Lay Summaries of Research Projects for 2023-2024

New Projects:

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Arroyo, L. - Pulse Wave Velocity in Equine Palmar Digital Arteries and Laminitis: A Pilot Study

Laminitis is a common crippling condition in horses, causing relevant losses in the equine industry. To date, the mechanisms of the disease have not been fully understood. With increased arterial stiffness of elastic arteries and changes in the vascular tone of the peripheral muscular arteries, the distal capillary beds may be exposed to increased mechanical stimulus by faster and more pulsatile blood flow. In humans, arterial stiffness appears to play a significant role in cardiovascular diseases, brain and kidney injury, by causing microvascular damage in these organs. The microvascular changes observed in laminitis are comparable to those observed in the brain and kidney lesions of humans with increased arterial stiffness and reported changes in hemodynamic in laminitic horses are also compatible with increased arterial stiffness of central arteries and vasodilation of peripheral muscular arteries. More, two of the main triggers of laminitis are known to affect arterial stiffness in humans (systemic inflammation and hyperinsulinemia). Pulse wave velocity (PWV) is a good indicator of arterial stiffness and should be measurable on equine distal limbs. There are many unanswered questions about laminitis, but the study of pulse wave velocity in the equine distal limb has the potential to deepen our knowledge regarding its pathogenesis and point out new targets for treatment of this condition. Thus, palmar digital artery PWV in horses appears as a new and extremely relevant topic waiting to be investigated.

Arroyo, L. Improving Methods for Detection of Intestinal Dysbiosis in Horses

Intestinal diseases are the leading cause of mortality in horses and are normally associated with microbiota changes before and during the outset of diseases or treatment with antibiotics. DNA sequencing (NGS) has been used to characterize changes in the microbiota of horses, but those technologies are relatively expensive, have a long turnaround time and require complex bioinformatic analyses. In addition, a major limitation of those techniques is the lack of absolute quantification, meaning that it is impossible to know how many bacteria were present in the feces. Recently, we have used quantitative methods to show that there were markedly lower amounts of bacteria in the feces of horses with colitis compared to healthy animals. In addition, we were able to find some bacteria that were statistically more abundant in horses that were euthanized compared to horses that survived. The objective of this study is to expand the markers that were found to be good indicators of microbial imbalances in horses with colitis. In the present study, we will conduct a multicenter study to determine if the dysbiosis present in horses with colic can be used to distinguish the type of colic and measure severity.

Changoor, A. & Koenig, J. - Portable Electroarthrography & Biomechanical Measurement System to Evaluate Equine Cartilage Quality at the Point-of-Care

Osteoarthritis (OA) is the most common cause of lameness in horses and is characterized by progressive and irreversible cartilage degradation. Cartilage is the thin tissue that lines the ends of bones in joints and normally enables pain free movement. Early recognition of OA is important to be able to treat and potentially prevent disease progression, yet veterinarians have no easy way of identifying cartilage changes and objectively monitoring joint disease. Electroarthrography (EAG) is an innovative technology that evaluates cartilage through sensors placed on skin around a joint, such as the equine fetlock (metacarpophalangeal) joint. This is similar to the way heart health can be understood using electrocardiography. EAG, measured with a prototype measurement system, successfully followed OA progression and treatment in an equine fetlock model of early OA. The prototype EAG-based measurement system used in this recent clinical

study was critically evaluated to identify areas for performance improvement. The proposed research aims to create a reliable, accurate and portable EAG-based measurement system for evaluating cartilage quality at the point-of-care. We hypothesize that such a system can be created by combining existing sensor technologies in a unique way to measure both EAG and biomechanics simultaneously in real-world situations and that the system can be successfully validated against a gold-standard. This research is expected to produce a robust EAG based measurement system that can be used by equine veterinarians to evaluate cartilage health in real time. Achieving the study aims would provide a critical link to further develop EAG into a sensitive diagnostic method and dramatically improve how OA is managed in horses.

Koenig, J. - Can 10 or 20 Million Umbilical Cord Blood-Derived Mesenchymal Stromal Cells Treat Equine Fetlock Synovitis Effectively?

Osteoarthritis (OA) is a condition in horses where the joints undergo changes that affect their structure and function. It's a common reason for lameness and reduced performance in athletic horses. While there are treatments available to manage OA symptoms, none of them directly targets the underlying disease process. We're looking at using mesenchymal stromal cells (MSCs) to treat joint inflammation, known as synovitis, in horses' fetlock or carpus joints. MSCs are thought to have longer-lasting effects than corticosteroids, another type of treatment commonly used to treat OA. In our study, we want to see if injecting either 10 million or 20 million MSCs, along with hyaluronic acid (HA), can improve the clinical signs of synovitis in horses. We'll compare this with using HA alone to see which approach is more effective in treating naturally occurring synovitis in client-owned horses.

