmed (TEND Academy)	Structured process where individuals or teams discuss and process stressful or traumatic events in a supportive environment to foster growth and wellbeing

11

Tips for grounded conversations

- Am I seeking consent?
- What's my bandwidth to receive
- How much time do we have?
- Do I want to Share or Solution?
- Set a time limit
- Check-in with self after

12



13

Debriefing is an approach that allows team members to process a stressful or traumatic event in a supportive environment fostering improved growth and professional wellbeing

14

Benefits of Debriefing

- Helps people recover from stress and trauma
- Helps people feel seen, heard, understood and valued
- Promotes psychological safety for employees and teams
- Allows for new perspectives
- Improves organizational processes

15

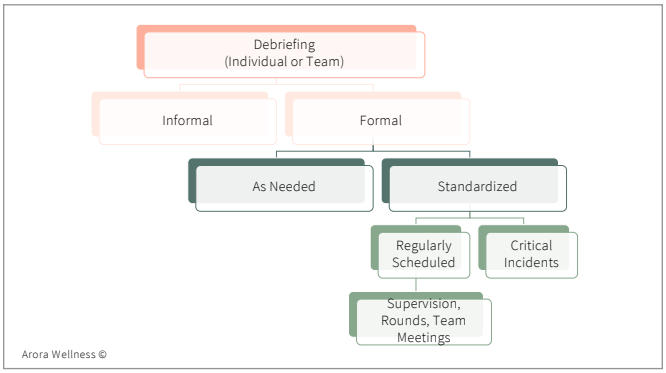
What might we need to debrief?

- Unsupportive workflows
- Medical errors
- Unexpected patient deaths
- Dysthanasias
- Severe cases of neglect or abuse
- Emotionally charged client interactions
- Ethical dilemmas
- High team conflicts
- Collegial traumas

16

- What are you currently debriefing?
- What needs to be debriefed that isn't?
- What changes are needed?

17



18

Regularly Scheduled Debriefing

Arora Wellness ©

19

Critical Incident Debriefing

Mitigates impact of trauma:

1. Introduction, Expectations, & Facts
2. Reactions (cognitive, emotional)
3. Support (education, validation, stress management tools, etc.)
4. Re-Entry

Should be facilitated by a trained professional (keep a roster!)

20

21

Facilitation Tips

- Find internal champions
- Understand the goal
- Determine if the right people are present
- Attentive, authentic listening
- Constantly scan and read the room
- Protect psychological safety
- Know your limits and stick to them

22

What's your greatest takeaway?

What's your next best step(s)?

23

Resources

Low Impact Debriefing
https://tendtoolkit.com/low-impact-debriefing-strategy/

Critical Incident Debriefing
https://www.betterhelp.com/advice/stress/the-7-steps-of-critical-incident-stress-debriefing-and-how-they-support-trauma-recovery/

https://wcb.ab.ca/assets/pdfs/employers/EFS_Critical_incidents_management_and_stress_debriefing.pdf

24

@VETERINARYWELLBEINGCOACH

Angie Arora, MSW, RSW

Arora Wellness
Veterinary Social Worker
angie@angiearora.com
www.angiearora.com

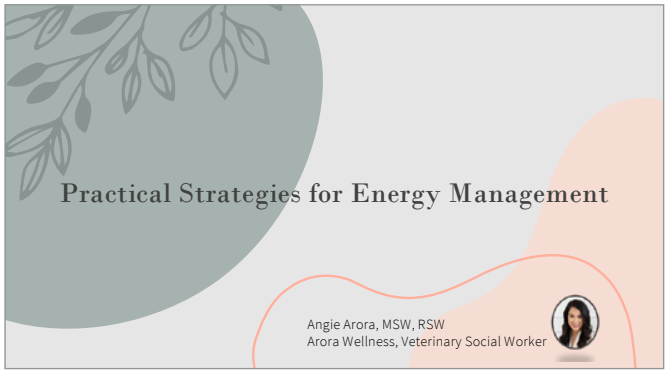
25

13005

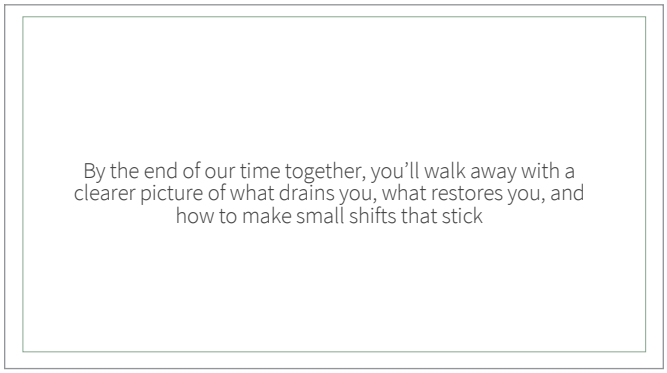
PRACTICAL STRATEGIES FOR ENERGY MANAGEMENT

PRACTICE MANAGEMENT PROGRAM | INSIDE VETERINARY WELL-BEINGE

Angie Arora, MSW, RSW



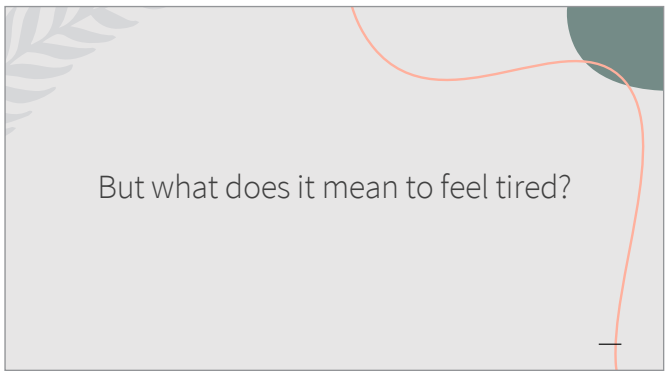
1



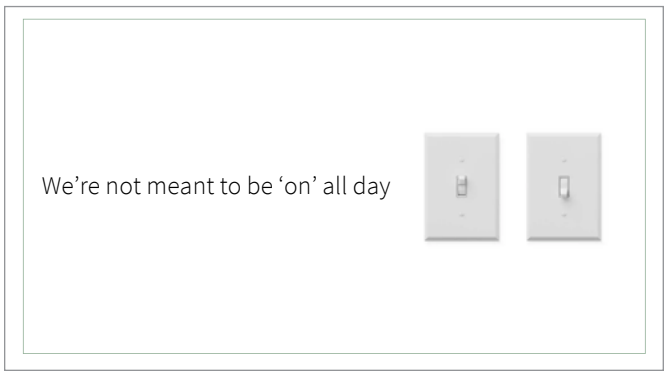
2

3

4



5



6

Understanding Energy

7

Types of Energy

Physical	Emotional	Mental	Sensory
The capacity to perform physical tasks and maintain bodily functions. **Movement**: Ability to walk, lift, and perform physical tasks **Endurance**: Sustaining energy levels throughout the day **Vitality**: Feeling physically strong and healthy	The ability to manage and express emotions effectively. **Mood**: Overall emotional state, such as happiness or sadness **Resilience**: Ability to bounce back from emotional setbacks **Empathy**: Understanding and sharing the feelings of others	The capacity to focus, think clearly, and process information. **Concentration**: Ability to stay focused on tasks **Clarity**: Clear and organized thinking **Creativity**: Generating new ideas and solutions	The ability to regulate and respond to sensory input **Stimulation:** Awareness of how sights, sounds, smells, textures impact your state **Tolerance:** Ability to stay grounded amidst stimulation **Restoration:** Creating moments of relief

8

Type	Energy Suckers
Physical	Long shifts (little to no time to recover) Physical demands (lifting, constant movement) Lack of breaks (nutrition, hydration impacted) Being on alert to protect physical safety
Emotional	Emotionally-charged interactions High-trauma exposure Lack of psychological safety at work
Mental	High workload (multiple high-priority tasks and responsibilities) Decision fatigue (numerous critical decisions all day) Frequent interruptions (disrupts focus)
Sensory	Particular sounds Overwhelming smells Harsh or poor lighting Touch overload

9

How do you feel when your energy dips low?

PHYSICALLY? EMOTIONALLY? MENTALLY? SENSORY?

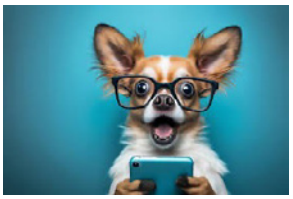
10

Impacts

- Errors (decreased productivity and concentration)
- Hypervigilance (everything feels urgent)
- Higher emotional reactivity (nervous system dysregulation)
- Decreased enjoyment at work
- Personal time impacted (hard to shut off or recover)

11

We do a better job of charging our phones than we do ourselves



12

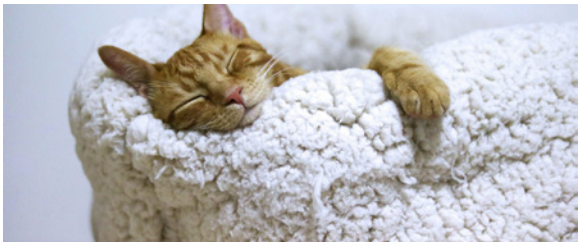
Practical Tips for Energy Management

13

The goal is to learn to dim the switch

14

How do you currently recharge?



15

We need to do some reframing

- Long breaks to micro charges
- "Manage your energy, not your time" (Tony Schwartz & The Energy Project)
- "Do less" – energy cycles/seasons fluctuate; work with them (Kate Northrup)

16

The following micro charges will help us:

- Bring more intention back into our days
- Get back into our window of tolerance
- Help care for our nervous systems
- Sustain our energy throughout the shift

17

18

Physical Micro-Charges

- Quick body scans
- Stretches
- Mindful drinking/eating
- Bites of nutritious foods
- Conscious breathwork

19

Emotional Micro-Charges

- Co-regulate
- 'Name it to tame it'
- Allow for quick releases
- Moments of gratitude
- Moments of awe

20

Mental Micro-Charges

- Switch tasks
- Intention setting
- Catch & shift rumination

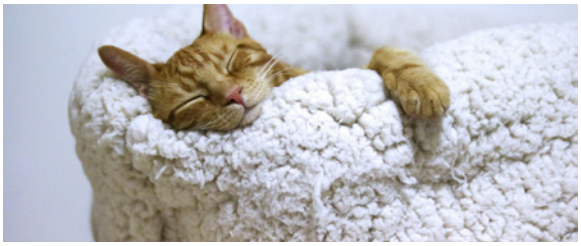
21

Sensory Micro-Charges

- Sensory rest
- Sensory awareness

22

What new things do you want to try?



23

24

Resources

Dr. Saundra Dalton-Smith: www.drdaltonsmith.com

Tony Schwartz & The Energy Project: www.theenergyproject.com

Emily & Amelia Nagoski - Burnout Book: www.burnoutbook.net

Kate Northrup – Do Less: www.katenorthrup.com

25

@VETERINARYWELLBEINGCOACH

Angie Arora, MSW, RSW

Arora Wellness
Veterinary Social Worker

angie@angiearora.com
www.angiearora.com

26

14001

MANAGEMENT & FINANCE

PRACTICE MANAGEMENT PROGRAM | MANAGEMENT & FINANCE

Christopher Doherty, DVM, MBA, CBV

LEVERAGING DATA TO STRENGTHEN ECONOMIC RESILIENCE IN VETERINARY MEDICINE

- Structuring associate veterinarian compensation and benefits
- Veterinary practice valuation in the post-COVID economy
- Comparing the business of veterinary practice across Canada and the USA

The AVMA's premier economic report on the veterinary profession, the 2025 AVMA Report on the Economic State of the Veterinary Profession, aggregates data from three of the AVMA' flagship annual research surveys: the AVMA Senior Survey of final-year veterinary students, the Census of Veterinarians, and the Veterinary Practice Owner Survey. This represents the latest data on the biggest trends and concerns for the veterinary profession. The report provides a detailed summary of the profession's economic state in three critical areas: veterinary education, veterinary employment, and veterinary services.

This report is available free to AVMA members. Non-members can access the report by using the code 'SOP2025'.

LEVERAGING DATA TO STRENGTHEN ECONOMIC RESILIENCE IN VETERINARY MEDICINE

- Comparing the business of veterinary practice across Canada and the USA
- Understanding what pet owners want and how to deliver

The 2025 AVMA Pet Ownership & Demographics Sourcebook provides in-depth analysis and insights into U.S. pet owners and U.S. pet populations. In the 46-page report, readers will discover the latest data and trends on U.S. pet populations, pet-owning households, pet owners, and pet acquisitions, as well as details on veterinary care visits and pet owner spending. The findings reflect responses to the AVMA Pet Ownership and Demographics Surveys conducted in 2023, 2024, and 2025.

This report is available free to AVMA members. Non-members can access the report by using the code 'PDS2025'.

15001

LEADING WHEN YOU'RE NOT IN THE BUILDING

PRACTICE MANAGEMENT PROGRAM | **TOOLS FOR TEAM LEADERS**

Andy Roark, DVM, MS

In a swiftly evolving post-pandemic professional landscape defined by the dynamics of remote work, managing multiple locations, and the seemingly endless quest for a harmonious work-life equilibrium, it's obvious that the core essence of leadership extends far beyond the mere confines of physical presence. As we have leaned in and embraced the digital era with virtual meetings and flexible work arrangements, the traditional boundaries of leadership are becoming fluid, no longer confined to the stationary bounds of an office chair. The all-too-familiar pang of guilt that accompanies our departure from the familiar workspace is about to meet its match. Contrary to the prevailing belief, the notion of being "always on" is not an emblem of superhuman power. Our voyage will traverse the complex emotional landscape driving this phenomenon, ultimately establishing a foundation for a leadership paradigm brimming with confidence and conviction, irrespective of our geographical coordinates.

UNVEILING THE MYTH OF WORK-LIFE BALANCE: CRAFTING HARMONIOUS BOUNDARIES

A perennial challenge that has traversed the annals of professional discourse is the pursuit of work-life balance – an enigmatic unicorn that has captured the imagination of many, often seeming just out of reach. However, our journey is poised to unveil the keys to unlocking this equilibrium. Welcome to the realm of boundary-setting, an intricate art that encapsulates the essence of finding that delicate balance. Amidst the constant hum of email notifications and the beckoning of text messages, the line between professional dedication and personal tranquility often blurs. Equipped with ingenious strategies and a profound understanding, we extend to you the tools to retake control of your time and detach without the perpetual weight of being tethered to your devices.

Boundary-setting is not about establishing rigid barriers that stifle your productivity or curtail your potential. Rather, it is a dance – a symphony of harmonious coexistence between your professional commitments and your personal well-being. By delving into the psychology that underpins this practice, you empower yourself to define clear expectations not only for your team but also for your own journey. The misconception that being "always on" translates to greater productivity is debunked, revealing the reality of burnout and the erosion of quality of life. Through a repertoire of insightful techniques, you will gradually redefine your relationship with work, affording yourself the freedom to recharge, rejuvenate, and return with newfound vigor.

LEADERSHIP BEYOND PHYSICAL PRESENCE: NURTURING GROWTH FROM AFAR

Imagine leadership as a symphony conductor – even when not on stage, the conductor's influence orchestrates the performance. Similarly, leadership transcends mere physical presence; it is the art of orchestrating efforts, irrespective of geographical expanse. The potency of remote leadership lies in its ability to guide, set expectations, and ensure alignment, regardless of the miles that separate individuals.

Our odyssey into the realm of coaching and feedback unveils the crux of nurturing team growth and sustaining a harmonious rhythm. Have you ever contemplated the art of offering insightful guidance without encroaching into the territory of micromanagement? This principle forms the bedrock of effective leadership, steering the wheels of progress even when your physical presence is absent. It's about cultivating an environment where team members flourish in their decision-making autonomy, cognizant of the unwavering support and guidance offered by their leader.

AUTHENTICITY AS THE ULTIMATE CATALYST

In an era that venerates authenticity, it emerges as a paramount catalyst. Visualize embracing your quirks, your unique self, and embodying authenticity in its purest form. This authenticity acts as the cornerstone for trust-building and the forging of genuine connections. Our deep dive delves into why authenticity functions as the bedrock of leading a team that feels empowered to voice concerns and seek guidance, transcending the constraints of geographical separation.

