

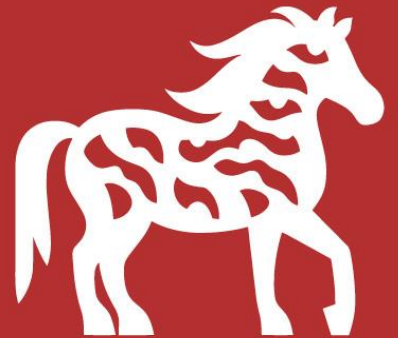
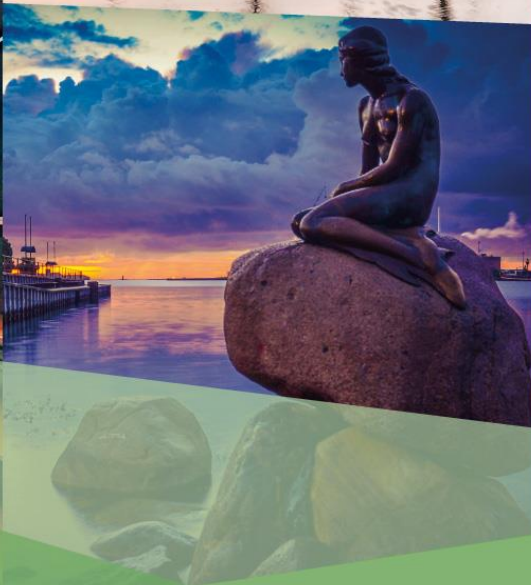
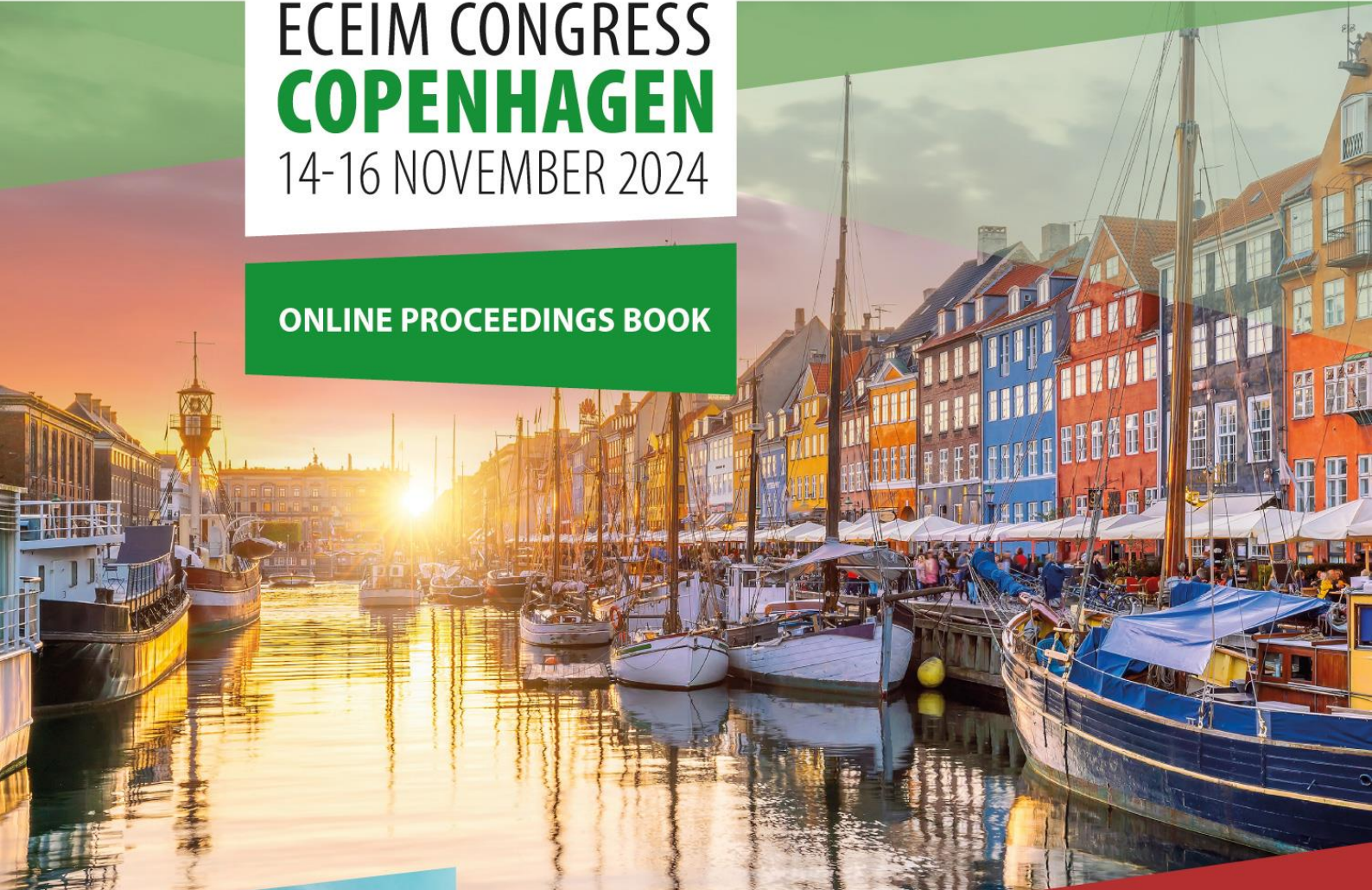


EUROPEAN COLLEGE OF EQUINE INTERNAL MEDICINE

ECEIM CONGRESS COPENHAGEN

14-16 NOVEMBER 2024

ONLINE PROCEEDINGS BOOK



ECEIM 2024
COPENHAGEN

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Chair of the ECEIM congress

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WELCOME WORD

Dear Colleagues and Friends,

Welcome to this year's ECEIM Congress in Copenhagen! We are honored to have Her Royal Highness Princess Benedikte as patron of the congress.

This year's focus is on the equine athlete, with special discussions on ethics in equestrian sports and the veterinarian's role. We will also cover a broad range of other aspects of equine internal medicine. The program features top speakers from around the world who will share the latest research and clinical practices, as well as selected research presentations. Additionally, this year's congress will feature poster presentations, with the best poster chosen by the audience. The pre-congress workshops are designed to provide hands-on learning experiences and in-depth discussions.

The congress is taking place at the Frederiksberg Campus, formerly known as Landbohøjskolen or KVL. Founded by Dr. Peter Christian Abildgaard in 1773, it has a long history of excellence in veterinary education and research.

Beyond science, we have planned some social activities to help you relax and mingle. Join us for a guided tour of the royal stables at Christiansborg on Wednesday, a Welcome Reception at Copenhagen City Hall on Thursday evening, and the grand finale: the Gala Dinner at Moltke's Palæ on Friday night.

As we gather in November, we hope you experience a bit of Danish "hygge" – that cozy, warm vibe that makes this season special. Take a moment to explore Copenhagen, recently celebrated in CN Traveler Readers' Choice Awards for its amazing food, art, design, and fantastic biking and public transport.

A big thank you to our sponsors, organizers, and volunteers for making this congress possible. Your support is invaluable.

We hope you find the congress informative and inspiring. Welcome to Copenhagen and the 2024 ECEIM Congress!

Warm regards,
Dr. Charlotte Hopster-Iversen, PhD
Dip.ECEIM
ECEIM Congress Organizing Committee

ECEIM 2024 CONGRESS ORGANIZING COMMITTEE



Charlotte Hopster-Iversen
(Chair of Organising Committee)



Isabelle Desjardins
(Past chair OC)



Rikke Buhl



Julie Fjeldborg



Susanne Nautrup-Olsen

ECEIM 2024 CONGRESS SCIENTIFIC COMMITTEE



Francesca Freccero
(Chair of Scientific Committee)



Charlotte Hopster-Iversen



Fernando Malalana



Anna Kendall



John Keen
(Board member)



Isabelle Desjardin
(Past Chair)

PROGRAM FRIDAY 15 NOVEMBER 2024

SCIENTIFIC PROGRAM Copenhagen 2024 MAIN CONGRESS at Frederiksberg Campus

Friday, November 15 th					
	TIME	LECTURE		TIME	LECTURE
AUDITORIUM A2-81.01	08:15-08:45	Outside lecture hall The Guard Hussar Regiment	AUDITORIUM A2-82.01		
	09:00-09:25	Congress opening and welcome <i>HRH Princess Benedikte</i>			
	09:30-11:00	Ethic in equine medicine plenum discussion and short presentations <i>M. Uldahl, J.W. Christensen, E. v. Erck-Westergren, Princess Nathalie zu Sayn-Wittgenstein-Berleburg, K. Visser, M. Morley</i>		09:30-11:00	
COFFEE BREAK 11.00 – 11:30					
AUDITORIUM A2-81.01	11:30-11:45	Pharmacokinetics of co-administration of misoprostol and sucralfate in adult horses E.Sundman	AUDITORIUM A2-82.01	11:30-11:45	Development and application of the EFFE (Ecographic Fast Foal Evaluation) protocol: a pilot study N. Ellero
	11:45-12:00	Comparing the inter- and intra-rater reliability of two scoring systems for equine gastric glandular disease C. Gilders		11:45-12:00	Neuronal and astroglial dysfunction in critically ill neonatal foals K. Dembek
	12:00-12:15	Pituitary gland abscessation after maxillary cheek tooth extraction in three horses A. Hendrikx		12:00-12:15	ACVIM Resident Research Abstract Award Winner: Biomarkers of Brain Injury in Foals with Neonatal Maladjustment Syndrome J. Perez Quesada

	12:20-13:00	Equine nutrition – The scientific evidence for feeding herbs for various diseases <i>I. Vervuert</i>		12:20-13:00	<i>AI in research</i> <i>M. Bilal</i>
LUNCH 13:00 – 14:00					
14:00-14:30 Posters 1-6			14:00-14:30 Posters 7-12		
AUDITORIUM A2-81.01	14:30-14:45	The seasonality of insulin concentrations in horses A. Lopes	AUDITORIUM A2-82.01	14:30-14:45	Equine Corona Virus infections in adult horses: investigating seroconversion and faecal shedding patterns H. Smith
	14:45-15:00	Retrospective case series on short-term responses and lipoprotein profiles following treatment with dapagliflozin or ertugliflozin in horses with insulin dysregulation E. Knowles		14:45-15:00	Seroprevalence of West Nile, Usutu, and Tick born encephalitis virus in equids from the Southwest of France in 2023 N. Chevalier
	15:05-15:20	ACVIM Resident Research Abstract Award Winner: A High-protein Meal Is Associated with Increased Glucose-dependent Insulinotropic Polypeptide Secretion in Insulin-dysregulated Horses A. Palmer		15:05-15:20	Comparison of the long-term humoral immune response against West Nile virus in clinically and inapparently infected horses C. Tolnai
	15:20-15:35	Preliminary results on the measurement of beta-endorphins in horses with pituitary pars intermedia dysfunction N. Fouché		15:20-15:35	Sequencing bacterial cell-free-DNA to detect pathogenic bacteria in the blood of equine neonates; a pilot study E. Siegers
	15:35-15:50	Vena contracta and proximal isovelocity surface area as potential echocardiographic		15:35-15:50	Nosocomial syndrome surveillance in an equine veterinary teaching hospital:

		measurements for severity grading of mitral valve regurgitation M. Demeyere			prevalence and feasibility M. Allano
COFFEE BREAK 15:50 – 16:20					
AUDITORIUM A2-81.01	16:20-16:50	Proteomics in human medicine <i>A. Lundby</i>	AUDITORIUM A2-82.01	16:20-16:50	JVIM updates and review process <i>K. Hinchcliff</i>
	16:55-17:30	Q&A session for the Board		16:55-17:30	Perinatal Endocrinology <i>R. Toribio</i>
19.00 – 01:00 Gala dinner and party Moltke´s palæ, city centre (metro stop Marmorkirken M3)					

PROGRAM SATURDAY 16 NOVEMBER 2024

SCIENTIFIC PROGRAM Copenhagen 2024 MAIN CONGRESS at Frederiksberg Campus					
Saturday, November 16th					
7:00 Morning run Frederiksberg (optional)					
AUDITORIUM	TIME	LECTURE	AUDITORIUM	TIME	LECTURE
A2-81.01	09:00-09:30	Equine performance testing <i>E. van Erck Westergren</i>	A2-82.01	09:00-09:25	Highlights from ACVIM Forum 2024 <i>C. Sanchez</i>
				09:25-09:50	Neonatal news hour – what’s new? <i>C. Sanchez</i>
	09:35-10:05	Performance and airway disease: a bidirectional relationship? <i>S. Pirie</i>		09:50-10:05	ACVIM Resident Research Abstract Award Winner: Characterization of Renal Lipidosis in Equids: A Postmortem Case-Control Study (2008-2022) K. Slavik
	10:10-10:40	Atrial fibrillation <i>R. Buhl</i>		10:10-10:40	Equine colitis <i>T. Pihl</i>
	10:45-11:00	Identifying the origin of left atrial ectopy, including pulmonary veins, via multiple catheter recording in the right heart E. Buschmann		10:45-11:00	Exploring paraoxonase-1 as a marker of inflammation and oxidative stress in horses with colitis M. Winther
COFFEE BREAK 11:00 – 11:30					
11:30 – 12:00 Posters 13-18			11:30 – 12:00 Posters 19-24		
	12:00-12:15	Metformin mitigates atrial remodeling in horses with induced chronic atrial fibrillation S. Nissen		12:00-12:15	Evaluation of biomarkers (BIOs) in healthy and colic horses: correlation with

AUDITORIUM A2-81.01			AUDITORIUM A2-82.01		Systemic Inflammatory Response Syndrome (SIRS) status and outcome F. Bindi
	12:15-12:30	Heart Rate Variability based upon P-wave indices in horses: an exploratory study G. Steenkiste		12:15-12:30	Measurement of thymidine kinase-1 activity in serum and body cavity fluids in horses with lymphoma, inflammatory bowel disease and other non-inflammatory gastrointestinal disorders K. Drozdowska
	12:35-13:10	Performance, behavior and equine gastric ulcer syndrome <i>S. Hansen</i>		12:35-13:10	Equine metabolomics: emerging diagnostic tools to detect disease and evaluate performance <i>S. Gonzalez-Medina</i>
LUNCH 13:10 – 14:15					
AUDITORIUM A2-81.01	14:15-14:30	Effect of steamed hay on airway inflammation in horses with severe equine asthma M. Leclère	AUDITORIUM A2-82.01	14:15-14:30	Histological and Immunological Comparison of Gastrointestinal Biopsies with their Respective Full-Thickness Tissue Counterpart in Horses D. Jean
	14:30-14:45	Dust exposure and pulmonary inflammation in mild asthmatic horses fed pelleted or round bale hay - A pilot study S. Preez		14:30-14:45	Genome-wide association study introduced novel genomic loci of insect bite hypersensitivity in Finnhorses M. Weckman
	14:50-15:20	Pain scores in equine medicine <i>C. Lindegaard</i>		14:50-15:20	The science of client motivation: how to foster behaviour change <i>A. Declodt</i>
COFFEE BREAK 15:20 – 15:50					

	15:50-16:30	How can exercise testing support equine welfare? <i>M. v. Sloet van Oldruitenborgh-Oosterbaan</i>		15:50-16:30	Using serum amyloid A and other acute phase reactants to improve patient management <i>S. Jacobsen</i>
AUDITORIUM A2-81.01	16:35-17:15	Clinical reasoning in European horses presenting with ataxia <i>E. Olsen</i>	AUDITORIUM A2-82.01	16:35-17:15	Endocrinology of Calcium, Magnesium, and Phosphorus in a Nutshell <i>R. Toribio</i>
	17:20-17:50	Closure of the Congress Award ceremony for best poster (DCA) Presentation of ECEIM 2025 Liverpool			
END OF THE CONGRESS					

POSTER SESSION FRIDAY 15TH NOVEMBER

Presenting author	Abstract title	#	Day	Timeslot	Room
Clemence Loublier	Longitudinal changes in fecal short chain fatty acids during hospitalization in horses with different types of colic and their association with survival	1	Friday 15 th	14:00-14:30	A2-81.01
Patricia Neira Egea	Fungal gastric lesions: morphological, histopathological and microbiological features in three horses	2	Friday 15 th	14:00-14:30	A2-81.01
Michelle Wyler	Clinical, clinicopathological, pathological and genetic findings in six Franches-Montagnes foals with suspected hypertriglyceridemia-induced pancreatitis	3	Friday 15 th	14:00-14:30	A2-81.01
Ann Kristin Barton	Association of equine squamous and glandular gastric disease with dental status in 54 horses	4	Friday 15 th	14:00-14:30	A2-81.01
Diego Gomez	Antimicrobial treatment approaches to horses with acute diarrhea admitted to referral institutions	5	Friday 15 th	14:00-14:30	A2-81.01
Helena Carstensen	Does equine asthma predispose horses to premature complexes during exercise?	6	Friday 15 th	14:00-14:30	A2-81.01
Sarah Dalgas Nissen	Discovering Genetic Variants Linked to Exercise-Induced Atrial Fibrillation in Racehorses	7	Friday 15 th	14:00-14:30	A2-82.01
Simon Haugaard	Exploring the molecular landscape of equine Atrial Fibrillation: A multiomics study	8	Friday 15 th	14:00-14:30	A2-82.01
Lize-Maria Verhaeghe	The TASK-1 potassium channel in equine atrial myocardium as a potential target to treat atrial fibrillation.	9	Friday 15 th	14:00-14:30	A2-82.01
Amie Kapusniak	Preliminary validation of a smart textile device during high-speed exercise for ECG quality & heart rate measurement	10	Friday 15 th	14:00-14:30	A2-82.01
Fernanda Timbó D'el Rey Dantas	Intra and interobserver reliability of pulsed-wave tissue Doppler imaging of the left ventricle in healthy Standardbred neonatal foals	11	Friday 15 th	14:00-14:30	A2-82.01
Eva De Bruijn	Bicuspid pulmonary valve in horses: a case series	12	Friday 15 th	14:00-14:30	A2-82.01

POSTER SESSION SATURDAY 16TH NOVEMBER

Presenting author	Abstract titel	#	Day	Timeslot	Room
Verena Zehetner	Equid hepatitis B virus detected in two livers of donkeys with hyperlipemia	13	Saturday 16 th	11:30-12:00	A2-81.01
Caroline Ribonnet	Clinical presentation, treatment and outcome of foals with umbilical infections (2014-2023).	14	Saturday 16 th	11:30-12:00	A2-81.01
Dilara Lale	High Prevalence of Subclinical Equid Hepatitis B Virus Infection in a Donkey Farm in Romania	15	Saturday 16 th	11:30-12:00	A2-81.01
Josefine Cecilie Borrye	Prevalence of Strongylus vulgaris in Danish horses and treatment response	16	Saturday 16 th	11:30-12:00	A2-81.01
Marie Welters	A retrospective study on intradermal skin Test (IDT) results and efficacy of allergen specific immunotherapy (ASIT) in horses with equine asthma (EA), equine allergic skin disease (EASD) and head shaking (HS)	17	Saturday 16 th	11:30-12:00	A2-81.01
Marion Allano	Prevalence of catheter-associated thrombophlebitis in horses at a veterinary teaching hospital from 2012 to 2022	18	Saturday 16 th	11:30-12:00	A2-81.01
Daniel Jean	Cystic calculi in horses: a retrospective study of 47 cases (2006-2023)	19	Saturday 16 th	11:30-12:00	A2-82.01
Sanni Hansen	The role of oxidative stress in the equine asthma pathogenesis	20	Saturday 16 th	11:30-12:00	A2-82.01
Elisabeth-Lidwien Verdegaal	A retrospective study of the incidence and associated risk factors of Exertional Heat Illness (EHI) in Thoroughbred racehorses in different states in Australia.	21	Saturday 16 th	11:30-12:00	A2-82.01
Peggy Moreau	Retrospective study of congenital anomalies observed at necropsy from 2015 to 2023	22	Saturday 16 th	11:30-12:00	A2-82.01
Laszlo Hunyadi	Selection of Acute Observation Timepoints with Intradermal Skin Testing in Horses	23	Saturday 16 th	11:30-12:00	A2-82.01
Slàine Freja Chaimbeul	Are the clinical effects of mesenchymal stem cells merely mediated by phagocytosing macrophages?	24	Saturday 16 th	11:30-12:00	A2-82.01

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SPEAKERS

Mushtaq Bilal



Mushtaq Bilal is a postdoctoral researcher at the University of Southern Denmark's Hans Christian Andersen Center. He holds a PhD in comparative literature from Binghamton University. Mushtaq is known for developing ways of incorporating AI apps into academic writing. He has an audience of more than 234,000 on Twitter and 75,000 on LinkedIn where he regularly shares tips on how to become an efficient academic writer with AI apps. His work has been featured in publications like Nature, Der Spiegel, and Times Higher Education.

Rikke Buhl



Professor and head of Section of Medicine and Surgery, Department of Large Animal Sciences, Faculty of Health and Medical Sciences, University of Copenhagen. Additionally, she is Head of The Graduate School at The Faculty of Health and Medical Sciences with more than 1900 PhD students enrolled. She has supervised 13 PhD students and four post docs. Research focus is on cardiovascular adaptations to exercise, often termed "Athlete's Heart" in racehorses with focus on translational perspectives. Especially atrial fibrillation has high interest and the disease is disabling for both horses and people. The horse is an alternative animal model compared to traditionally used models such as rodents and pigs and we show that the horse and human have several similarities regarding this disease. The research with establishing this new animal model has been funded both by the Danish Research Council, Marie Curie Horizon 2020 ITN network, Marie Curie Horizon 2020 IF and recently the Danish Cardiovascular Academy. The research methods goes from different electrophysiological measurements, echocardiography, various cellular and molecular analysis with collaboration between clinicians and basic scientists.

Janne Winther Christensen



Janne Winther Christensen is Associate Professor at the Department of Animal and Veterinary Sciences, Aarhus University, Denmark. She is also senior vice president of the International Society for Equitation Science (ISES). Janne has conducted a number of research projects in relation to horse behaviour, stress and welfare, incl. the effects of various training methods.

Annelies Decloedt



Annelies Decloedt is an associate professor at the faculty of Veterinary Medicine, Ghent University (Belgium). Annelies graduated as an equine veterinarian in 2008 from Ghent University, Belgium. She immediately started a PhD fellowship in the field of equine cardiology at Ghent University funded by the Research Foundation Flanders, investigating new echocardiographic techniques such as tissue Doppler imaging and two-dimensional speckle tracking for quantifying cardiac function in horses. This PhD was completed in 2012 and was followed by continued clinical research as a postdoctoral research fellow of the Research Foundation Flanders in the field of equine cardiology, ultrasound and exercise physiology.

The project focused on right heart function in equine athletes and horses with pulmonary hypertension due to equine asthma. As a member of the Equine Cardioteam Ghent, she is actively involved in research and clinical work in equine cardiology. She coordinates and participates in several research projects regarding improved diagnosis and treatment of mitral and aortic valve regurgitation and cardiac arrhythmias in horses.

In 2015, Annelies was appointed as assistant professor in veterinary clinical and communication skills at the Faculty of Veterinary Medicine, Ghent University. She is responsible for the courses "Clinical and communication skills" which run from the second until the fifth year of the six year program of Master in Veterinary Sciences. She developed and launched the veterinary skills laboratory for teaching veterinary clinical skills at Ghent University. In the skills laboratory, dummy models and simulators are used for teaching various skills such as injections or surgery. Flipped classroom teaching and blended learning is an essential part of the skills laboratory training. Annelies is also responsible for developing and teaching the communication skills training program, which includes both theoretical classes as well as many practical exercises including peer-to-peer role play, video analysis and role play using volunteers as simulated clients.

Sonia Gonzalez-Medina

Sonia graduated from the University of Córdoba, Spain, in 2007. After completing her degree, she undertook internships at a private hospital in Madrid, Spain, and at the Alfort Veterinary School in Paris, France. In 2010, she relocated to the United Kingdom, where she spent several years in private practice and served as an equine epidemiology clinician at the Animal Health Trust. Her work there primarily focused on influenza and strangles vaccine development, as well as managing infectious disease outbreaks.

During this period, Sonia also earned the Certificate of Advanced Veterinary Practice (CertAVP) in Equine Internal Medicine from the Royal College of Veterinary Surgeons (RCVS) and a postgraduate degree in Veterinary Ophthalmology from the University of Barcelona, Spain. In 2019, she completed her doctoral studies on Equine Atypical Myopathy at The Royal Veterinary College.

Following her doctoral studies, Sonia moved to Colorado, USA, where she completed a residency in Large Animal Internal Medicine and earned a Master of Science degree specializing in Cervical Compressive Myelopathy (Wobbler Syndrome). She is a board-certified American Specialist in Large Animal Internal Medicine with a particular interest in ophthalmology, neurology, muscular disorders, and infectious diseases.

Sonia has authored numerous scientific papers and has presented her research at various national and international conferences. Currently, she is actively engaged in clinical research on exercise biomarkers, toxicology, and infectious diseases.

Sanni Hansen



Sanni Hansen graduated from University of Copenhagen in 2008 and defended her PhD within Immunosenescence, Inflamm-aging in the Equine Lower Airway Immune System in 2012. She became a diplomate of the ECEIM in 2023. She is currently employed as Associate Professor, at the Department of Large Animal Sciences, Faculty of Health and Medical Sciences, University of Copenhagen. Her research focus is on airway diseases, primarily equine asthma as well as within equine gastric ulcer syndrome, primarily in the development of non-invasive biomarkers.

Ken Hinchcliff



A graduate of the Melbourne Veterinary School, Ken is former Dean of the Faculty of Veterinary and Agricultural Sciences at the University of Melbourne. After several years in large animal practice in Victoria, Ken completed an advanced training program in large animal internal medicine at the University of Wisconsin-Madison, and a PhD in equine exercise physiology at the Ohio State University with Ken McKeever and Bill Muir. Ken was a faculty member in the College of Veterinary Medicine at OSU until 2007. He is currently the

Warden (CEO) of Trinity College, Melbourne.

Professor Hinchcliff is the author of over 190 peer-reviewed scientific publications, the 9th, 10th (2007) and 11th (2017) editions of "Veterinary Medicine: A textbook of the diseases of cattle, horses, sheep, pigs and goats", which is the most highly cited textbook in veterinary medicine, and three editions of "Equine Sports Medicine and Surgery: basic and clinical sciences of the equine athlete" (April, 2023), "Five Minute Veterinary Consult – Equine" (2009) and Saunderson's Comprehensive Veterinary Dictionary (2021). He is Co-Editor-in-Chief of the Journal of Veterinary Internal Medicine, the official journal of the ECEIM, ACVIM, ECVN and ECVIM-CA.

Professor Hinchcliff was a member of the Zoological Parks and Gardens Board (2008-2021, 2022 – present), where he chaired its Science Advisory Committee, and is a member of the Listing Committee of the Fédération Equestre Internationale (FEI). He was previously chair of the National Committee of ICEEP (2002 Kentucky), a member of the International Committee (2002-2014), Chair of the International Committee (2010-2014, Chester) and member of the National Committee (2018, Lorne, Australia).

Stine Jacobsen



I graduated in 2003 from the Royal Veterinary and Agricultural University, Denmark, and obtained my PhD degree in 2003. I was made full professor of large animal surgery at University of Copenhagen, Denmark, in 2015, and I became diplomate of the ECVS in 2016. I divide my time between clinics, research and teaching and have published more than 100 peer-reviewed scientific papers. My main research interests are inflammation (where I have published extensively on serum amyloid A in horses and cattle), joint disease, and soft tissue surgery - particularly wound management. I have supervised more than 15 PhD students and residents, and have held several positions of trust, including board membership of Independent Research Fund Denmark and World Equine Veterinary Association.

Hannah Junge



Hannah K. Junge
Dr.med.vet., Dipl. ECEIM

Hannah Junge graduated from the Free University of Berlin, Germany. After this she worked on her doctoral thesis and worked on a stud farm. In 2010 she finished her doctoral thesis to attain the Dr.med.vet. degree.

From 2010 onwards she was intern and clinical instructor and completed an ECEIM Equine Internal Medicine residency program at the equine hospital of the University of Zurich.

In 2018 she moved to the University of Veterinary Medicine Vienna, where she was employed as a Clinician and Lecturer in the Equine Internal Medicine Section.

In 2020 she moved back to the Vetsuisse Faculty of the University of Zurich, where she is employed as a Senior Lecturer in the Equine Internal Medicine Section.

John Keen



Professor John A Keen BVetMed PhD Cert EM (Int Med)
Dip ECEIM FRCVS

Following graduation from the Royal Veterinary College, London in 1996, John spent 4 years in mixed and then equine practice before being appointed the RCVS Clarke and Sparrow Resident in Equine Studies at the 'Dick' Vet in 2000, where he has remained ever since. He was awarded the RCVS Certificate in Equine Internal Medicine in 2002, MSc by research in 2004, Diploma of ECEIM in 2007 and PhD in 2009. John was Director of the R(D)SVS Equine Hospital and Practice from 2012-

2019 and is currently a senior medicine clinician in the Equine Hospital with clinical, teaching and research commitments. Clinical and research interests are increasingly focussed on cardiovascular disease, particularly the link between cardiac tissue form and (dys)function.

Casper Lindegaard



Casper Lindegaard graduated from University of Copenhagen in 2002 and has worked in mixed rural practice before returning to academia. Casper defended his PhD within pain assessment and pain management in horses in 2009 and became a diplomate of the ECVS in 2012. Casper was head of surgery at the Evidensia Helsingborg Equine Hospital from 2012 to 2018 before returning to academia where he is professor of equine orthopedics and Director of the Large Animal Teaching Hospital at the University of Copenhagen. Casper has done research, published, lectured and advocated for better implementation of pain assessment and management in horses since 2005. In addition to pain, Casper's research interests are equine joint disease, upper respiratory surgery and diagnostic imaging.

Alicia Lundby



Alicia Lundby is Professor of Cardiac Proteomics at the University of Copenhagen. She received a M.Sc. degree in Physics and a Ph.D. in Health and Medical Sciences from the University of Copenhagen. During her pre- and post-graduate studies she received training at University of California in San Diego, The RIKEN Brain Science Institute in Japan and at The Broad Institute of Harvard and MIT. She was trained in quantitative phosphoproteomics strategies as a post doctoral fellow in the group of Prof. Jesper V. Olsen at the Novo Nordisk Foundation Center for Protein Research. She established an independent research group in 2015, where her interest in deep proteomics investigation was combined with cardiac electrophysiology and multi-modal data integration strategies. Her research is focused on uncovering molecular mechanisms contributing to cardiac pathologies. Her group has established methods to quantify protein abundances and signaling pathways from patient heart

samples, which in combination with functional studies in matched model organisms, enable data-driven strategies to identify dysregulated proteins and signaling networks characterizing cardiac disease states. The emphasis of her group is to apply unbiased large-scale experimental approaches combining state-of-the-art proteomics with orthogonal approaches, such as human population genomics, single cell transcriptomics, spatial transcriptomics or pharmacovigilance, to identify proteins of key importance in molecular cardiac pathology

Katharyn Mitchell



Dr Katharyn Mitchell graduated from Massey University, New Zealand, in 2003 and since graduating she has been on a journey with equine medicine that has taken her around the world. In addition to her first three years spent as an intern, and nearly 5 years in private mixed practice in Australia, Dr Mitchell completed her residency in large animal internal medicine at Cornell University, USA in 2010. In 2013, Dr Mitchell headed to Switzerland, where she completed a PhD in equine cardiology in 2018. Currently Dr Mitchell is an Assistant Professor in Large Animal Internal Medicine at Cornell University in the USA where she is continuing to investigate equine arrhythmias and the role of the cardiovascular system in critically ill patients.

Malcolm Morley



Malcolm Morley qualified from the University of Bristol in 1993. He started his career at the Liphook Equine Hospital, and has predominantly worked in first opinion ambulatory practice at Stable Close Equine Practice in the UK. He has been a council member of the British Equine Veterinary Association and chaired their Pre-Purchase Examination Committee. More recently he was President of the British Veterinary Association 2022-2023

Emil Olsen



Emil Olsen is a comparative neurologist at IVC Evidensia Specialist Animal Hospital Strömsholm in Sweden and a part-time clinical lecturer at the Swedish Agricultural University (SLU).

Emil graduated from the University of Copenhagen in 2005. He went into general ambulatory equine practice until 2009, when he undertook a PhD at the University of Copenhagen, researching subjective and objective assessment of gait in ataxic horses. The research was carried out at the Royal Veterinary College in the U.K. In 2013, he went on to a large animal internal medicine residency at the Cornell Nemo Farm Animal and Equine Teaching Hospital and, in 2014, a

dual residency in Neurology. Emil holds ACVIM diplomas in both Large Animal Internal Medicine and Neurology.

Emil's research interests are focused on gait analysis in animals with proprioceptive ataxia and activity monitoring as a biomarker for pain as well as inflammatory and infectious neurologic diseases and very much enjoys veterinary education

Tina Pihl



Tina Holberg Pihl has had an extensive career as a veterinarian since 2002. After working in a mixed practice with a focus on horses and cattle, she continued her career at the University of Copenhagen, with a PhD and later as an associate professor within large animal internal medicine at the University Hospital for Large Animals. Her research has focused on biomarkers in blood and peritoneal fluid for improved diagnosis and prognosis of equine colic and colitis. Tina has divided her time between research, teaching, and clinical work, with a particular interest in parasites and ophthalmology

Scott Pirie



Scott is a 1989 Edinburgh graduate and returned to the "Dick Vet" in 1991, where he has remained since as part of the Equine Internal Medicine team. His clinical and research interests largely focus on pulmonology (PhD 2002), gastroenterology and grass sickness (research sabbatical 2002-2005). He is a Diplomate of the European College of Equine Internal Medicine (2004), an ex-member of BEVA council, a member of the EVJ Editorial Consultant Board, Past President of the Veterinary and Comparative Respiratory Society and ex-Chair of the Examination Committee of the ECEIM. Scott is currently Academic Head of the Equine Division at the Dick Vet

Chris Sanchez



Dr. Chris Sanchez is a Professor of Large Animal Internal Medicine and Associate Dean for Clinical Services, Large Animal Operations at the University of Florida's College of Veterinary Medicine. Her research and clinical interests include equine neonatology and gastroenterology, with a focus on pain management. She is the past Specialty President for Large Animal Internal Medicine for the American College of Veterinary Internal Medicine.

Colin Schwarzwald



Colin C. Schwarzwald graduated in 1997 from the University of Zurich School of Veterinary Medicine. Between 1998 and 2001 he was intern and clinical instructor at the Equine Hospital of the University of Zurich and worked on his doctoral thesis to attain the Dr.med.vet. degree. Between 2001 and 2004 he completed an ACVIM Large Animal Internal Medicine residency program at The Ohio State University. Concurrently, from 2001 to 2006, he was also enrolled in a PhD program and conducted several research projects in the field of equine cardiology, in cooperation with Dr. John Bonagura, Dr. Robert Hamlin, Dr. William Muir, and several members of the cardiology section. In 2006 he moved back to the Vetsuisse Faculty of the University of Zurich, where he was employed as a Senior Lecturer in the Equine Internal Medicine Section. In 2012 he was appointed to a full professorship in Equine Internal Medicine. He is currently the director of the Clinic for Equine Internal Medicine and Chair of the Equine Department at the Vetsuisse Faculty of the University of Zurich.

His academic and clinical interests include large animal and comparative cardiology, with emphasis on echocardiography, cardiac electrophysiology, cardiovascular pharmacology, and cardiac biomarkers. In 2023, he was accepted as a Fellow of the American Society of Echocardiography.

