Lay Summaries of New Research Projects for 2022-2023

New Projects:

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Arroyo, L. - Screening for biomarkers indicators of intestinal health among the equine microbiota

Intestinal diseases are the leading cause of mortality in horses. Recently, the intestinal microbiota has been shown to be essential to the health of the host. Marked changes in the intestinal microbiota (dysbiosis) are present before and during the outset of diseases and after treatment with antibiotics. New technologies such as next generation DNA sequencing (NGS) are reliable to characterize changes in the microbiota, but are relatively expensive, have a long turnaround time and require complex bioinformatic analyses. Specific bacterial markers are currently being used in other species to accurately predict intestinal dysbiosis. For example, increased Enterobacteriaceae and the decreased Lachnospiraceae are constantly observed along with intestinal inflammation. This study will find and validate key bacteria that could be measured by real time PCR (qPCR), which is quicker and cheaper than DNA sequencing. The objective is to identify potential markers of intestinal dysbiosis to be used as an alternative to DNA sequencing to detect dysbiosis in horses, allowing early treatment and closer monitoring of those animals.

Beeler-Marfisi, J. - Macrophage responses of healthy and severely asthmatic horses to agents that exacerbate equine asthma

Severe equine asthma (SEA) is the most common non-infectious inflammatory airway disease of mature horses. This disease causes decreased athletic ability and with progression may lead to euthanasia. Severe equine asthma is caused by exposure to airborne dusts found in the barn, including fungal spores, LPS and inorganic particulates, such as silica from soil (challenge material, Beeler-Marfisi et al. 2010). Although studied for decades, it remains unclear why some horses develop SEA while others with the same dust exposure do not. Alveolar macrophages (AMs) are the first line of defence in the lung and during inflammation, are supplemented by monocyte-derived macrophages (MDMs). Broadly speaking, AMs and MDMs are classified as pro-or anti-inflammatory based on expression of cell surface markers including CD163 and CD206, as well as patterns of protein production. In previous work comparing healthy and SEA-affected horses (Kang et al. 2021), we noted that AMs from asthmatic horses had a different immunophenotype to healthy horses suggesting a relationship between this altered immunophenotype and lung inflammation. Therefore, we believe that differences exist in AM and MDM immunophenotype and other cellular responses between healthy and SEA-affected horses which will explain why some horses become asthmatic while others do not.

Changoor, A. & Koenig, J. - Evaluation of Non-invasive Electroarthrography to Predict Cartilage Quality in Equine Osteoarthritis

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. Veterinarians could benefit from having a way of identifying cartilage changes that would allow them to objectively monitor OA. Electroarthrography (EAG) is an innovative technology that evaluates cartilage through sensors placed on skin around a joint, such as the equine fetlock. This is similar to the way heart health can be understood using electrocardiography. The proposed research aims to improve EAG collection to make it easier to use in the clinic, as well as evaluate the ability of EAG to follow OA

progression and treatment in an equine fetlock (metacarpophalangeal) model of early OA. We hypothesize that we can streamline EAG collection by creating a read-to-wear device and that EAG will be able to detect cartilage changes over time and show a relationship to magnetic resonance imaging (MRI) and direct observations of cartilage quality using arthroscopy. This research will be the first to demonstrate that non-invasive EAG can be used in a clinical setting to monitor cartilage health and we anticipate EAG will produce comparable results to MRI. Achieving the study aims would provide a critical link to further develop EAG into a sensitive diagnostic method that could be deployed at the point-of-care and dramatically improve how OA is assessed and treated in horses.

Chenier, T. - Efficacy of an Oral Supplement Containing Omega Fatty Acids for Treatment of Persistent Breeding-Induced Endometritis (PBIE) in Mares

Reproductive efficiency in horses is generally low, for a variety of reasons, including infertility caused by uterine disease. Endometritis is the third most common medical condition encountered overall in equine veterinary practice (Traub-Dargatz et al. 1991), and approximately 60% of mares affected by endometritis are barren (Overbeck et al. 2011). Causes of endometritis include acute bacterial infections, chronic infections, and persistent breeding-induced inflammation (PBIE). PBIE is characterized by a prolonged inflammatory response following breeding, leading to early embryonic loss and infertility. A normal, transient inflammatory response occurs post-breeding; however, in a subset of susceptible mares, this inflammation persists. One study identified PBIE in 43% of a mixed population of mares and found a lower pregnancy rate in affected mares compared to normal mares (49% versus 62%; Newcombe 1997). Given the large number of horses in the breeding sector both in Ontario and Canada as a whole, endometritis and more specifically PBIE, causes a significant economic impact to both the Canadian and Ontario breeding industries. Cytokines are proteins produced by cells that have an effect on the immune system to fight disease. The uterine inflammatory response can be characterized by alterations in these cytokines. Levels of both pro-inflammatory and anti-inflammatory cytokines are different between PBIE-susceptible versus normal mares.

