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Calgary International Equine Symposium

Innovation and Discovery

September 9-11, 2021



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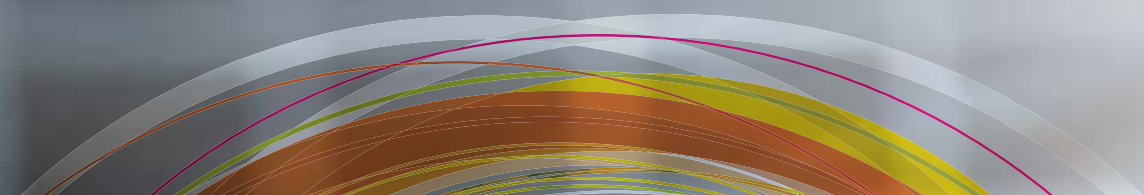
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SPRUGE MEADOWS



UNIVERSITY OF CALGARY
Hunter Hub for Entrepreneurial Thinking





PROGRAM SCHEDULE

THURSDAY, SEPTEMBER 9

Time	Description
8:30 am MT (2:30 pm GMT)	Opening remarks from Dr. Renate Weller, Dean of UCVM
8:40 am MT (2:40 pm GMT)	Welcome remarks from Dr. Ed McCauley, President and Vice-Chancellor, University of Calgary
8:45 am MT (2:45 pm GMT)	Keynote presentation by Dr. Klaus Osterrieder
9:45 am MT (3:45 pm GMT)	Break
10:00 am MT (4:00 pm GMT)	Rapid-fire poster presentations
10:25 am MT (4:30 pm GMT)	Break
10:45 am MT (4:45 pm GMT)	Platform presentations
11:45 pm MT (5:45 pm GMT)	Break
12:30 pm MT (6:30 pm GMT)	Platform presentations
1:40 pm MT (7:40 pm GMT)	Rapid-fire poster presentation
2:00 pm MT (8:05 pm GMT)	Program ends for the day

FRIDAY, SEPTEMBER 10

Time	Description
8:30 am MT (2:30 pm GMT)	Platform presentations
10:00 am MT (4 pm GMT)	Break
10:30 am MT (4:30 pm GMT)	Rapid-fire poster presentations
10:50 am MT (4:50 GMT)	Break
11:15 am MT (5:15pm GMT)	Platform presentations
12:15 pm MT (6:15pm GMT)	Break
1:00 pm MT (7pm GMT)	Hunter Hub Entrepreneurial Leaders in Equine Medicine <i>Panel discussion on innovation in equine health research with Dr. Molly McCue, Dr. Thilo Pfau, and Dr. Mike Scott, moderated by Dr. Renate Weller.</i>
1:45 pm MT (7:45 pm GMT)	Break
2:15 pm MT (8:15 pm GMT)	Winner announcements & symposium wrap up

SATURDAY, SEPTEMBER 11: Virtual event for horse-owners and the public

Time	Description
9:30 am – 11:00 am	This year, as part of the symposium, we are excited to offer a virtual event for our horse-loving community! Dr. Renaud Leguillet will demonstrate a dynamic respiratory endoscopy (an examination of the horse’s upper airway while under strenuous exercise conditions). Dr. Ashley Whitehead will give a video demonstration on assessing the heart of the horse, including performing a cardiac ultrasound and using new smartphone stall-side equipment.



Keynote Speaker **Dr. Klaus Osterrieder**

**Dean, Jockey Club College of Veterinary
Medicine and Life Sciences (JCC)**

**Chair Professor of Virology and One Health,
Department of Infectious Diseases and Public Health (PH)**



Dr. Klaus Osterrieder is currently Dean of the Jockey Club College of Veterinary Medicine and Life Sciences at City University. He previously served as Professor of Virology and Chair at Freie Universität Berlin, Germany (2007 – 2020), and Adjunct Professor of Virology at Cornell University (2007 – present). After finishing his veterinary degree in 1990, Klaus entered the field of virology, initially working with poxviruses. After his dissertation in 1993, his scientific focus switched to herpesviruses, specifically to work with equine herpesvirus type 1 (EHV-1). He completed his “Habilitation” in 1997. In the same year, Klaus started to work as a group leader at the Friedrich-Loeffler-Institute in Insel Riems, and began his investigations of an oncogenic herpesvirus, Marek’s disease virus (MDV) of chickens. He has continued to work on these two herpesviruses during his time on the faculty at Cornell and in Berlin. More recently his research extended into influenza and coronaviruses (SARS- and MERS-CoV, infectious bronchitis virus of chickens, and canine coronaviruses).

Dr. Osterrieder is an avid advocate of using natural virus-host systems, because of their unique model character and because they allow harnessing the strength of collaboration with clinicians and researchers from other disciplines. Using infectious clones and reverse genetics, his laboratory mechanistically studies viral pathogenesis and utilizes this knowledge for engineering of modified live virus vaccines. His research has been funded continuously since 1994 by public funding agencies including the European Union, the NIH, the USDA, the DFG and other public sources. He has also secured support for his work from pharmaceutical companies and philanthropists. Klaus has more than 230 scientific publications and his h-index currently stands at 51. He is editor and member of the editorial board of a number of journals, and his honors include membership in the Academy of Sciences of Thuringia since 2014, the Young Investigator Award of the Academy for Animal Health (2002) and the WVPA-Boehringer Ingelheim Vaccine Innovation Award (2017).



PRESENTATION ABSTRACTS

THURSDAY, SEPTEMBER 09



RAPID FIRE POSTER PRESENTATIONS

10:00 am MT (4:00 pm GMT)

Dr. Madison Ricard

Western College of Veterinary Medicine

Stefan Gavriliuc

Faculty of Veterinary Medicine, University of Calgary

A 13-year retrospective study of equine abortion in Canada

AUTHOR NAME / AFFILIATION

- Dr. Madison Ricard, Department of Veterinary Pathology | Western College of Veterinary Medicine
- Dr. Guillaume St-Jean, Département de Biomédecine Vétérinaire | Université de Montréal
- Harveen Atwal, Animal Health Centre | British Columbia Ministry of Agriculture
- Dr. Bruce Wobeser, Department of Veterinary Pathology | Western College of Veterinary Medicine

ABSTRACT

Introduction: There have been several retrospective studies of the causes of equine abortions conducted globally, including France, Germany, the United Kingdom, the United States, Italy and Japan. To the authors' knowledge, no comprehensive studies of this nature have been conducted in Canada. The previously completed studies showed differences in the prevalence of causes of abortion between countries, suggesting the need for a study specific to Canadian horses.