Bianca Schwarz



Dr. med. vet., DipECEIM

- 1996 – 2002 Veterinary medicine in Munich and Zurich
- 2002 – 2005 Doctoral thesis in Munich
- 2005 – 2006 Internship in Equine Studies, Royal Veterinary College, University of London
- 2007 – 2011 Residency in Equine Internal Medicine, Vetmeduni Vienna
- 2011 DipECEIM
- 2011 – 2018 Head of Internal Medicine and owner of a private equine clinic in Germany
- Since 2019 Equine Internal Medicine consultant:
www.pferdeinternist.de

- Member (2012-2015) and chair (2013) of the examination committee of the ECEIM
- WEVA board member 2013–2018
- Member of various committees (Veterinary Chamber of the Saarland) (since 2014)

Marianne Sloet van Oldruitenborgh-Oosterbaan

Marianne M. Sloet van Oldruitenborgh-Oosterbaan, DVM (1982, cum laude), PhD (1990), Dip. ECEIM (2001) and Dip. ECVSMR (2019), has retired on December 13th 2021 as professor of Clinical Equine Internal Medicine at Utrecht University. However, she continues research with five PhD candidates till December 2026.



Since December 2021, she works part-time as a specialist/consultant in Krommerijnstreek Equine Practice (Schalkwijk), as a resident supervisor in Emmeloord Equine Clinic (Emmeloord) and as a veterinary consultant in Eikenlust Equine Consultancy (Bilthoven), her own company since 2009.

Prof. Sloet was a founding member and the first president of the European College of Equine Internal Medicine (2002-2008), and past-president of this College (2008-2011). She was member of the Council for Animal Affairs (2013-2018) in the Netherlands, member of the Ministerial Advisory Committee for Equine Emerging diseases (2010-2022) and president of the Advisory Committee Equine Welfare (2016-2023). Since 2015 she is chair of the Animal Disease Group of the Sectorraad Paarden and also chair of the Equine Health Group of the Netherlands.

Prof. Sloet is honorary member of the ECEIM (2012) and honorary life contributor of the Royal Netherlands Veterinary Association (2017). In May 2022, she became Officer of the Order of Orange-Nassau and received the golden pin of the Dutch Equestrian Federation (KNHS).

Prof. Sloet is veterinary advisor of the Dutch National Equestrian Federation (KNHS), the Dutch Warmblood Studbook (KWPN), the Royal Friesian Studbook (KFPS) and others. Since 2001 prof. Sloet is FEI Head Veterinarian for the Netherlands and acts as veterinary delegate on several FEI Events

Ramiro Toribio



Dr. Ramiro Toribio is a full professor and chief of the Equine Medicine/Equine Field Service section of the College of Veterinary Medicine, The Ohio State University. He is board-certified by the American College of Veterinary Internal Medicine (ACVIM). His duties include research, clinical service, teaching, mentoring, outreach, and administration. He leads professional and graduate courses. Dr. Toribio directs research programs in equine endocrinology, equine neonatology, comparative medicine, and molecular biology. He has secured >\$5,000,000 in research funds and has >140 publications. He has collaborations with academic institutions (US and abroad), private practices, foundations, and industry. Dr. Toribio has trained many residents, interns, graduate students, and post-doctoral fellows. He is engaged in outreach and

continuing education activities

Mette Uldahl

Mette Uldahl graduated from Copenhagen University in 2001 as a trained veterinarian. She works with Animal Welfare, where updating ethics and transforming current cultures within the animal-human relationship to a modern standard is a particular focus area. Mette Uldahl also regularly take part in research projects and publications of peer-reviewed papers.

In her position as 1st Vice President of the European Veterinary Association, FVE, she also works with development of the veterinary profession, in particular Mental well-being and Diversity, Equity and Inclusiveness.

Emmanuelle van Erck Westergren



Emmanuelle graduated from the French Veterinary School of Maisons-Alfort. She obtained a PhD at the University of Liège (Belgium) and worked as a clinician at Equine Sports Medicine Centre in Liège where she specialized in the investigation of performance and poor performance in equine athletes of all disciplines. She contributed to developing the equine sports medicine unit in the CIRALE in France where she consulted as senior clinician.

In January 2010, she founded the 'Equine Sports Medicine Practice' (ESMP), a referral practice specialized in equine internal and sports medicine.

The Royal Belgian Federation of Equestrian Sports has appointed her as team veterinarian in 2015 and as veterinary expert for the FEI. She is president of the Belgian Equine Practitioners Society (BEPS).

Emmanuelle is boarded from the European College of Equine Internal Medicine (ECEIM) and the European College of Veterinary Sports Medicine and Rehabilitation (ECVSMR). She is co-editor for the 3rd Edition of "Equine Sports Medicine and Surgery".

Gunther van Loon



Gunther van Loon graduated from Ghent University, Belgium, in 1992 and has worked at Ghent University, Department of Large Animal Internal Medicine, ever since. In 2004 he became ECEIM Diplomate and in 2011 Associate Member of ECVDI. In 2001 he finished his PhD on "Atrial pacing and experimental atrial fibrillation in equines". He is author or co-author of more than 200 A1 publications and 24 book chapters, and gave about 240 presentations at international congresses. In 2015 he received the British Equine Veterinary Association (BEVA) award for 'Clinical Research' (Liverpool, UK) and in addition the prestigious Merit Applied Equine Research Award for outstanding

research regarding 'Advances in Equine Cardiology', awarded by the World Equine Veterinary Association (WEVA) (Guadalajara, Mexico). Gunther van Loon is head of the Equine Internal Medicine department at Ghent University and head of the Equine Cardioteam Ghent. He is Past-President of the Belgian Equine Practitioners Society (BEPS). His major interests are in the field of equine cardiology and vascular diseases with specific expertise in cardiac ultrasound (including 4D echo, intracardiac echocardiography), arrhythmias, electrophysiological studies, cardiac pacing and pacemaker implantation, 3D electro-anatomical mapping, radiofrequency ablation and cardiac biomarkers. Gunther has established the Equine Cardioteam Ghent which performs high level cardiac research and advanced treatment of clinical cases in a fully equipped lab.

Ingrid Vervuert



Professor Ingrid Vervuert is a faculty member at the University of Leipzig, Germany. She received her veterinary degree from the Free University of Berlin. Then, went on to complete her doctoral thesis in equine energy metabolism in exercising horses from the University of Hannover and postdoctoral program in starch digestion in horses at the University of Leipzig. She is a German diplomate in Animal Nutrition and Dietetics. Prof. Vervuert's current research covers forage quality, equine gastric ulcers and dietetic management of horses with internal diseases. Prof. Vervuert has 350 publications in peer-reviewed journals, review articles and book chapters; and she has spoken at numerous conferences on equine nutrition

Kathalijne Visser



Professor Dr. Kathalijne Visser, an esteemed expert in Human-Animal Interactions, holds a professorship at Aeres University of Applied Sciences, Dronten. She earned her Animal Science degree from Wageningen University and completed her groundbreaking PhD on horse personalities at Utrecht University in 2002. Her doctoral work, titled "Horsonality," focused on the personality of horses and marked a significant contribution to equine behaviour studies. After completing her PhD, Dr. Visser continued to lead impactful research projects in the realm of equine welfare, particularly concerning housing, feeding, and training of horses. In 2012, she played a pivotal role in developing the Dutch welfare monitoring system for horses, drawing from the Welfare Quality system principles. Her

expertise also extends to co-promoting several PhD students, thereby nurturing the next generation of scholars in her field. She chaired the organizing committee of the ISES Conference in the Netherlands in 2011, a significant event for the society. In her current role, she focuses on the welfare of dogs and horses in work, therapy, sports, and recreation, and is a recognized member of the FEI Equine Ethics and Well-Being Commission. Throughout her career, she has consistently demonstrated a deep commitment to improving the well-being of animals, particularly horses and dogs, through her research, teaching, and various leadership roles in professional societies and commissions.

Elizabeth Williams



Dr. Beth Williams grew up riding horses in California USA and then attended UC Davis for veterinary school and completed a large animal internal medicine residency. Throughout her veterinary education, she has developed an interest in large animal cardiology and am now pursuing that interest in a PhD. Her research focuses on investigating valve disease and its relation to arrhythmia formation and myocardial dysfunction in large animals.

LECTURES: FRIDAY 15 NOVEMBER 2024

ROOM: A2-81.01

09.30-11.00 – Ethic in equine medicine plenum discussion and short presentations

Veterinary Social License to Operate in Equine Medicine Should we foresee an ethical journey?

The ethical paradigm shift from intended use to intrinsic value in animals, and its effect on medical treatment of horses
(Mette Uldahl, DVM, Senior Consultant Animal Welfare, Vice president FVE, 10 min)

Governing the horse by observing its behaviour; an additional layer to be implemented when using horses
(Janne Winther Christensen, Associate Professor, University of Aarhus, Denmark, 10 min)

Governing bodies work with horse welfare in racing and equestrian sport; how does it affect vet work?
(Emanuelle van Erck, Equine Sports Medicine Practice, Belgium 10 min)

Rules on medication of horses in competition from a European perspective; the vet role and ethical integrity
(Mette Uldahl, DVM, Senior Consultant Animal Welfare, Vice president FVE 10 min)

Horse welfare and the future of dressage riding – perspectives from a professional dressage rider
(Princess Nathalie zu Sayn-Wittgenstein-Berleburg, 10 min)

How do we need vets to act to secure horse sport for the future?
(Dr. Ir. Kathalijne Visser, Professor in Human-Animal Interactions, Ares University, Netherlands 10 min)

Panel debate – 30 minutes
(Moderator Malcolm Morley, Senior Vice President BVA)

12.20-13.00 - Equine nutrition – The scientific evidence for feeding herbs for various diseases

Ingrid Vervuert
Institute of Animal Nutrition, Nutrition Diseases and Dietetics
Faculty of Veterinary Medicine
An den Tierkliniken 9
D-04103 Leipzig

Introduction

Herbs are plants used for health promotion or their olfactory or flavouring properties. The interest of horse owners and veterinarians in using herbal products to improve the health of the equine has increased significantly in recent years. Many of the herbs used in equine nutrition have a traditional reputation for their uses, but information of their active ingredients, the pharmacological mode of action, and evidence of efficacy or adverse effects from equine clinical studies are limited to a very small number of herbs.

Independent of the limited data available from scientific studies, the commercial feed market offers a wide range of herbal mixtures in dried or liquid form, herbal mono-products or complementary feed fortified with herbal additives for a wide variety of indications. Herbs of current interest in horse nutrition address metabolic disorders, such as pituitary pars intermedia dysfunction (PPID) or insulin dysregulation, and support gastrointestinal and respiratory health.

Legal requirements of herbs

Herbs which are used in equine nutrition are listed as feed materials in accordance with the catalogue of feed materials Part C of the Annex to Regulation (EU) 68/2013, meaning that herbs or their parts can be used as feed sources (e.g. in forage) or from their processing, such as crushing, grinding, freezing or drying. The European Union (EU) regulation (68/2013) also specifies crude fibre as a mandatory labelling nutrient in the processed herb product and, as applicable, the name of the herb should be specified. In addition, similar to any feedstuff, general requirements for safety and placing on the market in accordance with Article 4 of Regulation (EC) No. 767/2009 must be complied with in commercial products fortified with herbs. According to the catalogue of feed materials, herbs do not require further premarket approval by EU legislation. However, as herbs are listed in the catalogue of feed materials, health claims are not permitted, although feed companies widely ignore the ban of advertising health claims.

Herbs may contain banned or controlled doping-relevant substances and information on the current regulations is available at the Fédération Equestre Internationale homepage.

Herbs of interest to support hormonal regulation

There are several herbs which may have the potential to control glucose homeostasis and insulin regulation in obese and non-obese equids, as reviewed by Tinworth et al. (2010), but scientific data are still lacking in the equine.

The supplementation of chasteberry (*Vitex agnus-castus* L., syn. *Agnus castus*) to improve hormonal control in horses with PPID is widely used. Extracts of *Agnus castus* act as dopamine agonists. The active compounds are characterized as labdane diterpens. A lyophilised extract of *Agnus castus* (5 mg/L) *in vitro* was similar in activity to 10^{-4} mol/L dopamine in receptor-ligand binding assays (Barnes et al. 2002).

There are currently two studies about feeding a herbal blend containing chasteberry, ginkgo and artichoke to horses suffering from PPID.

Thirty-eight horses and ponies with PPID were divided into three groups and received either a herbal blend containing chasteberry, ginkgo and artichoke or pergolide (Bradaric et al. 2013). The herbal preparation was fed according to the manufacturer's instructions (0.05 g/kg BW PO/q24, level of chasteberry intake not labelled). Horses fed the herbal blend showed a significant improvement of hypertrichosis, hyperhidrosis, swayed back, pendulant abdomen, skeletal muscle atrophy, behaviour and abnormal fat distribution, which were comparable to pergolide therapy. Horse owners reported a significant improvement of the relevant clinical symptoms in their horses fed with the herbal mixture comparable to pergolide therapy in a questionnaire performed by the company who sells the respective herbal product containing chasteberry, ginkgo and artichoke (Schramm et al. 2018).

Herbs of interest to support gastric and liver health in horses

Equine gastric ulcer syndrome is a very common health problem in adult horses and foals. Several dietary supplements supporting gastric mucus integrity are commercially available. Sea buckthorn berry (SBB; *Hippophae rhamnoides* L.) has been highlighted as a supplement that is used to prevent gastric ulceration in horses. The SBB are rich in phytochemicals, such as phenols, vitamins, flavonoids, fatty acids, plant sterols and lignans. These compounds have antioxidant and immunoactive properties, which might be beneficial in mucosal healing. Two studies failed to show efficacy in the treatment or prevention of squamous ulcers in horses fed supplements containing SBB pulp and extract. However, glandular ulcer scores were improved when compared to untreated controls using an intermittent feeding protocol to induce gastric ulceration in horses fed SBB and pulp (Reese et al. 2008; Huff et al. 2012).

Aloe vera L. (syn. aloes) contains phytochemicals, such as anthranoids, chromones, phenyl pyrones and cinnamic acid. *Aloe vera* is recommended for the treatment of atonic constipation in humans, but the use of aloes has been superseded by less toxic laxatives, as the pharmacological effect may cause abdominal cramp and diarrhoea.

However, *Aloe vera* was tested for the treatment of gastric ulcers in horses. Four weeks of administration of an *Aloe vera* inner leaf gel (17.6 mg/kg BW twice daily) was less effective than the supplementation with omeprazole (4 mg/kg BW once daily) in the treatment of naturally occurring gastric mucosa lesions (Bush et al. 2018).

In conclusion, SBB may have some potential to promote gastric mucosa healing, but further work is needed, especially in spontaneously occurring clinical cases. However, the use of *Aloe vera* is not promising as adverse effects similar to humans cannot be excluded.

Milk thistle (*Silybum marianum* L.) fruits are traditionally used due to their hepatoprotective activity in the prophylaxis and treatment of liver damage and disease in horses. Milk thistle contains flavolignans, such as silymarin, a mixture containing ~50 % silibinin (syn. silybin, silybinin) and others.

Milk thistle and silymarin reduced endotoxin activity *in vitro* and inhibited endotoxin-induced effects on the lamellar tissue in equine hoof explants (Reisinger et al. 2014). The oral bioavailability of silybin was tested in horses by the administration of silybinin complexed with phospholipids (32.7 % silybin phospholipid) both by nasogastric tube and via feed. The bioavailability of the oral administration of silibinin phospholipid was determined from serum analyses as < 1 %, confirming that the bioavailability was low in horses, as in other species, regardless of the use of silibinin complexed with phosphatidylcholine (Hackett et al. 2013a).

Milk thistle was administered in the form of seed cakes (silymarin intake up to 19.4 g/d per horse) to 12 horses subjected to intensive exercise for 56 d. Silymarin provided by the supplementation of milk thistle seed cakes had a positive effect on energy metabolism by lower non-esterified fatty acids with a higher utilization of the latter during exercise, associated with a faster return of cortisol to resting values (Dockalova et al. 2022).

In addition, mares were fed with different daily feed doses of milk thistle expeller (100, 200, 400 and 700 g/d) with a silymarin content of 3.4, 6.8, 13.4 and 19.4 g/d, respectively, to evaluate the digestibility of silymarin (Dockalova et al. 2021). The digestibility of silymarin and other flavonolignans increased with the daily dose and then stagnated with the dose of milk thistle seed cakes at 400 g/day. The authors concluded from both studies that the most suitable daily dose in mares and equine athletes seemed to be 400 g/d of milk thistle seed cakes.

However, although extensive literature exists on the pharmacological effects of silymarin and silibinin, supporting evidence for their clinical use (e.g. Hackett et al. 2013b, Tedesco and Guerrini 2022), clinical studies in horses with hepatic disorders are still missing.

Artichoke (*Cynara scolymus* L.) is also used for its hepatoprotective activity in humans and several animal species. The main constituents include flavonoids and volatile oils. The commercial feed market offers a wide range of hepatoprotective products which frequently contain artichoke, however, scientific data are not available for its use in horses.

Herbs of interest to support respiratory tract or immunomodulation in horses

The efficacy of aniseed, cowslip, echinacea, elder, fennel, garlic, gentian, horehound, hyssop, liquorice, primrose, thyme and verbena (Table 1) has been investigated in horses, most commonly fed as a blend of several herbs.

Table 1: Selected herbs of interest modulating respiratory tract and immune function in horses (according to Barnes et al. 2002)

Species	Synonym	Constituents	Use
<i>Allium sativum</i> L.	Garlic	Enzymes, volatile oils	Expectorant, antispasmodic, antimicrobial
<i>Echinacea angustifolia</i>	Coneflower	Alkaloids, glycosides, terpenoids, amides, polyenes,	Immunostimulant, antiseptic, antiviral
<i>Foeniculum vulgare</i> L.	Fennel	Volatile oils, bitter substances	Expectorant, antispasmodic
<i>Gentiana lutea</i> L.	Bitter root, gentiana	Alkaloids, bitter substances, xanthenes	Bronchosecretion, immunostimulant
<i>Glycyrrhiza glabra</i>	Liquorice	Coumarins, flavonoids, terpenoids, volatile oils	Expectorant, antispasmodic
<i>Hyssopus officinale</i> L.	Hyssop	Volatile oils, terpenoids, bitter substances	Expectorant, antispasmodic
<i>Marrubium vulgare</i> L.	Common hoarhound	Alkaloids, flavonoids, terpenoids, volatile oils	Expectorant, antispasmodic
<i>Oenothera biennis</i> L.	Primrose	Essential fatty acids	Immunoregulation
<i>Pimpinella anisum</i> L.	Anise, anisum, aniseed	Coumarins, flavonoids, volatile oils	Expectorant, antispasmodic
<i>Primula veris</i> L.	Cowslip	Flavonoids, phenols, quinones, saponins	Expectorant, antispasmodic
<i>Sambucus nigra</i> L.	European elder	Flavonoids, volatile oils	Anti-catarrhal
<i>Thymus vulgaris</i> L.	Thyme	Volatile oils, flavonoids	Antitussive, expectorant, bronchosecretion, antispasmodic
<i>Verbena officinalis</i> L.	Verbena	Glycosides, volatile acids	Antispasmodic

O'Neill et al. (2002) investigated the effect of echinacea in eight healthy horses over 42 days in a placebo-controlled crossover design. Horses were supplemented daily with 30 mL of an echinacea syrup, which corresponds to an intake of 4 % echinacoside. The phagocytic function of isolated neutrophils and erythropoiesis were improved in horses fed echinacea compared to placebo conditions.

Six horses with clinical signs of a chronic obstructive pulmonary disease were fed a herbal mixture of anise, fennel, garlic, horehound, hyssop, liquorice and thyme over 21 d in a crossover study (Pearson et al. 2007). A trend to a decreased respiratory rate and an increase in the proportion of macrophages in the tracheal aspirate was observed in the horses receiving the herbal composite compared with the placebo fed group. Other relevant parameters were not affected and the diagnostic value of the tracheal aspirate is limited. Van den Hoven et al. (2003) fed an extract of thyme (4.8 g daily per horse) and primrose (1.8 g daily per horse) for 30 d in five horses with chronic obstructive pulmonary disease without modifications in feeding and housing management. A significant improvement was found on the pulmonary pressure and airway resistance, but without a change of the clinical signs, such as cough, nasal discharge, nasal flaring, the size of the lung percussion field and the character of lung auscultation. The plasma thymol concentrations as an indicator of the pharmaceutical activity differed considerably among the horses, but most horses had measurable plasma thymol concentrations after 8 h after thyme intake. However, a major flaw was that a placebo-controlled group was not included in the study.

Similar findings were published by Anour et al. (2005), who fed a herbal mixture of gentian, sorrel, cowslip, verbena and elderberry in a crossover design lasting 14 d in nine horses with a confirmed history of chronic obstructive pulmonary disease. A significant improvement was found on the pulmonary pressure and airway resistance, but other parameters remained unchanged.

In summary, the positive effects of feeding herbs in horses with chronic obstructive pulmonary disease cannot be excluded, but the effects seemed to be of minor significance compared to the reduction of dust inhalation by an adequate feeding and housing management.

The impact of immune modulation by echinacea in horses suffering from an impaired immune response is still open and further investigations are needed in order to assess the efficacy.

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ROOM: A2-82.01

12.20-13.00 - AI in research

How to Develop the Right Mindset for Using AI for Academic Purposes

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University of Southern Denmark

Before we start thinking about using AI apps for academic purposes, here is, a scenario I would like you to imagine.

You are starting a new research project. You begin by going to your university's library, not the library's website but the physical library. You spend hours browsing the library catalog and find a few relevant journals and books.

You then walk to the stacks where those journals and books are shelved. You check these materials out, go to your office or home, and start reading them.

This is a perfectly legitimate way of doing research.

But how likely is it that you will actually do this?

If you are already shaking your head, you are not alone.

A while back, I asked this question at a talk I gave at a research institute in Copenhagen. Instead of answering the audience, the audience burst out laughing.

Using your university's physical library is an effective way of conducting research. But it's not efficient.

You are more likely to start your research project by going to a website like Google Scholar, PubMed, or your university's online library.

Using these online sources seems like the "normal" way of doing things these days. It almost seems "intuitive." We don't think much about it and yet this is how most academics conduct research these days.

But twenty-five years ago, looking up sources on an online database did not seem intuitive. It took us several years to build these "intuitive" understandings.

The same is the case with pretty much every technology. Until the arrival of smartphone, we didn't think we would be able to browse the internet on our mobile devices. But nowadays, even elementary school kids know how to "google."

AI apps are very different and more powerful than traditional tools like Google Scholar or PubMed. This means we will need to build new intuitions.

Here are five points that help you build these new intuitions.

1. Use AI for Structure and Not Content

When it comes to AI apps, understanding the difference between structure and content is crucial. It can be a bit tricky though.

Imagine you are working on a journal article. You email the editor of your target journal that you are trying to be creative with your next article. You tell the editor that you will write your paper in the form a Shakespearean sonnet or a rap song.

The editor will not be impressed. If they are polite, they may tell you to stick to the structure of articles the journal has published in the past. If they are direct, they may tell you something like – Have you lost your mind?

Within a given field, academic articles have a very predictable structure. Anyone wishing to publish their research will have to follow that structure.

So, you agree to stick to the structure of an academic article. But you tell the editor that your article will only contain predictable results. Again, the editor is unlikely to be impressed. That's because an academic article must make an original contribution. And such a contribution cannot be predictable at all.

An academic article must have a predictable structure and unpredictable content.

AI apps like ChatGPT are trained on huge amounts of human-generated content. These models understand how we communicate, especially the way we structure our communication.

But since these apps use a predictive model, their content is always predictable. Predictable content, for our purposes, is of little value. Predictable structure, on the other hand, is very useful.

So, we have to learn to use AI for structure and not for content. For example, you can ask ChatGPT to give you an outline for a journal article or a grant proposal. But you can't ask it to write the article for you.

2. Outsource Academic Labor to AI But Not Thinking

Suppose you come across a paper published by two Nobel laureates. Because of their stature, many people could think of their evidence as irrefutable. Imagine you want to find out if anyone has contrasted the claims of these Nobel prize winners. You will have to read a lot of papers to do that. Google Scholar won't be much help.

But Scite, an AI-powered app, can do this for you in seconds. In this case, we are using AI to outsource our labor but not our thinking.

If we outsource our thinking to AI, we will be shooting ourselves in the foot. A while back, a high-level university administrator invited me for a consultation. We spend some time discussing how to craft an AI policy for their university.

At one point during the meeting, the administrator asked me, "If AI can do this, can I fire 20% of my research staff?" I nearly fell out of my chair.

It took me a couple of minutes to compose myself. "Instead of firing 20% of your staff," I said, "how about we try to make them more productive with AI?"

If there is an AI app that can do our research for us, the universities will not wait a single second before firing us all.

We want to make sure we produce the kind of original knowledge that an AI cannot. At the same time, we must be open to outsourcing academic labor to AI. That's the only way we will be able to keep our jobs.

3. Treat AI as a Research Assistant Not a Supervisor

Imagine you hire a research assistant and assign them a task. You tell them to read five research papers and prepare their summaries. They complete the task on time and give you the required summaries. Will you take your assistant's summaries and put them in your paper without even reading them once? Highly unlikely.

You will not only read those summaries but also give your assistant feedback. If they have done a good job, you will applaud them. And if there is a shortcoming, you will highlight that too. That's the only way they can improve.

Think of AI apps as your research assistants and not your supervisors. They are supposed to assist you in what you want to do. They are not supposed to tell you what to do.

One way to go about it is to imagine AI apps as a smart, willing, eager-to-learn undergraduate student. They have a lot of potential, but they need training and supervision.

4. Don't Over-Rely on AI and Don't Forget to Use You Common Sense

It goes without saying that we should use our common sense. But when it comes to AI, you'd be surprised by the number of people who refuse to do that.

Let me give you an example. On the homepage of ChatGPT, it's mentioned that it can make mistakes. In their naivete, the makers of ChatGPT assumed that anyone using their app will read this.

Many people didn't bother with it. Among them was a New York lawyer who used ChatGPT "to supplement his legal research." ChatGPT gave him fake citations to cases that didn't even exist. He didn't stop there. He asked ChatGPT to give him case reports to those fake citations. ChatGPT complied and generated fake reports to those fake citations.

The lawyer took this bundle of fakery and submitted it in a federal court. As for the judge, let's say that he was not happy. The lawyer ended up getting sanctioned and fined \$5,000. He also became a global embarrassment. Publications like the New York Times and the BBC published details about his misadventures with ChatGPT.

An American professor at the Texas A&M University suspected his students were using ChatGPT to cheat on their assignments. He ran their assignments through ChatGPT and asked it if it had written those assignments.

ChatGPT falsely claimed that it had, and the professor failed the whole class. These students had already graduated. But due to this mistake, they were unable to get their diplomas on time. The

whole episode caused a lot of embarrassment for the professor and the university. This could have been easily avoided had the professor learnt how ChatGPT actually works.

Perhaps the most egregious example of academics forgetting to use their common sense while using AI is this image of a rat with a huge penis. A team of researchers from China published a paper in a peer reviewed journal and included this image as an illustration. To their credit they did admit that they had used AI to generate this image. This became a huge scandal, and every major scientific publication wrote about it. The journal had to retract this article.

These are the kinds of things that could've been easily avoided if these academics had used common sense.

5. AI is Neither the Fantasized Utopia nor the Feared Dystopia

Finally, when it comes to AI, a lot of academics think in terms of extremes. One group of academics thinks AI is going to solve all their problems. You press a button and AI will write you a research paper. You just take it and submit it to a journal and get tenured. This is not going to happen any time soon.

On the other extreme are academics who think that AI is about to take over the world and soon we will be ruled by robots.

Neither of these positions are helpful. Instead of thinking in these extremes, we must try to understand AI apps as what they really are – tools.

That's why in this course you will learn how to use AI apps to optimize your research and writing processes.

16.20-16.50 – JVIM updates and review process

Journal of Veterinary Internal Medicine – update, report on review and introduction of ACVIM Endorsed Statements

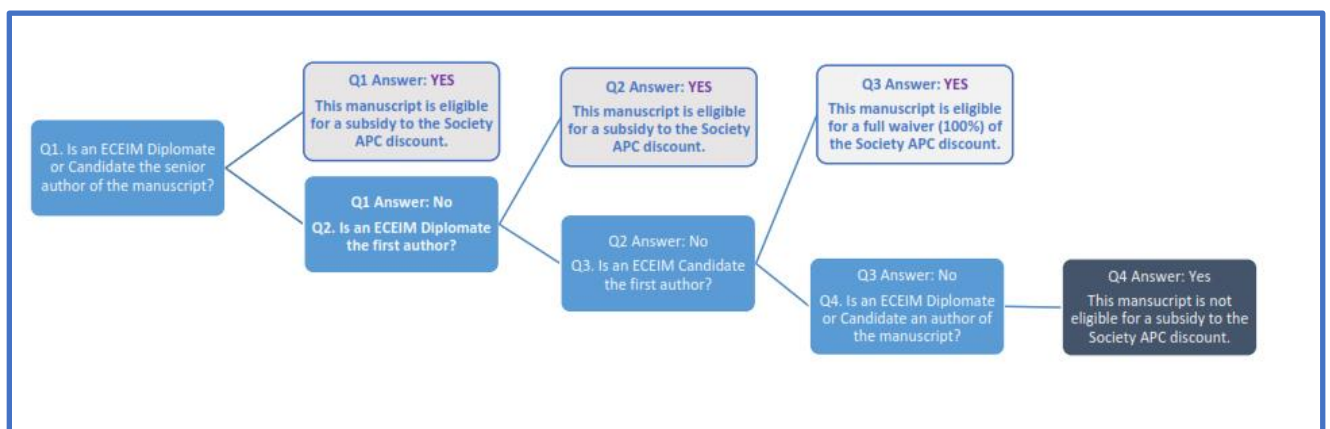
Kenneth W. Hinchcliff (and Stephen DiBartola)
Co-Editors-in-Chief,
Journal of Veterinary Internal Medicine

This update on the Journal, the official journal of the European College of Equine Internal Medicine, will report on recent publication statistics for the Journal, provide a summary of the 2023 review of the Journal, and briefly introduce the new ACVIM Endorsed Statements.

Journal metrics:

The Journal is fully open access with many institutional (university) authors eligible for partial or full payment of the Article Publication Charge (APC) that is levied on almost all articles published in the Journal. Detailed information about Open Access agreements are available at <https://authorservices.wiley.com/author-resources/Journal-Authors/licensing-open-access/open-access/open-access-account-codes.html>. The ECEIM provides access to subsidized or fully supported payment of APC for some members and candidates (Figure 1). Please contact the JVIM office, or the ECEIM, for details on this support.

Figure 1 – flow chart for ECEIM payment of article publication charges.



The Journal continues to receive an increasing number of submissions each year (Figure 2) from a wide range of countries (Figure 3).

Figure 2. Manuscript submissions and articles published by JVIM.

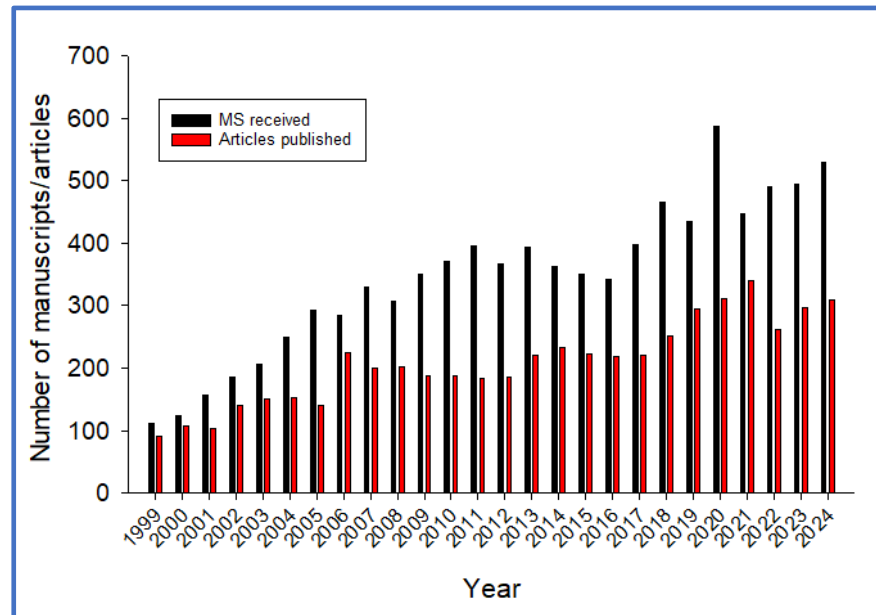
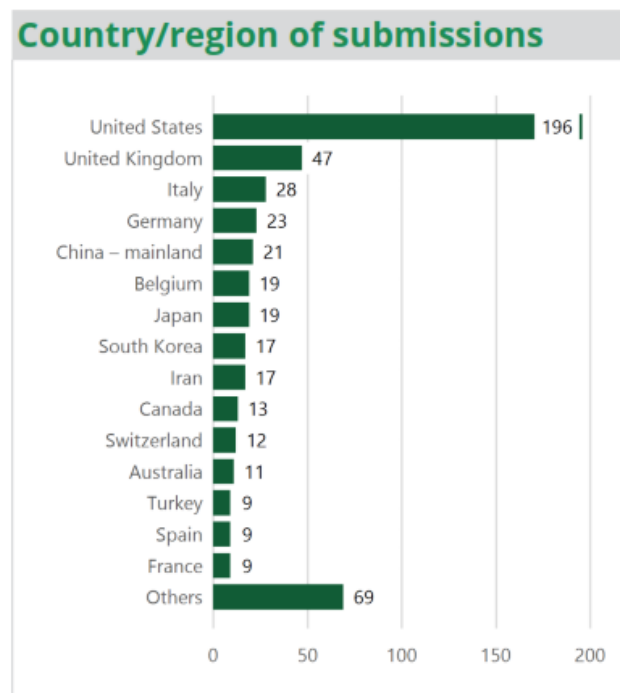


Figure 3. Submissions from various countries in 2023.



We receive approximately 70 equine related submissions a year, not all from ECEIM diplomates or candidates.

The Journal moved to fully open access in 2015 with the focus on enabling easy access by anyone in the world to all material published in the Journal. We decided that the key metric was the total number of downloads of files (ie readership) for the Journal and the number of downloads per article. We are on track to have over 6.5million downloads in 2024 (estimated, based on downloads to August 2024, Figure 4)), with an average of 2000 downloads per article (vs ~500 per article for all Wiley Veterinary titles). These metrics are now available for each article published in JVIM, and are in essentially “real time” (Figure 5). Such information is useful to authors as they provide evidence of the reach (impact) of the article.