Authentic leadership entails the willingness to unveil vulnerability, admit imperfections, and display empathy. It epitomizes the idea that leaders, too, are human, susceptible to challenges and fallibility. When team members perceive their leader as relatable, authentic, and genuine, they are more inclined to communicate openly, voice apprehensions, and seek counsel. Authentic leadership isn't restricted by the boundaries of physical presence; instead, it's an emotional presence that resonates profoundly with team members, fostering an environment of inclusivity and camaraderie.

REIMAGINING LEADERSHIP IN A REMOTE LANDSCAPE: THE PROACTIVE VANGUARD

Effective remote leadership demands a reinvented playbook. The spotlight shifts from reactiveness to proactive strategies, marked by a commitment to anticipatory action. The crux is scheduling strategic interactions and offering prescient guidance – tactical maneuvers that preemptively thwart chaos. Embracing this shift equips leaders with the capability to anticipate challenges and remain a stride ahead – an indispensable trait in the art of leading from a distance.

Proactive leadership isn't about forecasting every conceivable scenario; it's about erecting a scaffold of preparedness and success. By instituting structured communication channels, offering lucid guidance, and nurturing a culture of accountability, leaders craft an environment where teams thrive independently, even in the absence of continuous physical surveillance. Remote leadership thrives when leaders provide the requisite resources, tools, and support necessary for team members to excel autonomously.

KEY TAKEAWAYS FOR THE JOURNEY AHEAD

Mindset Magic: Our voyage embarks on an expedition through the psychological labyrinth of remote leadership, amplifying your confidence despite the absence of physical proximity. Recognizing the Psychological Dynamics offers you a deeper understanding of the emotions at play when leading from a distance, ensuring your confidence remains unwavering.

Boundary Bliss: We unravel the fine art of cultivating boundaries between work and personal life, transcending the vortex of constant availability to nurture holistic well-being. Implementing Boundary Strategies arms you with practical techniques to set and maintain these boundaries, empowering you to navigate remote leadership with equilibrium.

Feedback Fun: Master the art of remote coaching and feedback, propelling the team's momentum and ensuring a seamless trajectory of growth. Enhancing Communication Skills equips you with effective strategies to maintain team cohesion, motivation, and alignment even when physical presence is limited.

Be Unapologetically You: Authentic leadership emerges as the secret elixir. Embrace your individuality, cultivate trust, and let your unadulterated self radiate. Embracing Authentic Leadership fosters connections and collaboration within your veterinary team, regardless of geographical distances.

Stay Ahead: As a remote leader, the ability to foresee challenges and preemptively address them is paramount. Upholding a proactive stance allows you to shepherd your team through uncharted waters with confidence. Mastering Proactive Leadership allows you to guide your team effectively by scheduling strategic interactions, providing guidance, and ultimately preventing potential crises.

As we conclude our journey through the intricate realms of remote leadership, we extend our heartfelt gratitude for joining this expedition. Your commitment to transformative leadership, even amidst the challenges of distance, sets you on a trajectory of profound impact. The tools, insights, and revelations gleaned today equip you to navigate the nuanced terrain of leadership from afar – a journey that shapes not only the future of your team but the broader narrative of leadership itself.

15002

CREATING THE CULTURE YOU WISH YOUR CLINIC HAD

PRACTICE MANAGEMENT PROGRAM | **TOOLS FOR TEAM LEADERS**

Andy Roark, DVM, MS

Many veterinary leaders find themselves frustrated, caught between the culture they inherited and the positive, thriving environment they aspire to lead. Culture is not an accident; it is the **"non-negotiable" outcome** of consistent relationships and defined values, consuming strategy for breakfast. This session focuses on giving leaders the tools to intentionally design a workplace they are happy to inhabit by leveraging the power of **Core Values**, implementing the **Trust Economy**, and mastering relational tools like **"Ways of Working" (WOW)** conversations. Participants will learn how to shift the focus from individual survival to a **collective purpose**, set critical boundaries to protect their time, and strategically recruit new talent based on cultural fit. By the end of this session, attendees will possess a framework for achieving alignment, driving buy-in for key initiatives, and creating a cohesive, high-functioning team environment.

I. THE CULTURE IMPERATIVE: OWNERSHIP AND INTENTION

In the demanding environment of veterinary medicine, leaders often discover that the easy path—taking care of pets—is constantly available, yet the hard path—**facing resistance and navigating conflicts**—is the required work of leadership. The session premise, "Creating the Culture you Wish your Clinic Had," shifts the responsibility for workplace environment squarely onto the leader, recognizing that **culture eats strategy for breakfast**. Culture is defined as the collective **beliefs, values, attitudes, behaviors, and norms** that characterize how a team operates. Leaders are expected to develop competencies in **Leading & Managing for Culture** and manage vision and purpose. The goal is not merely individual satisfaction, but creating a positive culture that fosters retention, engagement, performance, and productivity.

II. DEFINING THE "WHY": CORE VALUES AND COLLECTIVE FOCUS

A vibrant culture begins with defining what the team stands for, moving away from subjective "happiness" toward a shared direction.

Finding Your Center and Shared Identity

Leaders must first define their own **self-identity and core values**. This personal introspection—recognizing strengths over focusing on weaknesses—is the basis of leadership brand. Next, leaders must guide their teams to define their **Core Values** and **Core Focus**. This process involves asking team members what characteristics they admire and ensuring the team's purpose is **bigger than a standard goal**. When values are defined, leaders can shift the team focus from individual interests to the **collective purpose**. Having defined values provides a vital framework for decision-making; for example, if the team values "lifelong learning," that influences the expected answer to an organizational challenge.

Setting the Vision for Success

To overcome challenges like negative attitudes or lack of solutions, the team must agree on what success looks like, starting with the end in mind. Tools like the **"Stop, Start, Continue"** exercise can facilitate team alignment

by having members define what they want to achieve (e.g., greater efficiency, better attendance, creating solutions instead of complaining about problems).

III. BUILDING THE FOUNDATION: THE TRUST ECONOMY

Culture change requires trust, and the veterinary leadership curriculum includes dedicated topics on the **Trust Economy**. Trust is the **non-negotiable foundation**, symbolized by the need to **"Build the bridge before you walk on it"**.

The Mechanics of Trust

Trust is actively built through consistent behavior, requiring leaders to be curious, present, and vulnerable. Critical trust-building actions include:

Assuming Good Intent: Leaders must avoid creating or believing external "stories" about a clinic and enter with a mindset of opportunity, maintaining an open mind.

Consistency and Follow-Through: Doing what you say you are going to do builds trust rapidly. This includes remembering details from the last conversation and intentionally scheduling check-ins.

Transparency (Balanced): Leaders must use transparency while maintaining a delicate balance. This can involve making the team calendar visible so doctors know where the leader is working.

Formalizing Relationships with Ways of Working (WOW)

To ensure cultural alignment across complex structures (especially when managing multiple hospitals), leaders must formalize their relationships using **Ways of Working (WOW)** documents. The WOW conversation establishes expectations and helps define the mission. This is especially crucial for key partnerships, most notably with the Practice Manager (PM), but also with the Medical Director, practice owner, and/or upper leadership. The WOW helps clarify expectations for communication, ensuring that important issues are discussed face-to-face rather than misinterpreted via email.

IV. OPERATIONALIZING CULTURE: COMMUNICATION AND BUY-IN

A defined culture must be continuously enforced through communication and effective management of change.

Achieving Team Buy-In

Team Buy-In is an organizational core concept essential for guiding the team in one direction. The Uncharted methodology emphasizes:

Starting with Why: Leaders must explain the **reason why** the change is happening, making sure the team understands the benefit for them and the pets.

Involving the Team in Solutions: Leaders should ask the team to identify barriers and brainstorm ideas, empowering them and increasing ownership. When faced with resistance (e.g., unwillingness vs. inability), the leader must identify the root cause of the concern and partner with a creative solution.

Lowering the Stakes: Change is hard, especially when staff are stressed. Leaders can increase buy-in by suggesting **pilot programs** or rolling out changes on a small scale/short timeframe to increase benefits while decreasing perceived sacrifices.

Accountability and Reinforcement

A healthy culture involves clear accountability. Leaders must use positive reinforcement to drive the culture they want to see. This means actively celebrating wins and leveraging **Affirmative Inquiry** to focus on successes. The ultimate cultural goal is achieved when the team demonstrates **self-accountability** and holds each other accountable, behaving the same way whether the leader is present or not.

V. Protecting the Culture: Boundaries and Talent Acquisition

Leaders must actively defend their desired culture against both internal burnout and the erosion of new hires who do not fit the team identity.

Setting Boundaries for Sustainable Leadership

Leaders are trained to accept that **"You can't be all things to all people"**. Cultural leaders must prioritize their time

for maximum impact (e.g., mentorship, meeting with PMs, advocating for the team). Setting clear boundaries is essential for staff and doctor retention.

When saying "no" to protect time (e.g., clarifying a "doctoring day" versus a "managing day" for medical directors), leaders should:

Start with why: Explain the reason for the boundary.

Use Positive Framing: Tell the team what the leader *can* do, rather than focusing on the refusal.

Ensure Clarity: The mantra "Clear is Kind" applies to setting expectations.

Culture-Driven Talent Acquisition

Culture is protected by hiring individuals who align with the team's norms. **Culture Driven Recruiting and Talent Acquisition** is a core component of leadership development.

Defining the Ideal Candidate: Leaders must control the narrative at the hospital level, defining their local culture (communication style, norms, values) and ensuring the recruiting team knows **EXACTLY who** the hospital needs.

Interviewing for Fit: Hiring candidates who align culturally leads to higher retention and job satisfaction. Interviewing techniques should focus on exploring the candidate's alignment with team values and their behavior in challenging situations. Examples of appropriate questions include: "How do you deal with ambiguity and change?" and "Can you describe a situation where you worked effectively as part of a team?". Making the interview "not feel like an interview" and lowering the stakes can help people show their true selves.

VI. CONCLUSION: COMMITTING TO CULTURAL STEWARDSHIP

The goal of creating a desired culture is ongoing. It requires using all the tools in the leader's toolbox, including **Critical Conversations** to address toxicity and conflict. Leaders must embrace the community of their peers for continuous support and mentorship. The transformation initiative is about giving leaders **ownership** and empowering them to find and leverage peer mentorship and support. By defining values, building trust, communicating clearly, and committing to cultural fit in hiring, leaders can transform their workplace into the high-functioning, happy environment they envisioned.

15003

HOW TO TRAIN YOUR DOCTORS

PRACTICE MANAGEMENT PROGRAM | **TOOLS FOR TEAM LEADERS**

Andy Roark, DVM, MS

Effective communication is the cornerstone of veterinary leadership, yet crucial conversations—especially those directed *up* the organizational hierarchy—often evoke anxiety. Many leaders feel nervous about confronting superiors or ensuring they are heard when facing crucial issues. This session will introduce structured, practical frameworks for providing effective feedback and coaching, adapting principles often associated with the GROW coaching model and the SBI feedback model to meet the unique challenges of the veterinary environment, particularly when engaging with senior leaders (Managing Up). Participants will gain tools to confidently establish accountability, drive development in their teams, and communicate their needs clearly and constructively to those above them in the power structure, turning anxious avoidance into prepared, actionable engagement. We will emphasize that while taking care of pets is often seen as "easy," facing resistance and navigating hard conversations is the truly challenging path of leadership.

I. INTRODUCTION: THE CHALLENGE OF COMMUNICATION IN VETERINARY LEADERSHIP

In the demanding world of veterinary medicine, professionals routinely face challenging circumstances, making effective communication a vital, yet often underdeveloped, tool. Many leaders in the veterinary space, such as associate veterinarians, medical directors, and their medical supervisors, often wrestle with **anxiety** related to having critical conversations, fearing that they may make someone angry or that their input will not be heard when it truly matters. This anxiety is particularly acute when the conversation involves communicating needs or providing feedback across the **organizational power gradient**, often referred to as "Managing Up".

Veterinary leaders are often caught between operational pressures (metrics, targets) and medical/doctor support needs. While taking care of pets is often described as "easy," tackling the organizational resistance necessary to drive change and have difficult conversations is acknowledged as "HARD". Leaders frequently require a clear plan and strategy to successfully navigate these challenging interactions, regardless of the topic.

II. ESTABLISHING THE FOUNDATION: TRUST BEFORE TOOLS

Before deploying structured feedback or coaching models, the necessary foundation is **trust**, as hard conversations happen *inside relationships*. A key mantra for leadership is: **"Build the bridge before you walk on it"**. Trust is established through behavior, requiring leaders to be curious, present, and consistent.

Leaders must consistently assume **positive intent** and avoid creating narratives or believing existing "stories" about a clinic before observing the situation firsthand. Transparency, though requiring a delicate balance, is also essential, often facilitated through setting expectations via tools like "Ways of Working" conversations, ensuring alignment with Practice Managers (PMs) and associate doctors. Consistency and follow-through—doing what you say you are going to do—are crucial components of rapidly building trust.

III. THE FEEDBACK FRAMEWORK (THE SBI PROXY): CLARITY AND CONSEQUENCE

The goal of effective feedback is development and performance management. To ensure feedback is effective, leaders must avoid confrontation for

confrontation's sake and aim for clarity, understanding that **"Clear is Kind"**. Research shows that intentional feedback leads to tangible results: companies that invest in regular employee feedback see a 14.9% lower turnover rate.

A foundational element of delivering high-stakes feedback (substituting the SBI model) involves focusing on measurable events and separating the person from the issue:

Situation/Behavior: The feedback must start wide, grounding the conversation in facts and specific instances, rather than subjective interpretation. Leaders must consciously avoid entering the conversation with their own *story* or preconceived notions. Gaining both sides of the story is essential before engaging.

Impact: After acknowledging the situation, the conversation should evolve towards consequences. This involves talking through the perspective of all involved: the individual, the team, the clinic, clients, and patients. The leader must validate the unfairness or difficulty the team member may feel, offering empathy.

Next Steps/Developmental Feedback: Feedback should be future-tense, moving toward clear developmental goals. Developmental feedback aims for growth, for example: "To get there, you're going to need to work on keeping your A-level professionalism... Can we discuss ways to do that in the future?".

IV. COACHING FOR GROWTH (THE GROW PROXY): ACCOUNTABILITY AND AUTONOMY

Moving from delivering structured feedback to coaching involves guiding the individual to identify their own solutions, fostering accountability and autonomy (substituting the GROW model). The biggest mistake mentors often make is believing they are the ones with the power. Instead, coaching must fundamentally stem from the mentee.

Leaders should utilize **affirmative inquiry**, focusing on what has gone well or successful times, rather than dwelling on failures.

The process of coaching for growth involves several defined steps derived from organizational planning and mentorship strategies:

1. **Goal & Reality Setting:** Begin by identifying where the individual stands (Reality) relative to where they want to go (Goal). Ask clarifying questions like: "What are the cases you love the most? What are the cases you actually dread?". Coaching aims to help DVMs understand what they need to be successful in their role and identify outside interests for future development.

2. **Options & Will/Way Forward (Action Planning):** Instead of telling the associate doctor what to do, effective coaching centers on **asking the question**, guiding them toward their own actionable solutions. For instance, regarding scheduling issues, asking them to draft their idea of an ideal day provides ownership and a guide for the team. The outcome should be a clear plan, sometimes codified in a 30/60/90-day format.

3. **Accountability & Checkpoints:** Accountability is crucial in the coaching process. The conversation should end with a mutual follow-up plan. Leaders must clearly define checkpoints: How will improvements be measured? How much time will pass before the next check-in?. Consistent follow-up ensures that the commitment sticks. Leaders should seek solutions from the associate DVM at the outset of 1-on-1s.

V. DEPLOYMENT UP THE POWER GRADIENT: MANAGING UP

The final challenge is deploying these structured communication tools when addressing organizational constraints or offering feedback to senior leaders—the practice of **Managing Up**. Managing up is considered "required" for leaders to achieve their objectives. This is especially critical in organizational structures where leaders feel pressure to prioritize operational tasks over core responsibilities like doctor development.

When managing up, the core objective is alignment, ensuring that the message is consistent and that the leader's needs are translated into the language and priorities understood by their superiors (often the operational, metrics-focused language of operational leaders).

Strategies for effective Managing Up include:

1. **Pre-Wiring and Empathy:** Building trust with superiors is paramount. Use **empathy** as a skill, putting yourself in their shoes to understand their priorities and pressures. Having a "Ways of Working" (WOW) conversation with a superior is essential for mutual understanding before conflicts arise.