Methods: 901 necropsy and histopathology reports of equine abortion cases were collected from provincial veterinary diagnostic laboratories from the years 2007 to 2020. The causes of abortion identified on the reports were first categorized as infectious, non-infectious or undetermined, then categorized based on their final diagnosis.

Results: Across Canada, the majority of cases were identified as non-infectious (n = 568, 63.0%), followed by infectious (n = 204, 22.6%) and undetermined (n = 92, 10.2%). The majority of non-infectious abortions had an unknown cause (n = 329, 57.9%). Non-infectious cases with a diagnosis were most commonly identified as fetoplacental issues, including umbilical torsion and placental insufficiency (n = 181, 31.9%). Infectious causes were most commonly bacterial (n = 92, 45.1%) and viral (n = 92, 45.1%).

Conclusion: The high prevalence of non-infectious causes of abortion identified in Canada differs from studies in the United States, where infectious causes, such as placentitis, were most commonly identified. The reason for regional differences in primary diagnosis for abortions submitted for necropsy is unknown, however may be related to differing hygiene standards or on-farm diagnosis by veterinarians.

Targeted genome-wide SNP genotyping in feral horses using non-invasive fecal swabs

AUTHOR NAME / AFFILIATION

- Stefan GAVRILIUC, Faculty of Veterinary Medicine, University of Calgary
- Salman REZA, Faculty of Veterinary Medicine, University of Calgary
- Chanwoori JEONG, Faculty of Veterinary Medicine, University of Calgary
- Fitsum GETACHEW, Faculty of Veterinary Medicine, University of Calgary
- Philip MCLOUGHLIN, Department of Biology, University of Saskatchewan
- Jocelyn POISSANT, Faculty of Veterinary Medicine, University of Calgary

ABSTRACT

Introduction: Through rapid advances in high-throughput sequencing, the generation of molecular marker data for animal populations has become commonplace. In particular, thousands of single nucleotide polymorphisms (SNPs) can be assessed simultaneously and are seeing increased use over microsatellites markers. For non-model study species such as feral horses, the generation of such data has remained at an impasse due to the need for large quantities of uncontaminated DNA. Obtaining high-quality DNA typically entails invasive sampling procedures, which are often prohibited or dangerous to sample in wildlife populations. A recently developed target enrichment assay by Tecan genomics may offer an alternative for non-invasive genotyping in feral horse populations.

Methods: We tested the performance of target enrichment using DNA extracted from fecal swab samples and compared the concordance of genotypes versus those obtained using commercially available genotyping arrays on hair root, saliva and muscle biopsy samples. Specifically, we genotyped 48 samples representing 44 unique individuals at 279 target sites on individuals the free-living population of horses on Sable Island, Nova Scotia, Canada.

Results: Target enrichment recovered an average of 97.8% of the targeted sites, and when a target site was present between the target enrichment assay and commercial genotyping array, the average concordance between genotypes was 95.3%. Samples obtained from the same host were highly repeatable with an average of 94.8%.

Conclusion: Target enrichment may offer a non-invasive genotyping method for feral horse populations, and can offer unique opportunities to interrogate sources of genetic diversity that have been hitherto unexplored.



RAPID FIRE POSTER PRESENTATIONS

Dr. Nadia Golestani

University of Guelph

Inflammatory response of cartilage explants to lipopolysaccharide in the presence of a biological extract of equine joint-care nutraceutical

AUTHOR NAME / AFFILIATION

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- Dr. Wendy Pearson, Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada N1G 2W1

ABSTRACT

Introduction: The potential of nutraceuticals for reducing clinical signs of osteoarthritis and equine lameness has been well-described by contemporary science. It was hypothesized that conditioning of cartilage explants with a simulated digestion extract of a nutraceutical product (HyalcarePLUS) would protect cartilage from inflammatory consequences of lipopolysaccharide (LPS) in a manner significantly different from that of an aqueous extract of the same nutraceutical. The objectives were to quantify inflammatory responses of cartilage responses to LPS in the presence of a simulated digestion or aqueous extract, with respect to LPS-induced nitric oxide (NO), glycosaminoglycan (GAG) and prostaglandin E2 (PGE2) production.

Methods: In Study 1, the nutraceutical product was incubated in stimulated gastric and intestinal fluid, liver microsomes, and NADPH to produce a simulated digestion (HCsim). In Study 2, the same mass of HC was extracted using ethanol (HCex). Porcine cartilage explants were cultured for 96 hours, in basal tissue culture media with HCsim (Study 1) or HCex (Study 2) (0, 10 µg/mL, 30 µg/mL) for the remaining 72 h. LPS (0 or 15 µg/mL) was added for the final 48 hours. Media samples were collected immediately prior to LPS exposure and were analyzed for PGE2, GAG, NO and cell viability.

Results: LPS produced a significant increase in PGE2, GAG and NO production in the absence of the HCsim and HCex. HCsim and HCex inhibited LPS-induced GAG release at 48 h and HCex reduced NO production at 48h.

Conclusion: HyalCare product is an effective inhibitor of the LPS-induced inflammation in cartilage explants.

Dr. Bruce Guest

University of Guelph

Preliminary evaluation of physiologically comparable directly 3D-printed equine pulmonary artery hemodynamic phantoms

AUTHOR NAME / AFFILIATION

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- Luis Arroyo, Department of Clinical Studies, Ontario Veterinary College, University of Guelph
- John Runciman, School of Engineering, University of Guelph 50 Stone Rd E Guelph

ABSTRACT

Introduction: Arterial phantoms have a valuable role in the study of arterial hemodynamics; however, replication of arterial nonlinear mechanical properties and complex architecture is difficult with typically applied material, design, and fabrication techniques. The potential to improve phantom performance through development of novel designs producible with practical 3D printing technologies was investigated.