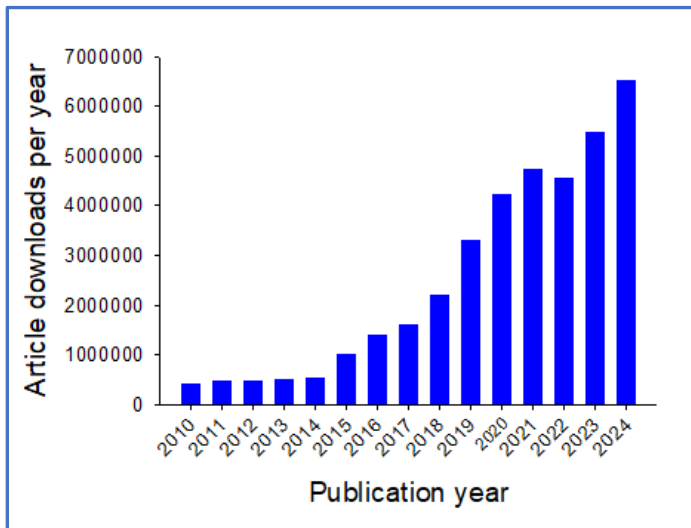
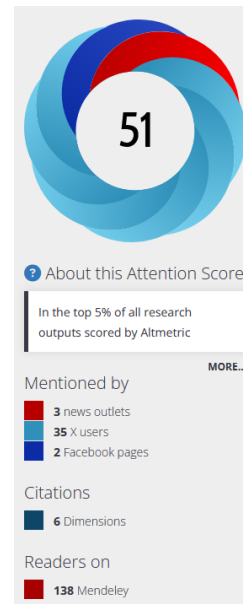
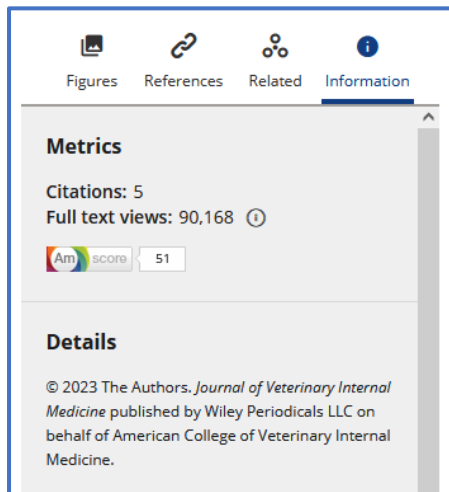


Figure 4. Downloads of articles published in JVIM, as recorded by Wiley and Pubmed.

Figure 5. Example of citation, download and Altmetric Score, and the attention score for an article published in January,

2024.



In line with the first recommendation of the Declaration on Research Assessment (<https://sfdora.org/read/>), we are no longer promoting journal level impact factors, although these are readily available.

The Journal is committed to double blinded, peer review of articles published in the Journal (with the exception of Consensus Statements, editorials and letters to the editors). It is well established that peer review and revision of manuscripts markedly improves the quality of the published article (Peng 2024 <https://doi.org/10.1016/j.joi.2023.101484>). The Journal remains committed to undertaking substantive, meaningful review of manuscripts submitted to it, which necessarily delays the time to decision (acceptance or publication) compared to publications with arguably less rigorous review. Table 1 provides data related to the peer review process in JVIM.

Table 1. Number of review invitations, those accepted, and those completed for JVIM.

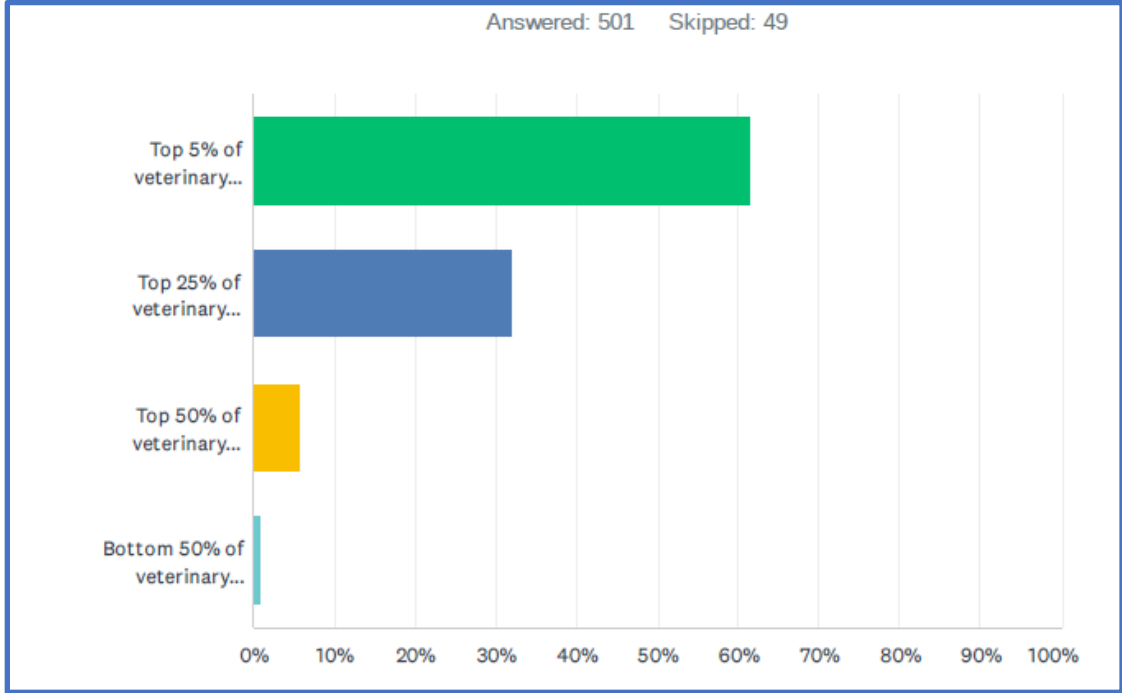
Review quantity					
	2019	2020	2021	2022	2023
Number of review invitations sent	2,718	3,592	2,878	3,028	3,804
Number of review invitations accepted	1,588	2,109	1,687	1,603	1,741
Number of reviews completed	1,543	2,009	1,656	1,518	1,658
Median days to review completion	14	14	14	14	14

The mean time from submission to publication was 7.4 months in 2023, with a first decision provided in a mean of 34 days.

Review of the Journal:

The internal review of the Journal is complete and a draft report for comment was provided to the Board of Regents in October 2023 with the final report submitted and noted by the Board in January, 2024. The review makes 27 recommendations which will be considered and implemented in coming months.

The review included a survey of ACVIM, ECEIM, ECVN and ECVIM-CA diplomates and candidates, both authors and non-authors, with a remarkably high return rate of 550 completed surveys. Details will be provided in the oral presentation, but it is noteworthy that in response to the question “How would you rate the Journal of Veterinary Internal Medicine?” the following responses were recorded (Figure 6):



ACVIM Endorsed Statements

The Board of Regents formed a group tasked with examining the existing Consensus Statements and recommending any changes. That working party proposed, and the Board of Regents accepted, that subsequent expert statements endorsed by the ACVIM be collectively referred to as ACVIM-Endorsed Statements (AES) and that they be developed using specific methodologies. These

statements and processes will be used for all new and revised ACVIM expert statements from the beginning of 2025.

Full details are provided in an editorial in JVIM "ACVIM-Endorsed Statements: Consensus statements, evidence-based practice guidelines and systematic reviews" JVIM 2023;37:1957-1965." (Kenneth W. Hinchcliff, Paul S. Morley, Stephen P. DiBartola, Sandra D. Taylor, Karyn A. Harrell). The Journal will not require that the ECEIM produce consensus statements in this form.

The working group proposed that AES follow one of three acceptable formats:

1. consensus statements (as more narrowly defined below)
2. evidence-based practice guidelines
3. systematic reviews

Narrative reviews, scoping reviews, and position papers are not considered suitable forms of AES. The most appropriate format for an AES will vary depending on the topic, the available published evidence, and the intent of the statement. The AES can be developed using one of three approved methodologies. The methodology chosen for a particular AES will be decided as part of the process for selecting a topic, convening a panel, and developing specific questions.

Regardless of the format, the AES should:

1. Have a defined, focused scope and address a topic by considering a series of unambiguous, succinct, and precise questions.
2. Use methodology appropriate for the topic and tailored to meet the requirements of the particular topic and questions.
3. Clearly describe the methodology, which will be different for each of the three types of statements.
4. Be well-written, concise, precise reports that conform to the Journal of Veterinary Internal Medicine format and editorial guidelines.

Types of ACVIM-Endorsed Statements

Consensus statement:

Consensus statements are always developed using the Delphi method and reflect the collective opinions of a group of content experts. The opinions of the experts will be based on their individual expertise, experience and knowledge of the literature. Consensus is tested and demonstrated using prescribed methodology to identify areas of agreement and disagreement within the group of experts.

Evidence-based practice guidelines:

Evidence-based practice guidelines ("guidelines") guide provision of current best practice care to animals and are ideally based on a rigorous, methodical, evidenced-based review of the relevant literature. Guidelines have become increasingly important and useful to practicing clinicians given the increasing availability of novel or innovative treatments, interventions, or diagnostic methodologies and large quantity of scientific literature. High quality guidelines recommend a course of action based on a comprehensive and systematic review, grading of the evidence, and explicit comparison of the benefits and harms of a given test or treatment, such as achieved by the GRADE (Grading of Recommendations, Assessment, Development, and Evaluation) process.

Systematic reviews:

Systematic reviews are important to veterinarians because they provide an objective assessment of existing data to assist with decisions about clinical practice, can provide rationale and justification for research, and are used as the basis for evidence-based practice guidelines. The usefulness of a systematic review depends on the methodology and the clarity of reporting.

Methodologist:

The working party recommended including a methodologist who advises and guides the development to ensure appropriate rigor and consistency among these statements. This individual should be appropriately experienced in these consensus/summarization methodologies, but would not necessarily be a content expert.

Conflict of Interest

The working group also proposed that there be clear and transparent consideration, and effective management, of potential conflicts of members of the panels creating the statements.

16.55-17.30 - Perinatal Endocrinology

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Equine fetal development requires fine coordination between endocrine differentiation and maturation of different body systems. Several homeostatic systems should be functional and work in synchrony during the transition from intra- to extrauterine life, to respond to physiological needs, stressors, and illnesses during this critical period. Endocrine maturation of the equine fetus takes place in stages, with most occurring few days before parturition and continuing after birth. Abnormal differentiation or delayed endocrine response to post-partum challenges can lead to organ dysfunction, which can be devastating to the newborn foal. Dysregulation of various endocrine systems has been documented with various perinatal disorders, including sepsis, neonatal maladjustment syndrome (NMS), and dysmaturity, and it has been linked to disease severity and outcome.

The Hypothalamic-Pituitary-Adrenal Axis (HPAA): The HPAA is a complex regulatory system that modulates numerous functions (hunger, metabolism, pain, thirst, blood pressure, electrolyte balance, autonomic activity, immunity, sexual behavior, fetal maturation). The HPAA consists of the hypothalamus, which secretes corticotrophin-releasing hormone (CRH) and arginine vasopressin (AVP) that stimulate the pituitary gland to release adrenocorticotropic hormone (ACTH), which stimulates the adrenal cortex to secrete glucocorticoids (cortisol), mineralocorticoids (aldosterone), sex steroids (androgens and progestogens) and steroid precursors. The HPAA is central in the transition from intra- to extrauterine life in equine neonates and is activated during perinatal illnesses. HPAA dysfunction results in adrenal insufficiency (AI), which can have devastating for the foal. Depending on which level of the HPAA is affected, AI is classified as primary, secondary, or tertiary. In primary AI, the failure is in the adrenal gland cortex, in secondary AI is at the level of the pituitary gland, and tertiary AI affects the hypothalamus. The terms relative adrenal insufficiency (RAI) or critical illness-related corticosteroid insufficiency (CIRCI) have been proposed because both animals and people maintain a level of response to stress, although insufficient to overcome challenges of critical illness. RAI has been documented in critically ill foals and horses.

Neuroactive steroids: Progestogens, androgens and estrogens have neuroactive properties. High progestogen, androgen, and estrogen concentrations have been measured in critically ill foals, and persistent elevations have been linked to disease severity and mortality. Steroid imbalances are common in septic and premature foals. Increased neurosteroids concentrations have been measured in foals with neonatal maladjustment syndrome (NMS)/neonatal encephalopathy (NE).

Energy: Pancreatic hormones include insulin, glucagon, and somatostatin. Insulin is an energy conservation hormone that is released in response to hyperglycemia, amino acids, lactose, and milk. Incretins, including glucagon-like peptide 1 (GLP-1) and gastric inhibitory peptide (GIP) are strong insulin secretagogues. The insulin-incretin system is known as the enteroinsular axis (EIA; incretins and insulin), which is functional in newborn foals. Glucagon main function is to make energy available during negative energy balances. Disorders of energy regulation in critically ill foals include hypoglycemia, hyperglycemia, and hypertriglyceridemia. Septic and premature foals often have low glucose and insulin concentrations. In premature foals, low insulin concentrations could be a consequence of low cortisol delaying beta cell differentiation. Septic foals also have high triglyceride and glucagon concentrations. Low insulin and high glucagon, and disorders of the EIA have been linked to disease severity and outcome.

Thyroid: Thyroid hormones (THs) include thyroxine (T4, free and total) and triiodothyronine (T3, free and total), which modulate cell growth, differentiation, thermogenesis, and energy metabolism. THs contribute to the differentiation of other endocrine systems (adrenal gland, pancreas) and are

essential for fetal development. Free T3 is the active hormone. TH concentrations are several folds higher in foals than in mares and horses. TH deficiency during fetal development can be detrimental to the foal. Disorders of THs include hypothyroidism, congenital hypothyroidism and dysmaturity syndrome (CHDS), and euthyroid sick syndrome (non-thyroidal illness syndrome - NTIS). Hypothyroidism is the clinical manifestation of TH deficiency. Critically ill and premature foals often have low TH concentrations (NTIS) that have been associated with disease severity and outcome. Diagnosis of hypothyroidism is based on clinical findings, epidemiology, farms history of having dysmature foals or foals diagnosed with hypothyroidism. Some foals may have thyroid gland enlargement (goiter). Measurement of TH concentrations often yields variable results. Treatment of hypothyroidism is palliative. It is important to consider the iodine and TH status of the mare and other animals at the farm.

Somatotrophic axis: The somatotrophic axis includes growth hormone (GH; pituitary gland), insulin-like growth factor-1 (IGF-1; liver), and ghrelin (stomach and brain). In addition to participate in growth, this axis is important for energy homeostasis. Disorders of this axis were documented in critically ill foals and linked to disease severity.

Renin-angiotensin-aldosterone system (RAAS): The central function of the RAAS is to maintain tissue perfusion by increasing blood pressure and intravascular fluid volume. During hypotension or low tubular sodium, the kidneys release renin that cleaves angiotensinogen to angiotensin I (ANG-I), which is converted in the lungs to ANG-II. ANG-II is a potent vasoconstrictor that stimulated aldosterone secretion. In turn, aldosterone increases renal reabsorption of sodium and water, and eliminates potassium. Most critically ill foals have an appropriate RAAS response, but some have low aldosterone and ANG-II, which compromises perfusion. Abnormalities should be suspected in hypotensive foals that are refractory to treatment.

Calcium, phosphorus, and magnesium: Calcium, phosphorus, and magnesium are essential minerals, with a multitude of functions. Extracellular calcium concentrations are regulated by parathyroid hormone (PTH), calcitonin (CT), and vitamin D (1,25-dihydroxyvitamin D; 1,25(OH)₂D). Magnesium is required for calcium homeostasis. Phosphorus is a major regulatory ion involved in a multitude of functions. Any process that requires energy requires phosphorus. Hypocalcemia, hypomagnesemia, and hyperphosphatemia are frequent in hospitalized foals. Abnormalities in PTH and vitamin D concentrations (hypovitaminosis D) have been documented in septic foals. High serum PTH and low vitamin D concentrations were linked to disease severity and mortality in foals. Parenteral calcium administration should be considered for most critically ill foals. Some foals may benefit from magnesium administration given its role in calcium regulation. Hypophosphatemia is rare in foals, except in those with energy dysregulation, often receiving parenteral nutrition. More often, critically ill foals develop hyperphosphatemia.

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09.35-10.05 - Performance and airway disease: a bidirectional relationship?

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Diseases and disorders of the respiratory system are second only to those of the musculoskeletal system with respect to their detrimental impact on athletic performance in the horse. The impact is greatest in disciplines involving high intensity exercise where even subtle compromise of respiratory function can result in significant deteriorations in performance. Such compromise is usually attributable to sub-optimal ventilation, either at the level of the upper or lower airways. With respect to the lower airways, ventilatory deficits attributable to reductions in airway calibre are usually underpinned by inflammation. Indeed, non-septic airway inflammation with an associated compromise in performance are two of the principal diagnostic criteria applied to Mild to Moderate Equine Asthma (MMEA). Cytological evidence of airway inflammation *per se* is common in certain equine athletic cohorts, with much of the data derived from the racing thoroughbred population in which prevalence rates as high as 80% have been reported (Ivester et al 2018). Such high prevalence rates do raise questions regarding both the factors that underpin airway inflammation and the degree of associated performance limitation on such a large scale. Empirical assessment of the latter is somewhat hampered by a number of factors, including the difficulties in objectively assessing performance and the fact that the thorough assessment of horses with poor performance will often identify more than one potential contributory factor (Martin et al 2000). That said, there is clear evidence of an association between markers of airway inflammation (excess tracheal mucus accumulation and both metachromatic and neutrophilic airway infiltration) and performance-related variables (Holcombe et al 2006, Ivester et al 2018). Current evidence supports a role of airborne dust (and associated dust components) in the induction of airway inflammation which may in part explain the cohort-specific prevalence rates reported where common exposures are likely (Ivester et al 2018). However, given the known potential for poor air quality to negatively impact performance (via the induction of airway inflammation), one might understandably surmise that premises which accommodate equine athletes undertaking high intensity exercise (e.g. racing yards) will have relatively favourable air quality conditions (i.e. low airborne dust levels). However, one must also consider that the diagnostic techniques required to detect low level airway inflammation in an otherwise clinically normal horse are more likely to be applied to this cohort, a fact reflected in the over-representation of the racing thoroughbred in MMEA studies published in the veterinary literature. Despite this explanation, consideration should also be given to other non-environmental factors which have the potential to contribute to airway inflammation in the athletic horse. Infectious agents (e.g. respiratory viruses) have been proposed as such pro-inflammatory candidates with the regular movement of horses on and off premises and the close proximity of horses within racing yards being potential factors that may facilitate pathogen introduction and transmission, respectively. However, there is little evidence in the veterinary literature to support a primary aetiological role for viruses in MMEA (Couetil et al 2021). Considering the racing Thoroughbred cohort, regular and high intensity exercise remains a major factor that warrants further exploration as a potential direct or indirect cause of lower airway inflammation. From an *indirect* causal perspective, it remains feasible that high intensity exercise induces a transient state of immunosuppression, leading to increased susceptibility to opportunistic pathogens. Known as the "open window" hypothesis, this theory has been proposed as an explanation for the high reported rates amongst human athletes of symptoms consistent with upper respiratory tract infection (URTI), especially following high intensity exercise competition (Campbell and Turner 2018). This proposed effect of acute vigorous exercise is distinct from the proven health benefits derived from regular lower intensity physical activity; benefits that have largely been attributed to an improvement in immune competency and regulation. The "open window" hypothesis has been widely accepted for decades and is largely based on certain key supportive mechanisms considered to underpin the theory. These include the high post-competition URTI symptom report rates amongst elite athletes (as mentioned above) and the impact of acute bouts of exercise on mucosal immunity (primarily salivary IgA levels) and circulating lymphocyte numbers and function. However, this theory has recently been questioned based on newly emerging data and alternative interpretations of the data previously used to support a transient decline in overall immunocompetence following acute bouts of exercise (Campbell and Turner 2018). Additionally, the "open window" theory is ultimately reliant on the contributory role of opportunistic pathogens exploiting any transient compromise in host immunity. Yet, despite the

high reporting rates of URTI symptoms, there remains a low pathogen recovery rate from these individuals (~30%), a discrepancy which suggests either poor pathogen detection or alternative mechanisms underpinning the symptoms. Proposed non-infectious candidates have included allergens, non-specific mucosal inflammation and airway epithelial cell trauma resulting from increased ventilation or exposure to cold air (Campbell and Turner 2018). In comparison to the “open window” theory, some of these proposed mechanisms reflect a direct causal effect of high intensity exercise *per se*.

Compared to the volume of published data supporting or refuting the “open window” theory in human athletes, there remains a dearth of information derived from the horse, thus limiting our ability to draw firm conclusions regarding the mechanisms underpinning the high prevalence of lower airway inflammation in the equine athlete. That said, a few studies have provided data that offer the opportunity to formulate a hypothesis. In keeping with the “open window” theory, studies in exercising horses have reported training-associated alterations in local airway innate immune function, both at the level of the alveolar macrophage and airway epithelial cell (Frellstedt et al 2014, Frellstedt et al 2015, Karagianni et al 2019, Raidal et al 2000). In contrast, other studies have yielded data consistent with a pro-inflammatory effect of race training, detectable both systemically (Arfuso et al 2020) and at the level of the lower airways (Karagianni et al 2022). Clearly, more work is warranted in this area to allow a more comprehensive understanding of the impact of training on both immune regulation with a view to determining whether the high prevalence of airway inflammation in racehorses during the training period is reflective of immunosuppression (with subsequent opportunistic infection) or solely a response to exercise *per se*. Obtaining a greater understanding of the mechanisms involved is a necessary pre-requisite to any proposed intervention aimed at either immunomodulation or inflammation suppression. In summary, lower airway inflammation is highly prevalent in the racing thoroughbred with evidence to support an inverse relationship between the magnitude of the inflammatory response and performance. That said, the source of the inflammation is not fully determined and likely multifactorial. Although there is clear evidence of a linear relationship between respirable dust exposures and magnitude of inflammation (reflected by inflammatory cell ratios), the contributory role of exercise *per se* remains poorly understood. Although our current ability to draw more definitive conclusions regarding the validity of applying the “open window” theory to the racehorse is hampered by a dearth of studies in this area, the available data does not support a role for opportunistic infections. Therefore, it may be timely to align with the recent challenges to the “open window” theory made within the human literature and continue to seek alternative explanations for the high prevalence of airway inflammation in horses undertaking high intensity exercise.

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10.10-10.40 - Atrial fibrillation

Atrial fibrillation – Translational research perspectives

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Atrial fibrillation (AF) is a complex and multifactorial supraventricular cardiac arrhythmia that develops due to irregularities in the otherwise strictly coordinated electrical signals, which results in uncoordinated atrial activation and irregular ventricular contractions.

Once AF is present, it maintains itself through progressive electrical, structural, and metabolic atrial remodeling (Nattel & Harada 2014), which reduces the long-term effectiveness of treatment in both horses and humans who particularly are prone to AF.

The mechanism underlying development and progression of AF includes changes in the expressions and function of various ion channels located in the myocardial cells, leading to electrical conditions that favor re-entrant circuits. Such electrical remodeling together with progressing structural and metabolic changes are pivotal factors in the development of chronic AF (Allessie 2002).

The first electrocardiogram of AF in horses was reported in 1911 (Lewis 1911) and since then AF has continuously been reported in several equine breeds, but never in ponies. The AF prevalence in larger horses range from 0.29% to 4.9%, with the highest prevalence in Warmblood riding horses, Standardbred trotter and Thoroughbred racehorses (Leroux et al 2013; Physick-Sheard et al 2014; Nath et al 2021). For the Standardbred trotter and Thoroughbred horses, a moderate genetic predisposition exists (Physick-Sheard et al 2014; Pedler et al 2021). Generally, AF is considered the most important clinically relevant arrhythmia in athletic horses.

The disease manifests differently in horses depending on their physical demands. In athletic horses, AF results in significantly reduced exercise capacity, increased maximum HR and ventricular arrhythmias during high speed exercise treadmill tests (Buhl et al 2018). In pleasure horses or horses with relatively low exercise demands, the disease might go unnoticed by the owner or rider. An exception to this is a minority of horses with significant structural or functional cardiac diseases, where signs of heart failure may dominate the clinical manifestation.

On auscultation, the arrhythmia can be heard as an irregularly irregular heart rhythm with absence of the S4 heart sound. Up to one third of horses with AF has concomitant mitral regurgitation and therefore a systolic murmur over the left thorax might be present as well (Decloedt et al 2015), but often no cardiac murmurs are heard.

The ECG reveals typical irregular RR intervals, absence of P waves and presence of the characteristic fibrillation waves (f-waves) at baseline, while the QRS complexes are generally normal.

Echocardiography will typically show normal morphology, unless valvular insufficiencies are moderate or severe, resulting in atrial enlargement. In all horses, atrial contractile function is markedly reduced leading to reduced ventricular filling. However, the long diastolic interval at the low heart rate compensates for this and therefore most horses show no clinical signs at rest.

Atrial fibrillation can be further categorized as paroxysmal, persistent or permanent depending on the duration and response to treatment of the arrhythmia (Kjeldsen et al 2022). Paroxysmal AF (PAF) spontaneously converts back to sinus rhythm, usually within hours or days after AF onset.

Even though PAF is more difficult to diagnose it may be responsible for periodic poor performance in racehorses, or may go completely unnoticed by the rider (Buhl et al 2020; Kjeldsen et al 2024).

In man, AF is also the most frequent pathological arrhythmia and is associated with increased morbidity and mortality with a two-fold increase in death rate (Iwasaki et al 2011). In people, the risk of AF increases with age, and with the increasing life expectancy, the lifetime risk for AF is expected to attain 25% (Chugh et al 2014). Like horses, the clinical symptoms include reduced physical performance and breathlessness (Savelieva & Camm 2000). However, in humans the biggest concern is the risk of thrombosis formation in the atria that may subsequently result in stroke leading to disability or death (Lip et al 2016). In horses no findings of thrombosis formation have been reported.

Horses with AF are treated either medically or with transvenous electrical cardioversion (TVEC) where the atria are stimulated electrically under general anaesthesia in order to restore normal sinus rhythm (Reef et al 2014). Recently, ablation of right and left atria has been reported as a

successful treatment of horses with AF and atrial tachycardia (Van Steenkiste et al 2022). Quinidine sulphate is a cheap compound that successfully restores sinus rhythm in 80% of the horses. However, the potential development of severe side effects such as colic, depression, ventricular arrhythmia, especially in the longer lasting persistent AF episodes, may lead to the necessity of electrical cardioversion. The TVEC procedure has a high success rate with 96% success rate. Both treatment options are however followed by a high AF recurrence rate between 15-43% (Reef et al 2014). Since 2010, the European Medicines Agency has not authorized any new drugs for treatment of AF in people. The leading explanation for the lack of new medicine is the high number of factors promoting AF and that the understanding of this complex disease, and what triggers its progression, is limited. Development of novel pharmacological therapies is therefore closely coupled to a more thorough understanding of the basic mechanisms and biology of AF. At the University of Copenhagen, we have developed and established a chronic AF horse model for studying AF disease mechanism in horses under controlled conditions to illuminate the dynamics and burden of AF from onset of the disease until it becomes persistent. With this longitudinal model we can study the disease progression over time by applying a variety of research methods from electrophysiological measurement to several omics techniques. This allows us to study changes in ion channel expression and cellular adaptations as well as clinical outcomes. This presentation will focus on the newest research within AF pathophysiology and potential future treatment options for horses and people.

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12.35-13.10 - Performance, behavior and equine gastric ulcer syndrome

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Introduction

Equine gastric ulcer syndrome (EGUS) including both equine squamous gastric disease (ESGD) and equine glandular gastric disease (EGGD) are highly prevalent diseases in horses, with prevalences from 30-70% regardless of breed and performance type (Begg and O'Sullivan, 2003; Luthersson et al., 2009, Malmkvist et al., 2012; Niedźwiedź et al., 2013; Pedersen et al., 2018; Sykes et al., 2015). In addition to the high prevalence, EGGD has a low treatment success rate and a high recurrence rate which makes this syndrome an even bigger challenge (Bowen, 2018; Rendle et al., 2018; Pratt et al., 2023). In this proceeding, the evidence linking EGUS, performance and behavior (including stress and pain) will be reviewed. Furthermore, preliminary findings from a research project that aims to understand if non-healing EGGD is driven by pain, focusing especially on musculoskeletal pain will be described.

Exercise and equine gastric ulcer syndrome

Research has identified a link between EGUS and reduced performance across various horse breeds and disciplines (Lo Feudo et al., 2023; Sykes et al., 2019; Pedersen et al., 2018; Vatistas et al., 1999). More specifically, the number of training days per week was found to be a risk factor for the presence of both ESGD and EGGD (Sykes et al., 2019; Pedersen et al., 2018), whereas an increase in training intensity was found to be a risk factor only for ESGD. (Pedersen et al., 2018). As exercise intensity rose, higher concentrations of gastrin were observed following feeding (Furr and Kronfeld, 1994). Gastrin has the capacity to boost hydrochloric acid (HCL) secretion, potentially leading to acidic damage of the squamous mucosa. Several theories have been proposed to explain the connection between poor performance and EGUS, including the idea that abdominal discomfort could contribute to a minor reduction in stride length in racehorses, through a restriction in diaphragmatic movement during breathing, reducing tidal volume and alveolar ventilation (Nieto et al., 2009). Furthermore, fitness parameters like V200 (velocity at which heart rates reached 200 beats per min) and VLa4 (velocity at which blood lactate reached 4 mmol/L) have been inversely correlated with EGUS (Freudo et al., 2022; Freudo et al., 2023), leading to the hypothesis that as EGUS severity increases, horses may more rapidly transition to anaerobic metabolism, resulting in quicker fatigue.

EGUS has been identified as the responsible factor for reduced performance in a few studies (Lo Feudo et al., 2022; Nieto et al., 2009; Franklin et al., 2008). As the horse exercises, and transition from walk to trot and canter the abdominal pressure increases and in gallop the pressure almost totally deflates the stomach causing the acid to splash upon the squamous mucosa increasing the risk of ESGD (Lorenzo-Figueras and Merritt, 2002; Tamzali et al., 2011). Exercise increases cardiac output and redirects the blood volume to the working musculature, reducing the splanchnic blood flow significantly. The vascular resistance in the glandular part of the stomach increased with a factor of 17 from rest to exercise at 13 m/s (Manohar et al., 1995) and could thereby be a potential risk factor for EGGD development.

Behavior and equine gastric ulcer syndrome

Clinical signs and behavioral changes most clearly linked to pain, such as abdominal discomfort or reluctance to run, have been thoroughly documented in horses with EGUS (Vatistas et al., 1999; Murray et al., 1989; Dukti et al., 2006; Videla et al., 2009; Murray, 1992). The horse grimace scale has been validated for both acute and chronic pain (Dalla Costa et al., 2016; Coneglian et al., 2020) but was not able to detect any differences looking at horses with and without EGUS (Ferlini Agne et al., 2023). Recently, the number of publications on behavior assessment in various scenarios have increased. A tacking-up protocol aimed at describing behaviors during tacking up and mounting, including those indicative of stress and pain, was proposed (Dyson et al., 2021). Additionally, a ridden horse pain ethogram, which focuses on abnormal behaviors during riding linked to pain, has been developed (Dyson et al., 2018) and validated to differentiate between sound and lame horses (Dyson et al., 2020). Even though no objective pain score has been validated or recognized for the EGUS, several abnormal behaviors have been linked to this syndrome. Among others, pain or discomfort when the girth is tightened, stereotypic behaviors such as crib-biting, head nodding, kicking, pawing, weaving, flehmen and walking (Sykes et al., 2019). Other clinical signs include colic, weight loss, and poor performance (Camacho-Luna et al.,

2018; van den Boom, 2022). Interestingly, a study found equal prevalences of clinical signs such as stereotypic behavior, behavioral changes, hypersensitivity, eating, decreased performance and colic between horses diagnosed with and without EGGD (Hewetson et al., 2021).

Exercise, behavior and equine gastric ulcer syndrome

As a measure of stress, an increase in cortisol with exercise was found in both Thoroughbreds (Freestone et al., 1991) and warmblood horses (Cayado et al., 2006; Munk et al., 2017). From human studies, we know that cortisol increases with exercise only when an appropriate threshold has been achieved, which is a combination of hemoconcentration and an increased activation of the hypothalamic-pituitary-adrenal axis and adrenocorticotrophic hormone (ACTH) concentrations (Hill et al., 2008). Thus, exercise elicits a normal physiological stress response that in humans is found to be beneficial (Anderson and Wideman, 2017).

Competition horses experience a high degree of stress, measured by an increase in cortisol levels (Munk et al., 2017; Olvera-Maneu et al., 2023). Horses competing recently were at higher risk of EGGD, whereas horses competing at international level had a lower prevalence of EGGD than horses competing at national levels (Pedersen et al., 2018). Building on these combined findings, there is evidence of a link between EGGD and stress, supporting the idea that stress plays a role in the pathogenesis of EGGD. The observation that horses performing at national level have a greater risk of EGGD than those at performing at international level could possibly be explained by international horses' superior conditioning to withstand stress during competitions, or by the possibility that EGGD hinders performance, preventing affected horses from achieving international competition status.

An increase in cortisol has further been linked to acute pain such as colic and castration (Merl et al., 2000). Baseline cortisol measurements in healthy and EGUS horses were similar (Malmkvist et al., 2012), but a higher cortisol response in competition horses with moderate EGGD compared to mild EGGD was found after an ACTH stimulation test (Scheidegger et al., 2017). Furthermore, warmblood horses with grade 2-4 EGGD showed a heightened cortisol response when approaching novel objects (Malmkvist et al., 2012) and in a group of horses recently shown in competitions and with a nervous temperament, a higher prevalence of EGUS than in non-nervous horses were found (McClure et al., 1999). A suggested mechanism for stress-induced EGGD involves high cortisol levels diminishing the regenerative ability of the glandular mucosa (Andrews et al., 2005; Sapolsky et al., 2005).

Research project

Preliminary research data will be presented with the aim of exploring if EGGD are triggered by musculoskeletal pain. The horses evaluated were examined at two time points. At inclusion, horses with a suspicion of EGUS were evaluated during tacking-up and riding as well as in an objective lameness evaluation. Horses with the EGUS diagnosis were evaluated again after a treatment period, with repeated evaluation during tacking-up and riding, as well as both an objective and a subjective musculoskeletal evaluation. For evaluation of the horses during riding, the ridden horse pain ethogram was applied. The subjective evaluation included a standard lameness examination including evaluation of the neck and back. In addition, blood creatinine kinase values were evaluated before, 4-6 hours and 12 hours after exercise. Our working hypothesis: When compared to horses with satisfactory response to gastric ulcer treatment, horses with non-healing gastric ulcers will have; 1. A higher behaviour score during tacking-up and riding when applying the ridden horse pain ethogram, 2. A higher prevalence of low-grade lameness, and 3. A higher prevalence of musculoskeletal pain. As the study is still ongoing, final results are not yet available. However, preliminary results show an increase in the number of abnormal behaviours expressed during riding for the group of horses with non-healing EGGD.

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14.50-15.20 - Pain scores in equine medicine

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Equine medical and surgical practice is progressing at an ever-increasing speed every day, constantly leading to new diagnoses and treatments. Many of these leads to less invasiveness and pain, but some also may lead to protracted healing and convalescence of horses which might previously have been lost due to the lack of treatment. With the advent of all these procedures follows an obligation to ensure the best possible welfare of the horse throughout the course of the treatment. With the increasing scrutiny of our horses enrolled in equine sports in several places throughout the world, this obligation also becomes even more relevant to protect the horses and preserve the sports that we all cherish.

All areas of equine medicine are always aiming for increasing the evidence behind diagnoses and treatments, which includes better imaging, more precise tests with more accurate measurements supporting final conclusions, diagnoses, prognoses and treatment plans. One of the corner stones of ensuring best possible wellbeing of hospitalized horses, is to provide optimal pain management. Since many analgesic and anti-inflammatory drugs has the potential of causing unwanted side effects, it is of utmost importance to provide adequate analgesia; not too little and not too much! To provide adequate and timely pain management, pain must be considered a vital sign just as temperature, heart rate, respiratory rate and blood pressure. For any of those measures, along with a long list of hematology, biochemical and inflammatory markers, none of us could imagine clinical decision making without objective measures of them. The same holds true pain, for a number of reasons; 1) when something can be measured it can be compared to previous observations and trends can be followed and the clinical development followed and 2) it can be communicated between clinicians over time and 3) normal values can be established and guidelines for when to intervene can be established.