2. **Positive Framing and Clear Messaging:** When making requests or pushing back, leaders must use **positive framing** by articulating what they *can* do, rather than simply saying "no". For instance, leaders must explicitly tie their needs (e.g., administrative time off the floor) to achieving organizational objectives or SMART goals (e.g., "I need xyz to get to SMART GOAL").

3. **Lowering the Stakes for Buy-In:** When encountering resistance or refusal to adopt an idea (e.g., a veterinarian saying "no"), leaders should reframe the proposal to mitigate perceived risk. This often involves suggesting **pilot programs** or rolling out the change on a small scale or short timeframe. This tactic increases the benefits while decreasing the perceived sacrifices, making the change more palatable to decision-makers.

4. **Addressing Micromanagement (Case Example):** In scenarios like micromanagement—where a leader's schedule is overly dictated by a superior (e.g., an ACoS being forced to spend 75% of time seeing patients despite managerial duties)—the coaching approach must be carefully adapted. Overcommunication is key before the conflict escalates, detailing current successes and the value being delivered. The conversation must seek to understand the superior's perspective, defining precisely what success (e.g., 75% clinical time) looks like to both parties, and using the WOW conversation to address disagreements.

VI. CONCLUSION: COURAGE AND COMMITMENT

Effective coaching and feedback, applied both downward and upward, require courage and initiative. Leaders must be willing to embrace the inherent conflict that comes with championing ideas and holding people accountable. By committing to structured frameworks like the adaptive principles of SBI and GROW (focusing on structured observation, customized goal setting, actionable plans, and clear accountability), veterinary leaders can transform difficult conversations from sources of anxiety into powerful mechanisms for development and organizational alignment. Final action involves establishing follow-through plans and checkpoints, ensuring that conversations lead to tangible commitments and sustained change.

15004

TRIAGING YOUR TIME

PRACTICE MANAGEMENT PROGRAM | **TOOLS FOR TEAM LEADERS**

Andy Roark, DVM, MS

For leaders in veterinary medicine, **time management** is often the single greatest source of overwhelm, as organizational demands and clinical responsibilities constantly compete for limited attention. The reality that **"THE WORK WILL ALWAYS EXPAND TO FILL THE SPACE"** dictates that leaders must adopt a mindset of ruthless prioritization and intentional boundary setting rather than passively trying to "get it all done". This session provides structured frameworks for **triaging time** by first defining high-impact priorities (using the Eisenhower Matrix and Pareto's Principle), then strategically **controlling expectations**—both up the organizational chain (Managing Up) and down to the team—through proactive communication and relationship management. Finally, we will focus on tactical **delegation techniques** necessary to "clone yourself," enabling leaders to free up administrative capacity for their core development and strategy roles. Participants will leave with clear strategies for turning time management challenges, which are fundamentally behavioral problems, into solvable systems, thereby sustaining focus on the activities that yield the highest organizational return.

I. THE TIME CRISIS: WHY WE STRUGGLE TO TRIAGE

Veterinary leaders, such as practice managers and medical directors, face an overwhelming barrage of demands, encompassing mentorship, hospital support, operational metrics, and clinical coverage. Time management is frequently identified as a challenge. Leaders often feel pulled between urgent operational tasks and important long-term development work. The primary lesson is that **time management challenges are behavioral and solvable**. We must resist the temptation to merely discuss how busy we are and instead focus on what we can do to feel more in control.

The fundamental hurdle is that **THE WORK WILL ALWAYS EXPAND TO FILL THE SPACE!** Therefore, feeling accomplished and impactful every day requires intentional planning to attack **"what's more important"**. A leader must prioritize their time intentionally.

II. SETTING PRIORITIES: DEFINING HIGH-IMPACT AREAS

Triage begins with differentiating high-value activities from low-value busywork.

Utilizing the Eisenhower Matrix and Cognitive Biases

Leaders often suffer from **Completion Bias**, the tendency to check things off a list, and **Present Bias**, the inclination toward immediate gratification. This drives leaders to prioritize immediate, often mundane tasks (like checking emails), over important tasks that achieve long-term goals. The Eisenhower Matrix helps leaders categorize tasks as **Urgent and Important**, forcing a strategic decision on allocation of limited resources.

The Pareto Principle (80/20 Rule)

The Pareto Principle dictates that approximately **80% of productivity comes from 20% of effort**. Leaders must use this rule as a filter to scrutinize what must be accomplished, ensuring they allocate most time and effort to the 20% of things that will have the most significant positive impact. For ACoS leaders, high-impact areas include:

- **One-on-ones**.
- **Mentorship time with Staff/DVMs** (strategic mentorship where the return on investment is highest).
- **Building relationships** with Staff, Vets, PMs, etc.
- **Developing leaders** in the hospital.

Low-impact tasks that should be filtered out often include tracking activities, pandering to egos, putting out fires that direct reports are equipped to handle, and repetitive conversations. Leaders must identify **where their effort will have the biggest impact** versus the smallest impact.

III. CONTROLLING EXPECTATIONS: BOUNDARY SETTING

Once priorities are set, the next challenge is protecting that focused time by setting **boundaries**. The central theme for sustainability is: **"You can't be all things to all people"**. Boundary setting is critical for **Staff and DVM retention**.

Strategies for Saying "No"

Setting boundaries often involves having to say "no," which is difficult for leaders who struggle with guilt or wanting to be liked. Effective communication strategies are essential to soften the boundary:

- **Start with Why:** Explain the reason for the boundary, referencing the *information bias*—people need to understand the rationale.
- **Positive Framing:** Tell them what you **can** do, rather than simply stating what you cannot.
- **Give Lead Time:** Communicate schedule changes or unavailability in advance.
- **"Clear is Kind":** The goal is not avoiding conflict, but setting clear expectations, ensuring the message is delivered effectively.

A leader must know **what the expectation is for yourself** (e.g., administrative versus clinical time) and how to communicate that repeatedly. For instance, practice managers (PMs) may ask a leader to fill in on the floor; the response should use positive framing, such as, "I'm managing today," or "I'm doctoring today," while explaining the rationale.

IV. DELEGATION AND CLONING CAPACITY

Delegation is the primary mechanism for freeing up capacity, effectively helping the leader **"Clone Yourself"**. Delegation should aim to shift problems away from the leader, recognizing the risk of the leader acting as the **"hero,"** which disempowers others and creates "learned helplessness".

Empowering Others (Delegation)

Effective delegation is about **empowering others, not enabling them**. When a team member presents a problem, the leader should resist jumping in immediately with solutions. Instead, the leader should **front-load support** by teaching the team to solve their own problems. Strategies include:

- Asking team members to come with a **solution, not just a problem**.
- Ensuring the team knows essential resources and **what constitutes an emergency**.
- Coaching the "victim" on **how to be their own hero** or where to find their hero.
- Using coaching questions like, "What is your plan for addressing it?" to shift ownership.

The leadership team must commit time to this process, as not giving team leads time to do development work in their role is counterproductive.

V. MANAGING EXPECTATIONS UPSTREAM (MANAGING UP)

Time is often consumed by demands coming from superiors who often focus on operational metrics. **Managing Up** is a required leadership skill.

Advocating for Time and Priorities

When asking for the time needed for administrative or developmental tasks, leaders must translate their needs into the language the superior understands. The most effective strategy is to link needs to organizational goals: **"I need xyz to get to SMART GOAL"**.

Leaders must approach this balancing act by **knowing the hill you need to choose to die on** and having a plan to stand your ground. Tools for effective **Managing Up** include:

- **Pre-Wiring:** Building strong relationships and **trust** with superiors *before* conflict arises. Hard conversations happen *inside relationships*, and trust must be built first.
- **Ways of Working (WOW) Agreements:** Establishing these with practice collaborators is crucial for mutual understanding and defining expectations for time allocation. This ensures a united front, where disagreements are discussed privately.
- **Rational vs. Emotional Needs:** Recognizing and addressing the basis of the superior's concern (often metric-driven/rational) while focusing on actionable solutions.

VI. INTENTIONAL ACTION AND ACCOUNTABILITY

The final step is transitioning from planning to **Intentional Action**. This requires adopting systems over simple goals, recognizing that **"You do not rise to the level of your goals. You fall to the level of your systems"**.

Scheduling and Time Blocking

Instead of maintaining overwhelming "to-do" lists, leaders should adopt a system of **Schedule Blocking**. This involves creating **Deep Work Blocks** (unreachable time) for important tasks that require focus, anticipating that clinical work expands to fill the time available.

Practical hacks include:

- **Scheduling emails and lunch time** into the calendar.
- **Color coding the calendar** to visualize time spent across different functions.
- **Creating catchup blocks** and acknowledging that focusing on one task at a time is key (turning off notifications, as it takes roughly 7 minutes to refocus).
- **Weekly calendar planning** which ties into communicating unavailability.

Goal Breakdown and Accountability

Effective action is built on refining objectives through a system like the LDPFT system (List, Define/Refine, Prioritize, Free up capacity, Take intentional action). This involves breaking down big goals into smaller ones and putting action steps **onto the calendar**.

Accountability must be built into the system. Leaders build **trust** by consistently **following through on goals** and commitments. Consistency and integrity in doing the small things build the trust necessary to succeed in larger organizational challenges. By applying intentional structure to prioritization, boundary setting, and delegation, leaders can effectively triage their time and successfully manage complexity in their demanding roles.

TECHNICIAN PROGRAM

ONTARIO VETERINARY MEDICAL ASSOCIATION

16001

BASIC ECG INTERPRETATION

TECHNICIAN PROGRAM | TECHNICIAN ESSENTIONS – ACUTE CARE

Megan Brashear, RVT, VTS (ECC)

Veterinary technicians are tasked with understanding how to identify ECG waves so they can alert the veterinarian to potentially life threatening cardiac arrhythmias and to monitor disease processes in their patients. It is important to start with the basics in order to understand why some arrhythmias are more dangerous than others and expected clinical signs from cardiac abnormalities. Review the path that blood takes through the heart:

Blood comes from the body to the vena cava

⌄

From the vena cava it enters the right atrium

⌄

From the right atrium it passes through the tricuspid valve into the right ventricle

⌄

From the right ventricle it goes to the pulmonary artery

⌄

The pulmonary artery takes it to the lungs where it picks up oxygen

⌄

From the lungs it goes to the pulmonary vein

⌄

The pulmonary vein takes it to the left atrium

⌄

From the left atrium it passes through the bicuspid valve to the left ventricle

⌄

From the left ventricle it travels via the aorta to the body

This understanding explains why patients in right sided heart failure experience ascites and patients in left sided failure experience pulmonary edema. As the heart is responsible for delivering blood and oxygen to all of the body's tissues, failure of the heart muscle or arrhythmias can create systemic emergencies for these patients. When a cardiac patient or an animal is respiratory distress is presented to the hospital it is important to supply them first with oxygen and take extra time with them. A mild sedative, such as butorphanol (0.2 mg/kg) is safe to use in these patients and often provides enough sedation to allow for treatment. Treatments should be prioritized and performed in a stepwise fashion allowing the patient time to recover prior to the next stressful event.

Cardiac drugs come in many different classes and it is very important that the nursing team understands why a patient is receiving the medication and the intended and unintended side effects. It is also important to monitor drug interactions as many patients will be on multiple classes of medications while hospitalized.

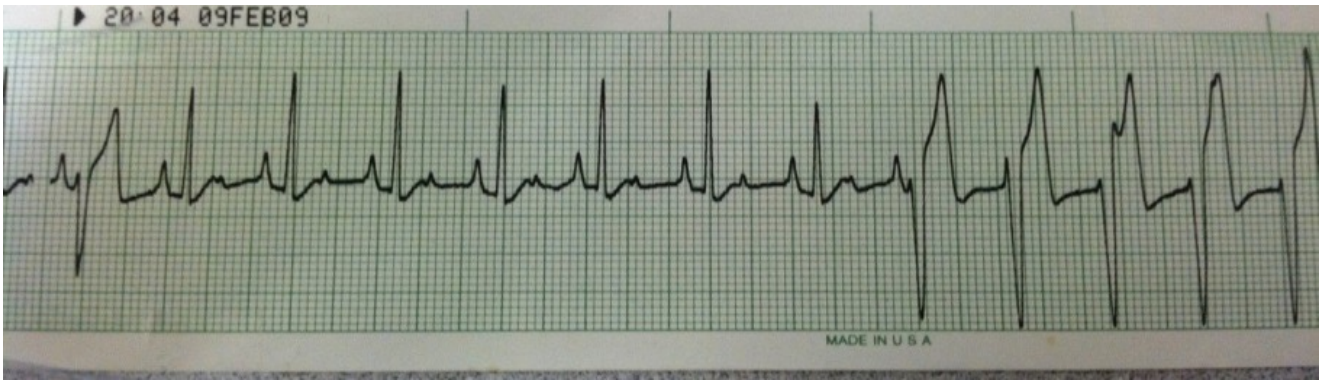
Again, the role of the nursing team is not to diagnose disease but to recognize abnormalities on ECG and the resulting clinical signs in the patient. Technicians also should understand which disease processes can result in cardiac abnormalities. Listen to the patient and compare the heart rate to the pulse rate, learn to interpret the pulse quality, and rely on perfusion parameters such as mucous membrane color, capillary refill time, blood pressure, mentation, and pulse quality to determine patient stability.

To interpret an ECG, begin by understanding what each wave represents:

- P wave: atrial contraction
- QRS complex: ventricular contraction
- T wave: ventricular repolarization

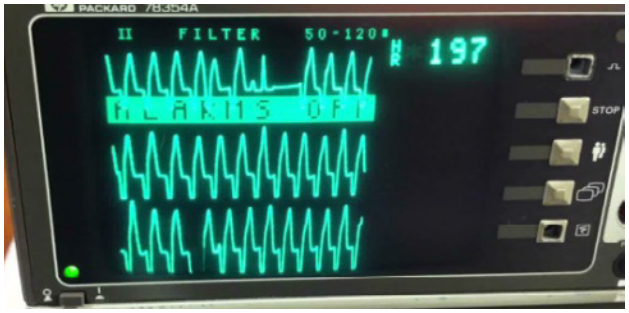
Start interpretation by looking at the heart rate to determine a tachy or brady arrhythmia. Then look at the QRS complexes and decide if they are rhythmic or not. Then examine each complex looking to see if each P wave has a QRS complex and each QRS complex has a P wave. Treat the patient not the arrhythmia; always go back and examine the patient's perfusion parameters to help determine next steps.

VPC (Ventricular Premature Contraction) - The left ventricle contracts prematurely, leading to a large T-wave that goes the opposite direction of the QRS complex, with a wide appearance. Can result from hypoxia, ischemia, acid-base disturbances, electrolyte imbalances, pain, reperfusion injury, trauma, and some medications. Can lead to pulse deficits and decreased perfusion. Treatment includes oxygen therapy, lidocaine as a bolus or CRI, fluid therapy to correct shock, and time (in the case of trauma or thermal damage)

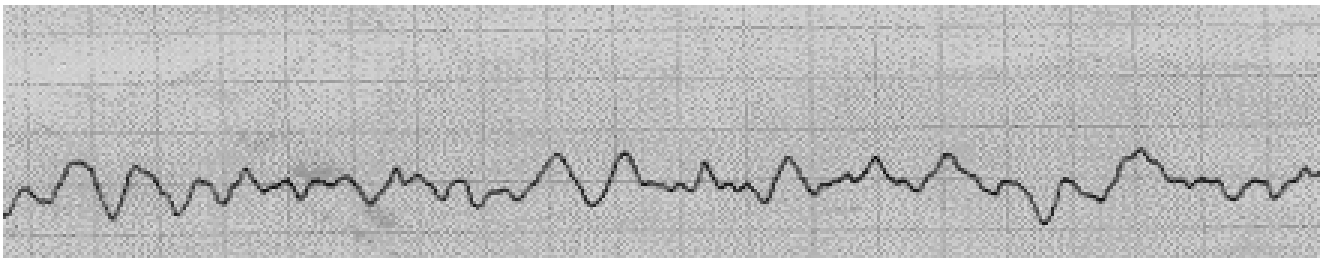


- Patients experiencing hyperkalemia will have tall tented T-waves and often will not have a P wave. As the potassium level increases, the T waves will get wider until the ECG looks like all VPCs. If not treated this will become fatal. As potassium levels decrease the T wave will get smaller until the ECG appears normal again.