Methods: A range of thin walled tubes with nonlinear circumferential elastic wall elements were directly produced from commercially available polyester-polyurethane using a customized low-cost open-source fused filament fabrication 3D printer. Nonpulsatile Peterson elastic strain moduli were measured, and a mock circulatory system was used to obtain pulse wave velocities.

Results: The nonpulsatile Peterson elastic strain modulus ranged from 5.6 to 19 kPa to 12.4 to 35.1 kPa over a pressure span of 5 to 50 mmHg for the most to least compliant designs respectively. Phantom pulse wave velocities over mean arterial pressures of 7 to 55 mmHg ranged between 1.5 to 5 m-s⁻¹, comparing favorably to measurements in the equine pulmonary artery of 1 to 3 m-s⁻¹. The elastic response of the phantoms varied between designs and was found to be nonlinear in a manner consistent with the behavior of biological arteries, becoming stiffer with increasing pressure.

Conclusion: Practical, low-cost production of simple hemodynamic phantoms with controllable wall properties that closely match the equine pulmonary artery is possible. Producing phantoms with more complex arterial architectures and mechanical properties has become feasible with recent open-source 3D printing developments. Further exploration of the directly 3D-printed phantom approach is warranted.



PLATFORM PRESENTATIONS

10:45 am MT (4:45 pm GMT)

Dr. Alexandra Frey-Belotta

Western College of Veterinary Medicine, University of Saskatchewan

Jonah Cullen

University of Minnesota

Radiation dose to X-ray tube operators and cassette holders involved in diagnostic radiographic procedures of the equine spine and limbs: a horse cadaver simulation study

AUTHOR NAME / AFFILIATION

- Alexandra F. Belotta, Western College of Veterinary Medicine, University of Saskatchewan
- Monique N. Mayer, Western College of Veterinary Medicine, University of Saskatchewan
- Cheryl L. Waldner, Western College of Veterinary Medicine, University of Saskatchewan
- Narinder Sidhu, British Columbia Cancer, Prince George
- Kate Robinson, Western College of Veterinary Medicine, University of Saskatchewan
- James Carmalt, Western College of Veterinary Medicine, University of Saskatchewan
- Fernando P. Freitas, Western College of Veterinary Medicine, University of Saskatchewan
- Niels Koehncke, College of Medicine, University of Saskatchewan

ABSTRACT

Introduction: Handholding of X-ray tubes and cassettes without use of hand shielding is common among equine workers involved in diagnostic radiographic procedures. The objectives of this study were to investigate scattered radiation doses to the hands of equine workers holding the cassette and the X-ray tube by hand, for both limb and spine studies, and to compare the scattered radiation attenuation of lead with that of lead-free gloves.

Methods: A whole-body horse cadaver and a portable X-ray unit were used to simulate six radiographic study types. Doses were measured with no shielding, and for cassette holders, with the ion chamber enclosed in a lead glove and a lead-free glove. Thirty exposures were performed for each study view and condition (n = 1920).

Results: Mean scattered doses to X-ray unit operators were higher than doses to cassette holders for hoof (P = .01), thoracic spine (P < .001), and lumbar spine (P < .001) studies whereas doses to cassette holders were higher than doses to X-ray tube operators for fetlock (P < .001) and hock studies (P < .001). Doses did not differ (P = .21) for stifle. Mean percentage decrease in scattered radiation dose with lead gloves (99.58%) was higher (P < .001) than with lead-free gloves (98.90%).

Conclusion: X-ray tube operators can be exposed to as much or higher scattered radiation doses to the hand as cassette holders. Lead-free hand shielding should only be considered as an alternative to lead gloves if their lighter weight increases frequency of use.

A draft RNA-seq atlas of gene expression in healthy Quarter Horses

AUTHOR NAME / AFFILIATION

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ABSTRACT

The annotation of the equine genome is incomplete, with the identity, function, location, intron/exon boundaries, and alternative transcripts of protein coding genes known with varying levels of certainty. Moreover, little to no information exists regarding long non-coding RNAs (lncRNA) or micro RNAs (miRNA), emerging key regulators of gene expression. This scarcity of information and uncertainty is compounded by observations in other species that the majority of transcripts are expressed in a tissue-specific manner. Characterizing tissue-specific expression is critical information needed to delineate the interplay between genetic alleles and phenotypic traits. Toward that end, we are generating an equine tissue gene expression atlas, cataloging transcriptome differences across tissues from a cohort of healthy Quarter Horses. To date, we have generated RNA-seq data from 5 healthy Quarter Horses across 11 tissue types (bone, cartilage, lamina, liver, synovium, and 6 adipose depots). Gene and transcript expression were quantified using an RNA-seq pipeline designed for accuracy of both known and novel transcript isoform identification by tissue. Differential transcript usage was compared between tissue pairs. Co-expression networks were analyzed to provide functional context for genes of unknown function and to identify potential additional functions for protein coding genes. Our results suggest the majority of expression differences are due to tissue as opposed not individual. Adding more tissue types to the equine tissue expression atlas will enable improved mining of the coding and non-coding transcriptomes, ultimately advancing our understanding of the complex interactions and the intra- and intercellular interconnectivity that links genotype to phenotype.



PLATFORM PRESENTATIONS

12:30 pm MT (6:30 pm GMT)

Jennifer MacNicol

Ontario Veterinary College, University of Guelph

Molecular Detection of *Clostridium innocuum* in healthy horses and horses with colitis

AUTHOR NAME / AFFILIATION

- J.L. MacNicol, L. Sakia, A.S. Borges, D. E. Gomez, L.G. Arroyo - Departments of Clinical Studies, Ontario Veterinary College, University of Guelph, University of Guelph, Guelph, Ontario, Canada N1G 2W1

ABSTRACT

An etiological agent is not identified in most equine colitis cases despite extensive microbial investigation. *Clostridium innocuum* has recently been established as a potential causative agent in antimicrobial-associated diarrhea in humans. The objective of this study was to determine the prevalence of *C. innocuum* in fecal samples of healthy horses and horses with colitis. Feces were collected from horses with colitis (D, n=56) admitted to the Ontario Veterinary College and healthy horses (H, n=78) residing on farms in Southern Ontario. Colitis cases were further subdivided into survivors (S, n=27) and non-survivors (NS, n=29). PCR using *C. innocuum* specific primers was performed on extracted DNA. PCR products positive for *C. innocuum* were sequenced and BLAST used for identity confirmation. *C. innocuum* frequencies between groups were compared using Fisher's exact tests, odds ratios and 95% confidence intervals (95% CI) were calculated. *C. innocuum* was identified in 27% of D and 15% H cases (p=0.13). The odds of being positive for *C. innocuum* were not statistically different between colitis and healthy horses (OR:2.01, 95%CI: 0.86-4.72). It is unclear at this time if *C. innocuum* represents a potential risk factor of interest in equine colitis. Moreover, whether *C. innocuum* is an opportunistic pathogen which exacerbates disease requires further study.