As established above, it is obvious that pain should be monitored more carefully in our equine patients, and this should be organized in an organized manner to obtain as objective data as possible to guide clinical decision making in the best possible way. The good news is that there has been made significant progress with regards to objective pain evaluation over the last 10-15 years and that there is a plentitude of pain scales out there. Some are more generalized and others more specific with regards to pain type, age of the patient and degree of chronicity. Still, many of these scales are relative manual although significant effort is used to try to make these automated with help of video surveillance and artificial intelligence. Until more trustworthy automated pain evaluation tools are available, all clinics and hospitals should try to establish routines for pain evaluation, determine how to interpret the results for different patients and when to intervene.

To implement systematic pain scoring in a clinic, the team should go through the following steps:

1. *Select a practical and applicable pain scale*
2. *Appoint a key person responsible for the procedures of clinical pain-scoring*
3. *Develop local routines for pain scoring*
4. *Conduct training sessions for all caregiving personnel*
5. *Establish routines for interpretation and "red flags" for horses with high pain scores.*

1 - Select a practical and applicable pain scale:

There is a plethora of pain scales out there, and they might be more or less specialized for different purposes like abdominal pain, orthopedic, chronic pain, ocular pain, pain in foals etc. Most pain scales are made after the same template as "composite pain scales" comprised of several "simple descriptive scales" encompassing a number of different behavioral traits, facial changes and potentially some physiological parameters. In general, the more generalized pain scales are probably better for their specific type of patient and pain, but on the same time might also introduce an increased level of complexity for those working with the pain scoring. Therefore, the author suggests starting with a more generalized pain scale, such as the "The Equine Pain Scale" (Gleerup and Lindegaard, EVE, 2015).

2 - Appoint a key person responsible for the procedures of clinical pain-scoring:

A key person interested in the subject and willing to take on the task is appointed to set up routines and internal training. Another important point should be that the appointee, should be given the mandate to actually implement this important task. For this to happen, it is very important that the entire team of senior veterinary staff and nurses in collaboration with management has initially agreed that this is a common decision.

3 - Develop local routines for pain scoring:

The appointee should then set up local routines for how, when and by whom the actual pain scoring of patients is performed. It is important that this happens in a collaboration between veterinary staff, nurses and technical staff, in order to avoid challenges of implementation with regards to potential collision with other routines (stable work, examination, medication rounds etc.). It is therefore advised that the entire group collaborates to establish the best routines of how and when to perform pain scoring.

4 - Conduct training sessions for all caregiving personnel:

When routines are agreed upon and en-route to implementation, training sessions should be held to ensure that all staff knows how to use the chosen pain scale. It is also important to have these training sessions at reasonable intervals (6-12 months) to ensure continued correct application and introduction for any potential new staff.

5 - Establish routines for interpretation and "red flags" for horses with high pain scores.

It is important to establish "red flags" or guidelines for when to intervene based on the actual pain score. These thresholds will vary between pain scales and should be decided accordingly.

One very important part of establishing routines, is to decide which patients should have their pain assessed and how often this should be done. Factors that will influence these decisions include:

- What type of patient; what is the anticipated pain severity for that particular type of patient. Some patients, diseases and or interventions result in higher pain than others. With the right decisions, resources for pain scoring can be directed towards the most relevant patients. However, all patients should have their pain assessed at least once daily.
- What type of analgesics is the patient on and how long is the expected effective duration of these drugs. By also considering these aspects, a pain scoring schedule can be tailored to identify at the end of these intervals.

Another very important aspect of pain scoring in a busy hospital or a smaller clinic is the degree of disturbances happening in the stables during the day and night. It has been shown that all human presence will preclude the pain scoring since horses will try to hide their true "pain behavior" if they know they are being observed. Pain scoring, entirely or partially, via video surveillance might therefore be relevant to consider.

Below is the Equine Pain Scale in its entirety (table 1).

In our hospital, we have the guide for the EPS on door of each horse and along with that, the scoring sheet. For every pain scoring event, the date, time and score for each of the included behaviors are noted. All scores are summarized and a total pain score, noted at the bottom and transferred to the patient's record.

All pain scoring starts with the first observing the horse from a distance and as little disturbance as possible. This observation takes 1-3 minutes and will allow to assess the first 7 parameters of the pain score. After observation on a distance, the stall and horse is approached and the last 2 parameters can be assessed.

Table 1 The Equine Pain Scale (Gleerup and Lindegaard, 2016)

Behaviour category	Score				
	0	1	2	3	4
Pain face	No pain face	NA	Pain face present	Intense pain face	NA

Gross pain behaviour*	None		Occasional		Continuous
Activity	Exploring, attention towards surroundings or resting	No movement	NA	Restless	Depressed
Location in the stall	At the door watching the environment	Standing in the middle, facing the door	Standing in the middle facing the sides	Standing in the middle facing back or standing in the back	NA
Posture/weight bearing	Normal posture and normal weight bearing	Foot intermittent of the ground/ occasional weight shift	Pinched (groove between abd. muscles visible ¹)	Continuously taking foot off the ground and trying to replace it.	No weight bearing. Abnormal weight distribution ²
Head position	Foraging, below withers or high	Level of withers	Below withers ³	NA	NA
Attention towards the painful area	Does not pay attention to painful area	NA	Brief attention to painful area (e.g. flank watching)	NA	Biting, nudging or looking at painful area ⁴ (e.g. flank watching)
Interactive behaviour	Looks at observer or moves to observer when approached	Looks at observer does not move	Does not look at observer or moves away avoids contact	Does not move, not reacting/introverted	NA
Response to food	Takes food with no hesitation	Looks at food	NA	No response to food	NA

***Gross pain behaviour includes all readily visible behaviours like, excessive head movements (vert/lat), flehmen, kicking, pawing, rolling, tail swishing, mouth playing, stretching etc.**

For the first category, "pain face", the observer should adhere to guidelines from Gleerup et al. 2012 "An Equine Pain Face" (fig 1.)

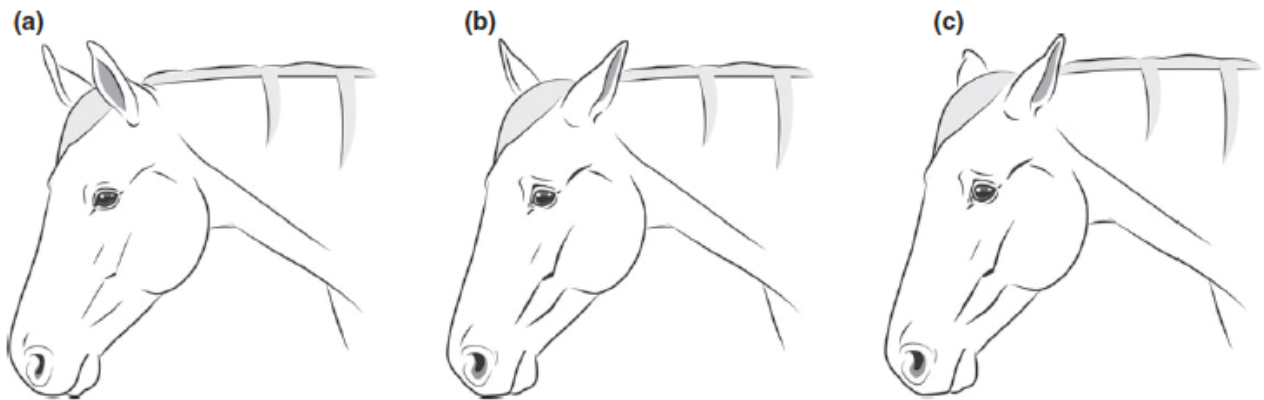


Fig 1. Facial expression of a pain free, relaxed and attentive horse (Ill. Andrea Klintbjer). (b) Facial expression of a horse in pain, comprising all features of the pain face including asymmetrical ears (Ill. Andrea Klintbjer). (c) Facial expression of a horse in pain, comprising all features of the pain face including low ears (Ill. Andrea Klintbjer). From Gleerup et al. 2015, "An Equine Pain Face"

It is very important to emphasize the existence of many more pain scales, and of which many are more specific for both patient and pain type. However, the EPS offers a well established all-round pain scale which is easy to implement and use, and which will only take 2-5 minutes per patient to execute.

In addition to the overview given above, this lecture will discuss the use of the EPS as well as personal experiences, challenges and pit-falls associated with its implementation.

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15.50-16.30 - How can exercise testing support equine welfare?

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Introduction

Equine welfare is currently a hot topic. The use of horses for pleasure riding, sport and other work (e.g. police work) is scrutinised, and the equestrianism's social licence to operate is questioned by some parties. The benefits of contact with horses for human mental and physical health is not often recognised by the general public. This makes clarification of the positive effects of contact with horses important and concurrently we need to prove that the horse's health and welfare are not compromised by this relationship.

Questions about the welfare of horses have been raised over many decades, and in this lecture we hope to demonstrate how exercise testing can provide useful information about the use of horses for different purposes.

Vaulting horses

Already in 1991 the workload imposed on vaulting competition horses was questioned within equestrian and animal welfare organisations. We were asked to study this workload. Eight Dutch Warmblood horses from four different vaulting groups were used. All horses were experienced and trained at full international level. A standardized lunging test was carried out under three conditions: 1) without vaulters on a good firm surface (n=8); 2) with vaulters on a good firm surface (n=8); and 3) without vaulters on a (very) loose sand surface (n=6). All horses cantered at random under the three different conditions at their own, individually established pace. Mean heart rate (HR) during the 15-minute canter session was 117 ± 7 beats/min in the not-mounted horses and 113 ± 7 beats/min in the mounted horses on a good surface, and 159 beats/min in the unmounted horses on a loose surface. Lactate accumulation was not demonstrated in any of the tests on the good surface and the concentration was between 0.8 to 4.1 mmol/L on the loose surface. In conclusion: The metabolic stress and workload in vaulting horses is considered to be low on the good surface compared with that in horses in other disciplines.

Horses in police work

We know that mounted police horses have to cope with challenging, unpredictable situations when on duty and since their public profile is visible it is essential to guarantee their welfare and to gain an insight into how these horses cope their work. Six experienced and six inexperienced horses were followed over a 7-week police training period. Horses were evaluated during an outdoor track test, a street track test, an indoor arena test with challenging objects and a smoke test. Behaviour score did not show significant differences between tests, and the heart rate of horses was not consistently correlated with observed moderate behavioural responses. There were no significant differences in any of the four tests between experienced and inexperienced horses. Overall, it was clear that this kind of police work is not significantly stressful for horses and therefore the work has little or no negative impact on their welfare. A further study in police horses showed that the influence of the rider on the fear response seemed to be important in the stress that ridden horses experience during challenging situations.

Eventing horses

Eventing is generally recognized as a challenging equestrian discipline and wastage figures for this discipline are relatively high. We conducted a prospective study following the entire national selection of event horses (n = 20) and ponies (n = 9) in The Netherlands being prepared for the European Championship in 2010 (ponies) and 2011 (horses). During this study, causes of withdrawal were identified and as well as detailed fitness assessments using standardized exercise tests (SETs). Assessed parameters included heart rate (HR; beats/min), speed (V; m/s) and plasma lactate concentrations (LA; mmol/L) as measured parameters. Field tests were useful in assessing potential injury risk since individuals with better fitness indices (good performers) were less likely to become injured than average performers. Furthermore, monitoring of training sessions showed predictive value for future injuries; horses withdrawn because of injury later on

showed higher peak HRs during conditional training sessions than horses that stayed sound. Increase in peak HR appeared to precede visible lameness in a horse.

Horse-rider match

We believe that a good horse-rider match is important in equine welfare. Sixteen warmblood horses were studied in a test-setting with three different riders during a novel object test. The horse-rider interaction was evaluated with each combination and assessed as 'matching' or 'mismatching'. The horses were categorised as 'compliant', 'partly compliant' or 'non-compliant'. Perhaps unsurprisingly matching horse-rider combinations had a lower average heart rate and a lower behavioural score than mismatching horse-rider combinations. 'Compliant' and 'partly compliant' horses had a significant lower heart rate than 'non-compliant' horses.

Workload as management tool to prevent injury

In human sport science, the acute:chronic workload ratio (ACWR) is used to monitor an athlete's preparedness for competition and to assess risk of injury. Training load (heart rate, duration and GPS data) and injury data were collected from conditional training sessions and competitions for 58 international eventing horses (CCI2*-CCI5* level) over a one to three year period. The ACWR of high-speed distance of the present week and the previous week were significantly associated with injury risk. In agreement with findings in human athletes, eventing horses subjected to acute spikes of workload have an increased risk

of injury. Evaluation of the workload of eventing can be used to design and effectively monitor training programmes and may help to improve equine welfare by reducing injury risk.

Suitable training programme for young Friesian horses

Young Friesian stallions have to complete a 10-week training programme (70-day test) before becoming studbook-approved breeding stallions. The effect of the original studbook's training programme, which consists of dressage and driving training, on fitness progress was evaluated in a study in 2020. The external workload (EW) of 16 stallions (3.2 ± 0.4 years old) was registered during the 9 weeks preceding the 70-day test (preparation period) and during the 70-day test. Ridden indoor standardized exercise tests (SETs), measuring heart rate (HR) and plasma lactate concentration (LA) at walk, trot and canter, were performed in week 1 (SET-I), week 6 (SET-II) and week 10 (SET-III) of the 70-day test. Compared to SET-I, horses showed increased HR and LA after canter in SET-II and SET-III, indicating that they were more fatigued. The fact that the fitness of these Friesian stallions decreased during the 70-day test suggests that overtraining was prevalent.

Therefore, for the 2021 cohort of Friesian stallions the training programme was adjusted: The training frequency and duration of training sessions were reduced and high-intensity training was followed by one or two days of relative rest or low-intensity training. The time spent in canter was reduced, and cantering was only performed during the high-intensity training sessions. This proved to be the right approach as during the ten weeks the fitness parameters (heart rate and lactate concentration) improved after cantering during standardized exercise tests. It proved to be important while training young Friesian stallions to alternate the training days with days of active rest or low intensity training (no canter) to reduce the risk of overreaching or overtraining. A well-balanced training programme improves the welfare and performance of the equine athlete.

Conclusions

It proved possible to evaluate the workload of horses in different work situations using standardized exercise tests with heart rate, speed/distance and plasma lactate concentrations as parameters. Objective measurement of the workload helps to prevent overtraining and injury and thereby improves the welfare of working horses. This may also serve to answer some of the criticism levered against the use of horses in sports and other human activities.

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16.35-17.15 - Clinical reasoning in European horses presenting with ataxia

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Introduction

This talk will focus on what information are important to differentiate the common types of ataxia in horses and how to use clinical reasoning to prioritize the etiologies and facilitate a diagnostic plan.

Ataxia in equine patients can be divided into three main types: cerebellar, vestibular, and spinal, each having distinct clinical phenotype. The talk will briefly go through how to differentiate the types of ataxia however the priority will be to explore the clinical reasoning for proprioceptive ataxia in horses in Europe. We will discuss the neuroanatomic pathways involved, differential diagnoses, diagnostic approach.

A QR code for download of the presentation pdf (excluding materials with copyright) will be available on the first three slides and the last slide during the talk.

1. **Signalment:** Breed, age, sex and athlete type is essential information for prioritising differentials.
2. **Duration of disease:** When did the disease start and with what symptoms did it start.
3. **Progression:** How has the disease progressed and what symptoms have changed and how.
4. **Pain?** Is the horse painful in the stall, when it moves or has there been episodic pain?
5. **Symmetry:** Are the clinical signs lateralising or symmetric
6. **Neuroanatomic Localisation**

The cornerstone of diagnosing equine ataxia is a thorough and systematic neurologic examination and detailed knowledge of neuroanatomic localisation.

Using the above system can help us prioritise the differentials for proprioceptive ataxia and come up with a rational diagnostic plan. It is helpful to remember that the proprioceptive pathways involve both the spinal cord, brainstem, thalamus and forebrain.

Differential diagnosis for proprioceptive spinal cord disease in European horses

Etiology	Disease
Vascular	Fibrocartilagenous embolus (FCE)
	Aorto-iliac thrombosis
	Air embolus
	Post anesthetic hemorrhagic myelopathy
	Epidural hematoma
	Vascular malformations
Infectious	Viral Encephalitides (WNV, EHV, Rabies, TBE, RusV)
	Aberrant parasite migration (<i>P. tenuis</i>)
	Anaplasma
	<i>US: Equine Protozoal Myelitis</i>
	Abscess / Granuloma
	Discospondylitis
	Bacterial Meningoencephalitis
	Vertebral osteomyelitis (foals)
Meningoencephalomyelitis (Bacterial)	
Autoimmune	Meningoencephalomyelitis of unknown etiology - MUO?
Metabolic	Portosystemic Shunt

	PPID (Cushings)
Iatrogenic	Iatrogenic air embolus
Idiopathic	
Neoplastic	Lymphoma
	Plasma cell myeloma
	Undifferentiated sarcoma
	Melanoma
	Squamous cell carcinoma
	Angioma
	Ependymoma
	Hemangiosarcoma
Metastatic Intestinal Carcinoma	
Congenital	Atlanto-axial malformation
	Synovial Cyst
	Subarachnoid diverticulum
	Spina Bifida
	(Equine Cervical Complex Malformation?)
	Vascular malformations
Degenerative	Cervical Vertebral Malformation / Malarticulation (CVM/M) - Type I
	Cervical Vertebral Malformation / Malarticulation (CVM/M) - Type II
	Intervertebral Disc Protrusion
	Intervertebral Disc Extrusion
	Hydrated Nucleus Pulposus Extrusion

ROOM: A2-82-01

09.00-09.25 - Highlights from ACVIM Forum 2024

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The purpose of this talk is twofold. For the first part, I will review highlights from the equine program at the 2024 ACVIM Forum in Minneapolis, MN. For the second part, I will review some top recent work in equine neonatology.

Highlights from the Forum include:

- Unleashing AI in Veterinary Medicine – Krystle Reagan, UC Davis
- Keynote address – Accelerating the Future of Health and Medicine: What’s Now, Near and Next for Veterinary Medicine – Daniel Kraft, MD
- Large Animal Internal Medicine Research Exchange
 - Investigation of Valvular Regurgitation and Its Role in Equine Sudden Cardiac Death – Katharyn Mitchell, Cornell University
 - Ongoing Investigation of Genetic Diseases in Horses – Carrie Finno, UC Davis
 - Increased Peritoneal Fluid Lactate in Colic Cases Treated Medically that Survived to Discharge– Tine Schlievert, University of Glasgow
 - Investigation of Seasonal Idiopathic Hepatitis in Midwestern Horses – Carla Olave, Purdue University
 - Moral Distress in Large Animal Veterinarians in North America – Daniela Luethy, University of Pennsylvania
 - Equine AKI and CKD Network - A Web-Based Data Base for Collaborative Research – Hal Schott, Michigan State University
 - Identification of Gene by Environment Interactions Influencing Genomic Risk Alleles Contributing to Equine Metabolic Syndrome – Elaine Norton, University of Arizona
 - Investigation of Putative Alleles Associated with Pituitary Pars Intermedia Dysfunction Risk and Pergolide Response – Lauren Hughes, University of Arizona

09.25-09.50 - Neonatal news hour – what’s new?

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Some articles of interest include, but are not limited to:

- Samuels AN, Kamr AM, Reed SM, Slovis, NM, Hostnik LD, Burns TA, Toribio RE. Association of the neutrophil-lymphocyte ratio with outcome in sick hospitalized neonatal foals. *J Vet Intern Med* 2024; 38: 1196-1206 DOI: 10.1111/jvim.16995
- Gomez DE, Kamr A, Gilsenan WF, Burns TA, Mudge MC, Hostnik LD, Toribio RE. Endothelial glycocalyx degradation in critically ill foals. *J Vet Intern Med* 2024; 38: 2748-2757 DOI: 10.1111/jvim.17196
- Gustafsson K, Sykes BW, Verwilghen D, Palmers K, Sullivan S, van Galen G. Trimethoprim-sulfonamide: a valid antimicrobial treatment in foals? *J Am Vet Med Assoc*; 262(6): 825-833 DOI:10.2460/javma.23.09.0536

10.10-10.40 - Equine colitis

Equine acute colitis - Serum amyloid A and L-lactate as diagnostic and prognostic biomarkers

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Introduction

Equine acute colitis is a severe and often life-threatening condition characterized by inflammation of the colon and caecum, leading to diarrhea, dehydration, and systemic inflammatory response syndrome (Gomez et al.). The rapid onset and progression of the disease necessitate prompt treatment to improve survival rates. Various blood and peritoneal fluid biomarkers have been proposed as valuable tools for evaluation of diagnosis and prognosis in equine acute colitis. This proceeding reviews the utility of the serum amyloid A (SAA) and L-lactate for improved diagnosis and prediction of non-survival of equine acute colitis.

Serum Amyloid A (SAA)

Serum amyloid A (SAA) is an acute-phase protein that increases rapidly in response to inflammation (Jacobsen, 2022). In horses with severe acute abdominal disease, measurement of SAA in serum along with clinical assessment, improved differentiation of horses with acute inflammatory colic such as colitis, that did not require surgery, from horses with acute colic requiring surgical intervention. Serum amyloid A could thereby minimize the risk of unnecessary or delayed surgery (Pihl et al., 2016). Duration of disease and kinetics of a biomarker is very important to consider. In per-acute intestinal disease (<4 hours) SAA will not have had time to rise, and a low SAA cannot rule out inflammatory lesions in these cases (Pihl et al., 2015). Measuring SAA in peritoneal fluid did not improve the diagnostic ability in horses with severe colic (Pihl et al., 2016).

Serum amyloid A was not useful in differentiation of acute colitis from peritonitis and non-strangulating intestinal infarctions associated with *Strongylus vulgaris* (Poulsen et al., 2023). The prognostic ability of SAA measured in serum was investigated in a study of 176 horses with acute colitis (Runge et al., 2023). SAA at admission was not useful for predicting survival of acute colitis in horses. The study could not assess the prognostic value of repeated SAA measurements due to the high mortality rate within the first day of admission.

Lactate

Lactate is a byproduct of anaerobic metabolism and is commonly used as a marker of tissue hypoxia and perfusion. Plasma L-lactate concentration has been associated with non-survival in horses with colitis in several studies (Gomez et al., 2024; Hashimoto-Hill et al., 2011; Petersen et al., 2016; Runge et al., 2023). Repeated measures of lactate improve the prognostic ability as it reflects how the horse responds to treatments and fluid resuscitation (Hashimoto-Hill et al., 2011; Petersen et al., 2016).

Combining L-lactate measurement with clinical and other clinicopathological variables improves the ability to predict non-survival even further. Variables identified in multivariable analyses with L-lactate are; increased heart rate, age and duration of disease before admission > 24h (Runge et al., 2023) and altered mentation status, presence of a toxic line, increases in packed cell volume and creatinine (Gomez et al., 2024). Combining increased L-lactate (>2.99 mmol/L) and positive SIRS status also identified horses with a higher risk of non-survival (Gomez et al., 2024).

When specific L-lactate cut-offs are used to predict non-survival, it is important that there seem to be significant breed differences. In the study by Runge et al. (2023) L-lactate at admission was significantly higher in Icelandic horses ($n = 79$, median 4.5 mmol/L, range 1–26 mmol/L) than in other breeds ($n = 96$, median 2.9 mmol/L, range 0.7–22 mmol/L) ($p < 0.001$). Even though there was no significant difference in survival rates between Icelandic horses and other breeds. The optimal lactate cut-off value at admission for non-survival in the entire population was 3.8 mmol/L, with a sensitivity of 82.8% (95% CI = 70.2%–94.8%) and a specificity of 74.8% (95% CI = 64.3%–85.2%). This cut-off was, however, lower than the median lactate at admission in surviving Icelandic horses (4.0 mmol/L). If the cut-off value for the entire population was used in Icelandic horses, it would result in misclassification of 38% (18/48) of the surviving Icelandic horses as non-survivors.

The reason for this finding is unknown, but it is hypothesized to be related to differences in metabolism, hepatic clearance of lactate, or oxidative capacity in horses and ponies (Dunkel et al., 2017; Dunkel et al., 2019). The generally higher body condition score (obesity) of ponies (Jensen et al., 2016; Potter et al., 2016) can also have a significant effect on plasma L-lactate concentration.

Icelandic horses had a higher relative risk (RR: 2.9 (95% CI = 2.2–3.8) of being diagnosed with acute colitis compared to other breeds (Runge et al., 2023). It is hypothesized that differences in management causing increased risk of sand intake (Husted et al., 2005) could be part of the explanation.

Conclusion

SAA and L-Lactate offer rapid assessment of diagnosis and prognosis in equine acute colitis. Combining multiple biomarkers may enhance the accuracy of prognosis and guide treatment decisions. Early diagnosis and prompt initiation of treatment remain critical for improving the outcomes of horses with acute colitis.

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12.35-13.10 - Equine metabolomics: emerging diagnostic tools to detect disease and evaluate performance

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Equine metabolomics: emerging diagnostic tools to detect disease and evaluate performance

Metabolomics is the study and comprehensive measurement of generally low-molecular-weight molecules (metabolites) which are the intermediate and/or end products of metabolic reactions required for cell function. Metabolites include a wide range of different chemical compounds that participate in the main cellular metabolic processes, such as mitochondrial respiration, tricarboxylic acid cycle, fatty acid oxidation, amino acid deamination, etc. This discipline, although still emerging, offers invaluable information about the complex interaction between genes and environment. Comprehensive metabolite cataloguing can, therefore, provide a deep understanding into the mechanisms underpinning superior exercise capacity in athletes, as well as detecting physiological perturbations that might lead to disease.^{1,2} Although few metabolomic studies have been performed in the horse, this technology has proven useful in human medicine to investigate exercise adaptations during training³ as well as important diseases such as obesity⁴⁻⁶ and cardiovascular ailments⁵.

In horses, most studies have looked at metabolic profile before and after exercise^{2,7-9}, with fewer addressing the effect of training¹⁰⁻¹². Currently, drawing strong conclusions from current data is challenging due to the small number of horses included in the studies, differences in breeds and athletic disciplines, and the diverse analytical techniques used.

In endurance horses, probably the most studied discipline so far, prolonged exercise decreases circulating fatty acids and increases circulating branch amino acid metabolites, tyrosine, citrate and some acyl-carnitine species^{8,12,13}. Interestingly, lactate continues to be an important metabolite determining performance, as higher concentrations in plasma have been associated with better placement on races in one study¹¹. Prolonged exercise is also known to activate other minor fatty-acid oxidative pathways such as gamma-oxidation⁷. In standardbreds, training has been associated primarily with elevations of citric acid intermediates (citric acid and aconitic acid), branch amino acids such as leucine, and cellular enzymes that increase the rate of fatty acid oxidation¹⁰. Notably, Thoroughbreds in the resting state seem to have higher plasma and muscular concentrations of branch amino acids and other basic amino acids when compared with non-athletic breeds¹⁴.

Likewise, in human athletes, endurance exercise stimulates significant increases on many tricarboxylic acid cycle intermediates, NADPH and Co-A precursors which contribute to effective glycolysis and enhance fatty acid oxidation³. Specifically, better performance in cyclist was associated with lower glycolytic intermediates, higher lactate and pyruvate concentration after exercise, lower pentose phosphate metabolites and enhance amino-acid catabolism³. Similarly to Thoroughbreds, baseline circulating levels of certain amino acids were higher in the better performance groups¹⁴. Regardless of performance, exercise seem to promote free fatty acid mobilization and acyl-carnitines release (medium and long species) as identified in endurance horses¹³. Interestingly,

within the best performing athletes, lower lactate concentration corresponded with higher tricarboxylic acid cycle intermediates and short-chain acyl-carnitines³. Sprinter training has also shown to reduce the lactate, pyruvate and branch amino acids concentration after exercise as well as higher resting citrate and oxalacetate concentration at rest¹⁵.

Collectively, these findings indicate physiological adaptations in athletes of both species that promote the use of branch amino acids and fatty acids to support aerobic pathways, thereby sustaining maximal exercise after glycogen depletion. Although further research is still needed to elucidate the superior metabolic capacities in successful athletes, recent studies have narrowed the focus to specific metabolic pathways. Notably, branch amino-acid catabolism.

Use of acyl-carnitines as a biomarkers of disease

The role of acyl-carnitines as biomarkers in disease diagnosis and management is increasingly recognised, given their central involvement in fatty acid oxidation and branched-chain amino acid metabolism. Traditionally, acyl-carnitines have been used to detect both inherited and acquired metabolic disorders in human medicine and to identify plant toxicities in horses, such as atypical myopathy¹⁶ and malva poisoning¹⁷. More recently, their relevance has expanded, indicating potential applications in assessing critical diseases, such as cardiac disorders and obesity—two major health concerns in equine species as well.

Cardiac muscle inherently contains high concentration of acyl-carnitines reflecting the heart's reliance on fatty acid oxidation for energy production¹⁸. In humans, elevated concentration of long-chain acyl-carnitines in plasma have been linked to various cardiovascular conditions, including heart failure, coronary artery disease, and cardiac arrhythmia^{5,19}.

Specifically, high plasmatic concentration of medium and long-chain acyl-carnitine species (C10-C18) were shown to impact systolic dysfunction and contribute to left ventricular remodelling^{19,20}. Moreover, abnormal accumulation of cytoplasmatic acyl-carnitines appears to disrupt cellular sodium and calcium exchange, leading to sarcolemma instability creating a substrate for arrhythmogenesis^{21,22}. These metabolic alterations have been shown to precede the development of atrial fibrillation in human studies²², thus opening new avenues for research in horses. The acyl-carnitine profiling may, therefore, serve as a valuable tool for the early detection, risk assessment, and therapeutic monitoring of cardiac health in equine species, mirroring its emerging utility in human medicine.

Human insulin resistance and type 2 diabetes mellitus are linked to reduced utilisation long-chain fatty acids by skeletal muscle²³. Additionally, type 2 diabetes is associated with significant accumulation of medium-chain fatty acids intermediates, while insulin resistance also shows significant elevations on branch amino acid metabolites²³⁻²⁵. C4-dicarboxyl-carnitine has been proposed a suitable biomarker for glucose and lipo toxicity in diabetic patients²³. Incomplete fatty acid oxidation seems to be a hallmark of insulin resistance and obesity in human patients due to cellular oversupply of fatty acids during defective glucose metabolism. Similar metabolic patterns might exist in horses with insulin dysregulation for which detecting early biomarkers of glucose toxicity might help to reduce the risk of endocrinopathic laminitis.

Metabolomic approaches present new opportunities in equine medicine, facilitating a deeper understanding of the physiological mechanisms underlying athletic performance and enabling the identification of biomarkers for the early diagnosis of diseases.

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14.50-15.20 - The science of client motivation: how to foster behaviour change

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Introduction

Client motivation plays a pivotal role in veterinary medicine, especially when a lasting change in client behaviour is needed. In this case, client compliance and engagement are crucial for successful clinical outcomes. Whether this involves adjusting management practices in case of respiratory disease or altering the horse's diet in case of metabolic disease, veterinarians frequently rely on the willingness of clients to make informed and sustained behavioural changes. This highlights the importance of understanding the factors that motivate clients and drive their decisions regarding equine care.

The role of motivation in healthcare has been the focus of extensive research, with several psychological theories providing frameworks for understanding how behaviour can be influenced and changed. This presentation will focus on the scientific basis for client motivation, particularly within the context of veterinary medicine, and explore the communication skills which veterinarians can use to enhance client motivation. Special emphasis will be placed on the role of autonomous motivation, as described by Self-Determination Theory (SDT), and how motivational interviewing (MI) techniques can be employed to foster motivation in veterinary practice.

The importance of client motivation

Equine internal medicine frequently involves chronic conditions that require long-term management strategies, such as equine asthma, recurrent colic or metabolic syndrome. In these cases, the effectiveness of treatment often depends on the client's willingness to make and maintain necessary changes in the horse's diet, training or stable environment. Understanding what motivates clients can help veterinarians to give recommendations which align with their clients' values, making it easier for them to adopt and sustain recommended changes. Effective communication and client motivation strategies can improve treatment adherence, which, in turn, enhances clinical outcomes. A range of behavioural theories have been used to explain the mechanisms that drive client behaviour and motivation in (veterinary) medicine, including amongst others the Theory of Planned Behaviour, the Health Belief Model and the self-determination theory.

1. Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) is a widely used model for understanding behaviour. [1] This model is based on the theory that behaviour change follows an intention to change behaviour. The theory postulates that the intention to change behaviour is influenced by three key factors:

- Attitude towards the behaviour, which is defined as a the client's negative or positive evaluation of a certain behaviour, based on the expected outcomes
- Subjective norms: the perceived social pressure to perform or not perform the behaviour (e.g., influence from other horse owners or veterinarians)
- Perceived behavioural control: the client's perception of their ability to perform the behaviour (e.g., confidence in being able to change the horse's management).

Based on this theory, veterinarians can influence client behaviour by addressing these three components through clear communication, education, and support. For instance, a veterinarian can improve a client's attitude toward a diet change by providing evidence-based information about the benefits, while simultaneously addressing perceived barriers, such as cost or availability of specific feeds.

The Theory of Planned Behaviour has been widely used in various fields to understand and predict human behaviour. However, an important limitation of this theory is that it assumes that the individual rationally weighs the different factors against the behaviour, without taking into account environmental and economic factors (e.g., cost of treatment) or emotional, intuitive and irrational factors (e.g., cognitive biases such as the authority bias or placebo effect).

2. Health Belief Model

The Health Belief Model (HBM) is another theory specifically regarding healthcare behaviour change [2], which suggests that people are motivated to take action based on:

- Perceived Susceptibility: how likely they believe the horse is to develop a particular condition
- Perceived Severity: how serious they believe the consequences of the condition will be
- Perceived Benefits: the perceived advantages of taking a specific action (e.g., improved horse health through dietary changes).
- Perceived Barriers: the obstacles to taking the action (e.g., time, cost, or effort).

In veterinary medicine, addressing these factors can motivate clients to take preventive measures or adhere to treatment protocols. For example, if a client understands the susceptibility of their horse to developing laminitis due to obesity and recognizes the severity of this condition, they may be more inclined to follow the veterinarian's recommendations regarding diet and exercise.

3. Self-Determination Theory

One of the most important concepts in motivation is the distinction between controlled and autonomous motivation. According to the Self-Determination Theory (SDT), individuals are more likely to engage in and sustain behaviours when they are autonomously motivated (intrinsic motivation). [3] Autonomous motivation contrasts with controlled motivation, where actions are driven by external pressures or demands. SDT suggests that three basic psychological needs must be met to foster autonomous motivation:

- Autonomy: The client must feel that they have a choice in how they manage their horse's care, rather than feeling coerced by the veterinarian.
- Relatedness: The client must feel connected to the veterinarian and believe that their concerns are understood and respected.
- Competence: The client must feel capable of successfully implementing the recommended changes.