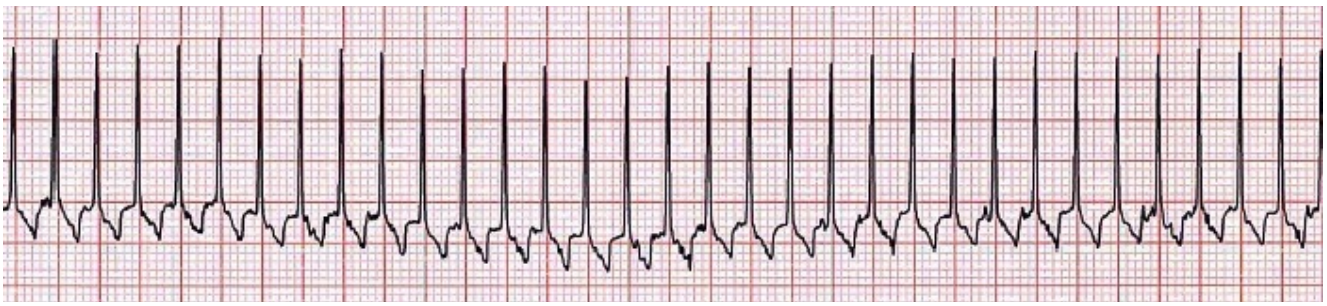
Ventricular Tachycardia - A high number of VPCs strung together with a heart rate > 180. Can be divided into "stable" and "unstable", If patient has mentation changes, hypotension, or changes to mm color, treatment may be warranted with lidocaine (bolus and/or CRI). Seeing ventricular tachycardia means the patient has poor perfusion and often low blood pressure; watch these patients very carefully as they can arrest during ventricular tachycardia.



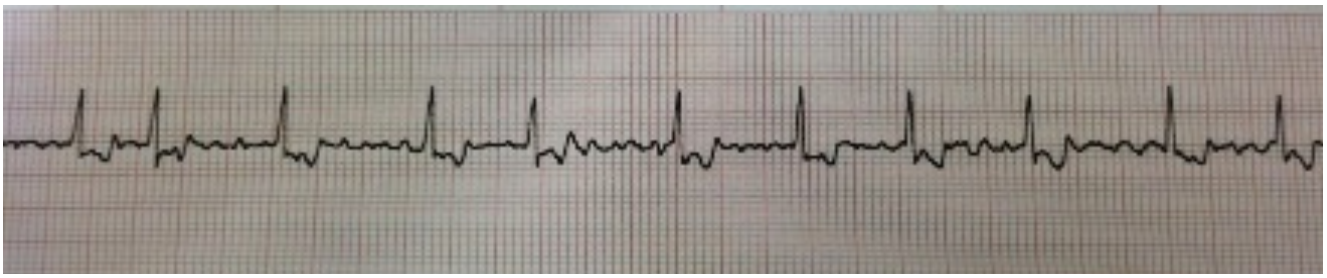
Ventricular Fibrillation - caused by the activation of too many circuits in the heart, everything is firing out of control. This is a fatal arrhythmia. On ECG – undulation of baseline, no P waves or QRS complexes can be discerned. Treatment is defibrillation (electrical shock to the heart to repolarize and get everything firing back on schedule).



Supraventricular Tachycardia - usually seen secondary to heart disease or other systemic disease. Clinical signs (weakness, collapse, poor pulses, poor mm color) are not always seen unless the heart rate is >250bpm. ECG findings are a tall, skinny QRS complex, not necessarily always following a P wave. P waves are very difficult to differentiate from T waves.

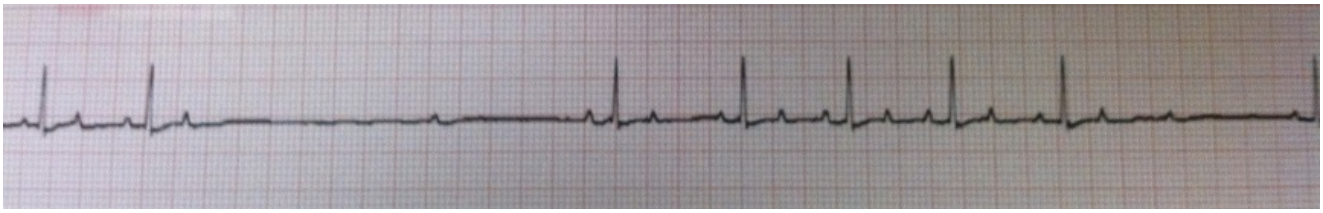


Atrial Fibrillation - poor atrial contractions and a high atrial rate. May auscultate a "tennis shoes in the dryer" sound and feel pulse deficits. On ECG – P waves are replaced by small fibrillations, and QRS complex varies in height and width. Tachycardia, regularly irregular, and P waves not always connected to a QRS complex are characteristic of this arrhythmia. Treatment is aimed at lowering the heart rate with beta blockers or Ca++ Channel Blockers.

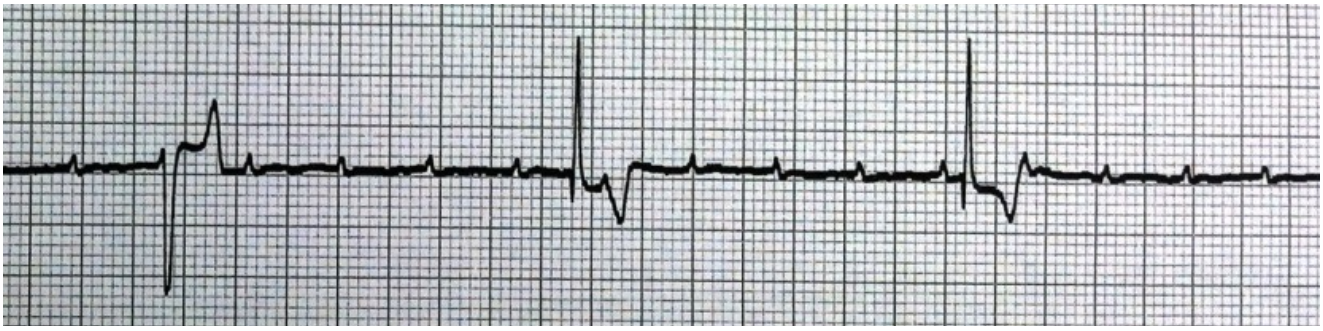


1st Degree Heart Block – is usually asymptomatic, it can be seen in the very old, very young, and brachycephalic breeds. ECG – prolonged distance between each P wave and the start of the QRS complex. There are P waves for each QRS. Treatment is usually not necessary.

2nd Degree Heart Block – patients may present with exercise intolerance, weakness, syncope or heart failure. It can be seen during anesthesia, especially if the patient is bradycardic. Treatment is necessary if the patient is symptomatic and normally consists of an atropine trial. Some patients can be maintained on atropine or a pacemaker may be necessary. ECG – P waves are not always followed by QRS complexes.



3rd Degree Heart Block – These patients are often symptomatic (exercise intolerance, collapse, syncope) and need treatment. ECG – P waves have no association with QRS complexes. The only reliable treatment is a pacemaker.



Treatment for any patient experiencing cardiac arrhythmias requires close monitoring by the nursing staff. Frequent patient assessment, even if the ECG appears normal, will help in developing a baseline for the patient. Any changes in mentation, respiratory rate and effort, activity level, and eating patterns can signal changes in cardiac tracings. With any abnormalities noted on ECG, the patient perfusion values must be immediately evaluated (heart rate, pulse quality, mucous membrane color, capillary refill time, blood pressure, mentation) and results reported to the veterinarian. Technicians must understand cardiac drugs and the expected effect of administering these drugs so that proper patient monitoring is carried out and proper client education occurs.

SUGGESTED READING:

1. *Creedon, Jamie M. Burkitt., and Harold Davis. Advanced Monitoring and Procedures for Small Animal Emergency and Critical Care. Chitchester, West Sussex: Wiley-Blackwell, 2012.*
2. *Norkus, Christopher L. Veterinary Technician's Manual for Small Animal Emergency and Critical Care. Chitchester, West Sussex, UK: Wiley-Blackwell, 2012.*
3. *Tilley, Lawrence P., and Naomi Burtnick. ECG: Electrocardiography: For the Small Animal Practitioner. Jackson: Teton NewMedia, 2000.*

16002

FROM THE TRENCHES: ECC CASES

TECHNICIAN PROGRAM | TECHNICIAN ESSENTIONS – ACUTE CARE

Megan Brashear, RVT, VTS (ECC)

Critical thinking involves putting together all knowledge sources to lead to a decision. It involves book and school knowledge, asking intelligent questions of those you work with, and thinking through past experiences. One who thinks critically can adapt to new situations and puzzles out answers even when faced with unfamiliar information. Critical thinking is not something that we are born with, it is a skill that must be taught and practiced. In school, many of us are taught to memorize facts and regurgitate them on a test. With real patients, the answer is never that simple; it requires thought. In medicine, critical thinking is a vital skill that technicians should be practicing and perfecting every day.

Veterinary technicians and nurses enter the field with an excitement to learn the technical aspects of our duties. Placing IV catheters, drawling blood, advancing to arterial catheters, central lines, urinary catheters, feeding tubes, perfecting radiographs and learning new dentistry techniques are obviously vital to the practice, and they are also the "fun" part. Fewer want to put in the continued work and study required to cultivate the understanding and mastery of physiology, pharmacology, understanding disease processes, and learning to look for subtle changes in the patient. These skills are what set stellar veterinary technicians and nurses apart from merely good ones. Anyone can be taught to place an IV catheter in an afternoon. Not everyone understands the progression of parvovirus, the signs of sepsis, and how to manage hypotension in a puppy. Committing to continued learning contributes a large portion to the ability to think critically.

The nursing process, well-defined in human nursing, is a great model for veterinary technicians and nurses to follow as they learn to think more deeply about the cases they are treating. The entire nursing process requires critical thinking at every step as nurses must have a basic understanding of medicine as well as technical skills and knowledge to complete veterinarian orders. They need to understand diagnostic equipment, catheter placement, how to collect vitals, and how to administer medications. Nursing also requires interpersonal skills and their development as one interacts not only with fellow nurses and technicians but also veterinarians, assistants, client services, and especially pet owners. Participating in the nursing process will help to develop all of these skills and is as follows:

- ASSESS is the first stage in the nursing process and is simply date collection. In a hospital environment, data is gained from many sources including the initial triage phone call, history taking with the client, through hospital rounds, and through a physical exam on the patient. Nurses and technicians must always remember to perform a physical exam on their patient each and every time they contact the animal, as the assessment phase can bring new information to light with each interaction.
- ANALYSIS is where all of the information gained is brought together to aid in the diagnosis. While veterinary technicians and nurses cannot make a diagnosis, the information we provide is vital to the diagnosis process. Palpating a large, turgid bladder on a male cat that is straining in the litterbox allows the nurse to think ahead to the potential emergencies that can occur and how they can either be mitigated or monitored. A golden retriever that presents after collapsing at home and has pale gums can lead the team to prepare monitoring and diagnostics before being asked by the veterinarian.

- PLANNING allows the technician and nursing team to participate in prioritizing diagnostics and treatments. A dog that presents to the hospital in hypovolemic shock is ordered to receive pain medication, survey radiographs, IV fluids, an IV catheter placed, and a minimum database of blood work drawn. These tasks must be prioritized for the best care of the patient and critical thinking and experience will aid in this step. Patients in the ICU setting will also have multiple treatments due or multiple patients requiring treatments at the same time. The managing technician or nurse for these cases will need to think through the competing priorities to determine which treatment or which patient needs to be completed first. As information becomes available, these priorities may change. That same dog that presented in hypovolemic shock is receiving his IV fluid bolus when the blood results return showing hyponatremia, hypochloremia, hyperkalemia, hypoglycemia, and azotemia. Suddenly the need for radiographs decreases and the need to supply dextrose support and continued IV fluid therapy moves back to the top priority. Critically thinking technicians and nurses must be aware of changes and remain flexible. They must always be thinking ahead to potential problems that may occur and have a plan for how they will respond. How will it be determined that the patient is worsening? What can be done to confirm the concerns? This step in the process is beneficial for case studies and quizzing as it requires understanding and forethought.
- IMPLEMENTATION is exactly that – implementing the plan in the order deemed appropriate. Placing the catheters, drawing the blood, administering the anesthesia, taking the dental radiographs. This step will change with the planning step as more information becomes available and the patient status changes.
- EVALUATION is an important step and one that should be carried out along with the veterinarian. Is the patient improving? Is the information being received as planned? What has changed? What needs to change? Each body system must be evaluated, and each hospital system must be evaluated as well. How long did it take the lab work to come back? Is the team properly trained on taking dental radiographs? How are the treatment sheets communicating with the team? Was the client kept apprised of the changes with the plan? The nursing team is critical to all aspects of patient care and the nursing process must reflect this, along with examining all areas of the hospital the nursing team affects.

Fully implementing the nursing process may seem tedious at first and take more time than you may have available. The more you think through the process, the more second nature it becomes. Each step is an opportunity for learning, and each new skill learned or disease process better understood adds to the bank of knowledge to be accessed with additional patients. This process can be discussed during nursing rounds, even if it is just utilized for one or two patients, to showcase the importance of critical thinking.

In order to think critically, one has to understand both the problem and how to solve that problem. It is not enough to simply know that anaphylaxis can occur due to vaccines in a puppy, one must understand why and how and what to do to save that puppy's life. In order to learn, questions must be encouraged. Many hospitals perform rounds, whether formal and structured or informal and conversational, and these rounds are a good opportunity to quiz employees and foster learning. The goal is not to embarrass employees and point out what they do not know, but to lead them through a case or disease process asking pointed questions along the way. These questions should be evidence based and journal reading encouraged to for research. As employees grow accustomed to these question and answer sessions, they will soon see them not as punishment, but look forward to the opportunity to learn and grow in their job.

If rounds are not regularly occurring, critical thinking exercises can be done in a group setting in the hospital. Hypothetical case studies are the best way to learn, as these questions will have a natural conclusion and employees can see the benefit as they are discussing. Start simple with a commonly occurring patient type in your hospital. Begin with a phone call from a client stating that their dog just ate two weeks worth of chewable carprofen. What questions should be asked? Is this an emergency? What will happen when the dog arrives? What should be set up? Is everyone comfortable with the math involved in calculating drug dosages? What can happen if the dog is not treated? What is the physiology behind the toxicity?

What treatments may be needed in the hospital for the dog? What medications may be used? Why? How are they administered? What are potential problems that may arise while in the hospital? What nursing concerns does the team have? What monitoring will be required? Most staff will be comfortable with what needs to be done for this patient, but few will understand why. The best critical thinkers are not satisfied with simply knowing what to do, they are searching for the why.

Do not allow yourself to fall into the trap of cookbook medicine. 'Because I was told' is never a good enough reason to perform a treatment on an animal. As veterinary technicians and nurses it is the job description to carry out veterinarian orders, but perform that treatment because you understand the motivation. What is happening in that patient that requires this medication? Why is it happening to that patient? How does this treatment or medication help this pet's situation? Why was this treatment chosen now? Knowing the answers to these questions will help you become a better technician and enrich your experiences with your patients. Critical thinking will lead you to the most right answer. Medicine is complex, often without a singular right answer; utilizing critical thinking skills can help wade through the potentials to understand the best answer at that time.

In veterinary medicine, technicians are expected to closely monitor patients and alert the veterinarian to minor changes, but should also be aware of complex diseases processes and know the signs of change. Understanding sepsis can help an alert technician to ask if the blood glucose should be measured in the patient with declining mentation. Understanding SIRS can help a technician look closely at each treatment time for signs of early respiratory compromise of a coagulopathy. Critical thinking involves planning ahead for procedures and keeping one step ahead of the receiving veterinarian during a busy emergency shift.

Test your critical thinking skills by anticipating results. Look at the presenting complaint, medical history and physical exam results on a sick patient and anticipate their blood values. Anticipate what you may find on radiographs. Were you right? If not, why? Did you learn something new? Anticipate the results of vital signs every time treatments are performed on a hospitalized patient. If a post-operative gastrointestinal foreign body dog is sleeping soundly and breathing comfortably you might anticipate a heart rate of 70bpm and a normal blood pressure. If his heart rate is 140bpm and his blood pressure is elevated, something is wrong. Maybe a different blood pressure cuff was used or a different machine than the last treatment time. Maybe the dog should go out to urinate and then recheck his vitals. If his heart rate and blood pressure are still elevated those will be reported to the doctor, but at least you have thought through some potential simple causes are confident in the results. Simply writing the results in the record and moving to the next patient is not utilizing your skills and knowledge to their potential, as well as not benefiting the patient or the veterinarian.