Dr. Laurent Coeutil

College of Veterinary Medicine, Purdue University

The role of dust exposure and omega-3 polyunsaturated fatty acids on Thoroughbred racehorses' airway health: A randomized, controlled trial

AUTHOR NAME / AFFILIATION

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- Olave CJ / Department of Veterinary Clinical Sciences, College of Veterinary Medicine, Purdue University, Ivester KM / Department of Veterinary Clinical Sciences, College of Veterinary Medicine, Purdue University
- Burgess J / Department of Nutrition Science, College of Health and Human Sciences, Purdue University
- Park JH / School of Health Sciences, College of Health and Human Sciences, Purdue University

ABSTRACT

Introduction: Mild equine asthma is associated with dust exposure and omega-3 polyunsaturated fatty acids (PUFA) intake may mitigate airway inflammation. The purpose of the study was to compare dust exposure, bronchoalveolar lavage fluid (BALF) cytology, and plasma PUFA between racehorses fed dry hay, steamed hay, and haylage.

Methods: Thoroughbreds (n=43; 73 measurements) at the racetrack were randomly assigned to be fed hay, steamed hay, or haylage for six weeks. Plasma PUFA and BALF cytology were evaluated at baseline and after three and six weeks. Respirable dust was sampled at the racehorse's breathing zone on two occasions and analyzed gravimetrically. Mixed models were constructed to examine the effect of forage upon respirable dust exposure, BALF cytology, and plasma PUFA. Adjusted p-values < 0.05 were considered significant.

Results: Airway cytology data were obtained at week 3 (69 measurements) and at week 6 (53 measurements). Exposure to respirable dust was reduced in racehorses fed steamed hay (0.056 ± 0.018 mg/m³) or haylage (0.053 ± 0.016 mg/m³) compared to hay (0.078 ± 0.037 mg/m³; p<0.05). Racehorses eating haylage had a lower proportion of BALF neutrophils at week 3 (p=0.025) and 6 (p=0.003) compared to baseline and hay at week 6 (p=0.04). Plasma phospholipid eicosapentaenoic acid (EPA) proportion after 6 weeks on haylage was higher when compared to data from racehorses eating steamed hay and hay (p=0.04).

Conclusion: Feeding steamed hay and haylage reduced racehorses' exposure to respirable dust, while only haylage significantly decreased airway inflammation with concurrent increase in the plasma omega-3 PUFA EPA.



RAPID FIRE POSTER PRESENTATIONS

1:40 pm MT (7:40 pm GMT)

Em Adams

University of Minnesota, College of Veterinary Medicine

Identification and validation of alleles for cardiac arrhythmias and atrial fibrillation with ECG analysis

AUTHOR NAME / AFFILIATION

- Em Adam (University of Minnesota [UMN] College of Veterinary Medicine)
- Lauren Hughes (UMN Veterinary Population Medicine Department)
- Kendall Blanchard (UMN Veterinary Population Medicine Department)
- Jenifer Gold (Washington State University Veterinary Clinical Sciences Department)
- James R. Mickelson (UMN Veterinary and Biomedical Sciences Department)
- Molly E. McCue (UMN Veterinary Population Medicine Department)
- Sian A. Durward-Akhurst (UMN Veterinary Clinical Sciences Department)

ABSTRACT

Cardiac arrhythmias are an important cause of sudden death (SCD). Most horses with arrhythmias have no underlying structural heart disease, making it virtually impossible to detect those that will develop arrhythmias. Similar arrhythmias in human athletes are almost exclusively caused by mutations in ion channel genes. We hypothesized that mutations in ion channel genes are a cause of arrhythmias in racehorses without structural heart disease.

We used whole genome sequence of 6 Standardbred racehorses with atrial fibrillation to identify 506 putative arrhythmia-causing mutations based on being: 1) within 5 kb of biologic candidate genes; and 2) rare (<5% variant frequency) in the equine population. 115 variants (8.8%) were false positives due to poor reference genome annotation or genotyping errors. Additional evidence of pathogenicity was obtained using PROVEAN, SNPS&GO, and SIFT. Overall, 131 variants (26%) in 77 candidate genes had sufficient evidence to be considered putative arrhythmia-causing mutations.

To determine which of these variants are associated with arrhythmias, we'll genotype them in 1,200 racehorses. So far, we've performed ECGs (before, during, and after exercise) on 143 Standardbred and 171 Thoroughbred racehorses. The average heart rates (beats per minute) at rest, exercise, and post-exercise were 35, 191, and 62 respectively. 8 horses had arrhythmias at rest. Mutations associated with the presence of arrhythmias will have strong evidence to support them having a functional effect on cardiac polarization. Our long-term goal is to reduce the rate of SCD in racehorses by establishing risk factors that contribute to the development of SCD.

Lorie De Maré

Faculty of Veterinary Medicine, Ghent University & University of Liege

Profiling the aerobic window (AW) of horses in response to training by means of a new LMS (lactate minimum speed) test: Flatten the curve.