By addressing these needs, veterinarians can help clients feel more motivated to take ownership of their horse's care, which can lead to sustained behaviour change. The feeling of autonomy can be supported, for example, by addressing the perspective of the client, allowing input and ideas to come from the client, offering options and by explaining why something is important. Coercive language or the use of punishment and/or rewards, on the other hand, are counterproductive. A sense of competence can be stimulated by setting achievable goals and giving specific, positive feedback when the client succeeds. Finally, the feeling of relatedness is stimulated by approaching the other person respectfully and warmly. Research in human medicine demonstrated that patients who felt that their doctor "liked them" were also more likely to follow the doctor's advice.

4. Transtheoretical model of behaviour change or 'stages of change' model

This model is based on the different stages which people go through when they consider behaviour change. [4]

- Precontemplation: the client is not yet considering change, either because the client is unaware of the problem or resistant to change.
- Contemplation: the client acknowledges the problem and is considering change but has not yet committed to action.
- Preparation: the client is planning to make a change soon and may begin taking small steps toward it.
- Action: the client actively makes changes in behaviour.
- Maintenance: the client works to sustain the change and prevent relapse, integrating the new behaviour into their routines.

The model is often represented as a circle because behavioural change is a cyclical process, as relapse frequently happens. However, relapse does not automatically mean that the behavioural change needs to start again from scratch and therefore sometimes the circle is represented as a spiral. Different communication skills are needed depending on the stage. Often a technique that belongs to the next phase is used too quickly. E.g., clients who say 'My horse might have to lose some weight' are probably still in the phase of contemplation and not ready yet for immediate recommendations of concrete actions. Overall, moving through the stages of change takes time and varies greatly from

person to person, depending on several factors such as motivation, readiness, environmental support, and the complexity of the behavior being changed. Each stage reflects a different level of readiness, and progression is typically not linear. People often cycle back and forth between stages, particularly when facing relapse.

Motivational Interviewing (MI) to enhance client motivation

Motivational Interviewing (MI) is a client-centered communication technique designed to elicit and strengthen motivation for change. [5] Originally developed in the field of addiction, MI has been increasingly applied in human healthcare and veterinary medicine to improve adherence to treatment recommendations. MI is based on the principle that clients are more likely to change their behaviour when they themselves verbalize their reasons for change (a concept known as "change talk"). Rather than using a directive approach that tells clients what to do, MI focuses on exploring the client's own motivations and concerns, helping them resolve ambivalence about making changes.

Key communication skills used in MI include:

- Open-ended questions: encouraging clients to talk about their experiences, concerns, and goals regarding their horse's care.
- Affirmations: recognizing and reinforcing the client's strengths and past successes.
- Reflective listening: demonstrating understanding by reflecting the client's thoughts and feelings back to them.
- Summarizing: bringing together the client's statements to emphasize their motivation for change.

MI has been shown to be effective in various human healthcare settings, with numerous randomized controlled trials demonstrating its ability to enhance patient motivation and improve health outcomes. In veterinary medicine, research is beginning to show similar benefits. [6] For example, recent studies indicate that veterinarians who adopt an MI approach are more successful in eliciting change talk from their clients, which in turn leads to higher rates of adherence to treatment recommendations. [7, 8]

Despite the clear advantages of MI, research indicates that veterinarians often adopt a more directive communication style. [9, 10] This is likely due to time constraints, the pressure to convey complex medical information, and a lack of training in MI techniques. However, studies have shown that veterinarians can be trained to use MI effectively. [11, 12] Shifting toward a more client-centered communication style may lead to significant improvements in client motivation and treatment adherence, particularly in cases where long-term behaviour change is required.

Conclusion

Client motivation is a critical factor in the successful management of equine internal medicine cases, especially when behaviour change is necessary. By understanding the psychological theories that underpin client behaviour and utilizing communication techniques such as motivational interviewing, veterinarians can foster autonomous motivation in their clients. This approach not only improves compliance with treatment recommendations but also empowers clients to take an active role in their horse's care, leading to better health outcomes.

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15.50-16.30 - Using serum amyloid A and other acute phase reactants to improve patient management

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Summary

Serum amyloid A (SAA) has become an indispensable part of management of equine patients in general practice and specialized hospital settings. While several proteins possess acute phase properties in horses, usefulness of SAA exceeds that of other acute phase proteins. This is due to the highly desirable kinetics of the equine SAA response. SAA concentrations exhibit rapid and pronounced increase in response to inflammation and a rapid decline after resolution of inflammation. This facilitates detection of inflammatory disease and real-time monitoring of inflammatory activity. By assessing SAA in combination with other acute phase reactants, clinicians can succinctly stage inflammation.

The equine acute phase response and acute phase proteins

The acute phase response is the immediate systemic reaction to a various types of tissue injury incl. inflammation, infection, and trauma. In the horse, several proteins are positive acute phase proteins (APPs), ie, proteins that are synthesized *de novo* in response to inflammation and released into the circulation. Serum amyloid A (SAA) is a major APP in horses and its concentration can increase many-fold in response to inflammation (> 10 times above the reference interval, but often 1000 times or more).¹ In contrast, fibrinogen is a moderate APP, and increases in fibrinogen concentration are more modest (most often 1-3 times above the reference interval).^{2,3} Several APPs that are very useful in other species have been shown to be of limited value in horses, e.g. haptoglobin⁴⁻⁶ and C-reactive protein.⁴⁻⁷

Response patterns of the APPs differ substantially, with some having a fast and others a slower response to an inflammatory stimulus.¹ The SAA response is fairly rapid, with plasma concentrations increasing 8-12 hours after induction of experimental inflammation^{8,9} and peaking after 48-72 hours.^{3,8,9} The amplitude of the SAA response is impressive; plasma concentrations can increase from within the reference interval (<0.5 mg/L) to 5000 mg/L or more in horses with severe inflammation.¹⁰ Due to its short half-life (30-120 minutes),^{11,12} serum concentrations of SAA decrease rapidly as inflammation resolves, as demonstrated in horses exposed to a single experimental inflammatory stimulus^{8,9} or surgery.³ With its concentration closely paralleling changes in inflammatory activity, SAA is very useful for real-time monitoring of inflammation.¹ A clinically useful approach is to measure some APPs and other inflammatory markers with fast and some with slower response patterns.¹³ This ensures that peracute, acute, and subacute inflammation can be detected and monitored. It is important to keep in mind that, despite their name, APPs are produced not only in acute inflammation. APPs are synthesized and can be detected as long as there is active or ongoing inflammation, over days to weeks.

Compartment-specific assessment of SAA

In addition to hepatic production of SAA resulting in release of the protein into the systemic circulation where it can be measured in blood, plasma, or serum, SAA is also synthesized in extrahepatic tissues.¹⁴⁻¹⁷ In horses, SAA has been found in normal colostrum,^{17,18} and in inflamed saliva,¹⁹ synovial fluid,^{8,20,21} and peritoneal fluid.²² Measuring SAA in these biological fluids may provide information on compartment-specific inflammatory activity.

Increased concentrations of SAA and other APPs (haptoglobin, fibrinogen) have been detected in peritoneal fluid after experimental exploratory laparotomy^{23,24} and in horses with abdominal disease such as intestinal strangulations and inflammatory conditions (acute enteritis, typhlocolitis, or peritonitis).^{22,25} Measuring APPs in peritoneal fluid could thus have diagnostic potential.

Methods for measuring SAA

An analyte such as SAA, whose response pattern is characterized by very pronounced concentration changes from essentially unmeasurable in the healthy horse to several thousands of mg/L in response to inflammation, is very difficult to quantify reliably in the entire concentration

range. We recently validated an automated latex bead-based immunoturbidometric assay (VET-SAA, Eiken Chemical Co., Japan) with a very broad working range,¹⁰ which measured equine SAA with acceptable reliability in the concentration range of 0 to > 6000 mg/L. There was statistically significant inaccuracy in the high concentration range. However, inaccuracy was slight, and – considering SAA’s rapid and pronounced concentration changes – deemed to be clinically insignificant.¹⁰ When using SAA measurements for monitoring purposes in horses with severe inflammation, it is important to choose an assay that can reliably detect concentration changes in the high concentration range.

Several horse-side point-of-care (POC) assays have been developed and have shown reasonable performance in validation studies.²⁶⁻²⁸ These assays are marketed for different SAA concentration ranges, e.g. up to 3000 mg/L for the StableLab assay (<https://www.zoetis.com/products/horses/stablelab>)²⁷ and the VMRD assay system (<https://vmrd.com/core/files/vmrd/uploads/files/SAA%20circular%20version%202.pdf>);²⁸ up to 180 mg/L for the EquiCheck system (<https://www.targetvet.com/equine-progesterone-igg-and-saa-testing/visual-equicheck-saa-test-or-quantitative-saa-check/>); up to 500 mg/L for the Eurolyser (<https://www.eurolyser.com/veterinary-diagnostics/poc-test-parameters/saa-test/>); and up to 1000 mg/L for the LifeAssays test system (<https://www.lifeassays.com/equine-serum-amyloid-a-saa-test/>). StableLab (Zoetis, USA) is available in Europe and the US. This assay has been validated and compared to the most commonly used immunoturbidometric SAA assays (LZ-SAA and VET-SAA, both from Eiken Chemical Co., Japan).^{27,29} Kiemle et al (2022)²⁹ demonstrated a high degree of constant and proportional concentration bias between the StableLab assay and the immunoturbidometric SAA assays. The StableLab assay had high intra- and inter-assay coefficient-of-variation, poor recovery rate and a hook effect. All of these findings may severely limit the validity of results obtained with the assay, which users should be aware of.

POC assays are generally user-friendly, but considering the limited working range and inferior reliability, these assays are mainly useful for basic detection of inflammation in the field or after-hours, where fast results are needed and/or samples cannot be shipped to larger reference laboratories. It is important to keep in mind that there may be quite substantial concentration bias between methods, so measured concentrations cannot be compared across assay systems. Very high intra- and inter-assay coefficient-of-variations (8-45 %) demonstrated in the StableLab POC^{27,29} means that repeated measurements need to be interpreted with caution, as changes in concentration may result from analytical as well as biological variation.

Reference intervals

Many textbooks and reviews state reference intervals for equine APPs. But reference intervals can only be shared across laboratories using the exact same methodology.³⁰ Each laboratory must therefore establish its own reference intervals, preferably *de novo*, or by transference using a small number of samples according to established guidelines.³¹

For SAA, reference intervals reported in different studies differ slightly, but most have suggested that serum concentrations in healthy adult horses are < 10-20 mg/L.

Reference intervals in neonatal foals have been described.³²⁻³⁴ A recent study found that mean serum SAA in 151 healthy neonatal foals (< 19 hours old) was 27.7 mg/L.³⁴ In contrast, two small studies have suggested that healthy foals have slightly higher serum concentrations of SAA than adult horses, with peak concentration of up to 120 mg/L at 24-72 hours after birth.^{32,33} These slightly higher concentrations could be associated with passive transfer of SAA, as SAA has been found in colostrum,^{17,18} or from endogenous production as a consequence of the foal sustaining mild trauma while passing through the birth canal. It is not clear at which age SAA concentrations level out, but presumably within few weeks after birth.

Having said all this, it is important to keep in mind that for analytes such as SAA, where the amplitude is extremely high, it is preferable to use a so-call clinical decision limit (CSL) to differentiate healthy from inflamed. CSLs are set by experienced user (clinicians) of the assay/analyte³⁵, and for SAA the CSL reflects that minor changes in the very low concentration range is considered to be clinically insignificant. At the Large Animal Teaching Hospital (LATH), University of Copenhagen, the SAA CSL is 75 mg/L.

Use of SAA in equine medicine (and surgery)

SAA and other APPs can be valuable at all stages of patient management:¹

Before a diagnosis has been made: SAA can be used to assess inflammation and prioritize differential diagnoses with and without inflammation, or to detect subclinical inflammatory disease. Once a diagnosis has been established: SAA might serve as a prognostic indicator.

Monitoring disease progression and response to therapy: SAA is highly suited for monitoring changes in inflammation in the intervention phase of patient management; repeated

measurements are useful for assessment of response to therapy, detection of relapse, or occurrence of infectious or inflammatory complications. SAA can also be used to support decision to stop antimicrobial therapy.

Several reviews on the equine acute phase response and more specifically, SAA in a variety of clinical conditions is available.^{1,36-38} Veterinary clinicians need to have a thorough understanding of the SAA response to interpret measurement results. One important aspect to keep in mind is the effect of duration of disease on SAA. The time-dependence is related to the large amplitude of the SAA response, where concentrations can increase many fold within hours.¹ This was demonstrated in horses with abdominal disease, where SAA and haptoglobin concentrations in serum and peritoneal fluid were markedly influenced by the duration of disease prior to sample collection.²⁵ In the following, a general description of the use of SAA is provided. Please refer to <https://onlinelibrary.wiley.com/doi/full/10.1111/vcp.13195> and other reviews^{1,36-38} for a detailed account of specific conditions.

Patient assessment and diagnosis

Hepatic synthesis of SAA only occurs during inflammation; non-inflammatory disease does not result in increased blood concentrations of SAA, as demonstrated in foals³⁹⁻⁴¹ and adult horses.¹⁰ SAA is thus a specific marker of inflammation and infection. This is in contrast to other commonly used inflammatory markers, where levels can change in response to a variety of non-inflammatory stimuli. Leukocytosis can occur after vigorous exercise, in frightening or painful conditions, during stress or after corticosteroid treatment;⁴² iron deficiency caused by blood loss, parasitism and other non-inflammatory conditions can result in hypoferrremia;⁴³ and fibrinogen concentrations can change as result of coagulation and coagulopathies.⁴⁴ Interpretation of SAA is therefore more straightforward than other inflammatory markers.

For certain patient groups, it may be necessary to rule in or rule out inflammation to properly prioritize differential diagnoses. In horses with severe acute abdominal pain (colic), it is crucial to quickly categorize the underlying condition as either surgical or infectious in nature. Similarly, assessment of SAA is useful for neonatal patient management. Diagnosing infections in neonatal foals can be a challenge because the clinical signs are nonspecific, and diseases with a noninfectious cause can manifest similarly to infectious diseases such as sepsis. SAA may thus help differentiate infectious from non-infectious disease,^{33,40,41,45} and aid the clinician in obtaining a correct diagnosis and make a more informed decision whether to start antimicrobial therapy while waiting for bacteriology results.

In apparently clinically healthy horses, assessment of inflammatory markers may be of value to detect subclinical inflammation. This is relevant before surgery, where distant site infection increases the risk of surgical site infection,⁴⁶ and where subclinical airway infections potentially increase anesthetic risk.

Measurement of SAA or other APPs in apparently healthy horses could be relevant also for other purposes, e.g. to ensure fitness or document animal welfare in potentially stressful situations. During transportation, APPs have been shown to reflect stress.⁴⁷ There is also a fairly substantial bulk of literature describing changes in APPs in response to training and exercise in healthy horses. It has been suggested that SAA could indicate training exceeding the horse's fitness level. Inexperienced endurance horses had increased serum SAA concentrations after a training session, while experienced ones did not.⁴⁸ Blood concentrations of SAA and other APPs increase after strenuous exercise such as endurance rides, races and eventing.^{4,48-52} In over-weight ponies and horses, low intensity exercise reduced blood concentrations of SAA and haptoglobin, suggesting that health benefits and positive effects of training on obesity-related inflammation can be monitored by APPs.^{53,54}

Similar to other inflammatory markers, SAA will be produced in response to inflammation independent of etiology, so SAA cannot be used to make etiological diagnoses. Aseptic tissue injury and inflammation (accidental or iatrogenic, e.g. vaccination or surgery) as well as infectious diseases will elicit an SAA response,^{10,46,55-60} It has been suggested that viral disease is accompanied by lower serum SAA concentrations than bacterial disease.⁶⁰ However, overlap between groups is substantial, and while SAA may give an indication of etiology, it cannot categorically distinguish viral infections from bacterial ones.

While SAA has been repeatedly shown to reliably indicate presence of systemic inflammation in horses,^{21,57,58,61-64} it has been suggested that local inflammation gives rise to lower plasma SAA concentrations.^{10,64} Certain specific conditions such as gastric ulcer syndrome,⁶⁵ intestinal cyathostomiasis,⁶⁶ inflammatory airway disease,⁶⁷ and ulcerative keratitis and anterior uveitis⁶⁸ do not seem to reliably elicit an SAA response. This is not surprising nor considered a specific drawback of SAA in comparison to other inflammatory markers, as patients suffering from these conditions have insufficient systemic inflammation to consistently cause alterations in blood levels

of any of the inflammatory markers routinely assessed.⁶⁶⁻⁶⁸ In several older studies, SAA concentrations were found to be normal or low in horses with abscesses (i.e. walled off inflammation).^{40,69} Two recent case reports have questioned this generalization, as increased serum SAA concentrations were detected in a horse with an abdominal abscess⁷⁰ and a horse with a pararectal abscess.⁷¹ In foals with *Rhodococcus equi* pneumonia, SAA has been suggested to be of limited diagnostic value.^{69,72,73} However, in foals with clinical signs of *Rhodococcus equi* pneumonia (fever, nasal discharge), serum SAA levels were found to be significantly elevated and to decline in response to successful treatment.^{45,72,74} Fibrinogen was suggested to be superior to SAA for screening purposes in farms with endemic *Rhodococcus equi* in a study with 10 foals,⁷³ while a larger study involving 54 foals found similar predictive capacity of the two APPs.⁷² In the LATH case load, horses with strangles generally show markedly elevated SAA concentrations (> 2000 mg/L, author's unpublished observations). Taken together, the current literature suggests that serum SAA concentrations must be interpreted with some caution in abscessing infections. The author's unpublished observations suggest that the same is true for foals with osteomyelitis (type P or E septic arthritis), where SAA is often modestly increased, while fibrinogen is often markedly increased.

Predicting outcome

Based on the assumption that more severe or sustained inflammatory disease carries a worse prognosis, SAA may, by its excellent ability to reflect intensity of the inflammatory response, serve as a prognostic indicator. However, results of studies attempting to link early assessment of SAA to outcome are generally discouraging, as most equine studies have failed to demonstrate a reliable prognostic value of measuring SAA.^{59,63,75,76}

Apart from disease severity, other factors may influence SAA concentrations, including timing of sampling (a horse with peracute disease may be admitted before SAA concentrations have increased), mass and type of tissue affected, and disease etiology. At The LATH, patients with peritonitis, colitis, acute cellulitis-lymphangitis and septic arthritis have the highest serum SAA concentrations, with concentrations of 6000-8000 mg/L SAA observed often, and up to 12.000-15.000 mg/L occasionally encountered (author's unpublished observations). These factors may explain why many studies fail to demonstrate a strong association between admission SAA concentration and outcome.

Monitoring response to therapy

SAA is very useful for patient monitoring. In patients being treated for infectious conditions, declining SAA concentrations in samples taken every 2-4 days help clinicians ascertain that infection is being eradicated and inflammation is resolving. This is particularly useful in cases awaiting culture results, where choice of antibiotics is initially based on preliminary clinical evidence and the clinician's experience. Declining SAA concentration has been demonstrated to parallel to successful treatment of synovial sepsis^{59,77} and pneumonia in foals.⁷⁴

In horses undergoing exploratory laparotomy, SAA initially increases in response to the surgical trauma and then, in the absence of surgical site or other infections, declines towards normal within 4-6^{62,78} and 11 days,³ depending on the extent of the surgical trauma. Fibrinogen also increases in response to laparotomy, but due to the long half-life of the protein, plasma concentrations stay elevated for longer periods, making fibrinogen of limited value for real-time monitoring of post-surgical inflammation.^{3,62,78} When APPs are used to monitor for infectious complications, the expected APP response for the primary disease must be characterized before deviations, such as sustained increases or unexpectedly high APP concentrations, can be identified.¹ In horses that developed complications after exploratory laparotomy (e.g. diarrhea, ileus, thrombophlebitis, and fever), postoperative SAA^{62,78} and fibrinogen⁷⁸ concentrations were significantly higher than those found in horses without complications. Unexpectedly high concentrations of SAA and other APPs post-operatively should thus prompt a thorough examination of the patient to identify site of infection.

The effect of concurrent inflammatory conditions may be additive and result in higher-than-expected SAA concentrations. This can be exploited to identify bacterial superinfection in horses with viral infections. For example, with experimental influenza infection, horses that developed clinical signs of secondary bacterial infection had persistently high plasma SAA concentrations.⁷⁹

Concluding remarks

It is now more than 35 years ago since Husebekk et al (1986)⁸⁰ first isolated SAA from serum from a horse which had suffered a septic abortion. For the last decade more than 30 papers on equine SAA have been published annually. Use of SAA undoubtedly increases quality of patient assessment in equine medicine and surgery. In the LATH it is considered an indispensable part of

patient management, especially for diagnostic and monitoring purposes. Use of a reliable assay is the prerequisite for making the most of SAA assessments.

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16.35-17.15 - Endocrinology of Calcium, Magnesium, and Phosphorus in a Nutshell

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Calcium, magnesium, and phosphorus are essential minerals involved in a multitude of structural and regulatory functions. Disorders of these ions are frequent in equine patients and have been linked to disease severity and outcome. A basic understanding of their physiology and pathophysiology could enhance our diagnostic abilities and therapeutic approaches.

Calcium: Calcium is essential for numerous physiological processes (muscle contraction, neuromuscular excitability, blood coagulation, enzyme activation, hormone secretion, cell division, and cell membrane stability). Extracellular concentrations are influenced by physiological and pathological conditions. Maintaining blood Ca concentrations within a narrow limit is essential. Calcium requirements are higher in foals, physically active horses, as well as pregnant and lactating mares. In blood, total calcium (TCa) exists bound to proteins (albumin), in an ionized/free form (Ca^{2+} ; active calcium), and chelated to anions (bicarbonate, citrate, lactate, phosphate). Extracellular Ca concentrations are regulated by parathyroid hormone (PTH), calcitonin (CT), and 1,25-dihydroxyvitamin D ($1,25(\text{OH})_2\text{D}$; calcitriol). Hypocalcemia stimulates PTH secretion, which enhances renal reabsorption of Ca^{2+} , synthesis of $1,25(\text{OH})_2\text{D}$, excretion of phosphorus, as well as bone resorption. Acidosis increases Ca^{2+} concentrations by decreasing Ca binding to albumin. Animals with hypoproteinemia can have low TCa concentrations, but Ca^{2+} concentrations can be normal.^{181,182} Conversion factors for Ca are: $\text{mmol/L} = \text{mg/dL} \times 0.25$; $\text{mg/dL} = \text{mmol/L} \times 4$.

Phosphorus: Similar to Ca, phosphorus (PO_4) has structural (mechanical) and non-structural (ionic) functions. Phosphorus is essential for energy homeostasis, the intermediary metabolism of carbohydrates, fats, and proteins, enzyme activity, oxidative phosphorylation, electrolyte transport, oxygen transport, cell membrane stability, neuromuscular excitability, muscle contraction, nucleic acid metabolism, gene transcription, and cell proliferation. PO_4 is important to the movement of magnesium (Mg) and K^+ across the cell membrane. PO_4 , Mg, and K^+ are highly interactive ions. Extracellular PO_4 are regulated by PTH, vitamin D, fibroblast growth factor-23 (FGF-23), and insulin. PO_4 concentrations are higher in foals than horses, and PO_4 nutritional needs are higher in foals, physically active animals, pregnant, and lactating mares. In blood, PO_4 exists in organic (70%) and inorganic (30%) forms. Conversion factors for PO_4 are: $1 \text{ mmol/L} = 3.1 \text{ mg/dL}$; $\text{mg/dL} \times 0.32 = \text{mmol/L}$; $1 \text{ mmol/L} = 1.8 \text{ mEq/L}$.

Magnesium: Magnesium key functions are regulatory and like Ca and PO_4 , extracellular concentrations are influenced by physiological and pathological conditions. Mg is involved in enzymatic activation, energy generation and use, oxidative phosphorylation, intermediary metabolism of carbohydrates, fats, and proteins, ion transport, cell membrane stability, nucleic acid metabolism, neuromuscular excitability, muscle contraction, cell proliferation, immunity, Ca homeostasis, and has antioxidative properties. Mg is required for the activity of the Na^+/K^+ -ATPase, $\text{Na}^+/\text{Ca}^{2+}$ exchanger (NCX), N-methyl-D-aspartate (NMDA) receptor (NMDAR), Ca^{2+} channels, and other proteins involved in neuronal and glial function. In nervous tissue, Mg has neuroprotective actions because it blocks cellular entry of Ca^{2+} and Na^+ . This is the rationale for administering MgSO_4 to foals with neurological disease (neonatal encephalopathy and brain trauma). Mg is also involved with structural functions of Ca and PO_4 . Hypomagnesemia and Mg depletion can hinder Ca homeostasis, energy regulation, cardiovascular function, and neuromuscular activity. Unlike Ca, extracellular Mg is not under tight hormonal control. Similar to TCa, total magnesium (TMg) is bound to proteins (albumin), free/ionized/active (Mg^{2+}), and chelated to anions. Any reaction that requires energy also requires Mg^{2+} because ATP is complexed with Mg^{2+} ($\text{ATP} \cdot \text{Mg}^{2+}$). Blood concentrations of TMg and Mg^{2+} are similar between foals and horses. Conversion factors for Mg are: $\text{mmol/L} = \text{mg/dL} \times 0.41$; $\text{mg/dL} = \text{mmol/L} \times 2.43$; $\text{mg/dL} = \text{mEq/L} \times 1.21$; $\text{mmol/L} = \text{mEq/L} \times 0.5$.

REGULATING HORMONES

Parathyroid Hormone (PTH): PTH is released in response to hypocalcemia or hyperphosphatemia and its targets are the renal tubules and osteoblasts. In the kidneys, PTH enhances Ca and Mg reabsorption, inhibits PO_4 reabsorption, and increases 1α -hydroxylase activity to promote $1,25(\text{OH})_2\text{D}$ synthesis. In bone, PTH increases osteoclast-mediated bone resorption. Increased PTH

concentrations are expected in response to hypocalcemia and hyperphosphatemia, which occurs in critically ill foals and horses.

Calcitonin (CT): CT is synthesized by parafollicular cells (C-cells) of the thyroid gland. High Ca and gastrin concentrations stimulate CT secretion while the opposite occurs with low concentrations. CT decreases plasma Ca and PO₄ concentrations by suppressing osteoclastic bone resorption and increasing urinary excretion of Ca and PO₄. The relevance of CT in equine calcium disorders seems to be minimal. Procalcitonin (PCT) is a product of the calcitonin gene (unrelated to Ca homeostasis) that is produced by leukocytes in response to systemic inflammation.

Vitamin D: In horses, vitamin D is derived from plants (vitamin D₂; ergocalciferol) and cutaneous activation of 7-dehydrocholesterol into cholecalciferol (vitamin D₃). In the liver, vitamin D₃ is hydroxylated to 25-hydroxyvitamin D₃ [25(OH)D₃], which is transported to the kidney to be converted by 1 α -hydroxylase to 1,25(OH)₂D₃ (calcitriol), the active metabolite of vitamin D₃. Vitamin D₂ is a major source of vitamin D for horses and follows similar hepatic and renal steps as vitamin D₃. Vitamin D promotes intestinal absorption and renal reabsorption of Ca and PO₄, modulates bone remodeling, and suppresses PTH synthesis. It is also immunomodulatory, anti-inflammatory, enhances antimicrobial peptide synthesis, promotes epithelial and endothelial integrity, and facilitates energy metabolism. Hypovitaminosis D in foals and horses is rarely diagnosed because vitamin D metabolites are not routinely measured in the clinical setting. However, hypovitaminosis D is common in critically ill foals and linked to mortality. Hypovitaminosis D also occurs in horses with gastrointestinal disease. Due to its multiple functions, hypovitaminosis can contribute to hypocalcemia, bone disorders, alter epithelial and endothelial integrity, impaired immunity, increased risk of bacterial infections, and a pro-inflammatory state.

Parathyroid hormone-related protein (PTHrP): PTHrP is a pleiotropic factor with autocrine, paracrine, and endocrine functions. Under physiological conditions PTHrP concentrations are very low to undetectable. PTHrP works through the PTH receptor and high concentrations can resemble the actions of PTH.

Fibroblast growth factor-23 (FGF-23): FGF-23 is an endocrine factor secreted by osteocytes in response to PTH, vitamin D, and PO₄. It is a major regulator of phosphorus concentrations and vitamin D synthesis. FGF-23 is a hypophosphatemic hormone.

CALCIUM DISORDERS

Disorders of calcium homeostasis include hypo- and hypercalcemia, of which hypocalcemia is more frequent. Similarly, magnesium disorder include hypo- and hypermagnesemia, with hypomagnesemia being more common and in general linked to critical illness. Disorders of phosphorus include hypo- and hyperphosphatemia. Hypophosphatemia seems to be more common in adult horses, while hyperphosphatemia is frequent in critically ill foals.

Hypocalcemia: Hypocalcemia is frequent in ill equine patients, affecting up to 50% of septic foals and 70% of horses with acute gastrointestinal disease (e.g. colitis). Hypocalcemia is also common in certain acute conditions (e.g. pleuropneumonia, endometritis). The development of hypocalcemia is likely multifactorial and consequence of systemic inflammation, calciuresis, intracellular Ca accumulation, impaired Ca mobilization, Ca chelation (e.g., hyperphosphatemia in foals), parathyroid gland dysfunction, tissue refractory to PTH, hypovitaminosis D, and Mg depletion. Most foals and horses with acute illness have an appropriate PTH response; however, some have low to normal PTH concentrations, which is considered an inappropriate PTH response. This could be consequence of inflammatory cytokines and/or hypomagnesemia. High PTH concentrations have been associated with disease severity and mortality in foals and horses. *Equine Familial Isolated Hypocalcemia* (idiopathic hypocalcemia) is a condition so far restricted to Thoroughbred foals that develop hypocalcemia immediately after birth, are refractory to medical treatment, can be hypomagnesemic, and die. These animals have a non-sense mutation (*RAPGEF5* gene) that interferes with development of the parathyroid. This is a form of primary hypoparathyroidism. Clinical signs are those of hypocalcemia. Genetic testing is available at the UC Davis Veterinary Genetic Laboratory. Hypovitaminosis D is highly prevalent in critically ill foals, and also occurs in horses with systemic inflammation.

Hypercalcemia: Hypercalcemia is less common than hypocalcemia, in particular in foals. Idiopathic hypercalcemia has been reported in some sick foals and linked to placental disease, dystocia, or perinatal asphyxia. Hypercalcemia in horses is associated to hyperparathyroidism, malignancies (hypercalcemia of malignancy), chronic renal failure, and vitamin D toxicity.

Clinical Signs: Signs of hypocalcemia include hyperexcitability, seizures, convulsions, tremors, fasciculations, stiff gait, tetany, dysrhythmias, synchronous diaphragmatic flutter, ileus, and recumbency. These signs can be exacerbated with hypomagnesemia. Clinical signs of hypercalcemia in general are related to the underlying cause rather than high calcium concentrations per se.

Diagnosis: Most foals and horses with hypocalcemia do not show overt signs, but signs can be

evident with severe hypocalcemia. Signs can be exacerbated with hypomagnesemia. Ideally Mg^{2+} concentrations should be measured, but TMg provides valuable information. Depending on the clinical presentation and laboratory abnormalities, are the additional tests to pursue. For example, in horses with hypercalcemia and normal renal function, it is likely that the animal has hyperparathyroidism or a malignancy. In these animals it is recommended to measure serum PTH and PTHrP concentrations.

Treatment: In addition to addressing the primary problem, treatment of acute hypocalcemia is based on intravenous administration of calcium salts (e.g. calcium gluconate). Some animals may also require the administration of Mg salts (e.g. $MgSO_4$). Animals with refractory hypocalcemia may require long term oral supplementation with calcium salts (calcium carbonate) and magnesium ($MgSO_4$). Treatment of hypercalcemia should be oriented at the underlying problem (chronic renal failure, malignancy). Some animals may require dietary modifications. For example, for nutritional hyperparathyroidism, the dietary calcium should be increased.

PHOSPHORUS DISORDERS

Hypophosphatemia: Hypophosphatemia develops from reduced intestinal absorption of PO_4 , increased urinary excretion of PO_4 , and shift of PO_4 to the intracellular compartment (redistribution). The opposite occurs with hyperphosphatemia. Hypophosphatemia occurs in foals and horses with hyperglycemia, hyperlipemia, in those receiving enteral and parenteral nutrition or insulin administration, and less commonly, from sepsis. Hypophosphatemia is also frequent in horses with chronic renal failure. During enteral or parenteral nutrition there is increased intracellular demands for carbohydrate phosphorylation and ion shifts, in part driven by increased insulin concentrations, thus, decreasing PO_4 concentrations. This phenomenon is similar to refeeding syndrome. Increased PTH concentrations can also cause of hypophosphatemia by promoting PO_4 renal excretion. Hypophosphatemia may develop from respiratory or metabolic alkalosis, although this is infrequent in equine patients. Alkalosis stimulates glycolysis by increasing phosphofructokinase activity, glucose phosphorylation and intracellular PO_4 demands. In addition, parenteral nutrition, hyperglycemia, hyperinsulinemia, and insulin administration can cause hypomagnesemia and hypokalemia by shifting these ions into the cell. Therefore, in animals under nutritional management, it is recommended to assess PO_4 , Mg, and K^+ concentrations. FGF-23 and PTH are phosphaturic hormones that reduce renal reabsorption of PO_4 and may contribute to hypophosphatemia. Hypovitaminosis D is an unlikely cause of hypophosphatemia because most sick foals with low vitamin D concentrations are hyperphosphatemic.

Hyperphosphatemia: Hyperphosphatemia is common in hospitalized foals. Potential causes include metabolic acidosis (e.g., lactic acidosis) that shifts PO_4 to the extracellular compartment, cell lysis, hypoinsulinemia, acute kidney injury, and renal refractoriness to PTH. Phosphate containing enemas can cause hyperphosphatemia in foals, although rare. Hypervitaminosis D is an infrequent cause of hyperphosphatemia, usually iatrogenic, although in some regions could be consequence of plant toxicity.

Clinical Signs: Signs of hypophosphatemia are non-specific and difficult to determine in recumbent or weak animals. Signs are consequence of PO_4 regulatory functions on ion transport, cell membrane stability, and energy metabolism, and include muscle weakness, fasciculations, tremors, neuromuscular excitability, dysrhythmias, ileus, as well as cell membrane fragility and lysis from impaired glucose use, reduced ATP synthesis, and altered cell membrane action potential. Hypophosphatemia may impair leukocyte function and predispose to infections. Signs of hyperphosphatemia are mainly linked to hypocalcemia due to Ca chelation and include hyperexcitability, tetany, muscle fasciculations, ileus and dysrhythmias. In addition to PO_4 , it is important to measure Mg and K^+ concentrations as these ions are highly interactive.

Diagnosis: The diagnosis of hypo- and hyperphosphatemia is based on foal-specific reference values since clinical signs are vague. High PO_4 concentrations in foals parallel increased alkaline phosphatase activity. Laboratory abnormalities (e.g., hypomagnesemia) should also be considered as well as concurrent treatments, especially those related to energy supplementation. Hyperphosphatemia can be overlooked under the premise that PO_4 concentrations are higher in foals. In foals with hyperphosphatemia, it is important to assess the acid-base status (acidosis), Ca concentrations, and other electrolytes. Sepsis-mediated hypoparathyroidism could contribute to hyperphosphatemia.

Treatment: Most PO_4 disorders are addressed by treating the underlying condition. Parenteral supplementation with PO_4 salts is indicated in animals with severe hypophosphatemia, ideally via phosphate salts administered intravenously or orally. Potassium or sodium phosphate are available, but if unavailable, enemas that contain monobasic and dibasic sodium phosphate can be given via nasogastric intubation or rectally. Treatment of hyperphosphatemia is not specific and includes addressing the underlying process, correcting acid-base status, and Ca supplementation.