As a technician, you may not have the authority to change orders, add medications, or make a diagnosis, but those limits do not mean that you should not educate yourself in all of those areas. When medical orders are made, ask yourself why? Why are we using this antibiotic over that one? Why is this patient having an arrhythmia now? Why is the blood pressure dropping in this situation and can I do anything about it? Why are we giving a fluid bolus now? As you learn more you will be better about anticipating these changes in the next patient that you treat and you will be prepared. When the doctor orders that fluid bolus you will be ready. You will know that the blood pressure is dropping and be ready with the treatment.

It is important to remember that even though you may have advanced monitors and tools to tell you how a patient is doing, it is still important to use your skills of observation. You, the technician, can anticipate what is coming next. A monitor can only tell you what is happening right now. As you progress in your career, remember what has happened in the past. Collect anesthesia records and case reports of interesting diseases and experiences to help you remember them. Rely on your observations. Are the gums less pink than they were an hour ago? Do those pulses feel weaker than when the dog came in? Is that breathing pattern different? These are clues that no monitoring equipment will be able to detect. A skilled technician can never be replaced if they are using their critical thinking skills.

The following is a simple case study illustrating the use of critical thinking skills to come to decisions. You are managing anesthesia on a young dog with a GI foreign body. He presented to the hospital after vomiting for two days and is 7-8% dehydrated but otherwise has a normal physical exam and normal pre-operative blood work outside of slightly elevated PCV/TS. He receives IV fluids at 10mlkg pre-op for three hours and his anesthesia induction

with an opioid, benzodiazepine, and propofol goes well. As surgery begins, the dog's heart rate is persistently tachycardic at 130bpm. What is your next step?

First, go through the obvious potential reasons for tachycardia: pain, light plane of anesthesia, hypovolemia, drugs administered, anemia, hypoxia, and surgical manipulation. You can rule out anemia, as the PCV was normal heading in and there is no evidence of blood loss intraoperatively. The dog is intubated with normal Sp02 and respiratory values, his mucous membrane color is pink and his ETC02 is normal so you can rule out hypoxia. You are left with pain, hypovolemia, and surgical manipulation.

Next, look at your other monitoring parameters. How is the blood pressure? What is the surgeon doing at the moment? What is the CRT? Do the intestines look dry and tacky? Using this information you can decide to increase the inhaled gas, give a fluid bolus, or administer pain medication to correct the tachycardia.

A technician not used to using critical thinking skills might quickly reach for the gas inhalant and turn it up, but what if the blood pressure was borderline low? Increasing gas inhalant will cause vasodilation and cause further lowering of the blood pressure. By thinking through the entire situation, using what you know and what your monitors are telling you, you can make the best decision for the patient.

Critical thinking is open thinking, and it does not allow for remaining in one place. "This is how we've always done it" is the death toll for critical thinkers. Medicine evolves, patient status changes, and circumstances in veterinary medicine call for creativity and outside the box thinking. Do not allow yourself to be limited by the past or even by the tools on hand. Think through creative ways to get patients to eat, to help clients adhere to a complicated medication schedule, or keep a ferret from tangling his IV fluid lines. Veterinary technicians and nurses are a creative group and can fix anything with white tape and some vet wrap; encourage that creativity around the hospital to encourage advancement.

Teaching critical thinking in the hospital is vital to the job satisfaction of the nursing staff. Critical thinking allows technicians to become proactive, not reactive, in their job thereby making them an indispensable part of the team. Technicians should be empowered to think globally, plan ahead, anticipate need, and keep the hospital floor moving. This skill is often present in more senior technicians but can be taught and fostered in technicians at every level.

Ask some critical thinking questions when you interview technicians for your practice. Instead of closed ended questions like: "Are you comfortable placing IV catheters" or "Are you comfortable monitoring anesthesia" consider the following:

- We use dexmedetomidine here for minor procedures. What can you tell me about the clinical effects this drug has on dogs on cats? How would you monitor a patient under dexmedetomidine sedation/anesthesia?
- A client calls the hospital and her dog has eaten his entire 1-month supply of carprofen while the owner was in the shower. What are the body systems affected by a carprofen overdose, and what would you advise the owner to do? What would you set up for when the client arrives?
- You are running lab work and see that a dog has a PCV/TP of 58% and 8.2g/dl. What information about the dog can you get from these results?
- Talk through your concerns when anesthetizing a brachycephalic dog

Encourage senior staff members to participate in the critical thinking process. Often, if one person starts the conversation, others will be happy to join in. Quizzing a technician often brings the veterinarians over to listen and they often take over the quizzing, excited to see the learning occurring in their staff. Getting the veterinarians involved can help them teach better history taking, better procedure preparation, and help the nursing staff anticipate veterinarian needs better. Communication lines are opened when questions are encouraged and the nursing staff no longer has to guess what is wanted of them.

This process is something that must be built in to a clinic's culture. Information withholding, bullying, and horizontal violence are all too common in veterinary practices and spell death to critical thinking. When staff are afraid to speak up, afraid to ask questions and afraid to make mistakes, progress cannot be made. When only one person knows how to take dental radiographs or place difficult catheters the entire practice suffers. Critical thinking must be taught and practiced. While difficult, senior staff members must step back and allow employees to think for themselves. If a new technician or nurse is struggling with a question or technical skill, the instinct is to step in and do it for them for the sake of time. This is taking away a potential learning opportunity. If

they cannot answer a question, reword it or ask another question with a similar theme to try to get them to the answer. This process takes energy and patience, but the best leaders and teachers are willing to help others grow to be their best. Fight bullying by structuring learning expectations so that everyone is involved with teaching. Reward not only the learning and progression of staff but also reward those who are teaching. Again, a culture change needs to occur and all teams need to be on board with the process and the goals, but the outcome is beneficial to the team as well as the financial gain of the hospital. Engaged employees stay longer and contribute more than just their hours in the clinic.

One of the benefits of being a veterinary technician and nurse is the focus on practicality. Nothing a nurse does is wasted energy. Every interaction with a patient, even cleaning up diarrhea from that patient, is for their benefit. TLC is one of the 20 most important thoughts to have when evaluating a patient and it is almost solely performed by the nursing team. Every snuggle in a kennel is an opportunity to evaluate pain scores, respiratory status and patient mentation. Every trip outside is an opportunity for patient enrichment and to quantify urine output and character. Charting gives the opportunity to record important bits of information for the next shift to remember and to keep continuity of care. No minute throughout the day is wasted, every task is an opportunity to better the patient and learn more information about them and their status. Take pride in that work and what it means to the patient, the client, and the veterinarian. Technicians and nurses contribute every minute of every day.

Even if you have been a veterinary nurse for years you can still challenge yourself and learn more. Pick a disease process or type of cancer and learn all that you can about it. Choose a breed of dog and learn about their inherited diseases. Study cytology and improve your cell identification skills. The more you learn the more you will have to draw from when the need arises. Learn from those around you. Ask questions, participate in case rounds, attend as much continuing education as you can. Resist the temptation to do it just because you were told. Technicians are vital to a practice because of our brain and our ability to think. Cultivate your critical thinking skills and you'll be a valuable resource in your practice.

REFERENCES

1. *"Case-Based Learning." SpringerReference (2011): Faculty of Medicine, University of Ottawa.*
2. *Davis, Harold "A New Approach to Veterinary Nursing: The Nursing Process. William R Pritchard Veterinary Medical Teaching Hospital University of California, Davis CA*
3. *Irby, D. M. "Three Exemplary Models of Case-based Teaching." Academic Medicine 69.12 (1994): 947-53.*
4. *Lacroix, Charlotte, DVM, JD. "Improve Your Practice's Bottom Line: Effectively Use Veterinary Technicians." Proc. of Veterinary Specialists in Private Practice, Savannah, GA.*
5. *Lenz, Peter H., MD, Jennifer W. McCallister, MD, Andrew M. Luks, MD, and Henry E. Fessler, MD. "Practical Strategies for Effective Lecturers." Annals of the American Thoracic Society 12.4 (2015): 561-66*
6. *Mostafa, Soha Rashed Aref. "Problem-Based Learning." 6 June 2015.*
7. *Ruesink, Megan "The Importance of Critical Thinking Skills in Nursing. Rasmussen College*
8. *"Utilizing an Underused Resource: Veterinary Technicians." Veterinary Business Advisors.*

16003

UNDERSTANDING FLUID THERAPY

TECHNICIAN PROGRAM | TECHNICIAN ESSENTIONS – ACUTE CARE

Megan Brashear, RVT, VTS (ECC)

Fluid therapy is a potentially life-saving treatment performed in veterinary hospitals multiple times a day. Patients are supported during surgical procedures, supported during minor illness, and resuscitated from major fluid losses. A healthy animal is approximately 60% water, and that water is distributed through different compartments throughout the body:

- Intracellular fluid makes up the largest percentage of total water in the body. This is fluid inside the cells and is controlled by the flow of water, electrolytes, and other solutes across cell membranes.
- Extracellular fluid is all of the fluid not inside cells, and where water is lost first during sickness or disease states. Extracellular fluid is further divided into:
    - Interstitial fluid which is fluid surrounding cells in muscles and other tissue
    - Intravascular fluid which is the water portion of plasma in circulating blood
    - Transcellular fluid which is found in dense connective tissue and bone. This makes up a small portion of the body's total water

When a patient becomes compromised due to fluid loss, replacement and support is administered in the form of crystalloid or colloid fluids. Crystalloid fluids are water and electrolytes and are used to replace volume. Crystalloids can be administered in large volumes over short periods of time and can be administered over days at a time. Different types of crystalloid fluids may be chosen to treat various electrolyte abnormalities which may occur depending on electrolyte needs. Crystalloid fluids will shift from the intravascular space into the interstitial and intracellular space; this is beneficial to treat a variety of causes for fluid loss and is important to remember when monitoring patients on IV fluid therapy.

Colloids are fluids comprised of large molecules which will remain in the intravascular space longer than crystalloid fluids. Colloids can also help "pull" fluids into the intravascular space to increase circulating volume and give blood pressure support. Blood products such as packed red blood cells and frozen plasma are natural colloids. Vetstarch™ is a synthetic colloid that can achieve similar results. There is current controversy in both human and veterinary medicine regarding the use of synthetic colloids; there is concern for acute kidney injury in critically ill human patients. At this time there is no evidence that veterinary patients are under the same risks but caution should be exercised when administering synthetic colloids.

When determining fluid therapy needs for a patient, a physical exam with a patient history must be taken so that important questions can be answered. The veterinarian and nursing team must be able to answer the following questions:

IS THE PATIENT IN HYPOVOLEMIC SHOCK THAT REQUIRES IMMEDIATE ATTENTION?

Understand the physical signs of hypovolemic shock. Tachycardia, weak pulses, pale mucous membranes, prolonged capillary refill time, cool extremities, and decreased mentation can signal a critical fluid deficit that must be addressed immediately. Hypovolemic shock is treated with crystalloid fluid replacement; large volumes are bolused until the patient begins to respond with a decreasing heart rate and increased blood pressure. This initial rapid administration of fluids is referred to as

the resuscitation phase of fluid therapy and is completed quickly before rehydration occurs.

IS THE PATIENT DEHYDRATED?

Not every patient that needs fluid therapy is dehydrated but the majority of them are experiencing dehydration. Evidence of dehydration can be determined with both laboratory (elevated PCV and TS) and physical exam results. Dehydrated patients will have a loss of elasticity in their skin, will have sticky mucous membranes, tachycardia, and sunken eyeballs. Dehydration is replaced with fluids after the resuscitation period and it can take 24-36 hours to fully hydrated a patient.

CAN THE PATIENT CONSUME ENOUGH WATER TO REMAIN HYDRATED?

The answer to this question can help determine if the patient must be treated in the hospital or perhaps as an outpatient. As hospitalized patients begin to recover, water should be offered in the hospital and fluid requirements adjusted as they begin to drink water.

WHAT TYPE OF FLUIDS SHOULD BE GIVEN?

This question is dependent on many factors and includes administering crystalloid fluids, colloids, or both. It also concerns the type of crystalloid fluids based on the patient's electrolyte status and make-up of different fluids. Electrolyte additives can be introduced to the fluids to tailor them to the patient needs.

Within the water in the body is electrolytes. Any discussion of fluid therapy cannot be complete without an understanding of electrolytes and the role they play in fluid shifts within the body. Different cell membranes are made with different permeability to allow for these shifts. The following vocabulary is necessary to understand when learning about fluid therapy:

- Osmosis: the diffusion of fluid across a membrane from an area of low solute concentration to an area of high solute concentration in order to make both sides equal.
- Hypotonic: referring to a solution with a solute concentration less than plasma, causing fluid to shift out of the intravascular space.
- Isotonic: referring to a solution with a solute concentration equal to plasma.
- Hypertonic: referring to a solution with a solute concentration greater than plasma, causing fluid to shift into the intravascular space.

The kidneys are responsible for the sodium balance within the body. Through the renin-angiotensin-aldosterone feedback system, the kidneys recognize when perfusion is decreased and release renin. Renin signals the liver to release angiotensin I. In the lungs, angiotensin converting enzyme (ACE) converts angiotensin I into angiotensin II. Angiotensin II promotes sodium uptake by the kidneys and will cause vasoconstriction to increase circulating volume and increase blood pressure thereby improving perfusion to the kidneys. Angiotensin II signals the adrenals to release aldosterone which will further encourage sodium uptake and potassium excretion. In normal body states the kidney will excrete the amount of sodium ingested each day to maintain a healthy balance within the body.

Due to the principle of osmosis, fluid follows sodium. An increase in circulating plasma sodium means the concentration of sodium is higher outside of the cells. Fluid follows this gradient and will increase intravascular volume. When circulating sodium levels are decreased, this means the sodium content in the intracellular space is greater than the circulating plasma, and fluid will flow to the intracellular space. In patients with sodium disorders, it becomes important to monitor levels and anticipate changes in fluid shifts and monitor for complications.

Clinical signs of hypernatremia are often noticed when sodium serum levels reach greater than 170mEq/L. Hypernatremia can be caused by lowered water intake by the animal, fluid losses, or a dramatic intake of sodium (salt toxicity). Increased sodium in the circulating plasma will cause fluid shifts to the intravascular space in an attempt to dilute the plasma sodium levels. As this happens within the brain, vessels can rupture and cause cerebral hemorrhage.

The clinical signs seen with hypernatremia will vary depending on the speed that animal experienced the change. As a general rule, acute changes will cause acute signs, with more gradual changes in sodium the body has time to adjust and the animal may appear normal. At any rate, the clinical signs of hypernatremia are neurologic. Ataxia, depression, seizures, coma, and death can all be seen with an elevation in sodium levels.

When treating patients with hypernatremia it is important to treat any shock and hypovolemia first, as these conditions can lead to death, the focus on addressing

any underlying disease. In chronic disease states, the body produces idiogenic osmoles which act as sodium molecules in the brain to prevent large fluid shifts from the intracellular compartment. If correction to normal sodium levels occurs too quickly, the body will respond as if in acute hyponatremia and this is not desired. Correction of chronic sodium abnormalities should happen slowly; the goal is to decrease sodium levels 0.5 (for acute) – 1 (for chronic) mEq/hr. To begin treatment, choose a fluid with a sodium content closest to the patient's sodium levels. In many cases this is 0.9%NaCl. Once dehydration is corrected the patient may need fluid changes to balanced electrolytes replacement or maintenance fluids or a combination of different types of crystalloid fluids to strike the appropriate balance, Blood work should be checked often to make sure levels are not falling too quickly, and the patient monitored closely for any neurologic changes.

Clinical signs of hyponatremia are often evident at serum levels less than 140mEq/L. Hyponatremia results from volume loss (from vomiting or diarrhea), administration of diuretics, hypoadrenocorticism, kidneyl failure, or increased water intake (water toxicity). Decreased levels of sodium in the circulating plasma will cause a fluid shift from the extracellular space to the intracellular space and can cause cell rupture and cerebral edema.

The clinical signs seem with hyponatremia will vary depending on the speed that the animal experienced the change. As a general rule, acute changes will cause acute signs, with more gradual changes the body has time to adjust and the animal may appear normal. The clinical signs of hyponatremia are weakness, vomiting, ataxia, and seizures.