AUTHOR NAME / AFFILIATION

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- Berit Boshuizen - Faculty of Veterinary Medicine, Ghent University | Equine Hospital Wolvega, Oldeholtgade, the Netherlands.
- Carmen Vidal Moreno de Vega - Faculty of Veterinary Medicine, Ghent University
- Constance De Meeus - Faculty of Veterinary Medicine, Ghent University
- Lukas Plancke - Faculty of Veterinary Medicine, Ghent University.
- Yannick Gansemans - Laboratory of Pharmaceutical Biotechnology, Ghent University
- Filip Van Nieuwerburgh - Laboratory of Pharmaceutical Biotechnology, Ghent University
- Dieter Deforce - Laboratory of Pharmaceutical Biotechnology, Ghent University
- Jean E. De Oliveira - Cargill, Research and Development Centre Europe
- Catherine Delesalle - Faculty of Veterinary Medicine, Ghent University

ABSTRACT

Introduction: Classical incremental Standardized exercise tests (SETs) are commonly applied to deduce training advice. However, they require maximum intensity exercise and lack reproducibility. Our aim was to validate a modified LMS test, to compare with a SET and to assess mathematical approaches to deduce training parameters.

Methods: Untrained Standardbreds (♂, 3-4 years, n=6) were 8 weeks harness trained. At w0 and w8 SET and LMS-tests were executed. SET protocol: incremental steps (4km/h; 3 min/step; 20-40 km/h); LMS-test: 3 min trot (36-40 km/h until blood lactate (BL) >5mmol/L), steps (20 km/h; 3min; 2 km/h, max34 km/h). LMS-test validation (MLSS, Maximum Lactate Steady State) entailed >10 km at respectively LMS and 110% LMS. GPS, heartrate (Polar®) and BL were monitored and plotted. Curve parameters (R core team, 3.6.0): (SET) VLa1.5/2/4 and (LMS-test) AUC<LMS, AUC>LMS, LMS (comparison: paired T-test, except for LMS: paired Wilcoxon test; (p<0.05). Test correlations: Pearson correlation (r>0.80).

Results: No BL increase occurred during validation at LMS and did at 110%LMS. Training induced an increase in VLa1.5/2/4 (P=0.007; 0.007; 0.012) and decrease in LMS (P=0.008), AUC<LMS (P=0.020), AUC>LMS (P=0.008) (flattening parabola curve). BLmax was lower for LMS vs SET (P=0.002 before and P<0.0002 after training).

Conclusions: Significant better correlation was seen between LMS and MLSS compared to SETs. The aerobic window (AW) was overestimated by SETs. The LMS BL equilibrium is reached earlier (at lower speed) and maintained longer after training. This LMS-test entails a more robust tailored assessment of the AW at lower speed and BL compared to SETs.



RAPID FIRE POSTER PRESENTATIONS

Dr. Lidwien Verdegaal

Equine Health and Performance Centre, University of Adelaide

Continuous Monitoring of the Thermoregulatory Response in
Endurance Horses and Trotter Horses During Field Exercise:
Baselining for Future Hot Weather Studies.

AUTHOR NAME / AFFILIATION

Elisabeth-Lidwien J.M.M. Verdegaal^{1,2,3*}, Gordon S. Howarth², Todd J. McWhorter², Berit Boshuizen³, Samantha H. Frankli^{nl,2}, Carmen Vidal Moreno de Vega³, Stacey E. Jonas², Louise E. Folwell² and Catherine J.G. Delesalle³.

¹Equine Health and Performance Centre. ²School of Animal and Veterinary Sciences, Roseworthy Campus, University of Adelaide, South Australia, Australia, ³Research Group of Comparative Physiology, Department of Virology, Parasitology & Immunology, Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium

ABSTRACT

Prevention of equine heat stress becomes increasingly important, especially in the face of global warming. This study aimed to evaluate the thermal response to metabolic heat by a gastrointestinal (GI) pill to provide a detailed view on thermoregulation during field exercise and recovery under cool weather conditions.

Eight endurance horses and twelve trotters were equipped with continuous monitoring devices (GI pill temperature [T_c], heartrate monitor and global positioning system). Endurance horses exercised over 80km (40km loops) during four rides and trotters over a 1540m track. A T_c time profile curve was constructed, and net area under the curve was calculated using the trapezoidal method. Maximum T_c was compared using an independent samples t-test.

Endurance horses (mean speed 14.1 ± 1.7 km h⁻¹) reached mean maximum T_c ($39.0 \pm 0.4^\circ\text{C}$; 2 x 40km in 8 horses) *during exercise* at 75% of completion of exercise and T_c returned to baseline within 60 minutes into recovery. However, the mean T_c was still $38.8 \pm 0.4^\circ\text{C}$ at a heartrate of 60 bpm. Trotters (40.0 ± 2.9 km h⁻¹) reached a comparable mean max T_c ($38.8 \pm 0.5^\circ\text{C}$) *always during recovery*. In 30 % of trotters, T_c was still $> 39^\circ\text{C}$ at the end of recovery (40 ± 32 minutes).

The study shows that horses are individuals with a variable thermoregulatory response to all types of exercise and T_c can peak quite some time after finishing exercise. These findings may have implications for management of performance horses to safeguard equine welfare and to maximize performance.

Dr. Stephanie Bond

School of Veterinary Science, University of Queensland

Topography of the respiratory, oral, and guttural pouch bacterial and
fungal microbiotas in horses.

AUTHOR NAME / AFFILIATION

- Stephanie Bond: Faculty of Veterinary Medicine, University of Calgary | School of Veterinary Science, Faculty of Science, University of Queensland
- Christopher McMullen: Faculty of Veterinary Medicine, University of Calgary | Feedlot Health Management Services Inc., Okotoks, Alberta
- Edouard Timsit: Faculty of Veterinary Medicine, University of Calgary | I&D pharma departement, Ceva Santé Animale, Libourne, France
- Renaud Léguillette: Faculty of Veterinary Medicine, University of Calgary

ABSTRACT

Introduction: Respiratory disease has a large economic impact on the equine industry. It has been reported that the equine lower respiratory tract microbiota is different in states of health and disease; however, the bacterial and fungal composition of the healthy equine respiratory tract has not been studied in detail. Our objective was to characterize the bacterial and fungal microbiotas present along the upper and lower equine respiratory tract.