MAGNESIUM DISORDERS

Hypomagnesemia: Causes of hypomagnesemia include sepsis, GI disease, tissue sequestration, acute kidney injury, intracellular shift, and endocrine abnormalities. Hypomagnesemia could be a consequence of hyperglycemia, hyperinsulinemia, intestinal disease, and prolonged fluid therapy. Alkalosis can decrease Mg^{2+} concentrations. Mg deficiency increases intracellular Ca^{2+} which primes a pro-inflammatory response, releasing IL-1 β , IL-6, TNF- α , acute phase proteins, and free radicals. Mg is neuroprotective by blocking Ca^{2+} entry through the NMDAR, thus reducing excitotoxicity. Mg depletion could interfere with Ca homeostasis, energy regulation, cardiovascular function, and neuromuscular activity. Hypomagnesemia is often associated with hypokalemia and hypophosphatemia, especially in animals receiving enteral or parenteral nutrition. Any reaction that requires energy (PO_4 , ATP) also requires Mg^{2+} . Hyperinsulinemia shifts Mg^{2+} to the intracellular compartment and increases the activity of the Na^+/K^+ -ATPase, which requires PO_4 and Mg^{2+} to move K^+ intracellularly. Calcium regulation depends on Mg for PTH secretion and receptor activation. Mg concentrations should be measured in critically ill animals as it may influence therapy and outcome.

Hypermagnesemia: Hypermagnesemia is rare in equine patients and might occur from cell lysis (e.g., rhabdomyolysis, hemolysis) or chronic renal failure, but can be iatrogenic, in particular from enteral or parenteral administration of Mg salts.

Clinical Signs: Signs of hypomagnesemia and Mg depletion include muscle weakness, tremors, seizures, spasticity, cardiac dysrhythmias, synchronous diaphragmatic flutter, and ileus. Hypokalemia, hypocalcemia, and hypophosphatemia can also be present with some signs occurring as a combination of these electrolyte abnormalities. Signs hypermagnesemia are not specific and, and at least in horses, may reduce neuromuscular activity, have calming effects, reduce physical activity, and decrease blood pressure.

Diagnosis: The diagnosis of hypo- and hypermagnesemia is based on blood TMg and Mg^{2+} concentrations. Hypomagnesemia is frequent in critically ill equine patients, and often missed because Mg is not included in many chemistry profiles. Measurement of Mg concentrations is recommended in hospitalized animals, mainly in those with hypocalcemia, receiving enteral or parenteral nutrition, with hypophosphatemia and hypokalemia, or that have signs of neuromuscular excitability. Hypermagnesemia can be present in acute and chronic conditions.

Treatment: Intravenous $MgSO_4$ is indicated in foals and horses with hypomagnesemia, hypocalcemia, extended fasting, prolonged fluid therapy, and electrolyte abnormalities associated with enteral or parenteral nutrition and hyperglycemia (hypokalemia, hypophosphatemia, hypomagnesemia). Administration should be considered in foals with neurological disorders (NMS, seizures, cerebral and spinal trauma).

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ORAL ABSTRACTS

ROOM A2-81.01

Oral presentation

Friday 15 November 2024, 11.30-11.45

Pharmacokinetics of co-administration of misoprostol and sucralfate in adult horses

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Introduction:

Misoprostol and sucralfate are frequently utilized in the treatment of glandular gastric ulcers in horses. While sucralfate can bind with various medications, potentially affecting absorption when administered concurrently. However, co-administration of oral medications is desirable in equine treatment protocols. The objective of the study was to evaluate the pharmacokinetic profile of misoprostol following a single dose of misoprostol alone in comparison to misoprostol co-administrated with sucralfate in adult horses.

Materials and Methods:

This study consisted of two-phases, employing crossover pharmacokinetic study in eight horses. Treatment 1 included 5mcg/kg misoprostol tablet (M). Treatment 2 involved the co-administration of 5mcg/kg misoprostol tablets with a 12mcg/kg sucralfate tablet (MS). Both the treatments were administered as a top-dress pellet. Plasma samples were collected for analysis of misoprostol concentrations using liquid chromatography mass spectrometry. Standard single compartment pharmacokinetic parameters were calculated.

Results:

Mean \pm standard deviation results were reported for C_{max} (pg/mL) (M: 96.4 ± 61.1 ; MS: 101.7 ± 77.3), T_{max} (hr) (M: 0.8 ± 0.3 ; MS: 0.6 ± 0.2), $T_{1/2}$ (hr) (M: 0.9 ± 0.7 ; MS: 1.6 ± 1.5), mean residence time (hr) (M: 1.1 ± 0.4 ; MS: 1.2 ± 0.4), and AUC_{last} (pg*hr/mL) (M: 113.5 ± 94.4 ; MS: 194.7 ± 195.9). No statistical difference was identified in misoprostol pharmacokinetic parameters when administered alone in comparison to co-administration with sucralfate.

Conclusion:

This study confirmed that sucralfate did not result in a statistically significant change in misoprostol absorption when co-administered.

Clinical Relevance:

Additional work is needed to evaluate the clinical effect of administration dosage regimens in horses with glandular gastric ulcers. Co-administration of misoprostol with sucralfate may be a viable approach when treating horses clinically.

Oral Presentation

Friday 15 November 2024, 11.45-12.00

Comparing the inter- and intra- rater reliability of two scoring systems for equine gastric glandular disease

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Introduction:

The grading of Equine Gastric Glandular Disease lesions remains a controversial topic. A previously recommended system of descriptive terminology has shown poor inter-rater reliability. A modified 0-4 grading system has shown good inter- and intra-rater reliability. This study was designed to compare the descriptive terminology system with the 0-4 grading system. The hypothesis was that there would be increased inter- and intra-rater reliability with the 0-4 grading system.

Methods:

Gastroscopy images of 30 glandular lesions of varying types and severity were assessed in duplicate under masked review by 3 board-certified internal medicine specialists using both scoring systems. Images were viewed in a random order. Krippendorff's Alpha was used to determine intra- and inter-rater reliability of both systems and of individual criteria within the descriptive system. A non-parametric Kruskal-Wallis test was used to evaluate correlations between numerical grades and descriptive terms; $P \leq 0.05$ was considered significant.

Results:

Numerical grade ($\alpha=0.96$), severity ($\alpha=0.92$), appearance ($\alpha=0.91$), topography ($\alpha=0.92$), and distribution ($\alpha=0.88$), each as sole descriptive criterion, showed near perfect intra-rater agreements. Numerical grade ($\alpha=0.66$) and severity ($\alpha=0.68$), as sole descriptive criterion, also showed substantial inter-rater agreements, although what was considered 'normal' epithelium varied between assessors. There was a significant association between numerical grade and severity ($P < 0.0001$). When all 4 descriptive terms were combined there was poor inter-rater agreement ($\alpha=0.07$). Generally, erythematous lesions were given lower numerical grades (median=1, ranging from 0 to 3) than any of the other descriptive terms (median=3, ranging from 2 to 4). There were no significant associations between any descriptive term and numerical grade amongst assessors.

Conclusion and Clinical Relevance:

Numerical grade and severity appear comparable; numerical grade showed better intra- and inter-rater agreement than the descriptive system.

Limitations: use of still images and visualised on individual screens

Oral Presentation

Friday 15 November 2024, 12.00-12.15

Pituitary gland abscessation after maxillary cheek tooth extraction in three horses

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Introduction:

Reports of pituitary gland abscessation are rare in horses.

Methods:

This case series describes three horses diagnosed with pituitary gland abscessation at the Equine Veterinary Teaching Hospital at Utrecht University, between 2005 and 2023.

Results:

A (partial) extraction of a maxillary cheek tooth was performed in a 19-year-old Welsh pony mare (horse 1), a 6-year-old Standardbred gelding (horse 2) and a 16-year-old Trakehner gelding (horse 3), because of alveolitis of 207 (horse 1) and 209 (horse 2 and 3). The three horses developed pyrexia 1-11 days post-extraction and showed signs of a central nervous system disorder including dullness, muscle tremors and ataxia. All horses were treated with antimicrobials, nonsteroidal anti-inflammatory drugs and dexamethasone. Antimicrobial treatment included gentamycin and penicillin in all horses initially, in horse 1 followed by metronidazole and trimethoprim/sulfonamide. Horse 1 and 3 were additionally treated with vitamin B1, intravenous fluids and omeprazole. All three horses were euthanized due to marked deterioration of the neurological signs despite treatment. On post-mortem examination all horses were found to have pituitary gland abscessation; additionally, a concurrent meningitis was found in all horses and an embolic pneumonia was found in two horses (horse 1 and 2). Horse 1 had a concurrent osteomyelitis in the bone surrounding the ventral aspect of the pituitary gland. Bacterial culture from the pituitary gland was performed only in horse 2 and 3 and *Bacteriodes* spp. was cultured from both horses. In horse 3, additionally a mixed culture with other anaerobic bacteria was found.

Discussion/clinical relevance:

Pituitary gland abscessation should be considered as a differential diagnosis in horses with fever and signs of central nervous system disorder after maxillary cheek tooth extraction. Anaerobic bacteria including *Bacteriodes* spp. may be involved.

Oral Presentation

Friday 15 November 2024, 14.30-14.45

The seasonality of insulin concentrations in horses

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Introduction:

Measurement of serum insulin concentrations is the basis of diagnosis, monitoring and prevention of insulin dysregulation and insulin-associated laminitis. Current reference values do not consider seasonal variations in insulin concentrations and evidence available is limited. Our aim was to investigate the seasonality of insulin.

Methods:

Analysis of laboratory data from the Liphook Equine Hospital from 2012 to 2023. Cases were included where submissions requested resting insulin. Other endocrine variables were also measured in many of the cases. Breed effect was assessed in the 9 most prevalent breeds: Arab, Cob, Connemara, Irish Sport Horse, New Forest, Shetland, Thoroughbred, Warmblood and Welsh; and donkey. Multivariate analysis was used to investigate a seasonal effect alongside other variables.

Results:

In total, >50,000 submissions requested insulin analysis. In cases where it was requested, basal ACTH concentrations showed expected seasonal changes, as previously published. Insulin showed significant seasonal variability and was highest in winter (estimate = 2.2; SE \pm 0.3; P < 0.001) and lowest in late summer and autumn (estimate = -0.4 and -0.7, respectively; SE \pm 0.1; P < 0.001) compared with spring. The circannual pattern was broadly similar for all breeds except for resting insulin values in Thoroughbreds which had higher values in June and donkeys which had the highest insulin in May.

Discussion:

Circannual changes in insulin showed higher values through winter and the lowest values through the summer and autumn. This could reflect a physiologic adaptation to increasing sugar ingestion through the grazing season being associated with a diminishing b-cell response. Alternatively, seasonal changes in peripheral insulin sensitivity (therefore resting insulin concentrations) could lie behind this observation.

Clinical relevance:

An improved understanding of insulin seasonality may improve the interpretation of laboratory data and management of clinical cases.

Oral Presentation

Friday 15 November 2024, 14.45-15.00

Retrospective case series on short-term responses and lipoprotein profiles following treatment with dapagliflozin or ertugliflozin in horses with insulin dysregulation.

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Introduction:

Sodium-glucose cotransporter 2 inhibitors (SGLT2i) are prescribed to manage hyperinsulinemia but the effects of dapagliflozin have not been investigated. Although hyperlipaemia is very rare, hypertriglyceridemia is commonly associated with SGLT2i treatment and investigation of the lipoprotein profiles is warranted.

Methods:

Retrospective analysis of clinical records and stored serum from horses with hyperinsulinaemia that received dapagliflozin (0.02mg/kg, (n=34)) or ertugliflozin (0.05mg/kg (n=24)) PO SID for 30 days. Within-horse changes, correlations between variables and differences between treatments were assessed using Wilcoxon signed-rank, Spearman's rank correlation coefficient (rho) and the medians tests respectively.

Results:

Between day 0 (pre-treatment) and day 30 within-horse changes (median, inter-quartile range (IQR) were: basal serum [Insulin] (uU/ml) reduced from 170 (92-280) to 28.7 (14.5-90), ($p < 0.0001$), lameness grade (scale 0-12) reduced from 6 (4-10) to 2 (0-2), ($p < 0.0001$), serum [triglyceride] (mmol/l) increased from 0.5 (0.3-0.6) to 1.0 (0.6-1.56), [β -hydroxybutyrate] (umol/l) increased from 0.22 (0.17-2.7) to 0.30 (0.24-0.35) ($p < 0.0001$), [total cholesterol] (mmol/l) increased from 2.36 (2-2.6) to 2.84 (2.4-3.7) ($p < 0.0001$) and, as a percentage of serum lipids, high-density lipoprotein (HDL) reduced from 52.4% (47.9%-61.0%) to 50% (41%-54.8)% ($p = 0.034$), very-low density lipoprotein (VLDL) increased from 10.4% (6.4%-14.4%) to 12.3% (9.9%-16.8%) ($p = 0.005$). Differences between ertugliflozin and dapagliflozin groups in these parameters were not significant at day 0 or 30. At day 30, 10/48 (21%) cases had [triglycerides] > 2.0mmol/l (maximum = 10.8mmol/l). Day 30 [triglyceride] was correlated with day 0: basal insulin ($p < 0.001$, $\rho = 0.47$), [triglyceride] ($p = 0.003$, $\rho = 0.42$) and %VLDL ($p = 0.019$, $\rho = 0.34$) and day 30: [total cholesterol] ($p < 0.001$, $\rho = 0.67$), %HDL ($\rho = -0.432$, $p = 0.014$) and %VLDL ($\rho = 0.708$, $p < 0.001$).

Discussion and clinical relevance:

Dapagliflozin or ertugliflozin treatment is associated with reductions in [insulin] and lameness grade. Changes in [triglyceride] and lipoprotein profiles were usually minor with occasional marked hypertriglyceridemia. [β -hydroxybutyrate] increased indicating ketosis, a metabolic pathway previously not thought to be relevant in horses.

ORAL PRESENTATION ACVIM Resident Research Abstract Award Winner

Friday 15 November 2024, 15.05-15.20

A High-protein Meal Is Associated with Increased Glucose-dependent Insulinotropic Polypeptide Secretion in Insulin-dysregulated Horses

Allison Palmer, DVM – The Ohio State University

Background:

The incretin hormones glucose-dependent insulinotropic polypeptide (GIP) and glucagon-like peptide 1 (GLP-1) augment post-prandial insulin secretion. Managing equine insulin dysregulation (ID) often involves feeding high-protein ration balancers. Recent studies suggest that dietary amino acids can promote GIP secretion, enhancing post-prandial [insulin]; this may increase the risk of hyperinsulinemia following consumption of high-protein meals in horses with ID.

Hypothesis:

Consumption of high-protein meals will increase post-prandial [GIP] and [GLP-1] in horses with experimentally-induced ID. Animals: Adult light-breed horses with normal [ACTH] (n = 7).

Methods:

Each horse underwent a frequently-sampled insulin-modified IV glucose tolerance test to characterize systemic insulin/glucose dynamics and a feed challenge test (FCT; 1 kg ration balancer [min 32% CP, max 13% NSC] consumed within 15 minutes, [GIP] and [GLP-1] measured 0-240 minutes afterward). Both tests were repeated after induction of ID (dexamethasone, 0.08 mg/kg PO SID, 7 days). Outcomes, including [GIP] and [GLP-1] during the FCT, were compared between baseline and ID.

Results:

[GIP] and [insulin] increased after a high-protein meal; ID AUC-GIP (1166 ± 363 pg/mL) was significantly higher than baseline AUC-GIP (767 ± 199 pg/mL; $P = 0.014$). There was no difference in AUC-GLP-1 between baseline (50.7 ± 16.6 pg/mL) and ID (39.1 ± 25.3 pg/mL; $P = 0.47$).

Conclusions and Clinical Importance:

Horses with experimentally-induced ID displayed significantly greater GIP responses to a high-protein meal than at baseline, suggesting that GIP plays a role exacerbating post-prandial hyperinsulinemia in this context.

Oral Presentation

Friday 15 November 2024, 15.20-15.35

Preliminary results on the measurement of beta-endorphins in horses with pituitary pars intermedia dysfunction

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Introduction:

Pituitary pars intermedia dysfunction (PPID) is a common disorder in aged horses, associated with overproduction of proopiomelanocortin-derived peptides, including beta-endorphins. Three reports from the early 1990s demonstrated elevated beta-endorphin concentrations in horses with PPID compared with controls.

Methods:

A competitive immunoassay, designed for measuring beta-endorphin concentrations in human samples, was validated for use in equine serum. Beta-endorphin concentrations were measured in July in horses with PPID (n=17; ACTH: 76.4-1251 pg/ml) and healthy controls (n=17; ACTH 9.7-27.4 pg/ml), and in both July and October in horses with PPID (n=8; ACTH: July 51.9-433.4 pg/ml, October 98.8-1251 pg/ml) and healthy controls (n=8; ACTH: July 5.6-16.7 pg/ml, October 11.5-42 pg/ml). Groups were defined based on ACTH concentrations.

Results:

The within- and between-assay CVs of the assay were 3.37% and 3.24%, respectively.

Beta-endorphin concentrations were significantly higher ($P < 0.01$) in horses with PPID (median, 195 pg/mL; range, 9-1440 pg/mL) compared with controls (median, 22 pg/mL; range, 5-64 pg/mL). ACTH and beta-endorphin concentrations were significantly correlated in horses with PPID ($\rho = 0.5$; $P = 0.04$) but not in controls.

Regarding seasonal differences, beta-endorphin concentrations were significantly higher in horses with PPID in July (median, 165 pg/mL; range, 47-950 pg/mL) and October (median, 506 pg/mL; range, 211-1764 pg/mL) compared with controls (July: median, 74 pg/mL; range, 19-167 pg/mL; October: median, 217 pg/mL; range, 33-474 pg/mL).

Beta-endorphin concentrations measured in July that exceeded 91 pg/mL exhibited a sensitivity and specificity of 76% and 96%, respectively, for detecting PPID (AUC 0.90).

Conclusions:

The assay used is suitable for the measurement of equine beta-endorphin concentrations. Our analysis demonstrates that beta-endorphins are higher in horses with PPID compared to controls and that concentrations surpassing 91 pg/mL show diagnostic potential for detecting PPID.

Clinical relevance:

This study serves as a basis to investigate the role of beta-endorphins in the pathophysiology and diagnosis of equine PPID.

Oral Presentation

Friday 15 November 2024, 15.35-15.50

Vena contracta and proximal isovelocity surface area as potential echocardiographic measurements for severity grading of mitral valve regurgitation

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Introduction:

Vena contracta (VC) and proximal isovelocity surface area (PISA) measurements are commonly used in human cardiology to assess mitral valve regurgitation (MR) severity. This preliminary retrospective study aimed to investigate whether VC and PISA measurements can be used to distinguish different grades of MR in horses.

Methods:

VC and PISA measurements were performed on cardiac examinations of 80 horses with MR, aged 7±6 years. The VC width and radius, flow and area of the PISA were measured on a right and left parasternal view using colour flow Doppler. From the right parasternal view MR could only be visualized in 53 horses. MR was graded according to the MR grading system used by the Equine CardioTeam Ghent as trivial, mild, moderate or severe. Each group consisted of 20 horses. Since data were non-normally distributed, the Kruskal-Wallis test was used for pairwise comparisons.

Results:

On a left parasternal view, VC width and PISA (radius, flow and area) measurements (n=80) showed a significant difference between the following groups of MR: trivial-moderate (p<0.001), trivial-severe (p<0.001), mild-moderate (p<0.03), mild-severe (p<0.001). However, all measurements displayed a considerable amount of variation, illustrated here with the VC data: trivial: 0.37cm[0.10-0.50], mild: 0.61cm[0.20-1.50], moderate: 0.99cm[0.40-1.60], severe: 1.47cm[0.60-2.30]. Right parasternal images (n=53) only showed a significant difference between trivial-severe (p=0.038), mild-moderate (p=0.048) and mild-severe (p=0.008) in the radius and area PISA measurements. PISA flow only showed a significant difference between mild-severe MR (p=0.006).

Conclusion:

VC and PISA (radius, flow and area) measurements on a left parasternal view differed significantly between different MR grades and were superior to the same measurements on a right parasternal view.

Clinical relevance:

Since VC and PISA measurements can be used to distinguish certain grades of MR, they may have an added value in improving MR diagnosis. However, measurement variability still needs to be determined.

ROOM A2-82.01
Oral Presentation

Friday 15 November 2024, 11.30-11.45

Development and application of the EFFE (Ecographic Fast Foal Evaluation) protocol: a pilot study

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Introduction:

Point-of-Care Ultrasound protocols in adult horses (e.g., FLASH and CRASH) are increasingly used in emergency scenarios. This pilot study aimed to develop and apply a focused ultrasound (US) protocol to assess specific thoraco-abdominal windows in foals.

Methods:

EFFE (Ecographic Fast Foal Evaluation) protocol included 12 thoraco-abdominal US windows from left and right recumbency (4 right-side, 3 ventral, 5 left-side) using a curved array probe (frequency 5-1MHz). To test feasibility and preliminary diagnostic performances, qualitative imaging score (QIS; 0-3), 2D-US findings, small intestine motility score (SIMS; 1-4) and diagnosis were described in a cohort of healthy (n=12) and sick (n=14) foals. Images were blindly reviewed by the same observer.

Results:

Acquisition time was relatively long but improved along with experience. In healthy and sick foals (QIS, 2.6 vs 2.3), stomach was visible in 100% vs 71% in a ventral view (cranio-caudal diameter, 5.4cm vs 6.2cm; wall thickness, 0.40cm vs 0.39cm), duodenum in 92% vs 83% in a right-side view (1 vs 0.78 contractile act/10sec; wall thickness, 0.25cm vs 0.23cm), small intestine in 100% in a ventral view (SIMS, 3.9 vs 3.2, p=0.04; wall thickness, 0.23cm vs 0.24cm), large intestine (wall thickness, 0.33cm vs 0.32cm) and urinary bladder in 100% of cases in a right-side and ventral view, respectively. EFFE imaging findings agreed with the clinicians' diagnosis in all sick foals with strangulating (e.g., intussusception), non-strangulating intestinal lesions (e.g., enteritis) and peritoneal effusions (e.g., uoperitoneum and septic peritonitis) (n=7). Three/12 views were poorly performing.

Discussion:

The overall feasibility of EFFE protocol was good. For optimization, left-side views may not be performed, and total windows reduced to 4 right-side and 3 ventral views in the left recumbency only.

Clinical Relevance:

Once validated, EFFE protocol may become a useful tool in emergency settings for rapid US diagnosis of major abdominal equine neonatal conditions.

Oral Presentation

Friday 15 November 2024, 11.45-12.00

Neuronal and astroglial dysfunction in critically ill neonatal foals

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Introduction:

Neurological dysfunction is often recognized in critically ill foals presented for sepsis or neonatal maladjustment syndrome (NMS). Astrocyte and neuronal proteins such as glial-fibrillary-acidic protein (GFAP), astrocytic-protein-S100B, and brain-derived neurotrophic factor (BDNF) may be used for monitoring and prognosis in critically ill foals. The goal of this study was to measure the plasma concentration of biomarkers of neurological damage in healthy and critically ill foals and to determine their association with outcome.

Methods:

Biomarker concentrations were measured in foals (<7 days old) upon admission and at 24h and 48h of hospitalization in this prospective, longitudinal study. Based on clinical and laboratory findings foals were categorized into 4 groups: healthy (n=8), septic (n=17) with sepsis score > 12, sick non-septic [SNS] (n=19), and NMS (n=14). The plasma concentration of biomarkers was determined using ELISA and single-molecule-array technology, and the data were analyzed using parametric methods.

Results:

Baseline BDNF concentration was higher compared to 24h and 48h in septic foals (P<0.05). In NMS foals, BDNF concentration decreased over the first day of hospitalization and was lower compared to healthy foals at 24h (P<0.05). Baseline GFAP concentration was decreased in all 3 groups of foals compared to healthy. NMS and SNS had lower concentrations of GFAP at 24 and 48h compared to healthy foals (P<0.05). In SNS foals, S100B concentrations decreased from baseline over 24h (P<0.05). Non-survivors had a decreased baseline concentration of GFAP and increased concentration of BDNF compared to survivors (P<0.05).

Discussion and clinical relevance:

An increased concentration of BDNF on admission in septic and NMS foals is consistent with its role in postnatal brain development, synaptogenesis, and survival. Reduced GFAP concentration in NMS and septic foals suggests astroglial dysfunction or delayed postnatal astroglialogenesis. Both BDNF and GFAP may be used as prognosticating factors in critically ill foals.

ORAL PRESENTATION ACVIM Resident Research Abstract Award Winner

Friday 15 November 2024, 12.00-12.15

Biomarkers of Brain Injury in Foals with Neonatal Maladjustment Syndrome

Javier Perez Quesada, DVM – North Carolina State University

Background:

Neonatal maladjustment syndrome (NMS) is a common disease of foals resulting in neurological dysfunction and increased mortality. Plasma biomarkers of brain injury, such as brain-derived neurotrophic factor (BDNF), glial-fibrillary-acidic protein (GFAP), and astrocytic-protein-S100B may be used for diagnosis and monitoring of foals with NMS.

Objectives:

To measure plasma concentration of biomarkers of neurological damage (BDNF, GFAP, and S100B) in foals with NMS, foals presented for other diseases (sick-foals), and healthy foals, and determine their association with outcome. Animals: 8 healthy foals, 10 NMS foals, 16 sick-foals hospitalized for other diseases (e.g. diarrhea) < 7 days of age. Of the NMS and sick-foals, 20 survived and 6 did not.

Methods:

Biomarker concentrations were determined in all foals on admission and at 24h, 48h, and 72h of hospitalization in this prospective, longitudinal study. Plasma concentration of biomarkers was measured with ELISA and single-molecule-array technology. Data were analyzed with parametric methods.

Results:

GFAP concentration was decreased in NMS and sick-foals compared to healthy foals at time 0 (0.9 ± 0.52 , 0.6 ± 0.21 , 3.7 ± 1.2 ng/mL), 24h (0.84 ± 0.22 , 0.73 ± 0.25 , 3.6 ± 1.03), and 48h (0.5 ± 0.1 , 0.56 ± 0.12 , 3.1 ± 0.8) ($P < 0.05$), respectively. Non-survivors had a decreased concentration of GFAP (0.4 ± 0.12 ng/mL) compared to healthy foals (3.7 ± 1.2) and survivors (1.2 ± 0.21) over the first 24h of hospitalization ($P < 0.05$). BDNF and S100B concentrations were not different between groups of foals or time points ($P > 0.05$).

Conclusions:

Reduced GFAP concentration in NMS and sick-foals suggests astroglial dysfunction or delayed postnatal astroglialogenesis. GFAP may be used as a prognosticating factor in critically ill foals.

Oral Presentation

Friday 15 November 2024, 14.30-14.45

Equine Corona Virus infections in adult horses: investigating seroconversion and faecal shedding patterns

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²Royal GD, Deventer, Netherlands

Introduction:

Equine Corona Virus (ECoV) causes outbreaks of anorexia, pyrexia, lethargy, and enteric disease in horses. In this study we aim to 1) evaluate if horses seroconvert after clinical ECoV infection and 2) to investigate the pattern of faecal excretion of ECoV to determine the optimal testing moment.

Methods:

We performed a prospective observational study of a naturally occurring outbreak of ECoV including 16 horses presenting with clinical complaints. Serum was collected twice from each horse: on the first day of clinical signs (D1) and 16 days later (D16). Seroconversion was defined as change from negative to positive and a significant increase as at least 0.6 sample to positive ratio units (S/P units) between acute and convalescent samples. Clinical data and faecal swabs for PCRs were collected on D1, D2, D3, D4, D7, D10, D13 and D16.

Results:

Eight out of sixteen horses 50% (95% CI 26%-75%) seroconverted or showed a significant increase in S/P units by D16 and 11/16 horses 69% (95% CI 46%-91%) had a positive PCR result at least once within the study period. Shedding was intermittent, some horses tested negative before then testing positive again. Day 2 had the greatest number of positive PCR results; 6/16 horses 38% (95% CI 14%-61%). At day 16, 3/16 horses 19% (95%CI 0%-38%) were still shedding ECoV.

Discussion:

Seroconversion or a significant increase in S/P units, identified 50% of cases with ECoV complaints. Day two after the start of clinical signs was the most likely day to detect ECoV by PCR in our study. Faecal shedding was found to be intermittent over the course of 16 days.

Clinical relevance:

Submitting faecal samples over multiple days might improve chances of detecting ECoV by PCR. Demonstrating seroconversion or a significant increase in S/P units could be a useful adjunctive test to PCR.

Oral Presentation

Friday 15 November 2024, 14.45-15.00

Seroprevalence of West Nile, Usutu, and Tick born encephalitis virus in equids from the Southwest of France in 2023

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Introduction:

In 2022, France faced the emergence of West Nile virus (WNV) on the Atlantic coast, in Gironde county. Three equine cases of WNV infection were diagnosed in October 2022 with symptoms consistent with ataxia, weakness, and/or encephalitis.

We investigated the seroprevalence of WNV and the occurrence of orthoflaviviruses actively circulating (Usutu (USUV) and Tick born encephalitis viruses (TBEV)) within three risk zones defined in Gironde containing wetlands and protected bird habitats.

The aim was to obtain an overview of orthoflaviviral circulation in Southwestern France and to evaluate risk factors associated with WNV seropositivity.

Methods:

Serum samples were collected from 494 equids during spring 2023. They were first tested for IgG orthoflavivirus using a commercial pan-flavivirus ELISA kit. Positive serum samples were then subjected to virus neutralisation tests specific for WNV, USUV and TBEV.

Mixed-effects logistic regression models were then performed.

Results:

Our results confirm an active circulation of WNV in the Confluence area of Gironde (seroprevalence rate of 9%). The occurrence of USUV and TBEV in equids was estimated to 5% and 2% respectively.

For WNV, model selection allowed to identify two risk factors of VNT seropositivity in the Confluence zone: the type of housing with a strongly increased risk in animals always kept on pasture, and the distance to the nearest bird protection area, with a decreasing risk when this distance increased.

Conclusions:

WNV seroprevalence rate estimated in horses in Gironde is close to that estimated on the Mediterranean basin. The type of housing and the distance to bird protected habitats were identified as risk factors associated with an increase of WNV seropositivity.

Clinical relevance:

Active circulation of orthoflavivirus is reported for the first time in Gironde, reflecting epidemiological changes. Environmental factors and animal housing must be taken into account to mitigate the risk of exposure.

Oral Presentation

Friday 15 November 2024, 15.05-15.20

Comparison of the long-term humoral immune response against West Nile virus in clinically and inapparently infected horses

C. H. Tolnai¹, P. É. Forgách¹, B. Paszerbovics¹, O. Kutasi¹

¹University of Veterinary Medicine Budapest, Budapest, Hungary

Introduction:

West Nile virus (WNV) emerges into new territories and re-emerges in endemic areas causing significant numbers of equine and human neurological cases annually. According to the literature, survivors develop life-long immunity against the pathogen; however, the data are limited in horses.

Our study aimed to compare the magnitude and length of humoral immune response in clinically and asymptotically infected horses.

Methods:

Serum samples were taken from naturally infected animals 1-, 2- and 4 years post-infection. 19 clinically and 25 asymptotically infected horses were enrolled into the study. The WNV neutralising antibody (nAb) titers were measured. First, a WNV IgG ELISA was performed, followed by a micro-wells virus neutralisation assay.

Results:

All clinically infected horses were WNV IgG positive during the study. 25/25 asymptotically infected animals were seropositive in the first year of the study, afterwards, one horse became and remained seronegative. The mean nAb levels in the first, second and fourth year of the study were 704 (SD = 554.6), 435.2 (SD = 352.8) and 554.6 (SD = 376.8) in clinically infected horses and 241.8 (SD = 334.5), 128.1 (SD = 134.9), and 15.1 (SD = 21.8) in asymptotically infected animals, respectively. A significant difference ($p = 0.0139$) was found between the WNV nAb levels of clinically and asymptotically infected animals. There was a significant decrease ($p < .01$) in titers over time among inapparently infected horses, while this was not statistically significant in clinically infected animals.

Discussion:

The level of nAbs correlates best with the protection against Orthoflaviviruses. Clinically infected horses maintained protective WNV nAb levels 4 years post-infection, however, the significantly decreased WNV titers of inapparently infected animals might not be protective against re-infection.

Clinical Relevance:

We recommend the regular monitoring of WNV nAb levels. Animals with inadequate protection should be vaccinated.

Oral Presentation

Friday 15 November 2024, 15.20-15.35

Sequencing bacterial cell-free-DNA to detect pathogenic bacteria in the blood of equine neonates; a pilot study

E.W. Siegers¹, L.T. Chen², A.E. Wesdorp², M. Jager², C. Vermeulen², A.L. Zomer¹, A.J. Brom-Spiereburg¹, C.M. Westermann¹, E.M. Broens¹, J.A. Wagenaar¹, J. Ridder², M.J.P. Theelen¹

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Introduction:

Blood stream infections (BSI) are an important cause of death in neonatal foals. Current diagnostic methods are time consuming and lack sensitivity and specificity. In humans, bacterial cell-free-DNA (cfDNA) sequencing enables rapid detection of bacterial pathogens. The aim of this study was to explore the diagnostic potential of bacterial cfDNA sequencing in neonatal foals.

Methods:

Eight healthy and 22 ill foals (<14 days) were included in this pilot study. Ill foals were classified based on neonatal systemic inflammatory response syndrome (nSIRS) scores: n=10 positive (nSIRS+), n=12 negative (nSIRS-). Blood samples were collected for cfDNA sequencing. Single-stranded sub-nucleosome-size-enriched DNA-capture based library preparation was used to enrich for bacterial cfDNA, followed by untargeted illumina sequencing. Total cfDNA yield, host mitochondrial cfDNA fraction and bacterial cfDNA fraction were compared between groups using a Kruskal-Wallis and post-hoc Dunn's test. The reads were decontaminated and classified to detect pathogenic bacterial species and compared to blood culture results.

Results:

Bacterial cfDNA was detected in all foals at varying levels. No significant differences were observed in total cfDNA or bacterial cfDNA fraction between groups. Mitochondrial cfDNA fraction was lower in nSIRS+ compared to healthy foals ($p=0.013$). In the nSIRS+ foals, 80% showed elevated bacterial counts compared to healthy background counts, whereas only 30% had positive blood cultures. Elevated numbers of bacterial genera associated with BSI were observed in the SIRS+ group compared to the SIRS- and the healthy group. The observed mapped bacterial species identified multiple species per individual foal.

Discussion/clinical relevance:

in SIRS+ foals, 80% had elevated mapped bacterial cfDNA levels with multiple bacterial species identified, whereas only 30% of SIRS+ foals had a positive blood culture. Bacterial cfDNA sequencing holds potential as a new and potentially more sensitive diagnostic tool for detecting BSI in foals. These findings support further investigation to validate the technique.

Oral Presentation

Friday 15 November 2024, 15.35-15.50

Nosocomial syndrome surveillance in an equine veterinary teaching hospital: prevalence and feasibility.

L. Liot¹, M. Allano¹, T. Juette¹

¹Université de Montréal, Saint-Hyacinthe, Canada

Introduction:

Healthcare-acquired infections, or nosocomial syndromes (NS), are a health issue, requiring surveillance. There is little data in veterinary medicine. We aimed to estimate the prevalence of seven nosocomial syndromes in our teaching hospital and to study the feasibility of an active surveillance tool.