Muñoz, A. - Near-infrared display of indocyanine green in intraoperative tissue blood flow and tissue perfusion of healthy equine small intestine under laparoscopic guidance

There is no objective method for intraoperative assessment and quantification of blood perfusion in the equine gastrointestinal tract. Quantitative evaluation of indocyanine green fluorescence during laparoscopic and laparotomy surgery will enhance the precision and accuracy of real-time intraoperative visualization of blood flow and perfusion in the small intestine of healthy horses. This pilot study will set the framework for further studies of colic surgery in the clinical setting.

Avison, A. - Equine Myocardial Ion Channel Expression

Since their domestication, horses have been selected for their athletic ability. However, Thoroughbred racehorses have been estimated to have up to 260 times greater risk of sudden athletic death than human athletes. Additionally, non-fatal heart rhythm disturbances or “arrhythmias” are common in racehorses. It is estimated that at least 20% of equine sudden athletic deaths may be the result of rhythm disturbances that proved fatal. The reason horses are susceptible to these arrhythmias is not known. In order to advance our understanding of cardiac contributions to sudden athletic death, we require a greater understanding of the normal heart electrical activity in horses. As such, we aim to investigate specific proteins that are essential to the heart’s electrical activity in horses, which has never been done before, and is an essential step to understanding potential predispositions to dangerous heart rhythm disturbances. The overall goals of this project are to identify markers of cardiac dysfunction in performance horses, identify those horses most at risk for sudden cardiac death, and reduce the risk of morbidity and mortality of equine athletes.

Riley, C. - A Prospective Study of Antimicrobial Susceptibility and Multidrug Resistance in Bacteria Isolated from Diagnostic Samples from Foals in Ontario

Ontario is a major hub for horse breeding in Canada and North America, with Thoroughbred and Standardbred horses being a significant part of the industry. The success of the breeding and performance sector in Ontario depends on the survival, health, and growth of foals. Unfortunately,

many neonatal foals are admitted to veterinary hospitals due to sepsis, a severe infection, and only 60 to 80% of them survive. This is a leading cause of death in young horses. The key to effectively treating these infections is to use antibiotics, but treatment often starts before the lab results are available. Therefore, it's essential to understand the likely bacteria causing the infection and their antibiotic resistance patterns. Adhering to guidelines for antibiotic use is recommended, but these guidelines should be adapted to the specific region (i.e., Ontario), as antibiotic resistance patterns differ between regions and change over time. While some studies have looked at antibiotic resistance in Ontario's horses, none have focused on neonatal foals. Investigating antibiotic resistance in sick foals is crucial to improve their survival and prevent the spread of antibiotic resistance in Ontario's horse breeding operations. We believe that antibiotic resistance patterns in sick neonatal foals in Ontario are unique, and the rates of multidrug resistance are unknown compared to other regions. We aim to identify the species of bacteria causing infections in Ontario's foals under 30 days old by studying bacteria from diagnostic samples and determining the antibiotic susceptibility patterns and the extent of multidrug resistance in the isolates from these neonatal foals.

Torrent, A. - Fecal Microbiota Transplantation in horses via Pelvic Flexure Enterotomy during Colic Surgery

Diarrhea is a common postoperative complication observed after colic surgery in horses. Diarrhea increases post-operative morbidity and is associated with abdominal pain, dehydration, electrolyte and acid-base disturbances, toxemia, sepsis, and increased risk of laminitis. Overall, represents a complication that affects the well-being of the horse, may endanger its life, prolongs hospitalization times, drains resources and increases the cost of treatment. Historically there has been limited evidence supporting the effectiveness of oral administration of microbiota from healthy donors in restoring the normal microbiota of the large intestine in horses with diarrhea. The digestive juices secreted in the stomach and small intestine, along with the fermentation processes occurring within the cecum, are the most likely cause of failure. There is conflicting evidence among studies. Recent research conducted by McKinney et al. in 2021 has endorsed the use of fecal microbiota transplant (FMT) to mitigate the severity of diarrhea in horses with colitis and enhance the diversity of the microbiome. The current research project aims to explore an alternative route of administration of microbiota in horses. Our hypothesis suggests that the direct introduction of fecal microbiota from healthy donors into the large intestine during colic surgery will be both effective and readily available to the intestine, resulting in a positive impact on the patient's microflora after surgery.