Monitoring cytokines in the uterus can help evaluate the effectiveness of treatments for PBIE. Treatment approaches used in mares with PBIE include uterine lavage and oxytocin to remove fluid in the uterus, drugs to suppress the immune response such as dexamethasone, and mycobacterial cell wall extract to suppress inflammation. More recently, uterine infusion of platelet rich plasma has been shown to reduce fluid accumulation and inflammation in affected mares. Omega-3 fatty acids (FA) inhibit production of both acute and chronic inflammatory cytokines, showing benefit for treatment of inflammatory diseases in humans and horses. In a recent study, Omega-3 FA supplementation reduced the time for the uterus to shrink after foaling. In a different study, mares fed Omega-3 fatty acids had less uterine fluid and inflammation after breeding. It appears that correcting the altered inflammatory response in mares with PBIE may be an effective approach to treatment. This study will compare uterine lavage, uterine infusion of platelet-rich plasma and oral supplementation with Omega-3 fatty acids, as treatments in mares with PBIE. Levels of several inflammatory proteins (cytokines) in the uterus will be evaluated, and clinical signs of endometritis will be assessed. The benefits of this study include potential identification of a new, effective therapy for PBIE in mares, resulting in reduced antibiotic use, improved fertility and improved understanding of this important condition.

Cote, N. - Evaluation of factors contributing to upper airway obstruction through repeated resting and dynamic respiratory endoscopies in 2-year-old Standardbreds

Identification of upper airway abnormalities at the beginning of a racing career may predict future airway obstruction and therefore the productive performance of the horse. It has been demonstrated that endoscopy at rest is not a sufficient means of evaluating underlying upper airway pathology. Therefore, a combination of resting and dynamic endoscopies is recommended to fully evaluate the upper respiratory system. It is well described in the literature that abnormalities found during post-sale endoscopies are negative predictors for future racing performance (e.g., lower earnings). Currently, it is unknown the number of yearlings racehorses that develop upper airway problems during their careers despite normal resting and dynamic endoscopic evaluation post-sale. Proposed predisposing factors for the development of upper airway disease include viral infection, pharyngeal lymphoid hyperplasia (PLH), lower airway inflammation (LAI), and exercise-induced pulmonary hemorrhage (EIPH). However, contradictory results have been reported in the literature and currently it is unknown what the contributing factors are in these individuals for the development of upper airway problems. A prospective longitudinal cohort study is needed to evaluate the number of horses that develop upper airway diseases and the contributing factors on the development of those diseases.
Performing periodic resting and dynamic endoscopies may predict the development of upper airway disease and help identify factors that may play a role in their development. Furthermore, changes to the appearance of the upper airway in these young racehorses may occur under the influence of exercise and as they mature.

Gomez, D. - Fecal and serum metabolome and fecal bile acids and D-lactate concentrations in healthy horses and horses with colitis

Colitis (inflammation of the colon resulting in diarrhea) is a serious disease in horses with high rates of morbidity and mortality. Infectious agents causative of colitis include bacteria, virus and parasites. Microbiological evaluations of feces from diarrheic horses revealed an association between some gut bacteria communities and the development of the diarrhea and the mortality of horses with colitis. However, the metabolites produced by bacteria during colitis are unknown as well their association with disease severity (i.e., mortality). Investigation of the metabolic-end products of bacterial activity will help to elucidate the significance of gut bacteria communities during inflammation of the gut. Therefore, the aim of this study is to examine the fecal and serum metabolites and fecal bile acids concentrations of healthy horses and horses with colitis. This research will combine several microbial and metabolic parameters to uncover the complex relationships between bacteria and gut inflammation in diarrheic horses especially in those that succumb to disease. The discovery of these novel relationships will enable the progress of targeted and individualized animal health care to improve disease prognosis and welfare.