Methods:

A paper-based questionnaire was developed and pre-tested. For each patient hospitalized at least one night for 8 weeks, data (signalment, occurrence of one or more SNs, procedures, and treatments) were collected prospectively and verified with medical records. A survey was submitted to respondents at the end of the collection period. Descriptive analyses were used, including prevalence estimations. The statistical effect of variables on prevalence was tested using a generalized linear mixed model (R software).

Results:

Out of 116 equids, 29 (25%, CI 95%: 17-32) presented at least one SN: mainly intravenous catheter site infections (11%), digestive syndromes (9%), fever of unknown origin (7%), surgical site infections (3%) and respiratory syndromes (2%). Sepsis and urinary inflammation were not detected. Six patients presented more than one SN. The variables gender, age, breed, duration of hospitalization, service of admission, and type of affection did not significantly affect the occurrence of SNs ($P > 0.05$). Respondents were satisfied with the tool but suggested some modifications.

Conclusions and clinical relevance:

The prevalence of nosocomial syndromes was measured prospectively for the first time at our equine hospital, using an active surveillance tool. It appears applicable in the long term, even if adjustments will be necessary to improve data collection.

Saturday 16 November 2024

Room A2-81.01

Oral Presentation

Saturday 16 November 2024, 10.45-11.00

Identifying the origin of left atrial ectopy, including pulmonary veins, via multiple catheter recording in the right heart

E. Buschmann¹, G. Van Steenkiste¹, I. Vernemmen¹, M. Demeyere¹, S. Schauvliege¹, A. Decloedt¹,
G. Van Loon¹

¹Ghent University, Merelbeke, Belgium

Introduction:

Knowing the anatomical origin of atrial arrhythmias is essential before planning ablation. In humans and dogs, multiple catheter mapping allows to characterize arrhythmias but requires fluoroscopy, a poorly applicable technique in horses. The aim was to perform ultrasound-guided multiple catheter mapping via the right heart during left atrial pacing in order to identify specific activation patterns characteristic for the origin of ectopy.

Methods:

In seven anesthetized horses, under ultrasound guidance and confirmation by 3D mapping, four decapolar catheters were positioned at the crista terminalis, tuberculum intervenosum, caudal vena cava and coronary sinus (CS) for electrogram recording. After performing a transseptal puncture, a fifth catheter was used to pace (45/min) in the left atrium at left atrial appendage, septum, ostium I, II, III and IV. Atrial activation timings were recorded for each pacing site, relative to the pacing stimulus (0 ms).

Results:

Pacing the left atrial appendage sequentially activated CS (38[IQR 54]ms), tuberculum (100[32]ms), crista (115[43]ms) and caudal vena cava (127[53]ms). Pacing the septum activated the caudal vena cava (67[24]ms), tuberculum (71[22]ms), CS (87[24]ms) and crista (102[36]ms). Activation patterns from ostium I and II were: CS (60[20]ms; 76[24]ms, respectively), caudal vena cava (103[17]ms; 84[40]ms), tuberculum (124[34]ms; 119[92]ms) and crista (145[14]; 131[58]ms). Pacing ostium III activated tuberculum (66[18]ms), caudal vena cava (70[33]ms), crista (93[21]ms) and CS (123[13]ms). Pacing ostium IV activated CS (81[36]ms), tuberculum (107[44]ms), caudal vena cava (119[36]ms) and crista (139[16]ms).

Conclusion:

Pacing-induced ectopic depolarizations from the left atrium result in characteristic multiple catheter activation patterns.

Clinical relevance:

Ablation of pulmonary veins has been performed experimentally but is very challenging, requiring a long anesthesia. Knowing the anatomical origin of atrial premature depolarizations is helpful to target specific pulmonary veins for ablation in order to reduce atrial fibrillation recurrence and might reveal which pulmonary veins are most often arrhythmogenic.

Oral Presentation

Saturday 16 November 2024, 12.00-12.15

Metformin mitigates atrial remodeling in horses with induced chronic atrial fibrillation

S.D. Nissen¹, S.L. Haugaard¹, M. Schneider¹, S.A.T. Kjeldsen¹, S.M. Sattler¹, J.A. Bastrup¹, J.B. Birk¹, C. Hansen¹, H. Carstensen¹, C. Hopster-Iversen¹, A. Altintas¹, T.A. Jepps¹, S. Larsen¹, R. Kjøbsted¹, J.F.P. Wojtaszewski¹, A. Saljic¹, T. Jespersen¹, R. Buhl¹
¹University of Copenhagen, Copenhagen, Denmark

Introduction:

Atrial fibrillation (AF) is a prevalent cardiac arrhythmia characterized by progressive atrial remodeling, challenging conventional therapy approaches. This study investigates the potential of metformin in preventing cardiac remodeling during chronic AF in horses. Metformin is an indirect AMP-activated protein kinase (AMPK) activator and is currently used for treating equine metabolic syndrome, however, studies suggest that the activation of AMPK may be protective against AF.

Methods:

Twenty retired Standardbred racehorses underwent continuous right atrial (RA) tachypacing until self-sustained AF was achieved. Another four horses served as sham-operated controls. Ten horses were treated with 30 mg/kg metformin orally twice daily during the study period and ten served as controls. After four months of AF, AF inducibility and atrial refractoriness were assessed. The transcriptomic and proteomic changes of the posterior wall of the atria were assessed, followed by a comprehensive metabolic and structural tissue characterization.

Results:

Metformin-treated horses required significantly longer tachypacing compared to control horses ($p = 0.02$) and had longer RA effective refractory periods after 4 months of AF compared to controls ($p = 0.03$). Prolonged atrial refractoriness is considered to be protective against AF. RNA sequencing and proteomic analysis revealed upregulation of AMPK signaling pathways and mitochondrial function in metformin-treated horses. Right atrial AMPKa2 activity was higher in metformin-treated horses. However, metformin did not significantly alter mitochondrial ultrastructure or function. Our molecular analysis identified significant changes in protein levels regulating the atrial extracellular matrix, however, overall atrial collagen levels on histology did not differ between groups.

Conclusion:

Four months of AF induced atrial electrical and molecular remodeling, but metformin treatment appeared to protect against AF initiation and progression.

Clinical relevance:

Our findings support the use of metformin for AF prevention in horses and propose AMPK activation as a promising drug target for AF management.

Oral Presentation

Saturday 16 November 2024, 12.15-12.30

Heart Rate Variability based upon P-wave indices in horses: an exploratory study

G. Van Steenkiste¹, E. Van Den Branden¹, A. Decloedt¹, G. Van Loon¹

¹Ghent University, Merelbeke, Belgium

Introduction:

Heart rate variability (HRV) aims to assess autonomic tone by measuring variation in sinus node depolarization, usually measured by RR-intervals. In horses, significant PQ variations and 2° atrioventricular-blocks may affect results. Therefore, our study compared P-wave and R-wave intervals for HRV assessment in horses.

Methodology:

24-hour resting ECGs were recorded from 9 healthy mares, clinically assessed to ensure absence of distress. ECG data were processed with custom Matlab scripts for filtering, normalization, and QRS-complex detection. Automatic QRS-markers were manually corrected. Bifid P-waves were identified within specific windows set by Q onset and T-wave offset, considering amplitude, slope, morphology, and prominence to detect P onset (Pon), P1 peak, and P2 peak. HRV metrics such as standard deviation (SDNN), root mean square (RMSSD), Triangular Index (TRI), low-(LF), and high-frequency (HF) components, and LF/HF have been calculated from the different P-wave indices and RR intervals over 30-minute time windows. A general mixed model with post-hoc Bonferroni correction compared the HRV measures with marker type (P or R wave) as a fixed effect.

Results:

HRV metrics for P2P2 intervals showed significantly lower SDNN, RMSSD, and TRI (mean difference -24.5, -11.9, -1.7, respectively; $P < 0.001$) but higher HF and LF/HF (0.069 and 0.008, $P < 0.001$) compared with RR intervals. HF was higher for P1P1 (0.093, $P < 0.001$). P1P1 intervals exhibited decreased SDNN (-23.1, $P < 0.001$) and LF/HF (-0.124, $P < 0.001$). PonPon and RR metrics did not differ significantly. 2° atrioventricular-blocks and large PQ variations were absent in this study sample.

Conclusions:

P-wave interval analysis is feasible for HRV analysis in horses, offering a potential advantage over RR interval assessment in more accurately reflecting autonomic nervous system function. Further studies on horses with more 2° atrioventricular-blocks and PQ variations are needed to confirm.

Clinical relevance:

P-wave-based HRV metrics may improve autonomic tone monitoring precision by mitigating atrioventricular nodal conduction effects.

Oral Presentation

Saturday 16 November 2024, 14.15-14.30

Effect of steamed hay on airway inflammation in horses with severe equine asthma

M. Leclère¹, C. Raïsky¹, B. Mozo Vives¹, L. Leduc¹, A. Symoens¹, T. Juette¹, C. Bédard¹
¹Université de Montréal, St-Hyacinthe, Canada

Introduction:

Although steaming hay reduces respirable particles, it has shown inconsistent results in clinical studies. The objective was to compare airway inflammation in horses with severe equine asthma (SEA) fed dry hay and steamed hay for a month. We hypothesized that horses with SEA would develop airway inflammation when fed dry hay but not steamed hay.

Methods:

Nine horses with SEA from a research facility were selected. Before the study, they were maintained in remission on a pelleted diet, indoors. They were then fed steamed and dry hay for 4 weeks, in a prospective, cross-over study, with a 4-week washout period on a pelleted diet. Bronchoalveolar lavage fluid (BALF) differential cell counts were analyzed before and after 4 weeks of hay feeding. Data were analyzed using a linear mixed model with post-hoc tests and Benjamini-Hochberg corrections for multiple comparisons, and a Pearson correlation test was performed between BALF neutrophils with dry and steamed hay.

Results:

Pulmonary neutrophils increased after the 4-week period (time effect and post-hoc End versus Baseline: $p < 0.001$), with no significant difference between dry and steamed hay (Baseline dry: mean 6.7% (SD 5.4); End dry: 13.1% (6.0); Baseline steamed: 5.6% (2.6); End steamed: 10.5% (4.4)). There was no significant correlation between airway neutrophilia of horses fed dry hay and steamed hay ($r : -0.2, p = 0.7$).

Discussion:

Since all horses were housed in the same barn, those receiving steamed hay were also exposed to the dust generated by handling dry hay during feeding time. This nevertheless reflects common practice in many barns. The results are consistent with those of a previous study in which a short exposure (5 days) to steamed hay led to an increase in BALF neutrophils.

Clinical Relevance:

Feeding steamed hay does not prevent airway inflammation in horses with severe asthma.

Oral Presentation

Saturday 16 November 2024, 14.30-14.45

Dust exposure and pulmonary inflammation in mild asthmatic horses fed pelleted or round bale hay - A pilot study

S. Preez¹, S. Franklin¹, J. Watson¹, S. Gaskin¹, Y. M.. Tefera¹, R. M.. Jurkowski¹

¹The University of Adelaide, Adelaide, Australia

Introduction:

The mainstay of treatment and prevention of equine asthma (EA) is centred around reduction of organic dust exposure. Most of the organic dust originates from feed matter, rather than the environment.

Objectives:

To evaluate respirable particle exposure and airway inflammation of horses fed a pelleted diet compared with round bale hay, using two feeder types.

Methods:

Four horses, with mild EA (mEA) were housed in paddocks (40mx20m) during a 16-week cross-over design, with four-by-four-week exposure periods. During exposure period one and three, all horses were fed a pelleted diet. During exposure period two and four, horses were in two groups (n=2), each group was fed round bale hay from either a small-hole-net or metal feeder. Breathing zone dust particle collections and clinical examinations, including "improved clinically detectable equine asthma scoring system" (IDEASS) clinical score, were performed weekly and respiratory endoscopies, tracheal wash and bronchoalveolar lavage (BAL) were conducted fortnightly.

Results:

Median (Inter Quartile Range) of respirable dust exposure was significantly higher in horses fed round bale hay, 0.180 (0.05-0.41) mg/m³, in comparison with pelleted diet, 0.085 (0.04-0.18) mg/m³, P=0.037, whilst no significant differences were found between the net and metal feeder. The round bale diet resulted in significantly higher BAL neutrophil proportions compared to the pelleted diet, 4.67% (3.00-8.08%) and 1.33% (1.00-2.68%), P<0.0001 respectively, with no significant difference between the net and metal feeder. Clinical score (mean rank) was significantly higher for the metal feeder (1.88) than the pelleted diet (1.13, P=0.034), with no significant difference between the pelleted and net, nor the net and metal feeder diets.

Discussion:

The complete pelleted diet resulted in lower respirable dust exposure, less pulmonary inflammation, and lower clinical score than the round bale diet.

Clinical relevance:

Feeding round bale hay has a detrimental effect on the respiratory health of horses with mEA.

ROOM A2-82.02

ORAL PRESENTATION ACVIM Resident Research Abstract Award Winner

Saturday 16 November 2024, 09.50-10.05

**Characterization of Renal Lipidosis in Equids: A Postmortem Case-Control Study
(2008-2022)**

Kali Slavik, DVM – University of Pennsylvania

Background:

Although reported in other species, findings associated with renal lipidosis have not been previously described in horses and donkeys.

Objective:

To describe the signalment, clinicopathologic indices, and postmortem findings of equids with histologic diagnosis of both hepatic lipidosis and renal lipidosis (HL+RL) and compare to matched cases with hepatic lipidosis only (HL).

Animals: Twenty five equids with findings of renal and/or hepatic lipidosis at necropsy from a state diagnostic laboratory between 2008-2022.

Methods:

Retrospective case-control study. Signalment, history, affected system, and selected biochemical data were extracted from medical records. Each case of HL+RL was assigned a matched control from group HL for comparison of selected clinical data.

Results:

Renal lipidosis was diagnosed in 0.55% of equid necropsies. Donkeys with hepatic lipidosis were more likely to also have renal lipidosis (7/13, 54%) compared to horses and ponies (18/197, 9%; $p < 0.005$). No cases of renal lipidosis were identified without concurrent hepatic lipidosis. Renal lipidosis cases most commonly presented with gastrointestinal (61%, 16/25) or neurologic (46%, 12/25) disease. Group HL+RL had a higher median intake plasma lactate (+6.2 mmol/L, IQR 0.4-10.5; $p=0.04$) and higher GGT activity (+246 U/L, IQR 72-360; $p=0.02$) compared to group HL controls. No significant differences between groups were noted in creatinine or triglyceride concentration.

Conclusions:

Renal lipidosis is an occasional postmortem finding in equids with hepatic lipidosis, but is markedly more common in donkeys. Cases with renal lipidosis were not more likely to be azotemic than those with only hepatic lipidosis. The clinical significance of renal lipidosis is unknown.

Oral Presentation

Saturday 16 November 2024, 10.45-11.00

Exploring paraoxonase-1 as a marker of inflammation and oxidative stress in horses with colitis

M. Winther¹, J. Johnsson², P. Madsen², S. Jacobsen¹, T. Pihl¹, S. Paltrinieri³, D. Scavone³, J. Céron⁴, L. Pardo-Marin⁴

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³University of Milan, Department of Veterinary Medicine and Animal Sciences, Milan, Italy

⁴University of Murcia, Department of Animal Medicine and Surgery, Murcia, Spain

Introduction:

Oxidative stress occurs due to imbalance between the production of reactive oxygen species and available antioxidants, and it is connected to inflammation. While the inflammatory response during equine colitis is well characterized, the role of oxidative stress is less understood. The novel marker paraoxonase-1 (PON-1) decreases during inflammation and oxidative stress, and its serum activity was therefore investigated in horses with colitis to assess its diagnostic and prognostic capacity.

Methods:

PON-1 activity was measured at admission in 161 horses with colitis and 57 healthy horses. Follow-up samples from 106 horses with colitis were available. Correlation analyses were used to compare PON-1 activity with known inflammatory- and disease severity markers (serum amyloid A [SAA], serum fibrinogen, serum iron, white blood cell count [WBC], heart rate [HR], blood lactate, packed cell volume [PCV]).

Results:

Serum PON-1 activity was significantly lower in horses with colitis (median [min-max range] U/mL) (44.7 [3.8-147.0]) compared to healthy horses (77.5 [11.3-112.6]), and in non-survivors (38.6 [3.8-147.0]) compared to survivors (49.4 [8.8-118.0]). However, PON-1 activity could not reliably categorize horses as survivors/non-survivors and the sensitivity and specificity were poor to-modest. Activity did not change consistently over time in response to treatment. Serum PON-1 activity was significantly but weakly correlated with SAA, HR and blood lactate.

Conclusion:

Despite statistical differences between groups, PON-1 activity varied greatly within horses with colitis and there was no consistent change in activity, neither in horses with resolution of clinical signs (survivors) nor in horses that did not respond to treatment (non-survivors). PON-1 activity correlated only weakly with known inflammatory markers and disease severity markers and does not appear to reflect the clinical status of horses with colitis.

Clinical relevance:

PON-1 seems to add little to existing markers as it had suboptimal diagnostic performance and little prognostic abilities in horses with colitis.

Oral Presentation

Saturday 16 November 2024, 12.00-12.15

Evaluation of biomarkers (BIOs) in healthy and colic horses: correlation with Systemic Inflammatory Response Syndrome (SIRS) status and outcome

F. Bindi¹, A. Elias-Cortajarena², L. De Marchi¹, V. Vitale², A. Spadari³, R. Rinnovati³, G. Sala¹, F. Bonelli¹, M. Sgorbini¹

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Introduction:

In colic horses, ischemic damage and inflammation have been attributed to morbidity and mortality and disease-associated molecular changes. This study aimed to measure BIOs in healthy and colic horses to assess the correlation with SIRS status and outcome.

Methods:

This prospective, multicentric study enrolled 78 horses: 10/78 were healthy, 68/78 were colic. At admission, 24, 48, 72, and 96h post-hospitalization, colic horses underwent a complete physical exam, blood collection, and SIRS status assessment. A SIRS-positive status was defined by the alteration of 2 or more of the following parameters: HR (>52 bpm), R (>20 bpm), temperature (<37 or >38.5°C), WBC (<5 or >12.5×10⁹/L). Blood collection and SIRS status assessment were performed once in healthy horses. Data distribution was assessed using the Shapiro-Wilk test. Differences in BIOs concentration among groups (SIRS-positive, SIRS-negative, survivor, and non-survivor, accounting for sampling times, were analyzed using the Generalized Linear Mixed Models (IBM SPSS, BM-Corporation, USA).

Results:

Overall, 44/78 were SIRS-negative and 34/78 SIRS-positive horses. Significant differences were found between SIRS-positive and SIRS-negative horses for lipid peroxidation (p=0.005), butyrylcholinesterase (p=0.002), glutathione S-transferase (p=0.028), and glutathione peroxidase activities (p=0.011). Significant differences were found between survivor and non-survivor horses for lactate (p<0.001), superoxide dismutase (p=0.003), and total antioxidant capacity (p= 0.027).

Discussion:

Colic horses exhibited BIOs' variations and alterations in relation to SIRS status and outcome. To date, studies have assessed these BIOs individually or in combination across different species and under various pathology, yielding heterogeneous results. To our knowledge, this is the first study assessing this panel of BIOs in relation to the SIRS status and outcome in colic-afflicted horses.

Clinical relevance:

The BIOs assessed in this study might be potential tools in determining the SIRS status and forecasting outcomes in colic horses. Further research is needed to clarify their potential clinical application in colic-afflicted horses.

Oral Presentation

Saturday 16 November 2024, 12.15-12.30

Measurement of thymidine kinase-1 activity in serum and body cavity fluids in horses with lymphoma, inflammatory bowel disease and other non-inflammatory gastrointestinal disorders.

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³Institute for Veterinary Epidemiology and Biostatistics, FU Berlin, Berlin, Germany

Introduction:

Serum thymidine kinase-1 activity (TK1_S) is an internal tumor marker with variable accuracy. Measurement of TK1 in peritoneal / pleural fluid (TK1_{PF}) remains unestablished in horses. The aim of this study was to compare both results.

Methods:

TK1_S and TK1_{PF} were measured (chemiluminescent immunoassay) in horses with lymphoma, inflammatory bowel disease (IBD) and other non-inflammatory gastrointestinal disorders (control). Wilcoxon test compared TK1_S and TK1_{PF}, while Spearman's rho (ρ) assessed correlation. Kruskal-Wallis test examined group differences. Data were presented as median and interquartile range. Significance was set at $p < 0.05$.

Results:

Among the 29 horses, 10 had lymphoma, 8 had IBD and 11 were controls. TK1_{PF} (3.52 U/L; 1.18–14.15 U/L) was significantly higher ($p=0.001$) than TK1_S (0.69 U/L; 0.49–1.89 U/L). A moderate correlation between TK1_S and TK1_{PF} was observed ($\rho=0.42$, $p=0.03$), with the strongest correlation in control group ($\rho=0.77$, $p=0.006$). Significant differences were found in TK1_S between groups ($p=0.02$), but not in TK1_{PF} ($p=0.35$). TK1_S in horses with lymphoma (3.45 U/L; 0.65–8.16 U/L) was significantly higher ($p=0.02$) than in controls (0.49 U/L; 0.49–0.75 U/L), but not significantly higher than in IBD (0.67 U/L; 0.49–1.52 U/L).

Discussion:

TK1_{PF} measurement proved feasible and can be performed on peritoneal / pleural fluid routinely taken during oncologic work-up. Notably, TK1_{PF} showed a relevant rise compared to TK1_S in most horses with lymphoma, but elevation was observed in few horses with IBD as well. The main limitation was the small sample size, potentially preventing the detection of group differences. Additionally, inflammation accompanying gastrointestinal diseases might elevate TK1_S and potentially TK1_{PF}.

Clinical relevance:

Reference ranges for TK1_{PF} in horses should be evaluated. Further studies are needed to assess the usefulness of TK1_{PF} in lymphoma diagnostics and differentiation from other proliferative disorders, including inflammation.

Oral Presentation

Saturday 16 November 2024, 14.15-14.30

Histological and Immunological Comparison of Gastrointestinal Biopsies with their Respective Full-Thickness Tissue Counterpart in Horses

D.J. Jean¹, C.R. Ruault¹, J.M. Monbrun¹, T.J. Juette¹, N.W. Wenzlow²

¹University of Montreal, St-Hyacinthe, Canada

²Texas Tech University, Amarillo, Texas, United States

Introduction:

The histologic interpretation of gastrointestinal biopsies remains a challenge in horses, with lacking standards for these procedures.

Objectives:

The study aimed to 1) describe and compared the histological and immunological findings in biopsy and full-thickness gastrointestinal (GI) segments in horses.

Methods:

Ten donated horses (6 females, 3 geldings and one stallion; 5 to 28 years old) to the University of Montreal, without digestive conditions, were used. Full-thickness and endoscopic forceps obtained mucosal biopsies were taken postmortem from the duodenum, jejunum and rectum in each horse. Standard hematoxylin eosin phloxine saffron (HEPS) sections from all GI tissues were evaluated blinded histologically by a board-certified veterinary pathologist. Immunohistochemically stained slides allowed histomorphometrical counts (absolute numbers per field) of B lymphocytes (CD20) and T lymphocytes (CD3) within the duodenal and rectal epithelium, lamina propria (apical and basal areas) and the subcryptal areas (rectum only). CD3 and CD20 staining of biopsy samples were compared with the same immunohistochemical staining of three sections of their corresponding full-thickness duodenal and rectal counterparts of equivalent size. Each section of full-thickness tissue had similar size to the biopsies taken. Results were analyzed using intra-class correlation (ICC).

Results:

Preliminary data show that biopsies tissues tend to under-estimate the number of lymphocytes and plasma cells in the duodenal lamina propria compared to their full-thickness counterparts. Eosinophils are more prevalent in the jejunum compared to the duodenum. Rectal biopsies tend to have lower counts of neutrophils and macrophages compared to their full-thickness counterparts.

Discussion:

the trend to under-estimate the immune cells in the duodenum biopsies compared to the full-thickness duodenum and jejunum could hide a more severe and diffuse digestive infiltration.

Clinical relevance:

These differences of immune cell distribution in the different sections of the horses' GI tract must be taken into consideration when interpreting GI tissues of equine patients.

Oral Presentation

Saturday 16 November 2024, 14.30-14.45

Genome-wide association study introduced novel genomic loci of insect bite hypersensitivity in Finnhorses

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¹University of Helsinki, Helsinki, Finland

²University of Oulu, Oulu, Finland

Introduction:

Equine insect bite hypersensitivity (IBH) is an allergic skin disease caused by the allergens in the saliva of *Culicoides* spp. The IgE-mediated reactions are characterised with chronic seasonal pruritic dermatitis. Pruritis often results to severe skin lesions and significantly impairs the well-being of horses. IBH is thought to be multifactorial; morbidity is influenced by both environmental and genetic factors.

Methods:

DNA samples were collected from Finnhorses with typical, recurrent (at least 2 consecutive years) IBH symptoms (age minimum 3 years) and healthy controls (age minimum 10 years). The symptoms included pruritus, skin thickening, hair loss and scaling. A case-control genome-wide association study was performed using the Illumina's Equine 80K Genotyping BeadChip containing 65157 single nucleotide polymorphisms (SNPs). PLINK v1.9 software were used for association analysis by applying the Fisher's exact test and for pruning and quality control.

Results:

DNA samples were available from 72 cases (mean age \pm SD 11.5 \pm 5.9) and 72 controls (mean age \pm SD 15.9 \pm 4.7). The lowest *P*-value was found in SNP BIEC2_1080912 ($P = 9.241 \times 10^{-6}$, OR = 3.719) which is in chromosome 9.

Discussion and Clinical Relevance:

Protein coding gene close to the SNP with the lowest *P*-value is a potential candidate gene for IBH. Candidate gene has role in the formation and regulation of several immune cells. Additionally, it promotes immune exhaustion. Further studies are required to clarify the role of this candidate gene in IBH in Finnhorses.

POSTER ABSTRACTS

Poster presentation 1

Longitudinal changes in fecal short chain fatty acids during hospitalization in horses with different types of colic and their association with survival

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Introduction:

Short chain fatty acids (SCFA) are end-products of intestinal bacterial fermentation. Previous research has assessed longitudinal changes in the fecal bacterial microbiota of horses with colic, but evolution of their metabolome remains unknown. This study investigates SCFA dynamics in horses hospitalized with different colic types and their association with survival.

Methods:

Twenty-three horses with colic were prospectively studied, including 9 with inflammatory pathologies (INFL group), 9 with simple obstruction (SIMPLE group), and 5 with strangulated obstruction (STR group). Fecal SCFA (C2, C3, C4, iC4, C5, iC5, C6) were quantified by solid-phase microextraction and gas chromatography-mass spectrometry on days 1 (admission), 3, and 5 of hospitalization. Data were analyzed using a mixed model analysis including the effect of horse, group, and hospitalization duration, and considered significant when $p < 0.05$.

Results:

Concentrations of C5 ($p=0.0346$) and C6 ($p=0.0418$) were significantly higher in INFL compared to SIMPLE group on admission. By day 3, C2, C3, and C4 were higher in SIMPLE compared to INFL group (respectively $p=0.0035$, 0.0218 , and 0.0134), while iC4, iC5, C5, and total SCFA were higher in SIMPLE compared to INFL and STR group (respectively, $p=0.0015$ and 0.0385 ; $p=0.0006$ and 0.0185 ; $p=0.0061$ and 0.0093 ; $p=0.0138$ and 0.0335). On day 5, concentration of SCFA were not statistically different between groups. Survivors exhibited lower C2, C4, iC4, C5, iC5, and total SCFA on day 5 (respectively $p=0.0057$, 0.0296 , 0.0044 , 0.0443 , 0.0102 and 0.0110).

Conclusions:

Fecal SCFA profile in hospitalized horses with colic varies with disease type and survival status.

Clinical relevance:

The use of fecal SCFA profile as outcome markers in horses with colic deserves further research.

Poster presentation 2

Fungal gastric lesions: morphological, histopathological and microbiological features in three horses

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Introduction:

Fungal gastrointestinal infections are rare in the horse. *Candida spp.* are ubiquitous yeast, part of the skin and mucosal microbiota of human and animals, that can become opportunistic pathogens under suitable conditions. In the horse, gastrointestinal candidiasis has been described in neonatal foals but not in adults. In humans, *Candida* colonization has been associated to inflammatory bowel disease (IBD) and gastric cancer.

Methods:

Our aim is to describe the morphological, histopathological and microbiological features of gastric lesions associated with fungal infiltration in 3 horses referred to tertiary hospitals for weight loss and other unspecific signs. Multiple ancillary test to investigate weight loss were performed. Common features, including results of gastroscopy, gastric and duodenal biopsies, fungal and bacterial culture of the gastric lesions will be described.

Results:

Horses included a 3 y.o. Miniature stallion, a 10 y.o. KWPN gelding and a 11 y.o. crossbred mare. Grossly, fungal lesions appeared as irregular, multifocal, yellow/white pseudo-membranous plaque-like areas on the squamous gastric mucosa. Concomitant grade 2 ESGD was found in 2 horses and pyloric lesions in 1 horse. On histological examination, fungal involvement was confirmed in all cases by the presence of fungal hyphae infiltrating the superficial layers of the squamous mucosa. Fungal culture yielded *Candida spp* in 2 horses and was negative in one. Bacterial colonization of gastric lesions was supported in 2 horses by histology or culture. Additionally, mild to moderate lymphoplasmacytic duodenitis was identified in all horses.

Conclusion:

Candida spp. can be found in the stomach of adult horses associated to lesions with a characteristic yellow/white pseudo-membranous aspect. As described in humans, concomitant IBD can be found in affected patients.

Clinical relevance:

Candida spp. infection of the stomach can occur in adult equine patients. Further studies are needed to establish its clinical significance and a possible relationship with IBD.

Poster presentation 3

Clinical, clinicopathological, pathological and genetic findings in six Franches-Montagnes foals with suspected hypertriglyceridemia-induced pancreatitis

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Introduction:

Severe acute pancreatitis associated with hypertriglyceridemia is rarely reported in foals. A genetic cause for suspected hypertriglyceridemia-induced pancreatitis in foals has not yet been described.

Methods:

The current abstract delineates a retrospective case series of six Franches-Montagnes foals with confirmed pancreatitis at necropsy. Genetic analyses were carried out to identify the cause of the suspected hypertriglyceridemia-induced pancreatitis.

Results:

Median age of the affected foals at admission was 5 days (range 4-93) and all six were fillies. The affected foals were inbred to a single stallion and their pedigrees were consistent with an autosomal recessive disease. Most common clinical signs included apathy, reluctance to nurse, fever, abdominal distension, and diarrhea. One foal primarily showed neurological signs attributed to hepatoencephalic syndrome. All foals displayed severe hypertriglyceridemia (mean 33.3 mmol/L \pm SD 8.2; RI 0.16-0.73 mmol/L). Lipase activity was measured in 4/6 cases with a median of 146 U/L (range 95-648; RI 9-21 U/L). All the foals were euthanized, and severe necrotizing pancreatitis was diagnosed at necropsy. A candidate causative genetic variant affecting the *LMF1* gene encoding lipase maturation factor 1 was identified. It was a frameshift variant, XM_023616679.1:c.369_373delinsTCT or XP_023472447.1:p.(Leu125Argfs*193). All six foals carried the mutant allele in a homozygous state.

Conclusions:

A causal relationship between severe hypertriglyceridemia and the postmortem diagnosis of pancreatitis in the present cases is strongly suspected. A candidate variant in the *LMF1* gene for hypertriglyceridemia has been identified.

Clinical relevance:

Pancreatitis should be considered in the differential diagnosis of sick foals with diarrhea, colic, and possibly neurologic signs, especially those with high triglyceride levels. Since a genetic predisposition seems to be associated with hypertriglyceridemia and pancreatitis, genetic testing and strict avoidance of carrier x carrier matings should be implemented to prevent this fatal condition in the future.

Poster presentation 4

Association of equine squamous and glandular gastric disease with dental status in 54 horses

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Introduction:

Gastric pH seems to be a key factor for the development of Equine Gastric Ulcer Syndrome (EGUS). It is influenced by amount and duration of roughage uptake, as chewing increases the production of alkaline saliva. The proton-pump-inhibitor omeprazole is currently recommended in the ACVIM/ECEIM consensus statement (CS) for therapy of both Equine Squamous Gastric Disease (ESGD) and Equine Glandular Gastric Disease (EGGD). We hypothesized that dental disease decreases saliva production and in consequence gastric pH, therefore predisposing horses to EGUS.

Material and methods:

Intragastric pH after 12h of feed and 3h of water withdrawal was documented in 54 horses (September 2023 - April 2024). Scoring included grades 0-4 for ESGD (CS), 0-3 for EGGD (modified from CS), and 0-3 for dental disease. Omeprazole therapy (buffered formulation 4mg/kg PO SID, Gastrogard™, Boehringer Ingelheim or enteric coated granules 2mg/kg PO SID, Equizol™, CP Pharma) was recommended (n=32), dental disease was corrected (n=20) and gastroscopy was repeated 4 weeks later (n=9).

Results:

The Chi² test showed a trend that dental disease grade 3-4 was associated with a low gastric pH (1-4) (p=0.100). Moderate-severe dental disease increased the chance of low gastric pH by factor 2.6 (odds ratio [OR] = 2.57; 95% confidence interval [CI] 0.124-1.214). An association between dental disease and ESGD ($\geq 2/4$) (p = 0.394) was not clearly shown and no association was found for EGGD ($\geq 2/3$) (p = 0.857). ESGD was improved ≥ 2 subgrades or achieving grade 0 in 5/9 of horses and EGGD was improved ≥ 1 subgrade or achieving grade 0 in 3/9 horses after omeprazole therapy.

Discussion and clinical relevance:

No influence of dental diseases on ESGD/EGGD could be determined, but may have been found in a larger study population. There is no evidence that gastroscopy should be recommended in horses with dental disease and vice versa.

Poster presentation 5

Antimicrobial treatment approaches to horses with acute diarrhea admitted to referral institutions

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Introduction:

A multicenter description and comparison of antimicrobial treatment approaches for acute diarrhea in horses is missing. This study aimed to describe and compare the treatment approaches for diarrheic horses used in different regions of the world.

Study Design:

Multicenter retrospective study.

Methods:

Information from diarrheic horses presented to participating institutions between 2016 and 2020, including clinicopathological data, pathogens detected, and antimicrobial drug use, was collected.

Results:

This study included 1438 horses and 26 referral institutions across 5 continents (North and South America, Europe, Australia, and Asia). The fatality rate was 24%, with no differences between regions. A pathogen was identified in 16% of the horses. 55% (792/1419) of the horses were administered one or a combination of antimicrobial drugs within the first 24 hours of admission. Penicillin and gentamicin were the most used combination (25%, 198/792). The proportion of horses treated with antimicrobial drugs differed among institutions, varying from 17% to 94%. The proportion of horses treated with antimicrobial drugs was lower in Europe and Australia than in the other geographic areas ($P < 0.05$). In total, 540/1139 (47%) horses had leukopenia, and 70% (380/540) of those horses were administered antimicrobial drugs, while 49% (293/599) of the horses without leukopenia received antimicrobial drugs. 66% (794/1105) of the horses met SIRS criteria, and 28% (311/1105) did not. Of those, 68% (542/794) and 44% (136/311) of the horses that did and did not meet SIRS criteria, respectively, were administered antimicrobial drugs.

Discussion:

Treatments varied between regions and hospitals. Prospective clinical trials are required to evaluate the effects of antimicrobial treatment on survival.