Methods: Eleven upper and lower respiratory tract anatomical locations were sampled in 11 healthy Argentinian Thoroughbred horses from the same herd using a combination of swabs, protected specimen brushes, and saline washes. DNA was extracted from each sample and negative control, and the 16S rRNA gene (V4) and ITS2 region were sequenced. Community composition, alpha-diversity, and beta-diversity were compared among sampling locations.

Results: Fungal species richness and diversity was highest in the nostrils. There was more spatial heterogeneity in bacterial composition than fungal communities. The pharyngeal and arytenoid microbiotas were most similar to the distal tracheal bacterial and fungal microbiota in healthy horses and therefore may serve as the primary source of bacteria and fungi to the lower respiratory tract.

Conclusions: The pharynx is an important location that should be targeted when doing equine respiratory microbiota research.



PRESENTATION ABSTRACTS

FRIDAY, SEPTEMBER 10



PLATFORM PRESENTATIONS

8:30 am MT (2:30 pm GMT)

Amie Kapusniak

University of Adelaide, Australia

Heritability of Sudden Unexplained Death in Thoroughbred Racehorses in Australia

AUTHOR NAME / AFFILIATION

- Amie Kapusniak
- Laura Nath
- Michelle Hebart
- Samantha Franklin

ABSTRACT

INTRODUCTION: Sudden unexplained death (SUD) is an important cause of exercise associated fatality in thoroughbred racehorses. Equine deaths share similarities with fatalities in human athletes resulting from inherited cardiac disease. The genetic contribution and heritability of SUD has not been estimated in thoroughbred racehorses.

METHODS: Steward and post-mortem reports of thoroughbred racehorses in Australia (2007-2020) were reviewed. For horses' whose death was attributed to SUD and for surviving (control) horses, a five-generation integrated pedigree chart was collected. Control horses raced contemporaneously with SUD horses and were randomly selected from races that SUD occurred (raced horses) or from a race on the date of death (unraced horses). Estimates of heritability were obtained using an animal model in ASReml-R, with SUD considered as either a binary or continuous trait.

RESULTS: Ninety-three horses with SUD and 465 control horses were identified. Heritability on the underlying scale was 0.15 ± 0.09 (binary) and 0.24 ± 0.12 (continuous). Incidence of SUD was highest in three-year-old racehorses (41.9%) with significant variation between sexes (males 66%; females 34%; $P=0.01$). Of the 16 first generation sires that appeared ≥ 5 times in the case-control data set, two produced affected horses more frequently than expected (OR 7.95-10.41).

CONCLUSION: The overall heritability of SUD in this population was low, however some sires were overrepresented amongst affected horses. It is likely that multiple genes are responsible rather than a simple Mendelian inheritance and that other environmental factors impact the prevalence of SUD. Further genomic studies are required to understand the underlying molecular pathology associated with SUD.

Nicole Philips

University of Calgary

Systematic review of intra-articular treatments for osteoarthritis-related lameness in horses

AUTHOR NAME / AFFILIATION

- Nicole Phillips, University of Calgary
- Heather Ganshorn, University of Calgary
- Alfredo Romero
- W. Michael Scott
- Campbell Rolian

ABSTRACT

Introduction: Osteoarthritis (OA) is a leading cause of lameness in horses. Intra-articular therapy has been used for over 50 years to alleviate the symptoms of OA, including injections of anti-inflammatory drugs, biologics (e.g., hyaluronic acid) and more recently, cell-based products and gene therapy. The purpose of this systematic review was to evaluate and contrast the efficacy of these intra-articular therapies for the treatment of OA-related lameness in horses.

Methods: In total, 26 placebo-controlled in vivo studies were included, and data were collected on therapeutic type, injection characteristics, and impact on clinical symptoms of lameness in relation to placebo.

Results: Among the studies, 6 used hyaluronic acid compounds, 4 evaluated autologous solutions (serum, synovial fluid, proteins solutions), 7 used mesenchymal stem cell-based preparations, 5 evaluated steroidal drugs, 3 used gene therapy (viral-driven expression of IL1 β receptor antagonist), and one evaluated an NSAID (Bufexamac). Most studies (15/26) used experimentally induced osteoarthritis with short induction periods to compare efficacy of treatments in OA-positive and control, with the remainder using longitudinal designs with client-owned horses. Among treatment classes, hyaluronic acid, which has been longest in use, and MSC preparations, gave mixed results, with only 2/7 studies and 3/6 demonstrating clinical improvement in lameness scores over placebo, respectively. Gene therapy and protein solution therapy showed consistent improvements in lameness scores.

Conclusion: This review did not identify a leading intra-articular treatment for OA-associated lameness; however it suggests that contemporary treatments such as gene therapy hold promise to improve clinical lameness associated with OA in horses.



PLATFORM PRESENTATIONS

Dr. Emma Santosuosso

Faculty of Veterinary Medicine, University of Calgary

Cardiac arrhythmias and breathing pattern during swimming in horses

AUTHOR NAME / AFFILIATION

- EmmaSANTOSUOSSO, DVM, MSc candidate, University of Calgary

ABSTRACT

Introduction: Cardiac arrhythmias during swimming have been reported in humans but have never been assessed in horses. The irregular breathing pattern and stress associated with swimming may contribute to the development of arrhythmias.

Objectives are:

1. To determine the prevalence and severity of arrhythmias during swimming in horses.
2. To quantify the apnea during swimming.

Methods: Sixteen endurance horses underwent a training swimming session of five pool lengths (75m long), each length is followed by a recovery walk. Electrocardiograms were recorded continuously (including underwater). Arrhythmias were categorized as atrio-ventricular block, sinus arrhythmia, supraventricular premature depolarization(SVPD), and ventricular premature depolarization(VPD). Breathing patterns were assessed using video recordings.

Results: Swimming heart rate (HR) was 164.9 ± 21.6 bpm. Mean HR was greater at the onset (30 seconds) of each swimming exercise ($p < 0.05$) and for the first pool length compared to lengths four and five. Fifteen (94%) horses experienced at least one arrhythmia during swimming. Sinus arrhythmia, SVPD, and VPD were all observed and predominantly isolated events. No difference was observed in the frequency and severity of arrhythmias between swimming lengths. The number of arrhythmias was greater during active recovery than during swimming ($p < 0.001$). An apneic period was observed at the onset of the swimming exercise ($p < 0.001$).