When treating patients with hyponatremia, it is important to assess their volume status first. Hyponatremia can exist with dehydration, normal hydration, or overhydration and fluid therapy will need to support that; assessing for dehydration must occur throughout the patient's hospital stay. Sodium supplementation will need to be provided to these patients using crystalloid fluids and care must be taken not to raise their sodium level too quickly. The goal is to raise serum sodium levels but 0.5 (for acute) to 1 (for chronic) mEq/hr. Fluid choices can range from hypertonic saline (7% NaCl) to 0.9%NaCl, to a balanced crystalloid solution (NormosolR, LRS) to raise sodium levels to normal. Blood values should be checked often to ensure that levels are not rising too quickly and the patient monitored closely for any neurologic changes.

Chloride will follow sodium and will rarely become hypo or hyper on its own. By treating sodium disorders, chloride levels will become normal as well. Chronic vomiting and loss of body acid can lead to chloride alterations. Severe changes in chloride can lead to ECG changes; these patients must be monitored closely as fluids are administered.

Potassium levels are closely monitored and replaced or diluted with fluid therapy. Potassium is the main intracellular electrolyte; normal circulating plasma levels of potassium are much lower than normal sodium or chloride levels. Clinical signs of hyperkalemia are often noticed at levels higher than 7.5mEq/L. Excess potassium is excreted from the body in the urine, so the most common cause of hyperkalemia is urinary obstruction followed by acute or chronic kidney failure. Patients experiencing a hypoadrenocorticism crisis can also suffer from hyperkalemia. Increased circulating potassium can cause muscle weakness, cardiac arrhythmias and death.

The clinical signs of hyperkalemia are often seen in connection with the heart. Bradycardia can occur, and on ECG you may see tall, tented T waves. As potassium levels continue to climb, the P waves disappear and the T waves continue to widen until the patient suffers cardiac arrest. Hyperkalemia is a true emergency that requires a quick correction of levels and correction of the underlying disease.

Treatment for hyperkalemia is aimed at diluting circulating levels potassium with intravenous fluids and promoting cell uptake of potassium. In cases of urinary obstruction, balanced crystalloid fluids, while containing some potassium, is safe to use in these patients prior to relieving the obstruction. An IV bolus of dextrose will cause cells take in the excess glucose. As this happens the cells will also take in potassium. In severe cases of hyperkalemia IV insulin may be administered to achieve the same effect.

Clinical signs of hypokalemia are often noticed at levels lower than 3.0mEq/L. Hypokalemia most commonly in chronic kidney failure patients, as they are excreting too much in their urine. The other common cause of hypokalemia is GI loss from vomiting and diarrhea. Muscle weakness (including the heart muscle) is the biggest concern with hypokalemia, and low potassium can decrease kidney perfusion making kidney disease worse.

Patients suffering from hypokalemia will express ventroflexion and profound weakness. Respiratory status must be monitored as some of these patients are too weak

to appropriately ventilate and may need support during treatment. It is important to monitor heart rate and blood pressure on these patients as their levels are corrected.

Treatment for hypokalemia is aimed at replacing potassium levels, most commonly this is done through IV crystalloids. Potassium chloride is added to fluids to increase the amount given but should not exceed a rate of 0.5mEq/kg/hr. Technicians and nurses should be comfortable calculating the rate of potassium as fluid rates change. Fluids containing potassium should never be bolused.

Colloid use is tailored to patient need and hospital supply. Natural colloids such as packed red blood cells can be administered to those patients suffering the clinical signs of anemia. Signs such as tachycardia, tachypnea, hypotension, pulse quality, and weakness will all direct choices on blood transfusions. Synthetic colloids may be used to support blood pressure in cases of large volume loss, anaphylaxis, or protein losing disease. Colloids carry the risk of patient immune mediated reaction (in the case of natural colloids) and the emerging knowledge of potential kidney damage with synthetic colloids. This knowledge should lead to judicious use of colloids and when other avenues of therapy have been exhausted.

BY WHAT ROUTE SHOULD FLUIDS BE GIVEN?

Many patients needing fluids need them to quickly replace losses (such as those in hypovolemic shock) or because the animal cannot take in fluids due to illness or obstruction. These patients will obviously require intravenous administration of fluids. However, a population of patients with minor disease or those that need daily support for chronic disease can receive subcutaneous fluids to maintain hydration. Any patient that suffers from vasoconstriction due to poor perfusion, hypothermia, or shock will be less successful with the subcutaneous route of administration.

HOW MUCH FLUID SHOULD BE GIVEN?

This question should be asked and answered multiple times during a patient's stay in the hospital. The rate of fluids should relate to the patient's physical exam, hydration status and nutritional status. In states of hypovolemic shock, large volumes of crystalloid fluids are administered intravenously until an improvement in tachycardia, blood pressure, pulse quality, and mucous membrane color is noted. This resuscitation phase of fluid therapy may see patients receiving 20, 50, even 90ml/kg of fluids. Isotonic crystalloids are quickly administered and the patient monitored often. Once physical exam parameters are normal and remain normal on lower rates of fluid can the fluid plan change.

Once the resuscitation is complete, the patient then has their hydration deficit replaced. This volume is calculated by the following formula:

% dehydrated x body wt in kg x 1000

This volume (in liters) is then divided into 24-36 hours and replaced over that time frame. Added to this is the maintenance fluid requirement, often calculated as 40-60ml/kg/day. For small dogs and cats and very large dogs, the quick calculation may underserve them, and more accurate calculations based on basal energy requirements may be performed.

Lastly, losses must be calculated into a fluid therapy plan. Patients with large volumes of vomit, diarrhea, or urine output need those losses corrected. Urinary catheters can help to quantify urine output, and nasogastric tubes can help to quantify gastric contents. Bedding can be weighed before and again after soiling to determine approximate losses. The nursing team can also guess at fluid volumes of vomit and diarrhea.

All patients on fluid therapy must be monitored closely during their hospital stay. Nurses must be confident in assessing hydration, monitoring for clinical signs of shock, and in looking for signs of fluid overload in patients. Thoracic auscultation, pule quality assessment, mucous membrane color and nature, blood pressure, and skin turgor should be tested multiple times throughout the shift and when any problems are noted. Urine output and urine specific gravity can be monitored as a way to gauge success of fluid therapy as well as PCV/TS and electrolyte levels.

SUGGESTED READING:

1. *DiBartola, Stephen P. Fluid, Electrolyte, and Acid-base Disorders in Small Animal Practice. St. Louis, MO: Saunders Elsevier, 2006.*
2. *Silverstein, Deborah C., and Kate Hopper. Small Animal Critical Care Medicine. St. Louis, MO: Saunders/Elsevier, 2009.*
3. *Thompson, Gale, and Janeen Levine. Fluids & Electrolytes Made Incredibly Easy! Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins, 2011.*

16004

RESPIRATORY EMERGENCIES

TECHNICIAN PROGRAM | TECHNICIAN ESSENTIONS – ACUTE CARE

Megan Brashear, RVT, VTS (ECC)

The role of the respiratory system is to perform gas exchange. Oxygen is inhaled into the lungs and is exchanged for carbon dioxide which is exhaled. The hemoglobin on red blood cells binds to oxygen and carries it to the tissues throughout the body. The lungs function within negative pressure; air passively come into the chest and diaphragm exhales it back out. The following terms are helpful in a discussion of respiratory emergencies:

Oxygenation refers to the body's ability to deliver oxygen to the cells. It is influenced by available oxygen, cardiac output, blood pressure, and circulating volume.

Ventilation refers to the mechanical ability of the lungs to bring oxygen in and exhale C02. It is influenced by the health of the thoracic muscles, any air/fluid that may impede lung expansion, and perfusion status.

Pulmonary Edema is excess fluid inside the lung tissue. This fluid cannot be removed with thoracocentesis, it takes treatment with diuretics to remove; the body can eventually resorb edema with time.

Pleural Effusion is fluid between the lungs and body wall. It restricts lung expansion and can be removed with thoracocentesis.

Receiving respiratory emergencies into the hospital takes quick action. Patients need immediate oxygen support in the form of an oxygen cage, flow by, nasal prongs, or an oxygen hood. These patients are fragile and must be handled with care; an important goal during treatment is to minimize stress. Observe the breathing pattern of the animal when they first arrive. Watch their posture and note if they are positioned with elbows abducted and/or their neck stretched out. Watch their thorax and abdomen as they breathe; are the chest and abdominal muscles moving together (outward movement during inhale, inward movement during exhale) or opposite each other? Patients exhibiting paradoxical breathing are at risk for respiratory arrest and should be closely monitored.

Auscultation of the chest is necessary and can assist in localizing the underlying problem causing the distress. Listen for upper airway sounds, absence of lung sounds, harsh lung sounds, crackles, and for cardiac abnormalities like a murmur or arrhythmia. Auscultation can help guide treatment and lead to interventions such as thoracocentesis which can stabilize the patient. Radiographs are helpful in diagnosing respiratory problems but are stressful and can be detrimental to the distressed patient; effort must be made to attempt to stabilize the patient as much as possible prior to radiographs. Ultrasound can also be utilized to identify pericardial effusion, pleural effusion, and pneumothorax and can be performed with the patient in sternal recumbency with minimal stress.

Mild sedation can be administered early in the treatment plan for these patients; sedation can help to facilitate procedures and diagnostics and provide mild relaxation while these animals rest in oxygen. For non-traumatic respiratory distress, butorphanol (0.2mg/kg IV or IM) can help to relax the patient while exhibiting minimal effect on their ability to ventilate. Trauma patients may require a stronger full mu opioid; technicians should be aware of the potential panting and dramatic relaxation that can occur with these drugs and monitor accordingly. In patients that are not responding to oxygen therapy, those too fractious to allow handling, or those with severe respiratory exhaustion, the best treatment plan may be general anesthesia and intubation. Sedation with

an opioid and benzodiazepine may be sufficient but a slow titration of propofol or alfaxalone can be utilized for induction and intubation. Although anesthesia in a critical respiratory distress patient can be a frightening thought, intubation provides a secure and open airway and allows full control (if necessary) of ventilation and allows for monitoring of end-tidal CO2. Adjustments to manual ventilation can then be tailored as needed.

It is vital for the nursing team to take diagnostics slowly with these patients. They are easily stressed and small things (like a temperature or blood pressure) can increase their distress and respiratory rate and effort. The team must learn to prioritize treatments; discuss with the veterinarian IM vs IV injections of medications, and allow long rest periods between interventions. When restraining for IV catheter placement, blood draws, or injections, allow the patient to remain sternal if possible and be cognizant of their head position. Do not put any unnecessary pressure on their neck or chest during restraint. If the patient allows, continue to provide at least flow by oxygen during treatments.

Many respiratory patients will eventually need radiographs; minimize time and stress by ensuring good diagnostic images. Be sure the patient positioning is good; be careful of patient rotation on both lateral and VD views. Ensure the cranial landmark is the thoracic inlet and include all of the lung fields. If at all possible take the radiograph on inspiration. The ventral-dorsal view is the most stressful for the patient, rather than wrestle, discuss taking a dorsal-ventral view if possible.

COMMON RESPIRATORY EMERGENCIES

- Choking – From tennis balls to treats and hairballs, choking can occur with both cats and dogs of all sizes. The animal may be coughing or gagging, pawing at the mouth, or collapsed. Quick anesthesia induction may be necessary to facilitate safe removal of lodged object; IV access should be obtained (a butterfly catheter is quick and effective) and immediate anesthesia (such as propofol) so that the object can be removed. In cases of an esophageal foreign body not obstructing the airway, a more planned approach can be taken but the object should be removed as soon as possible. Choking can lead to non-cardiogenic pulmonary edema and these patients should be observed for any respiratory distress. Esophageal foreign bodies can lead to stricture in the weeks after the event; owners should monitor for any changes in eating habits.
- Feline asthma (reactive airway disease) is often noticed at home as coughing. When these cats present during a crisis the can be open mouth breathing and cyanotic. Oxygen therapy is necessary when these patients first arrive. Treatment with an inhaled bronchodilator (such as albuterol)can bring relief to these patients, and some may need corticosteroid treatment while hospitalized to decrease inflammation.
- Laryngeal Paralysis is most common in older, large breed dogs. It is caused by the laryngeal nerve failing to abduct the arytenoids during inspiration and adduct during expiration. Early signs are 'harsh' panting and possibly exercise intolerance. As the disease progresses dogs can easily become distressed, especially in warm weather as they pant. Panting causes edema of the laryngeal tissues and they breathe harder to try and get more oxygen. This causes more swelling and more panting. These patients can progress to cyanosis and collapse. Treatment is oxygen therapy and sedation; intubation may be necessary for a few hours. Dogs can become overheated as they are less efficient at dissipating heat so monitor their temperature and treat as necessary. There is a surgical correction (laryngeal tieback) but many dogs live with the condition and the owners control their activity.
- Pneumothorax is caused by air accumulating between the lungs and the chest wall. It can be the result of blunt force trauma or may be spontaneous due to lung pathology (bulla, cancer). Pneumothorax can be identified on radiographs (lateral – heart elevated off the sternum; VD – lungs pulled away from the ribs) and should be recognized by technicians. Animals presenting with pneumothorax will often have an elevated respiratory rate and take shallow breaths (inability to expand their lungs) and it will be difficult to hear lung sounds. These patients need oxygen therapy but more importantly thoracocentesis to remove the air. If a pneumothorax is suspected thoracocentesis should be performed prior to radiographs. In cases where thoracocentesis does not yield negative pressure in the chest or the animal require a pneumothorax multiple times in a 24 hour period placement of unilateral or bilateral thoracostomy tubes may be required.

- Patients can present with penetrating thoracic trauma. Rarely there will be a foreign body lodged in the chest wall, but if this is noted, never remove a penetrating foreign body. It is sealing a hole into the chest cavity and should only be removed surgically. More often there will be a penetrating wound as the result of an animal maul. A penetrating chest wound will remove the negative pressure needed within the chest. If you discover a penetrating chest wound (or hear a sucking sound when the animal breathes) the immediate treatment is to cover the wound until surgery can be performed.
- A flail chest occurs when trauma to the chest breaks multiple ribs creating a section of the chest that moves the opposite direction when breathing (sucks in when the animal inhales, out when they exhale). There may be concurrent pneumothorax and/or penetrating chest wounds associated with a flail chest. Flail chest treatment will vary depending on severity. In some cases placing the patient in lateral recumbency with the flail side down can help with pain and ventilation. Some cases will heal with time; severe cases may need surgical correction. Oxygen therapy is required during the healing process
- Pulmonary contusions are caused by blunt force trauma, most commonly vehicular trauma. Pulmonary contusions are small hemorrhages within the lungs and can cause significant respiratory distress. Radiographic changes lag 6-12 hours behind clinical signs; pulmonary contusions can be diagnosed via radiographs but treatment begins with patient history and clinical signs. Treatment for pulmonary contusions includes oxygen therapy and pain management. Technicians must monitor ventilation status as respiratory exhaustion may necessitate mechanical ventilation in some patients. Fluids should be used judiciously when resuscitating patients with known pulmonary contusions as fluid overload can lead to fluid leaking into the pulmonary interstitial space.
- A diaphragmatic hernia can be a congenital condition or the result of trauma. A defect in the diaphragm allows abdominal contents to enter the chest not allowing full expansion of the lungs. Patients may present in respiratory distress with an absence of lung sounds or even bowel sounds in the chest. Radiographs will show abdominal organs in the chest and no definitive diaphragm line between the chest and abdomen. Surgical correction is needed for patients in respiratory distress, focus on stabilization as much as possible with oxygen therapy, pain management, and fluid therapy prior to surgery.
- Pleural effusion is caused by fluid accumulation between the lungs and the body wall. This fluid can be blood, pus, or serous fluid from a number of sources (infection, neoplasia, trauma, heart failure) and must be removed to allow the lungs to expand. In the case of a pyothorax chest tubes may be required to allow for fluid removal and to flush the thoracic cavity. Patients need oxygen support and thoracocentesis to remove fluid and allow lung expansion.
- Pneumonia can occur as the result of infection (like kennel cough) or from the animal aspirating stomach contents. Clinical signs of pneumonia can occur over a few days and can start subtle. Patients present lethargic, sometimes vomiting, febrile, and in some degree of respiratory distress. Pneumonia patients need supportive care with oxygen, IV fluids and antibiotics. Nebulizing (the animal breaths in tiny droplets of moisture) will help to thin the respiratory secretions and make it easier to cough them out. Coupaging (quick blows to the chest with your hands) will help loosen those secretions so they can be coughed out. A transtracheal or endotracheal wash can be performed to determine the correct antibiotic choice.
- Many forms of cancer can metastasize to the lungs and form many small tumors there. In some cases these lung mets are the first sign of the cancer. Pulmonary mets will show up like a snowstorm or popcorn throughout the lungs. Immediate treatment is oxygen support and locating the main source. By them time pulmonary metastasis cause respiratory distress many clients choose euthanasia.