Clinical relevance:

The high prevalence of antimicrobial use in diarrheic horses, even without evidence of systemic compromise, indicates that factors other than disease severity influence clinicians' decisions to administer antimicrobial drugs to diarrheic horses.

Does equine asthma predispose horses to premature complexes during exercise?

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Introduction:

A recent study indicated an association between mild-moderate equine asthma (MEA) and premature complexes (PCs) during exercise in Standardbred racehorses. Furthermore, asthma in humans is known to be associated with increased risk of arrhythmias. The hypothesis of this study was that horses with MEA based on clinical signs and bronchoalveolar lavage (BAL) cytology have increased number of PCs during exercise and recovery.

Methods:

A total of 59 horses with a history of poor performance were divided into three groups: Warmbloods, Racehorses and Icelandic horses. All horses underwent a clinical examination, an exercise test with ECG and a BAL. MEA was diagnosed based on increased neutrophil (>5%), eosinophils (>1%), and/or mast cells (>2%) percentages in the right and/or left lung. PCs during exercise and recovery were detected by ECG analysis. Atrial and ventricular PCs were not distinguished.

Results:

MEA was diagnosed in 83% of the horses. One or more PCs were observed in 31% of the horses during exercise and in 2% during the recovery period, with the majority found among the Racehorses (13/18 horses). A significant association between max heart rate (HR) and the occurrence of PCs was found ($p < 0.0001$). No significant association was found between MEA and the occurrence of PCs ($p = 0.15$). A negative correlation was noted between the number of mast cells in BAL from the right side and the occurrence of PCs ($p = 0.04$).

Discussion:

An association between MEA and the presence of PCs could not be confirmed in this study. Future studies should include a control group without poor performance, standardised exercise tests and larger group sizes as breed differences and/or max HR may have influenced the results.

Clinical Relevance:

This study highlights the importance of considering MEA and cardiac arrhythmias as two distinct causes of poor performance that may occur in the same horse.

Poster presentation 7

Discovering Genetic Variants Linked to Exercise-Induced Atrial Fibrillation in Racehorses

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Introduction:

Atrial fibrillation (AF) is a prominent cardiac arrhythmia in human athletes and is frequently observed in equine athletes too. The prevalence of AF in Thoroughbred (TB) and Standardbred (STB) racehorses is notably high (~5%), echoing the heightened risk evident in human athletes, thereby suggesting exercise as a distinct risk factor.

Racehorses, benefiting from selective breeding and detailed pedigree management, offer an ideal setting for genetic research. While both common and rare genetic variations contribute significantly to AF, no study has yet pinpointed genetic variants specifically linked to exercise-induced AF.

Objective:

We aimed to uncover genetic markers linked to exercise-induced AF in racehorses through a genome-wide association study (GWAS).

Methods:

We collected samples from 181 TB and STB racehorses, including 71 with confirmed paroxysmal or persistent AF. Genomic analysis involved whole-genome genotyping, imputation of missing markers, and expanding the control group using publicly available data. GWAS was conducted on 7.85 million markers in 71 cases and 296 controls using PLINK2 with covariates adjusted for population stratification, batch and sex.

Results:

We discovered a notable genetic locus adjacent to the protocadherin gene *PCDH18* linked to AF in horses. This locus has also been linked to the human ECG trait known as P-wave terminal force. Alterations in P-wave terminal force are associated with disturbances in atrial conduction and increased atrial dimensions. Additionally, we observed interesting genetic signals related to amino acid transport (*SLC6A15*), myosin binding (*MYBPH*), and myoblast differentiation (*MYF6* and *MYOG*).

Conclusion:

In this initial analysis, we have uncovered a novel genetic locus linked to atrial function and AF in racehorses. Furthermore, we detected multiple candidate genes warranting further investigation to unravel the genetic underpinnings of exercise-induced AF.

Clinical relevance:

Our findings contribute to the creation of risk assessment tools for exercise-induced AF and the development of novel medications for treatment.

Poster presentation 8

Exploring the molecular landscape of equine Atrial Fibrillation: A multiomics study

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Introduction:

Atrial fibrillation (AF) induces electrical, contractile and structural remodeling of the heart, which are associated with disease progression and treatment resistance. Here, we aimed to characterize the transcriptomic and proteomic changes in the early stages of sustained AF, to better understand the mechanisms contributing to AF induction and maintenance.

Methods:

We collected biopsies from the right atrium (RA), left atrium (LA) and left ventricle (LV) of eight horses with naturally occurring sustained AF (mean estimated AF duration: 47±36 days) and eight controls. We performed data-independent acquisition mass spectrometry on all samples and bulk RNA-sequencing on six samples from each group. Expression profiles were compared between the AF and control group.

Results:

We identified a total of 3,400 proteins, several of which were differentially regulated between AF horses and controls (268 in RA, 324 in LA, and 284 in LV, $p < 0.05$). Proteomic pathway enrichment analyses revealed changes in metabolic, contractile and extracellular matrix (ECM) proteins. Notably, atrial proteins associated with oxidative phosphorylation were upregulated in AF. With transcriptomics, we detected a total of 38,849 transcripts, of which 1,102 (RA), 534 (LA) and 41 (LV) genes were differentially regulated between groups (adj. $p < 0.05$). Gene-set enrichment analysis showed upregulation of ECM and endoplasmic reticulum stress response pathways in both atria, while genes related to muscle cell differentiation and orphan nuclear receptor transcription factors (NR4A1, NR4A2) were downregulated. Atrial ECM remodeling was confirmed by histological staining.

Conclusion:

Our findings detail molecular pathways associated with early AF in horses, which were characterized by substantial ECM remodeling, upregulation of metabolic proteins and transcriptomic evidence of the unfolded protein response.

Clinical relevance:

The molecular changes observed in the early stages of disease reveal new potential drug targets for mitigating disease progression and underscore the importance of early intervention in horses with AF.

Poster presentation 9

The TASK-1 potassium channel in equine atrial myocardium as a potential target to treat atrial fibrillation.

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Introduction:

The TASK-1 potassium channel is a potential target for novel atrial fibrillation therapies. This study aimed to compare human and equine TASK-1 channels and to confirm the presence and atrial-specific expression of TASK-1 channels in equine myocardial tissue. The effect of a TASK-1 blocker, ketodoxapram, was evaluated *in vivo*.

Methods:

Reciprocal Basic Local Alignment Search Tool analysis identified equine orthologs of human TASK-1 genes in the horse genome. Using the established *X. laevis* oocyte system and two-electrode voltage clamp electrophysiology, the functional properties of TASK-1 channels were investigated. Myocardial tissue samples were collected in twelve horses euthanised for non-cardiovascular reasons. TASK-1 expression was analysed using the StepOnePlus PCR system, with RNA quantification and integrity assessed by spectrophotometry and gel electrophoresis. Prior to euthanasia, 0.5 mg/kg ketodoxapram was administered intravenously to six horses under general anaesthesia. Measurements before and after ketodoxapram included atrial effective refractory period (AERP) via intracardiac catheterisation, blood pressure, respiratory rate, heart rate and P wave duration.

Results:

Human and equine TASK-1 channel isoforms are highly homologous, sharing DNA sequences with 96.5% identity and 97.5% similarity at protein level. Functional similarity could be observed as equine TASK-1 channels had the same current-voltage relationship as the human isoforms. Equine TASK-1 channel expression was higher in the atria compared to the ventricles ($P=0.0023$). Ketodoxapram administration resulted in increased AERP (median 250 [210-340]ms versus 420 [290-530]ms, $P=0.042$) with transient increases in blood pressure and respiratory rate, without changes in heart rate or P wave duration.

Conclusion:

There is a high degree of structural and functional similarity between human and equine TASK-1 channels, with predominantly atrial expression. AERP increased significantly after ketodoxapram administration without adverse effects.

Clinical relevance:

Medical treatment options for AF horses remain limited. Ketodoxapram, a TASK-1 blocker, might be a promising, safe drug for treating equine AF.

Preliminary validation of a smart textile device during high-speed exercise for ECG quality & heart rate measurement

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Introduction:

Widespread assessment of exercise-induced arrhythmias in horses requires user-friendly cardiac monitors. This study aimed to evaluate a novel smart textile band (Skiin Equine; Myant Inc.) for recording of electrocardiograms (ECGs) during strenuous exercise by comparing diagnostic quality and measurements of heart rate with a reference ECG device.

Methods:

ECGs were recorded simultaneously using the Televet II and Skiin Equine device in 16 separate exercise tests on 13 healthy Standardbred racehorses in training, during high-speed exercise. GPS data was extracted to determine maximum speed for each trial. ECGs were evaluated using Kubios software, where the percentage of artefact was recorded, and the diagnostic quality of the traces assessed by a blinded observer. Maximal heart rate (HR_{max} ; calculated over 30 sec) was calculated over 30 seconds during peak exercise and compared between devices. Pearson's correlation was performed and Bland-Altman test used to assess agreement (bias, 95% limits) between the two devices.

Results:

The median (IQR) peak speed during exercise was 13.90m/s (13.15-14.25m/s). One Skiin ECG and 2 Televet ECGs had artefact >10%. One Televet trace was excluded from further analysis due to loss of an electrode during maximal exercise. Mean (SD) HR_{max} was 225bpm (4.9) for Skiin vs 223bpm (4.9) for Televet. There was a very strong correlation between devices ($r=0.94$; $P<0.01$) and agreement was 1.53bpm (-3.4, 3.4).

Conclusion:

The Skiin Equine device provides a reliable ECG trace for heart rate detection, potentially allowing its application to widespread monitoring of horses during high-speed exercise. Further study is required to confirm its diagnostic capabilities for arrhythmia detection.

Clinical Relevance:

New smart textile technology may play a valuable role in cardiac arrhythmia detection and diagnosis.

Intra and interobserver reliability of pulsed-wave tissue Doppler imaging of the left ventricle in healthy Standardbred neonatal foals

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Introduction:

Little is known about tissue Doppler imaging (TDI) of the left ventricle (LV) in foals. The aim of this study was to assess intra and interobserver reliability of pulsed-wave (PW) TDI measurements for characterization of LV wall motion in healthy foals.

Methods:

Transthoracic echocardiography was performed in seven healthy Standardbred foals within 24 hours of life by an experienced operator. PW-TDI tracings were acquired on the LV free wall (LVFW) at the level of the chordae tendinae from a right parasternal short axis view, and on the septal and parietal LV segments at the level of the mitral annulus from a subcostal (SC) view to assess radial and longitudinal LV velocity profiles. PW-TDI systolic (S_1 , peak velocity during isovolumic contraction; S_m , peak systolic velocity) and diastolic (E_1 peak velocity during isovolumic relaxation; E_m , peak proto-diastolic velocity; A_m , peak late diastolic velocity) velocities were measured from the three views by four independent observers with various experience (equine internal medicine board-certified, PhD student, junior clinician, undergraduate student). Intra and interobserver reliability were evaluated using intraclass correlation coefficients (ICC). Measurement variability was quantified calculating the within-subject coefficient of variation (CV) and repeatability coefficient (RC).

Results:

Interobserver agreement was excellent (ICCs > 0.75) for all variables except S_m and E_m at the septal LV segment which showed a good agreement ($0.60 \leq \text{ICC} < 0.75$). Intraobserver reliability was good or excellent, except for S_m at the septal LV segment which was poor. The CV was <10% for all radial motion variables measured at the LVFW and longitudinal motion variables at the parietal but not septal LV segment.

Conclusions:

PW-TDI indices of LVFW radial and longitudinal wall motion have excellent inter and intraobserver reliability in healthy neonatal foals.

Clinical relevance:

PW-TDI indices may be implemented in the assessment of LV function of neonatal foals

Poster presentation 12

Bicuspid pulmonary valve in horses: a case series

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Introduction:

Bicuspid pulmonary valve (BPV) is a rare congenital condition described in human medicine, often associated with other congenital heart diseases. The occurrence of BVP is rarely mentioned in equine literature.

Methods:

Retrospective data (8 year period) were reviewed of all horses admitted for cardiac evaluation (n=2115) because of a murmur, arrhythmia, poor performance or congestive heart failure.

Results:

BPV was echocardiographically identified from a left-sided parasternal short-axis view in 19 horses. Median age was 4 years (range 8 days-22 years). Ten horses showed BVP combined with a ventricular septal defect (VSD), of which four showed additional congenital cardiac anomalies. In five, moderate to severe pulmonary valve regurgitation was present. Nine showed some degree of pulmonary stenosis, of which three had a 'hockey-stick' pulmonary valve, and three moderate stenosis (peak flow velocity > 2.6 m/s). One horse showed a bilateral holodiastolic (2/6) and left-sided holosystolic (5/6) murmur correlated with moderate pulmonary regurgitation and the hockey-stick valve conformation, respectively. In the other horses, attributing specific murmurs to the presence of a BPV was challenging due to coexistence of other heart diseases. In three horses marked pulmonary artery dilatation was present, of which one horse with also moderate pulmonary valve regurgitation was retired, and of which 2 had to be euthanized due to additional congenital heart disease and signs of congestive heart failure.

Conclusion:

BPV was often associated with VSD or other valvular regurgitation. In many patients BPV was thought to have no or limited clinical effects at the moment of examination. In three patients BPV resulted in severe pulmonary valve regurgitation, stenosis or pulmonary artery dilatation.

Clinical relevance:

Left parasternal views of pulmonary valve and artery allow to diagnose BPV, pulmonary stenosis, presence of a hockey-stick valve and pulmonary artery dilatation, and should be included in routine echocardiography.

Equid hepatitis B virus detected in two livers of donkeys with hyperlipemia

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Introduction:

Recent research has revealed significant similarities between the newly detected equid hepatitis B virus (EqHBV) and the hepatitis B virus (HBV) in humans. EqHBV was detected in 3.2% of sampled donkeys and zebras with a seroprevalence of 5.4% and displays a worldwide distribution. So far, all horses have tested negative. In donkeys, the virus exhibits hepatotropism and can lead to chronic infections, with histopathologic findings such as inflammation and fibrosis resembling those seen in HBV infections. This study aims to determine the prevalence and impact of EqHBV on different equid hepatopathies.

Methods:

A retrospective analysis was conducted on 92 formalin-fixed, paraffin-embedded (FFPE) liver samples, including 79 horses and 5 donkeys diagnosed with various hepatopathies and 8 healthy control livers. FFPE sections were stained with Hematoxylin and Eosin for histopathologic evaluation. DNA was extracted from FFPE liver samples and quantitative PCR (qPCR) analysis was performed to detect the presence of EqHBV-DNA. Positive samples underwent digital PCR (dPCR) to quantify viral loads.

Results:

Two livers tested positive for EqHBV-DNA by qPCR. Both originated from donkeys clinically diagnosed with hyperlipemia. Viral load measured by dPCR was 12.25×10^3 GE/million cells in case 1 and could be detected but not reliably quantified in case 2. Histologic examination revealed severe hydropic degeneration of hepatocytes and mild focal portal inflammation (case 1), respectively moderate diffuse lipidosis and multifocal portal/periportal fibrosis (case 2).

Discussion:

EqHBV could be detected in two of five livers of donkeys diagnosed with hyperlipemia, whereas all livers from horses were negative. Due to the low measured viral loads and unspecific histopathological findings, subclinical viral persistence may be possible, but further studies are required to better characterize the clinical relevance of EqHBV infections in donkeys.

Clinical relevance:

This study provides further evidence for the occurrence of EqHBV in donkeys as major host.

Poster presentation 14

Clinical presentation, treatment and outcome of foals with umbilical infections (2014-2023).

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Introduction:

Umbilical infections are common and important in foals. There are no recent reports describing clinical presentation, microbiology and management of foals with umbilical infections in UK.

Methods:

Retrospective review of case records of foals with clinical and/or ultrasonographic evidence of umbilical infection between 2014 and 2023. Data were analysed using Mann Whitney U and chi squared analysis.

Results:

118 records were included, 34 foals had umbilical disease alone, 36 had non-infectious comorbidities and 48 had other infection sites (7 gastro-intestinal, 4 respiratory, 11 musculoskeletal and 26 multiple comorbidities). Short-term survival was 92% (95%CI 87%-97%). Median antimicrobial therapy length was 18 days (IQR 13-26), 108 foals were treated conservatively and 10 had surgical resection of the umbilicus.

The most common isolates of all culture samples were *E. coli* (20%), beta-haemolytic *streptococci* (18%), *Enterococcus* sp. (12%) and of only umbilical samples were beta-haemolytic *streptococci* (31%), *E. coli* (23%), *S. aureus* (14%). Seven foals had multi-resistant bacteria cultured, one underwent surgery and all survived. Data from all samples showed non-protected antimicrobials with the highest sensitivity for gram-positive bacteria were rifampicin (78%, 95%CI 69%-88%), clarithromycin (68%, 95%CI 57%-78%), azithromycin (65%, 95%CI 54%-76%), and for gram-negative bacteria, amikacin (93%, 95%CI 85-100%), gentamycin (69%, CI 55%-83%), doxycycline (67%, 95%CI 52%-80%). In foals with infectious comorbidities, median fibrinogen and SAA were higher (6 vs. 4.1; 400 vs. 2; $p < 0.001$), antimicrobial therapy shorter (16 vs. 19; $p = 0.02$), hospitalisation longer (8 vs. 3; $p < 0.001$) and survival lower (100% vs. 83%; $p < 0.001$); there was no difference in medical treatment or surgical resection of the umbilicus (6% vs. 10%; $p = 0.47$).

Discussion:

Foals with umbilical infections often have multiple site infections. Survival rates are high, but foals can require a prolonged course of antimicrobials.

Clinical Relevance:

This study provides information to help veterinarians with evidence-based recognition and treatment of umbilical infections.

High Prevalence of Subclinical Equid Hepatitis B Virus Infection in a Donkey Farm in Romania

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Introduction:

Equid viral hepatopathies caused by equine hepacivirus (EqHV), equine parvovirus-hepatitis (EqPV-H), and the recently first-time described equid hepatitis B virus (EqHBV) are poorly understood in donkeys. Only one recent study reported the occurrence of EqHBV with a prevalence of 3.2 % (29/906) in donkeys and zebras. Similar to infection with hepatitis B virus (HBV) in humans, EqHBV infection in donkeys leads to hepatotropism, chronic infections, and possible simultaneous infection with other hepatic viruses. The study aimed to investigate the occurrence of equid hepatic viruses in an isolated donkey herd and look for possible co-infections.

Methods:

In this pilot study, 100 serum samples collected for routine diagnostics from a donkey herd used for milk production in northwest Romania were analyzed for the presence of EqHBV-DNA, EqPV-H-DNA by quantitative PCR (qPCR), and EqHV-RNA by RT-qPCR.

Results:

Of the 100 collected serum samples, 32% tested positive for EqHBV-DNA, while EqHV-RNA and EqPV-H-DNA could not be detected. The donkey herd consisted of 76 jennies and 24 jacks, which showed no abnormalities during routine clinical examination.

Discussion:

Subclinical infection with the recently described EqHBV was detected in a clinically healthy donkey herd. The prevalence of viremia in this cohort was higher than previously reported. No coinfections with EqHV or EqPV-H were detected.

Clinical relevance:

As HBV can cause serious liver disease in humans, the detection and further characterization of EqHBV infections and potential coinfections with other hepatic viruses in donkeys are essential to determine their clinical relevance and improve the health of donkeys.

Poster presentation 16

Prevalence of *Strongylus vulgaris* in Danish horses and treatment response

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Introduction:

The prevalence of *S. vulgaris* is increasing in Denmark and Sweden, and several studies indicate that selective therapy based only on fecal egg counts are contributing to this development. Evidence-based treatment guidelines for equine herds diagnosed with *S. vulgaris* are frequently requested by equine veterinary practitioners, but studies evaluating the efficacy of different treatment strategies have never been performed. Estimation of *S. vulgaris* prevalence in equine herds in Zealand (DK) and evaluation of two treatment protocols in infected herds: a single ivermectin treatment and two ivermectin treatments given 6-weeks apart.

Methods:

The prevalence of *S. vulgaris* was estimated with both larval culture and qPCR on isolated eggs, and these results were compared by McNemar's test. Herds identified as positive for *S. vulgaris* in larval culture (one or more positive horses) were divided into two groups receiving two different treatments. Follow-up fecal samples were evaluated at week 8 and 24 post initial treatment.

Results:

In total, 299 horses from 30 herds were included in the study. The prevalence estimated by qPCR was 5.74% (95% CI: 3.45-9.21%) on individual horse level and 33.33% (95% CI: 17.94-52.87%) on herd level. The prevalence estimated by larval culture (2.68%, 95% CI: 1.25-5.41%) was significantly lower ($p=0.04$) than the prevalence estimated by qPCR. Both treatment protocols appeared equally effective, as all follow-up samples were negative for *S. vulgaris*.

Clinical relevance:

Prevalence of *S. vulgaris* was lower than expected and might be explained by the participating veterinarians already having focus on testing for *S. vulgaris* with yearly larval cultures and treatments of all horses on the farm when finding one positive horse. One treatment with ivermectin seems to be effective, but further studies with more positive horses need to be performed.

Poster presentation 17

A retrospective study on intradermal Allergy Test (IDT) results and efficacy of allergen specific immunotherapy (ASIT) in horses with equine asthma (EA), equine allergic skin disease (EASD) and head shaking (HS)

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Introduction:

IDT was performed in 84 privately owned horses affected by EA, EASD and/ or HS. 55 received ASIT based on IDT results. The triggering allergens for each horse were identified and ASIT efficacy-- assessed.

Methods:

A retrospective study was conducted on 84 horses diagnosed with EASD, HS or EA with indication of an allergic component, such as eosinophilia in lung secretion and/ or seasonality. Diagnostics were performed based on the most recent consensus guidelines. 7 groups were made: EA (22/84), EASD (24/84), and HS (6/84), EA with EASD (20/84), EA with HS (1/84), EASD with HS (2/84), and 9 cases with mixed symptoms.

IDT was performed in all horses including up to 23 area and species relevant allergens. Results were evaluated at 30 minutes (by veterinarian), 3 and 24 hours, by the veterinarian or the owner. Efficacy of ASIT was evaluated by a standardized telephone questionnaire (Stepnik et al, Veterinary Dermatology, 23, 29–e7, 2011) after at least 8 months of therapy.

Results:

84 horses tested positive on IDT and 55 were treated with ASIT, while 29 due to owners preferences or incompatible results were not. Among the 55, 32 (58%), were followed up with a questionnaire, including 9 EA (16%), 10 EASD (18%), 3 HS (10%) and 10 combined EA-EASD (18%) cases.

Response to ASIT based on owners' perception:

EA: 6/8 good to excellent, 2/8 no improvement.

EASD: 7/8 good to excellent, 1/8 no improvement.

HS: 2/3 good to excellent, 1/3 no improvement.

Combined EA-EASD 7/7 good.

Conclusions:

Using a multimodal therapeutic approach, ASIT based on IDT can be beneficial in treating patients with EA and HS, as known for EASD. Further studies ideally within a controlled environment, with regular yearly follow up evaluations by clinicians and via questionnaires are necessary to confirm the efficacy of this therapy.

Prevalence of catheter-associated thrombophlebitis in horses at a veterinary teaching hospital from 2012 to 2022

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Introduction:

In veterinary clinics, thrombophlebitis (TB) is the most common complication following intravenous (IV) catheterization. Risk factors have been described in horses, but there is little data on prevalence in hospitals. The objectives of this study were to estimate the prevalence of IV catheter-associated TB in an equine hospital and to describe temporal variations over 10 years.

Methods:

Equids hospitalized for at least one day from 2012 to 2022, with thrombophlebitis (n=310) and with IV catheters (n=4490) were identified retrospectively through medical records. TB cases not related to IV catheterization were excluded. Signalment, date of admission, and duration of hospitalization were collected. The effect of variables (age, gender, breed, year, month, season, duration of hospitalization) on the prevalence of TB was evaluated through generalized linear mixed models (R software).

Results:

The patients with TB presented a mean age of 8.5 years (median 8.0 [0-29.9]), were mostly Quarter Horses, and had a mean hospital stay of 17.7 days (median 13 [1-110]). The prevalence of TB between 2012 and 2022 was 6.9% (IC 95%: 6.1-7.6). Significantly higher prevalence was observed in 2013, 2021, and 2022 ($p < 0.05$). In 2022, TB were more prevalent during winter ($p < 0.04$). There is a statistical effect of the hospitalization duration on TB prevalence. The patients with TB were hospitalized 17.7 days (IC 95%: 17.3-18.1), compared to those without TB, 9.8 days (IC 95%: 8.1-11.5).

Conclusions and clinical relevance:

The prevalence of IV catheter-associated thrombophlebitis at the CHUV did not increase over 10 years, except for 2021 and 2022, and seems not to be influenced by seasons. Identifying trends and basal rates in a veterinary hospital is important to detect variations outside the normal range. The variables studied, and possible risk factors, are directly affected by the quality of data extraction.

Cystic calculi in horses: a retrospective study of 47 cases (2006-2023)

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Introduction:

Large clinical studies of cystic calculi in horses are limited.

Objectives:

describe the clinical findings, alterations in renal function and short-term survival rate of horses with cystic calculi.

Methods:

Medical files of equids with cystic calculi presented to the Equine Hospital at University of Montreal (2006-2023) were reviewed. Extracted information included: patient data, reason for admission, clinical exam findings, blood workup, urinary tract procedures and treatments. Follow-up was obtained over the phone with the owners.

Results:

forty-seven equids (24 gelding, 22 females and one stallion) with a wide age range (1-25 years) met the inclusion criteria including two patients treated for recurrence (n=49 hospitalized cases). Cystic calculi were identified in 0,24% of all patients examined in our equine hospital in internal medicine and surgery services. Quarter Horse (31.9%) and Standardbred (19.1%) were overrepresented compared to our equine hospital population. Hematuria (34/49 hospitalized cases) was the most frequent clinical observation in these equids. The short term survival rate was 96% (45/47 cases) and two horses were euthanized after recurrence of cystic calculi for financial and prognosis reasons. Hypercreatinemia was observed in 17/38 cases (44,7%) and most cases (13/17) had slight increase of creatinine (between 135 to 200 $\mu\text{mole/L}$; normal range between 70-134 $\mu\text{mole/L}$) throughout their hospitalization. Perineal urethrotomy was mostly performed in males (22/27 hospitalized cases) and the transurethral approach was most frequently used in females (15/22 hospitalized cases). No significant differences were observed between the type of anesthesia (standing versus general anesthesia) and the length of hospitalization.

Discussion:

the prevalence of cystic calculi is similar than previously reported and females were more frequently involved. Little impact on renal function was observed in our patients.

Clinical relevance:

Patients with cystic calculi in this study showed a favorable prognosis and choice of surgical procedure depending of the sex of equids.

The role of oxidative stress in the equine asthma pathogenesis

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Introduction:

Inhalation of environmental allergens causes airway inflammation and the production of reactive oxygen species. Superoxide dismutase (SOD), an enzymatic antioxidant can partly counterbalance oxidative stress. The aim of this study was to investigate the local concentration of SOD in the lung fluid of horses with equine asthma (EA).

Methods:

A commercially available spectrophotometric assay (Randox LTD) was validated for the measurements of SOD in tracheal wash (TW) and bronchoalveolar lavage (BAL) samples. Then SOD was measured in these fluids in a group of healthy horses (n= 37) as well as horses with varying degree of neutrophilic EA (neutrophilic mild-moderate EA [n=29] and severe EA [n=25]).

Results:

A significant decrease in the concentration of SOD in the BAL fluid was found in horses with mild-moderate neutrophilic EA and severe EA compared to healthy horses. Further, horses with severe EA had lower values of SOD in TW compared to healthy ones.

Conclusion:

Results from this study confirm the involvement of oxidative stress and more specifically a deficient amount of SOD in the BAL fluid as part of the EA pathogenesis in horses.

Clinical relevance:

The impairment of SOD in the BAL fluid increased with EA severity. In human studies, low SOD status in asthmatic patients is linked to airway hyperreactivity and airflow obstruction. Future studies should explore a possible beneficial effect of antioxidant supplementation in alleviating clinical signs in asthmatic horses.

Poster presentation 21

A retrospective study of the incidence and associated risk factors of Exertional Heat Illness (EHI) in Thoroughbred racehorses in different states in Australia.

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Introduction:

Heat stress causes suboptimal performance and has significant impact on equine sport disciplines, especially the racing industry. If heat stress progresses to Exertional Heat Illness (EHI), it may become fatal. The incidence of EHI will further increase considering global warming. The main objective of this preliminary retrospective study was to review EHI cases in racehorses.

Methods:

Data were obtained from online steward reports of Racing Authorities Australia. Racetrack variables, horse-related variables, environment-related variables, and heat-stress case data were evaluated to determine risk factors associated with EHI and divided into two groups: identified EHI cases (1) and suspected EHI cases based on inclusion criteria (2). A descriptive analysis was performed.

Results:

Across the 2019-2020 racing season, 6,648 races were evaluated across 151 clubs in four states with a total of 61,064 flat race starters. The EHI incidence per starter (per race) was 0.158% (n=5 suspected, 1.26%) in Northern Territory (NT), 0.049% (n=1 and n=1 suspected, 0.43%) in Tasmania (TAS), 0.039% (n=2 and n=3 suspected, 0.36%) in South-Australia (SA) and 0.054% (n=20 and n=2 suspected, 0.50%) in Queensland (QLD). Queensland recorded the highest number in November (n=7) and January (n=4). An EHI history was recorded in four, seven, two and one cases in NT, TAS, SA and QLD, respectively. Poor recovery cases recorded 31(0.979%), 42(1.025%), 13(0.094%) and 96(0.234%) in NT, TAS, SA and QLD with an overall incidence of 0.298%. Synchronic diaphragmatic flutter was recorded in none, 4(0.126%), 18(0.141%) and 16(0.039%) racers in NT, TAS, SA, QLD respectively, overall, 0.062% and was never associated with EHI.

Discussion:

The reported overall incidence of 0.056% indicates variances in diagnosing EHI across states, showing potential gaps in veterinarian, steward and rider awareness of EHI.

Clinical Relevance:

Continued research into risk factors is required to prevent EHI in racehorses globally and address this welfare issue.

Retrospective study of congenital anomalies observed at necropsy from 2015 to 2023

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Introduction:

The French surveillance network of equine mortality (RESUMEQ) was created in 2015 for the qualitative monitoring of equine mortality through the centralization of necropsy data in a national database. Congenital malformations, although rare, represent an economic loss for the equine industry. Studies on congenital anomalies are generally limited to abortions or the neonatal period, or concern a particular malformation. The objective was to describe all congenital malformations observed at necropsy.

Methods:

A retrospective study was performed using necropsy data recorded in the RESUMEQ database from 2015 to 2023. The population consisted of all autopsied equids ranging from fetuses to adults. The malformations were classified according to the anatomical system of malformation and the type of anomalies. Variables were analyzed by logistic regression.

Results:

A congenital malformation was determined in 49 cases among 2210 equine necropsies (2.2%). All age groups were represented (mean 18 months, median 4 months), however malformations are less common in adults >2 years old ($p < 0.01$). The age varies depending on the type of malformation; for example, arthrogryposis affects newborn foals, while compressive cervical myelopathy affects young horses. The musculoskeletal system is most frequently affected (37%) with compressive cervical myelopathy, arthrogryposis/scoliosis or osteochondrosis; followed by malformations of the head and/or brain (16%), digestive system (10%), cardiovascular system (8%), multiple systems (8%) and miscellaneous (20%).

Conclusion:

The prevalence of congenital anomalies at necropsy observed in our study corresponds to those described in the literature although the distribution of malformations is a little different. It was difficult to group the malformations together because some cases had their own particularities, consequently the number of malformations and categories being low, it was not possible to carry out fine statistical analysis.

Clinical relevance:

This study provides a view of the epidemiology and type of congenital malformations observed at necropsy.

Selection of Acute Observation Timepoints with Intradermal Skin Testing in Horses

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Introduction:

Intradermal skin testing (IDT) in horses is a complicated and time-consuming procedure in ambulatory settings. Few recommendations currently are available for the selection of acute timepoints to evaluate. The objective was to identify the optimum time for acute observations in ambulatory settings.

Materials and Methods:

17 client-owned horses in Texas were included in the study. All horses were injected with 23 allergens, 1 positive control (histamine), and 1 negative control (saline). Lesion sides were measured by the maximum diameter 15 minutes and 30 minutes post-injection. Saline ratio, histamine ratio, and severity were calculated for each lesion.

Results:

Statistically significant differences in diameter were identified in 13/23 allergens between the two timepoints; however, no statistically significant differences were found in for the saline ratio, histamine ratio, or severity (normal, mild, severe). 5/17 horses had a minimum of 4/23 (17%) positive allergens at 15 minutes that were normal by 30 minutes. 8/17 horses had a minimum of 4/23 (17%) normal allergens at 15 minutes that were positive by 30 minutes. 14 horses had severe reactions at 15 and 30 minutes for at least one allergen. One horse had no severe reaction at 15 minutes and eight severe reactions at 30 minutes, while two horses had a severe reaction at 15 minutes and no severe reactions at 30 minutes.

Discussion:

Minor differences were detected in the allergic response to specific allergens between 15- and 30-minute timepoints. Three horses had a different diagnosis of severe allergy between 15- and 30-minute timepoints.

Clinical Relevance:

Further work is necessary to identify the relevance of temporal changes in lesion size when evaluating acute IDT results and the relationship to delayed IDT results. Evaluation of multiple timepoints may be useful for identifying positive allergens.

Are the clinical effects of mesenchymal stem cells merely mediated by phagocytosing macrophages?

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Introduction:

Despite the increasing use of intra-articular injections with mesenchymal stem cell (MSC) in equine joint diseases, the precise mechanisms remain unclear. The synovium, rich in macrophages, can interact with and phagocytose MSCs and this process may trigger changes in macrophage phenotype. The therapeutic benefits of MSCs may arise from their clearance by phagocytic macrophages prompting pro-resolving responses within the joint.

Objectives:

The aim of this study is to compare transcriptional and protein profile changes in equine bone marrow-derived macrophages (BM-M ϕ) after exposure to allogeneic live or dead adipose derived MSCs (AT-MSCs), naïve BM-M ϕ , and BM-M ϕ exposed to *E. coli*.

Methods:

BM-M ϕ were isolated from three horses and cultured as per standard protocols. Pooled AT-MSCs from four horses were used to stimulate. BM-M ϕ were exposed to either allogeneic live or dead AT-MSCs or *E. coli* bioparticles for 3 hours. Dead AT-MSCs were prepared by a freeze-thaw cycle to simulate clinical conditions. Cultures were assessed microscopically and then harvested for RNA-sequencing, flow cytometry and mass-spectrometry proteomic analysis.

Results:

Microscopy and flow cytometry analysis confirmed the phagocytic capacity of BM-M ϕ . RNA-sequencing revealed significant transcriptomic differences between treatments and naïve BM-M ϕ , with dead AT-MSCs-exposed cells displaying the most similar expression profile to the naïve BM-M ϕ . Proteomic results are pending.

Conclusions:

This study indicates that phagocytosing MSCs affects macrophages when compared to their naïve state or when phagocytosing bacteria. Macrophage phagocytosis may contribute, at least in part, to the therapeutic effect of MSC treatment.

Clinical relevance:

It is crucial to establish whether the therapeutic effect of MSC treatment results from live MSCs or merely from their uptake by macrophages, a mechanism that could potentially be achieved using any cellular matter. It is also highly relevant to understand the effect dead MSC may have, since a percentage of MSCs likely die before or during treatment.

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