Discussion: Prevalence and severity of arrhythmias was low and not affected by repetition of the swimming exercise. Swimming seems to be cardiologically safe for horses. An increase in HR associated with an apneic breathing pattern at the onset of swimming could indicate a stress response.



RAPID-FIRE POSTER PRESENTATIONS

10:30 am MT (4:30 pm GMT)

Dr. Sian Durward-Akhurst

University of Minnesota

Utility of a Modified Wearable ECG Patch for 7-Day Monitoring in Horses

AUTHOR NAME / AFFILIATION

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- RG Hauser, Minneapolis Heart Institute Foundation, Minneapolis, MN
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ABSTRACT

Idiopathic arrhythmias are an important cause of sudden death and diminished exercise performance in horses. The frequency of these arrhythmias in sedentary horses is not known. Available ECG methods to detect arrhythmias are not suitable for long-term (>24 hour) monitoring and are impractical for large studies or routine clinical use in horses.

The FDA-approved Cardea SOLO enables non-invasive ECG monitoring in people for up to 7 days. We modified the device's wearable adhesive patch ECG monitor to record a single ECG lead with one electrode behind the right elbow and the second on the left behind the proximal scapula to allow convenient ECG monitoring of horses. After 7 days the ECG recordings were analyzed by proprietary computer software. For the first and last 24 hours, a Televet was placed to allow comparison between ECG traces.

The modified SOLO was well-tolerated by all 15 sedentary mixed breed horses (14 mares, 1 stallion). During an average \pm SD 6.5 \pm 1.1 days of monitoring, the mean \pm SD heart rate was 40 \pm 4 beats/minute. Brief episodes of bradycardia and second degree atrioventricular block were common in all subjects. Two horses had one or more episodes of paroxysmal supraventricular tachycardia and one horse had 3 episodes of brief non-sustained ventricular tachycardia (fastest rate 141 bpm for 10.6 seconds). Atrial fibrillation was not observed. Overall, the SOLO recordings correlated well with those obtained with Televet.

These results suggest that the modified Cardea SOLO monitor is an accurate and practical long-term ECG recording method for detecting paroxysmal arrhythmias in horses.

Maria A. Papapetrou

Ontario Veterinary College, University of Guelph

Molecular detection of equine parvovirus in mares and their foals, and the correlation with serum markers of hepatic disease.

AUTHOR NAME / AFFILIATION

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- Luis G. Arroyo, Department of Clinical Studies, Ontario Veterinary College, University of Guelph
- John D. Baird, Department of Clinical Studies, Ontario Veterinary College, University of Guelph
- Rachel Shanahan, Port Perry Veterinary Services, Large Animal Veterinary Services.
- Brandon N. Lillie, Department of Pathobiology, Ontario Veterinary College, University of Guelph

ABSTRACT

Equine parvovirus H (EqPV-H) has been associated with equine serum hepatitis (Theiler's disease), a common cause of acute hepatic failure. The most common source of EqPV-H appears to be via administration of equine biological products contaminated with EqPV-H, but non-biological sporadic transmission has been reported. Although the majority of EqPV-H positive horses are asymptomatic or subclinical, some develop clinical signs similar to Theiler's disease, including lethargy, anorexia, icterus, encephalopathy-associated neurological signs, and/or potentially death. This study investigated the molecular prevalence of EqPV-H in mares and their foals at a stud farm in Ontario, Canada after a mare developed peracute neurological disease associated with Theiler's disease in 2019. 11 mares from the shared paddock and their foals were sampled at 2 time points for a total of 22 horses and 43 samples. Serum was collected from all the horses on May 29th, 2019, and 36 days later. DNA was isolated from serum and tested for EqPV-H using quantitative-PCR. Prevalence of EqPV-H DNA was 77.2 %, with 17/22 of horses testing positive at one or both time points with viral loads ranging from 5.93 x 10² to 6.10 x 10⁵ copies/mL. Serum biochemistry and bile acid panels were performed at the second sampling time point to assess liver disease. Regression analysis between EqPV-H DNA copy number and serum parameters revealed no relationship between the presence of parvovirus and indicators of liver disease. The role of EqPV-H in the development of Theiler's disease in horses remains uncertain and requires further research.



RAPID-FIRE POSTER PRESENTATIONS

10:30 am MT (4:30 pm GMT)

Dr. Amy Greer

Ontario Veterinary College, University of Guelph

Descriptive network analysis of Ontario equine competitions:
Implications for disease control

AUTHOR NAME / AFFILIATION

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- Terri L. O'Sullivan, Department of Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, ON
- Amy L. Greer, Department of Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, ON

ABSTRACT

Introduction. Equine competitions are an important source of entertainment and revenue in the horse industry. The objectives of this study were to i) describe the 2016-2018 contact networks of Equestrian Canada competitions in Ontario, Canada, and ii) determine if the networks exhibit characteristics of 'small world networks'.

Methods. Data on Equestrian Canada registered competitions in the province of Ontario, Canada and show results between 2016-2018 were used to create competition networks, horse networks, and venue networks.

Results. Dressage, hunter/jumper, and eventing competitions were connected through horses co-attending the same competitions. The median node degrees in the yearly horse networks were between 567 and 619 with wide variation in node centrality scores. Horse networks and venue networks had similarly short geodesics as random Erdős-Renyi networks of the same size but exhibited higher levels of clustering.

Conclusions. The high connectivity of both the competition and venue networks may provide opportunities for disease transmission to occur between competition levels and disciplines. The magnitude and distribution of node centrality scores in the horse networks suggest horses have a high average number of horse contacts during a show season, and that a small number of individuals have a high influence on network connectivity and structure. These highly influential individuals may, play an important role in the initiation of chains of disease. The 'small world' topography of the competition and venue networks means disease spread could occur more rapidly in this population and the threshold for disease persistence may be lower.