Once a treatment plan is created for any patient needing oxygen support the next step is monitoring. Along with routinely checking all of the animal's vital signs, their oxygen needs must be assessed regularly. A Sp02 reading is certainly part of that monitoring but it shouldn't be the only parameter used.

- Sp02 – results for a patient on supplemental oxygen support should be monitored and improve throughout hospitalization. Pulse oximetry measures patient oxygenation. Hypoxemia is low

oxygen content in arterial blood; hypoxia is low oxygen in tissues due to poor perfusion. Both can cause changes in SpO2 readings and need to be addressed immediately. SpO2 measures the percentage of hemoglobin saturated with oxygen and requires a certain level of perfusion to read in the periphery. Looking at the oxygen hemoglobin dissociation curve, a SpO2 in the low 90% range means a dramatic drop in PaO2 readings, which means it is important not to let SpO2 readings drop below 95%. The probe may need to be periodically moved to allow appropriate perfusion to the area. Check gum color, respiratory rate, and heart rate to help interpret readings. As the patient improves they should be challenged off of oxygen support for a time and a SpO2 reading taken off oxygen to help wean down to room air. Remember the limitations to SpO2 (ambient light, patient compliance, mucus membrane color)

- End Tidal CO2 - carbon dioxide is the gas that drives respiration in patients. It is a measurement of patient ventilation and gives a more complete picture compared to using SpO2 alone. Drugs administered, patient positioning, disease process and depth of anesthesia will all affect ETCO2 reading. ETCO2 is also a measurement of perfusion and cellular metabolism. In order for carbon dioxide to travel to the lungs to be exhaled and measured, appropriate perfusion and metabolism must happen. Changes in ETCO2 readings may be related to problems beyond the respiratory system; be sure to examine other monitoring parameters when troubleshooting abnormalities.
    - Hypercarbia/Hypercapnia is the result of hypoventilation. If left untreated, hypercarbia can cause central nervous system depression and eventually acidemia. If noted, attempt to determine the cause and work to alleviate it while decreasing the patient's ETCO2. This is accomplished by increasing the respiratory rate. A rapid, sudden drop in ETCO2 can signal impending arrest and should be viewed as an emergency that requires immediate attention.
    - Hypocarbia/Hypocapnia is the result of hyperventilation. Hypocarbia can cause a respiratory alkalosis in the patient and should be addressed while attempting to increase the patient's ETCO2. This is accomplished by decreasing the respiratory rate.
- Respiratory rate and effort – frequent (every 2 hours) monitoring of respiratory rate should be performed. It is important to try and observe the animals in secret as values may change in the presence of a technician. Effort should be noted as well.
- Mucous membrane color should be closely monitored; gray or muddy mucous membrane color can mean the patient's respiratory status is worsening.
- Heart rate should be closely monitored. Hypoxia will result in tachycardia; evaluate the patient if sudden tachycardia occurs or if the heart rate increases between treatments.
- Arterial blood gas –if your hospital has the ability, an arterial blood can be utilized to accurately record respiratory disease progress or decline.

A patient in respiratory distress may spend only hours in your hospital or may spend days in the ICU with mechanical ventilation. The technician role is to quickly recognize respiratory distress, provide oxygen support, and closely monitor patients for changing needs.

REFERENCES

1. *Aumann, Marcel, DMV, DACVECC, DACVIM. "Approach to Respiratory Emergencies." Proc. of 17th IVECCS, San Antonio, TX. 99-102.*
2. *Creedon, Jamie M. Burkitt., and Harold Davis. Advanced Monitoring and Procedures for Small Animal Emergency and Critical Care. Chichester, West Sussex: Wiley-Blackwell, 2012.*
3. *Norkus, Christopher L. Veterinary Technician's Manual for Small Animal Emergency and Critical Care. Chichester, West Sussex, UK: Wiley-Blackwell, 2012.*
4. *Silverstein, Deborah C., and Kate Hopper. Small Animal Critical Care Medicine. St. Louis, MO: Saunders/Elsevier, 2009.*

16005

CANINE HEATSTROKE: KEEPING YOUR COOL

TECHNICIAN PROGRAM | TECHNICIAN ESSENTIONS – ACUTE CARE

Megan Brashear, RVT, VTS (ECC)

Regardless of the climate, dogs run the risk of developing heatstroke. Even in cold and snowy regions, when temperatures begin to climb the cooling mechanisms of dogs may not be able to adapt appropriately and quickly enough to keep them from overheating. Heatstroke can be a deadly disease process that can affect all of the dog's major organ systems and requires quick recognition and aggressive treatment from the veterinary team. While cats can get heatstroke if trapped in a garage or attic, this discussion will be limited to dogs experiencing heatstroke as it is more commonly seen in canines.

Before beginning a discussion of heatstroke, it is important to note the difference between a physiologic fever (pyrexia) and heatstroke. Fever is the body's response to invasion or injury and is necessary to the healing process. The hypothalamus in the brain controls thermoregulation by detecting when the animal needs to pant/seek shade or when they need to start shivering to create heat. There is an internal set point in the hypothalamus at which these behaviors are triggered. In cases of infection or inflammation, the normal body temperature set-point is increased, and the body will work to keep the temperature increased despite external cooling efforts. Heatstroke is the result of external sources causing an increase in body temperature of which the dog cannot escape. Medical staff should be educated to the difference between heatstroke and fever and monitor and treat patients appropriately. In cases of true fever, active cooling is discouraged; patients may be more comfortable with less bedding or by lying directly on the kennel floor.

Dogs dissipate heat through four main channels:

Conduction – by laying on a cool surface
Convection – air blows over their skin and cools the dog
Radiation – they release heat into the atmosphere
Evaporation – by panting they evaporate heat

In most situations these methods are enough to keep the dog comfortable and functioning normally. If they can seek shade, they have access to water, their activity is limited in the heat of the day, or they are able to reside in an ambient temperature less than their body temperature, these dogs will remain comfortable and able to maintain an appropriate body temperature. Acclimatization will occur in dogs as temperatures warm with the season change. Their body will conserve higher quantities of water, conserve salt, they will undergo plasma expansion, and increase cardiac output over a period of approximately 60 days. In humans this process allows for an increase in sweat production and better cooling. This acclimation period is important to the body's ability to manage heat stress, and the reason why dogs may be seen to experience heatstroke in spring and early summer.

Heatstroke in dogs occurs when they can no longer dissipate heat efficiently and their body becomes overwhelmed. If there are no cool surfaces, shade, wind, or available water the dog has no help with cooling. As the dog's body temperature rises, the mechanisms to actively cool require an increased metabolic rate and are actually creating more heat. Panting, vasodilation, increased cardiac output and increased mean arterial pressure are attempts to cool, but also create metabolic heat. As the body temperature rises, heatstroke occurs, and without intervention the dog can quickly progress to critical condition. In severe cases of heatstroke, all of the major organ systems are affected and these patients need close monitoring and critical supportive care to survive. Core temperatures above 106◦F can lead to permanent brain damage; above 109◦F leads to organ damage. Body temperatures above 120◦F can lead to direct cellular damage.

Dogs experiencing heatstroke will have a history of heat exposure or extreme exercise in a warm environment, may have or are currently suffering from seizure activity, may be experiencing a laryngeal paralysis respiratory crisis, or experiencing increased muscle activity from hypocalcemia. These dogs will present to the hospital with a core body temperature >105°F (some as high as >110°F have been reported). Many of these patients will also experience decreased mentation, will have hyperemic mucus membranes, thick saliva, vomiting and diarrhea, and even collapse and coma. Dogs more prone to heatstroke are the brachycephalic breeds, dogs with laryngeal paralysis, and those who have survived a heatstroke episode in the past.

When a dog is noted to be experiencing distress due to heat, active cooling should begin as soon as possible. Dogs need to be moved out of the sun, have water offered, and activity stopped. Owners at home should soak the dog with room temperature or even warm (never cold) water and run the air conditioner in the car on the way to the vet hospital. This will allow for evaporative and radiation cooling. Once at the hospital, cooling can continue by soaking the dog with room temperature water, ensuring that in long and double coated breeds the water reaches to the skin. A fan can be directed at the dog to assist in cooling, and the patient can be placed on a wet towel on a wet table or exam table. Do not cover the dog with wet towels as these towels can slow evaporative and radiative cooling. Never use ice packs against the skin of a dog when performing active cooling. Ice will cause local vasoconstriction and can slow the effect of conductive cooling. The practice of using alcohol on the pads of heatstroke patients is often mentioned – but it is no longer a recommended treatment. Not only is the surface area of the paw pads relatively small when compared to the rest of the body, the vasodilation occurring in these patients can lead to increased absorption of alcohol into the bloodstream.

It is important to stop active cooling once the dog's temperature reaches 103◦F. At this point, dry the patient and cover them while continuing to monitor their body temperature. In severe heatstroke, the hypothalamus is damaged and will not recognize when the patient's temperature is falling below normal, and will not signify shivering and other attempts to stay warm. It is not uncommon for heatstroke patients to experience hypothermia after cooling, and rely on the hospital staff to monitor their temperature and supply heat as needed.

Because all body systems are affected by thermal injury, the cooling process is only the beginning of treatment. A complete physical exam must be performed early and the patient monitored closely for decline or change. Baseline blood work including a CBC and full serum chemistry panel are performed to assess organ function. The patient should be monitored for coagulation function and observed closely for changes in perfusion, mentation, comfort, and infection.

SHOCK

During thermal injury the body peripherally vasodilates, decentralizing blood flow to bring as much blood to the surface in an attempt to cool, and heatstroke patients can quickly experience hypovolemic shock. Evaporative cooling concurrently (panting) can dehydrate the dog. Early in the process, cardiac output must increase to maintain blood pressure, but the dog cannot sustain this long term. As the heat situation becomes more disastrous, cardiac output decreases and blood pressure and perfusion decrease as well. In "normal" hypovolemic shock the dog will vasoconstrict in an attempt to keep major organs perfused, but heatstroke patients remain vasodilated as they continue to attempt to dissipate heat. Every major organ system fails to receive appropriate blood flow and can suffer ischemic injury. As a result, we will see the clinical signs of shock in these heatstroke patients. Tachycardia, poor pulses, hyperemic mucus membranes and brisk CRT (some may have progressed to pale mucus membranes), and poor perfusion signal shock. Fluid therapy remains the mainstay of treatment for shock. Crystalloids are administered to clinical endpoints (decreasing tachycardia and increasing blood pressure) with the nursing team providing continued monitoring for patient improvement. Colloids may be used concurrently with crystalloids to maintain appropriate blood pressure and oncotic pressure. Hospitals with access to blood products may consider plasma and albumin products for life-threatening cases.

NUEROLOGIC SYSTEM

The intense heat experienced by heatstroke patients can cause cell rupture, at core temperatures of 120°F cellular necrosis occurs. Cellular death leads to edema and cerebral edema manifests as mentation changes in the patient. Heatstroke patients often present collapsed, but

they can be stumbling/ataxic, mentally inappropriate, or even present to the hospital with seizure activity. Reasons for mentation changes can range from poor cerebral perfusion, cerebral edema, direct thermal damage or hemorrhage. Decreased blood glucose levels can lead to seizure activity and should be checked to rule out hypoglycemia. Appropriate treatment with mannitol (0.5 – 1 gram/kg slow IV) should be considered if the dog's mentation fails to improve with treatment. Dogs that suffer from heatstroke should have their mentation evaluated often and close attention paid to declining changes.

GI SYSTEM AND SEPSIS

A combination of direct thermal injury to tissues and poor perfusion to the gut can cause GI ulceration and often vomiting and diarrhea. In many cases, evidence of intestinal sloughing is seen in the diarrhea. Breakdown of the gut mucosal barrier can quickly lead to gut-derived sepsis. Broad spectrum antibiotics should be considered in patients that present with heatstroke and hematochezia/hematemesis to treat the onslaught of bacteria. Blood glucose levels should be monitored frequently and hypoglycemia addressed as needed. With sepsis often comes hypotension and blood pressure must be closely monitored.

SIRS

The increase in body temperature experienced in heatstroke triggers both a pro-inflammatory and anti-inflammatory response in the body. This response can increase gut permeability but also puts the patient at risk for developing SIRS (Systemic Inflammatory Response Syndrome) as the body's systemic response to an inflammatory focus. SIRS and sepsis often go hand in hand, and in heatstroke patients can be seen concurrently. Dogs with an inflammatory insult are at risk for developing SIRS if they have two or more of the following parameters:

Tachycardia (>120bpm)

Tachypnea (>20bpm)

Temperature (>39.7°C <37.7°C)

CBC (Neutrophils >18k <5k or >10% band cells)

SIRS leads to a loss of vascular tone creating blood pressure challenges and poor organ perfusion, disturbance of the endothelial permeability barrier and can stimulate inappropriate coagulation. Cytokine release can lead to coagulation in the microvasculature and contribute to organ failure. In severe heatstroke, SIRS and sepsis can overwhelm a dog very quickly and the medical team needs to be aware of this and monitor blood glucose levels, supplement with IV dextrose as needed, provide antibiotics, and monitor WBC. Barrier nursing must be implemented in these patients to prevent secondary infections, and care taken with bedding and medical equipment used.

COAGULOPATHY

Coagulopathy is common in heatstroke patients. As mentioned previously, SIRS activates the clotting cascade and clotting factors are consumed. Hemorrhage can occur and can be catastrophic. Direct thermal injury to the endothelium and liver from extreme heat can also lead to inappropriate bleeding and the dog's inability to appropriately replace clotting factors. Once the clotting factors are consumed it is common to see petechiation, ecchymosis, hematochezia, hematemesis, and bleeding from injection sites. Clotting times should be measured and monitored and the patient treated with plasma and PRBC as needed. Platelet counts should also be performed and monitored as these will often drop as well.

HEPATIC SYSTEM

With body temperatures as high as are seen in severe heatstroke cases, the liver often suffers direct thermal damage. These dogs cannot rebound from clotting factor losses due to this damage. Liver enzyme elevations are common and should be monitored. Some patients may become icteric as total bilirubin levels rise due to red blood cell breakdown. In these cases an abdominal ultrasound may be necessary to rule out any surgical reasons for elevated total bilirubin (such as sloughing tissue causing gall bladder obstruction).

KIDNEYS

As blood shifts from the dog's core to the periphery in an attempt to cool, the kidneys can experience a decrease in perfusion. As the dog continues to lose water and experience further and severe hypovolemic shock, the kidneys begin to experience damage and azotemia is noted in lab work. Inappropriate bleeding from lost

clotting factors can also cause bleeding into the kidneys. Urine output is important to monitor in these patients, and measures taken to ensure that they are able to process the fluids they are receiving.

CARDIAC SYSTEM

There are a variety of problems that can result in cardiac arrhythmias, and many heatstroke patients experience most or all of these triggers and are therefore at risk for arrhythmias (mainly ventricular). Hypovolemia, hypoxia, direct thermal injury, ischemia, and reperfusion injury are common. ECG monitoring should be a part of heatstroke patient management and arrhythmias treated as they are noticed. Lidocaine, procainamide, oxygen therapy, pain management, and monitoring electrolytes can be considered when evaluating and treating any cardiac arrhythmias.

NUTRITION

Because the GI tract takes such a hit in severe thermal injury, nutrition can be a challenge in these patients. Protein levels can quickly drop and be tough to combat even in the face of multiple plasma transfusions. Feeding the gut is an important part of the healing process and should be started early in the treatment process. If possible, trickle feeding through an NG/NE tube should be instituted as soon as the patient is not vomiting. IV nutrition should be considered if enteral nutrition is not tolerated.

PAIN

Pain management should not be neglected in the heatstroke patient. If the gut is sloughing these patients will be painful, and even if we cannot see a source of pain, if they are bleeding into organ capsules that is also painful. These patients should be treated with opioids as needed to keep them comfortable during their hospital stay.