Gomez, D. - Cardiovascular effects of rapid and slow intravenous administration of sodium penicillin in horses undergoing exploratory laparotomy for colic: A randomized clinical trial

Perioperative antimicrobial prophylaxis is recommended in horses with colic that undergo abdominal corrective surgery. Current recommendations include administering antimicrobials drugs within 60 min before surgery and read minister time-dependent antimicrobial drugs, such as sodium penicillin, every 60 minutes after the first dose if the surgery is still ongoing. However, compliance with re-administration is usually not followed because intravenous administration of sodium penicillin in anesthetized horses is associated with a decrease in arterial blood pressure, often already present in compromised colic horses, and can result in multiple systemic complications, including death. In healthy anesthetized horses, the decrease in arterial blood

pressure caused by sodium penicillin administration is usually transient and of less clinical impact, although its severity is thought to depend on the speed of administration. The effect of sodium penicillin and the speed of administration on arterial blood pressure in horses with compromised cardiorespiratory function, such as colic, have not been investigated. Thus, the benefit of proper antimicrobial treatment has been outweighed by the risk of affecting cardiovascular function, without a proper assessment of this situation in a clinical scenario.
The objective of this study is to compare the cardiovascular effects of rapid versus slow intravenous intraoperative administration of sodium penicillin in horses undergoing exploratory laparotomy for colic.

Pearson, W. - New insights into immunomodulatory effects of Spirulina in vitro, and on local and systemic response to high-intensity exercise in horses

Inflammation and its associated oxidative stress have complex, dualistic adaptive and maladaptive effects on exercise performance, exercise recovery, and acclimation to repeated exercise bouts (i.e., 'training effect'). When these dualistic roles are in balance, exercise-induced inflammation imparts a net benefit to the training effect; however, when it exceeds adaptive capacity of tissue, degenerative inflammatory conditions such as arthritis can result. Dietary ingredients with the potential to dampen inflammation may reduce the incidence of exercise-induced tissue damage and degenerative disease but may also interfere with exercise recovery and training effect. Spirulina (Arthrospira sp.) is a nutrient-dense feed supplement with the potential to support robust health and optimize exercise performance in horses. Beyond just classical nutrition, Spirulina has marked antioxidant, anti-inflammatory, and immunomodulatory activities in various inflammatory conditions, including the inflammatory condition of exercise. These effects have not been shown in horses, and equine-specific downstream effects of Spirulina on local (cartilage) and systemic adaptation to exercise stress is not known.
The purpose of the proposed study is to: 1) quantify direct, dose-dependent in vitro effects of Spirulina on cartilage explants responses to hypoxic and impact strain with respect to biomarkers of inflammation (IL-1β, IL-6, TNFα, PGE2,), inflammation resolution (RvD1), cartilage turnover (GAG, CS846), and oxidative stress (total antioxidant status, catalase, SOD activity) 2) determine whether the observed in vitro effects are also observed in spirulina-supplemented horses during exercise recovery. This study will result in new information pertaining to the direct effect of Spirulina on cartilage and muscle health, and to its application in optimizing systemic and local adaptation to high-intensity exercise in horses.

Avison, A. - Cardiac dysfunction and sudden death in horses

Fatality among equine athletes is a rapidly growing concern with respect to animal welfare, ethical considerations, human safety, and public perception of equine sports.
Emerging evidence by our group supports cardiovascular disease –specifically cardiac arrhythmias and conduction disturbances –as a significant and under-recognized factor. The contribution of arrhythmias to racehorse fatalities is difficult to quantify and is often a presumptive diagnosis of exclusion owing to the inability to assess cardiac function after death. In addition to concerns regarding fatalities, there is ongoing public and industry unease about exercise-induced pulmonary hemorrhage (EIPH) and the use of race-day medication (Lasix ®, furosemide). It is widely accepted that non-fatal arrhythmias are often identified during exercise or in the immediate post-exercise period in apparently normal equine athletes. However, their frequent detection does not negate their possible significance. Small or transient increases in pulmonary vascular pressure due to such rhythm disturbances may be the underlying cause or a contributor to EIPH in many horses. Therefore, the overall contribution of cardiac dysfunction to equine mortality remains unknown.