Jennifer MacNicol

Ontario Agricultural College, University of Guelph

Investigation of changes in microbial and metabolic profiles of in
vitro equine cecal fermentation methods

AUTHOR NAME / AFFILIATION

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- Simone Renwick, University of Guelph, College of Biological Science, Department of Molecular and Cellular Biology
- Caroline Ganobis, University of Guelph, College of Biological Science, Department of Molecular and Cellular Biology
- Emma Allen-Vercoe, University of Guelph, College of Biological Science, Department of Molecular and Cellular Biology
- J. Scott Weese, University of Guelph, Ontario Veterinary College, Department of Pathobiology
- Wendy Pearson, University of Guelph, Ontario Agricultural College, Department of Animal Biosciences

ABSTRACT

Access to the cecum is challenging in horses. Cecal cannulation, which enables in vivo sampling, is a technically challenging surgical procedure and maintenance can be problematic. The objective of this study was to evaluate changes in the microbiome and metabolome of cecal inoculum maintained in an anaerobe chamber or a chemostat, and of a fecal slurry maintained in an anaerobe chamber over 48h. Cecal and fecal samples were collected immediately upon death from an abattoir in QC, CAN. Cecal fluid was used to inoculate chemostat vessels (ch_c, n=11) and vessels in an anaerobe chamber (an_c, n=15). A 5% fecal slurry was maintained in an anaerobe chamber (an_f, n=6). Sampling was performed upon collection, at the time of vessel establishment (0h), after 24h and 48h of incubation. Sequencing was performed on an Illumina MiSeq and bioinformatics analysis was run using mothur software. Metabolites were identified in samples via NMR. Measures of alpha diversity and metabolite concentrations were analyzed between methods and over time using a RM ANOVA in SAS 9.4. There were clear differences in microbiome indices between fecal and cecal inoculum and the fecal slurry had significantly lower metabolite concentrations ($p < 0.05$) than cecal fluid. Both ch_c and an_c systems presented reasonably comparable microbial profiles. Despite similar trends in metabolite change overtime, there was lower absolute concentration and amplitude of metabolite change within the an_c system. It is likely these results are reflective of lower overall microbial viability. Nevertheless, the activity of the an_c and ch_c systems was similar.



PLATFORM PRESENTATIONS

11:15 am MT (5:15 pm GMT)

Rebecca DiPietro

Faculté de Médecine Vétérinaire, Université de Montréal

Fecal Microbiota Transplantation with a Concentrated Bacterial Solution has Limited Impact on the Equine Fecal Microbiota after Antibiotic-Induced Dysbiosis

AUTHOR NAME / AFFILIATION

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- Luis Arroyo: Department of Clinical Studies, Ontario Veterinary College, University of Guelph
- Mathilde Leclerc: Department of Clinical Sciences, Faculté de Médecine Vétérinaire, Université de Montréal
- Marcio Costa: Department of Biomedical Sciences, Faculté de Médecine Vétérinaire, Université de Montréal

ABSTRACT

Introduction: Bacterial imbalances are observed in intestinal diseases and fecal microbiota transplantation (FMT) has been used to restore the intestinal microbiota of horses. The objectives were to concentrate the donor stool by centrifugation, and to determine the effect of FMT in horses with antibiotic-induced dysbiosis.

Methods: Dysbiosis was induced in 9 horses by administering trimethoprim sulfadiazine for five days (D0-D5). Horses received concentrated FMT (cFMT, n=3), fresh unconcentrated FMT (fFMT, n=3), or 10% glycerol in saline (vehicle, VEH, n=3) by nasogastric tube for 3 days (D7-D9). Fecal samples were collected for microbiota analysis by Illumina sequencing and analyzed with the software mothur.

Results: Significant compositional changes were observed in the cFMT and fFMT recipient horses after transplantation (D9) compared to after antibiotic administration (D5). Changes were not observed in the vehicle recipients, indicating that both FMT protocols induced transient changes. However, the microbiota from recipients did not resemble the microbiota present in neither of the transfused solutions. The *Escherichia* genus was found in significantly higher abundances in cFMT, indicating that manipulations changed the bacterial composition of the FMT.

Conclusions: Current FMT protocols have the potential to induce transient changes in the gut microbiota, but not to restore the microbiota composition of horses after antibiotic induced dysbiosis. The composition of the transplanted solution differed from the microbiota found in the healthy donor, possibly due to oxygen exposure and freeze-thawing.

Dr. Jenifer Gold

Washington State University, Department of Veterinary Clinical Sciences

Pharmacokinetics and Safety Parameters of Single Dose Administration of 3 Increasing Doses of Acetaminophen per os in 1-Month Old Foals

AUTHOR NAME / AFFILIATION

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- Holly Mason, Utah State University, Department of Animal Science, Logan UT.
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- Nicolas Villarino

ABSTRACT

Introduction: Nonsteroidal anti-inflammatory drugs (NSAIDs) are the most frequently used pain medication in horses. Side effects such as acute kidney injury and gastric ulceration can occur, therefore alternatives are needed. Acetaminophen is one of the most commonly used analgesic and antipyretic drugs in human medicine. It is unknown whether acetaminophen is safe or efficacious in foals. Thus, determination of the pharmacokinetics of acetaminophen in foals is important, because this might be an excellent alternative for analgesia and pyrexia.

Hypothesis/Objectives: The hypothesis is plasma pharmacokinetics of acetaminophen in foals will be linear with increasing doses. The objective: to determine the pharmacokinetics of acetaminophen following oral administration of a single dose of 10, 20, and 40 mg/kg in foals.

Animals: 6 clinically healthy 30-day old foals

Methods: In a blinded randomized cross-over study, foals received 10, 20 and 40 mg/kg once with a 2-week washout in between doses. Physical examinations were performed at each blood collection point. Complete blood count and biochemistry profiles were performed before and 7 days after each acetaminophen dose. Blood was collected pre-dose and then 15 min, 30 min, 1, 2, 4, 8, 16, 32 and 64 hours after acetaminophen administration.

Results: Peak plasma acetaminophen concentrations occurred at 2.5 hours post administration. Terminal half-life was 3 hours. Physical examination, CBC and biochemistry parameters remained normal. In foals, 10 and 20 mg/kg may not attain effective concentrations.

Conclusion: Foals metabolize acetaminophen faster than adult horses. Foals may need higher and more frequent dose administrations than adult horses.



NOTES



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