Heatstroke is a syndrome that requires quick and knowledgeable action from both the owner and the veterinary team. Multiple organ systems can be affected and need close monitoring. Nursing care is extensive and requires knowledge of what can occur, and heads up communication between teams is necessary. With excellent nursing care and supportive care it is possible for these patients to recover and return to normal lives.

SUGGESTED READING:

1. *Creedon, Jamie M. Burkitt., and Harold Davis. Advanced Monitoring and Procedures for Small Animal Emergency and Critical Care. Chichester, West Sussex: Wiley-Blackwell, 2012*
2. *Johnson, Scott I., Maureen McMichael, and George White. "Heatstroke in Small Animal Medicine: A Clinical Practice Review." Journal of Veterinary Emergency and Critical Care 16.2 (2006): 112-19*
3. *Silverstein, Deborah C., and Kate Hopper. Small Animal Critical Care Medicine. St. Louis, MO: Saunders/Elsevier, 2009*
4. *Wingfield, Wayne E., and Marc R. Raffe. The Veterinary ICU Book. Jackson Hole, WY: Teton NewMedia, 2002*

PLENARY SESSIONS

ONTARIO VETERINARY MEDICAL ASSOCIATION

17001

INFECTIOUS DISEASE ROUNDUP 2025

PLENARY SESSIONS | FRIDAY MORNING PLENARY

Maureen E.C. Anderson, DVM, DVSc, PhD, Dip. ACVIM
J. Scott Weese, DVM, DVSc, Dip. ACVIM

Highly Pathogenic Avian Influenza A(H5N1) in more cows, more cats, raw milk / raw diets The outbreak of H5N1 influenza A in dairy cattle in the US has now affected over 1000 herds in 18 states, with over 70% of the affected dairy herds located in California. Unlike Ontario, sale of raw unpasteurized milk for human consumption is allowed in some states, including California, which has resulted in a food safety hazard for both people and pets. In late 2024, at least 5 cats in California were confirmed to have died from H5N1 influenza after drinking recalled raw milk. The death of one cat in Oregon from H5N1 influenza was linked to consumption of a commercial raw meat diet that was found to contain the same strain of the virus, triggering a recall. Since then there have been multiple additional cases of cat deaths from H5N1 flu linked to raw diets (none of the lots of affected food were sold in Canada). Raw diets also pose many other infectious disease risks to people and pets. As of October 2025, H5N1 flu has yet to be detected in dairy cattle or dairy products in Canada, following testing of over 6100 raw milk samples collected at processing plants representing milk from approximately 27 000 dairy farms across the country.

Reports of human cases of H5N1 influenza, primarily in the US, slowed considerably in 2025 . Almost all reported cases to date were associated with close contact with infected (or presumed infected) poultry or dairy cattle, and fortunately most of the cases have been mild. In a small number of cases the source of the virus was not identified, and there have been at least two cases of severe disease (one in the US and one in Canada in 2024). Intense investigation has not shown any evidence of human-to-human spread, but the concern is the more mammalian infections occur, the more opportunity there is for the virus to adapt to and become a greater risk to people and other mammals.

The virus was considerably more active in Ontario in early 2025 compared to 2024, with six infected poultry premises in the first 3 months of the year, and at least one in the fall (up to mid- October) , as well as seven wild mammals (skunk, fox, mink, fisher) and numerous wild birds testing positive.

Cats, including domestic cats and big cats , appear to be particularly susceptible to the currently circulating strains of H5N1 influenza. Suspected household transmission between cats and between humans and cats has also been reported. Veterinarians are encouraged to keep H5N1 infection in mind for any cat presenting with severe acute neurological or respiratory signs or sudden death, especially (but not exclusively) if they have potential contact with other infected animals in the area (e.g. birds, cattle, rodents) or potentially contaminated raw meat or raw milk. To date, H5N1 has only been detected in one dog that passed away several days after being found scavenging a dead goose that also tested positive for the virus, in March 2023. The current virus has been detected in at least 48 mammalian species across 26 countries since 2020.

Reinforce routine precautions for potentially infectious patients (i.e. gloves, lab coat, hand hygiene, segregation)

Use enhanced precautions in suspect cases (e.g. N95 respirator, face/eye protection)

Promote testing in high-risk patients, and make use of the OAHN guide to Influenza A diagnostic testing in Ontario for cats, dogs and exotics to ensure the test requested will detect all relevant flu strains. Surveillance testing is also available for eligible cats (including barn cats and other outdoor cats) through the OAHN AIV in feral cats surveillance project. Visit the project webpage for details on case eligibility, sample collection and submission.

Any influenza strain in a companion animal is immediately notifiable and will be reported by Ontario laboratories to both OMAFA and the Ontario Ministry of Health. Although the risk of members of the general public contracting this strain of H5N1 influenza is still considered to be very low, owners are encouraged to take appropriate precautions to protect their pets and themselves by avoiding direct and indirect contact with sick or dead wildlife, especially migratory birds. There are also precautions to take around livestock.

ROCKY MOUNTAIN SPOTTED FEVER: LONG POINT ON

As of fall 2025, at least 8 confirmed cases of RMSF (*Rickettsia rickettsii*) in dogs and 2 cases in people who visited Long Point ON over the summer have been detected. Results of summer tick dragging confirmed infection in local ticks. It is difficult to predict how fast this pathogen could spread in Ontario given the wide distribution of the presumed vector here, *Dermacentor variablilis*. Tick checks are especially crucial because *R. rickettsii* transmits relatively quickly once ticks attach, compared to other disease agents such as *Borrelia burgdorferi*, so common tick preventatives may not provide effective protection against RMSF. Another significant risk is that clinical signs of RMSF can mimic early immune mediated thrombocytopenia, treatment for which (immunosuppressive therapy) can significantly worsen progression of RMSF.

ANTIMICROBIAL USE GUIDELINES

The long-awaited guidelines for antimicrobial use in canine acute diarrhea from the European Network for Optimization of Veterinary Antimicrobial Therapy (ENOVAT) are now freely available online in (Jessen et al. 2024). They provide strong evidence-based recommendations against use of antimicrobials in dogs with mild to moderate diarrhea. Consult the complete guidelines for more details. A convenient quick-reference infographic from ENOVAT and WSAVA is also available: Five steps of canine acute diarrhea treatment.

ISCAID also updated its AMU guidelines for canine pyoderma (2025) (originally published in 2014), including sections on surface pyoderma, superficial folliculitis and deep pyoderma.

The Ontario Animal Health Network (OAHN) has produced an open-access summary table of current systemic antimicrobial treatment guidelines for common clinical conditions in dogs as per the OVC-CPHAZ guidelines available through the FirstLine app. For additional details on patient selection and other factors that should be considered in selecting antimicrobial or non-antimicrobial therapy, veterinarians should continue to consult the complete guidelines in the app. This resource was developed in follow up to the OAHN antimicrobial categorization for dogs and cats (Canada 2024), which provides a quick reference table for categorization of on label and off label drugs used in companion animals, which is helpful in-clinic tool to help the whole veterinary team improve antimicrobial stewardship, and to help clients better understand antimicrobial selection as well.

ECHINOCOCCUS MULTILOCULARIS UPDATE

In 2025 (up to October) there were no cases of alveolar echinococcosis (AE) reported in people or animals in Ontario. Fortunately *Echinococcus multilocularis* (EM) infection in Ontario dogs also remains rare (or at least rarely diagnosed), but with the increased availability of PCR testing more cases are likely to be detected. In 2025, fecal PCR-positive dogs were reported in Middlesex, York and Oxford regions, and a case was also detected in Peterborough county in late 2024. All dogs were promptly treated with praziquantel and subsequently tested negative.

Due to the insidious and severe nature of AE in people, it is crucial that we keep this parasite on everyone's radar.

An unusual case of EM was also detected in Niagara in a clinically normal 10-week-old kitten. Cats are known but very uncommon definitive hosts for this parasite compared to dogs and wild canids. The kitten was tested as part of a routine check up after being acquired through Kijiji, but it is presumed the kitten was from the same region, which is one of the higher risk areas for EM in Ontario

Remember that infected people develop AE, but they can only be infected by ingesting eggs from canid feces. Dogs are typically infected by ingesting tissues from infected small mammals and develop intestinal infections, *but occasionally can also develop AE from ingesting large numbers of eggs!* Check out the OAHN EM infographic or the 2022 OMAFA veterinary update on EM risk in Ontario.

BAT-, FOX- AND RACCOON-VARIANT RABIES IN SOUTHERN ONTARIO, 2025

Forty-nine rabid bats were detected in Ontario in August alone, with the total number for the year at a record-breaking 100 as of the end of September, but with a percent-positivity lower than in 2024. The tragic case of bat rabies in an Ontario resident last year no doubt contributed to increased awareness of the risks from bats (which is good), but unfortunately likely also contributed to excessive fear regarding the true risk of transmission from bats when there is no direct contact. The Ontario Animal Health Network (OAHN) therefore produced a handy bat contact guide to help discern what is and is not a rabies risk (for pets and people) when it comes to bats. While it's important to beware of the risk of bats as rabies reservoirs, it is equally important to be kind to these amazing and ecologically critical creatures! Check out OAHN's N2K: Bats in Ontario resource for more information.

The last case of raccoon-variant rabies in Ontario was detected in 2023. The MNR once again successfully completed its rabies baiting and control operations in southern Ontario in 2025. Assuming no new detections, next year control efforts will return to focusing on high-risk areas along the border with New York State. A sizable outbreak of raccoon-variant rabies occurred in southeastern Quebec in 2025, emphasizing the need for ongoing vigilance for new incursions of this virus, particularly along the US border.

Fox-variant rabies has not been detected in southern Ontario since 2018. After seven additional years of careful surveillance, it is believed that this rabies variant has been successfully eradicated from southern Ontario for the first time since its arrival in in the 1950s. A publication detailing the efforts to achieve this momentous milestone is currently under review. It is also important to emphasize to owners that this is only eradication of one strain of rabies – the risk from bat rabies is still very prevalent, and we must remain vigilant for new outbreaks that could occur due to wildlife movement, including translocation by humans (intentional or unintentional). A rabid fox kit was detected in the Ottawa area this summer, but typing confirmed it was a bat strain of the virus – an important reminder that spillover infections of any strain can occur in any mammal.

Rabies information for Ontario veterinarians is available on the Ontario.ca website, including risk assessment and post-exposure management guidelines. You can view or download a pdf of the OMAFA rabies risk assessment flowchart on the OAHN website. For additional resources and flowcharts, log in and visit the OAHN rabies resource page for veterinarians. Rabies information for the general public is available at Ontario.ca/rabies, including the MNR's interactive rabies case map.

Veterinarians should contact OMAFA for assistance with rabies risk assessments, sample submission or post-exposure management, as needed. Veterinarians can submit a request for assistance online using the rabies response request form. Requests submitted within business hours will receive a response the same day, typically within 1-2 hours. Requests can also be submitted outside of business hours and will receive a response the next business day; interim triage guidance is provided on the webpage. If you require assistance with completing the online form due to limited internet access or due to any other accessibility issue, please contact the OMAFA Agricultural Information Contact Centre at 1-877-424-1300 (option 1) during business hours (weekdays 8:30 AM - 4:30 PM). Animal owners who contact OMAFA directly concerning potential rabies exposures will be advised to contact their local veterinarian.

FOX-VARIANT RABIES IN THE NORTH, 2025

Five red foxes from across northern Ontario tested positive for rabies between February-May 2025. Despite the success with managing fox-variant rabies in Southern Ontario, this highlights the ever-present risk of Arctic fox variant rabies in arctic and sub-arctic habitats in Canada, where it is endemic across the geographic range of Arctic foxes (which also overlaps with the range of red foxes). Two recent cases of translocation of rabid dogs from northern to southern regions of Canada – a dog moved from Sanikiluaq NU to Winnipeg, and a dog moved from Umiujaq QC to Montreal - also clearly illustrate how risks in one region can have wide-reaching effects. As for dogs imported from high-risk countries for canine variant rabies, the risk period for rabies in any dog from the north is 6 MONTHS from their last possible exposure if they were previously unvaccinated. A dog in Hopedale, Labrador that had a known history of exposure to a fox six weeks earlier tested positive for rabies in the early summer, resulting in

investigation of 20 potential human exposures, many of which could have likely been avoided through use of basic safe handling practices.

VACCINE-STRAIN CANINE DISTEMPER CASES

Post mortem examination of two puppies from two different litters (one unvaccinated, one vaccinated as early as 4 weeks of age) confirmed disease due to the Rockborn vaccine strain of canine distemper virus (CDV). A similar vaccine strain-associated case was detected in an Ontario puppy in 2023.

In June, authorities in New Zealand implemented a prohibition on the use of one particular canine distemper vaccine after a series of vaccine-induced distemper in 16 puppies over the previous 4 years, while they complete a reassessment of the product (which was voluntarily withdrawn by the manufacturer). However they emphasize that vaccination remains an important component of managing canine health, and distemper vaccination has helped create the current non-endemic status of the disease in the country.

This serves as a reminder of the possibility of reversion to virulence when using modified-live vaccines, and the importance of reporting adverse events and apparent break-through infections to manufacturers.

SALMONELLA IN PEOPLE: DOG FOOD / TREATS LINK

The Public Health Agency of Canada posted notice about an ongoing investigation into salmonellosis cases in people linked to handling of dog food and treats. From February to September 2025, there were 31 confirmed cases of a fairly specific strain of *Salmonella* Oranienburg across Canada, primarily out west, but with two cases found in Ontario. The initial report simply stated that many people who became sick reported handling dog food or treats, including kibble, dehydrated and freeze-dried treats. A further update in October linked some (but not all) of the cases to a specific brand of freeze-dried dog treats.

It may be difficult to pinpoint all the potential sources of the *Salmonella* in this outbreak, especially if there was contamination of batches of treats or food that were already consumed by the time the outbreak was identified.

It is an important reminder of the potential risks to people from handling these products – especially raw products, even if they have been preserved by various methods such as drying or freezing (check out the OAHN infosheet on raw meat based diets). Basic hand and household hygiene practices can protect pet owners (and especially high-risk members of the household including infants and seniors) from serious illness.

NEW WORLD SCREWWORM (COCHLIOMYIA HOMINIVORAX)

After being eradicated from the southern US and Mexico decades ago, New World Screwworm (NWS) is once again nearing the US border. Although there is currently no risk of the parasite establishing itself further north due to climate, it is important to identify in imported / travelling animals, as the maggots destroy living tissue and can cause significant damage. It is also critical to alert authorities at the pet's point of origin if it came from a non-endemic area in the south.

US CANINE IMPORTS

The CFIA remains in contact with the US CDC regarding US canine importation rules, which were set to be updated again in spring 2025. No additional changes have been made (yet) to the rules that came into effect in August 2024.

FELINE INFECTIOUS PERITONITIS (FIP) DRUGS UPDATE

In 2024, Canadia veterinarians were first able to import GS-441524 through the Emergency Drug Release (EDR) process from BOVA, a UK compounding pharmacy There are now at least 3 compounding pharmacies compounding GS-441524 in Canada: Trutina Pharmacy, Clearpoint Pharmacy and Summit Pharmacy. This means GS-441524 can now be ordered and stocked like most other drugs, making access to this game-changing drug the treatment of FIP in cats much quicker and easier.

Updates on FIP treatment and drug availability in Canada from feline specialist Dr. Kelly St. Denis in the June-2025 webcast from CommuniVet – FIP: Treating the Untreatable.

ADDITIONAL INFECTIOUS DISEASE RESOURCES & LINKS OF INTEREST

- OAHN anti-parasitics for dogs and cats (Canada 2024): Available in both simplified (open access) and veterinary (OAHN login required) editions
- Raw meat-based diets infosheet developed collaboratively with OAHN and Worms & Germs Blog, to help talk to clients about the risks of raw
- OAHN infographic for veterinarians on ticks and Lyme disease in Ontario (2025) with the latest risk area map for *Ixodes spp.* ticks from PHO. It also has quick tips on monitoring, screening, and when not to treat dogs. There is also an OAHN tick checklist for pet owners.
- OAHN "Need-2-Know: Rabies in Pets" whiteboard video: This 4.5 minute video helps explain to pet owners the importance of vaccination, and why vaccination or antibody titres can't necessarily eliminate the risk of rabies in dogs from high-risk areas.
- OAHN online disease reporting portal (for non-notifiable diseases) https://www.oahn.ca/companion-animal-disease-surveillance-submission-form/