

RESEARCH SPOTLIGHT

A publication of Grayson-Jockey Club Research Foundation

Summer Edition 2026

Understanding Equine Sudden Death ...A Critical Frontier in Equine Research

Grayson-funded research is turning uncertainty into answers—and answers into prevention. *Despite advances in equine care, sudden death remains one of the most complex and least understood challenges in horse health.* These rare but devastating events often occur without warning in otherwise healthy horses, leaving veterinarians and owners searching for answers. *This research is working to change that - investigating hidden cardiac abnormalities, identifying risk factors, and developing tools to detect potential issues before they become fatal.* While critical unknowns still remain, each discovery brings us closer to prevention.

What We Know

- Cardiac-related issues account for approximately half of exercise-associated sudden deaths
- Many horses show underlying heart rhythm irregularities that are not outwardly detectable
- Even with post-mortem evaluation, a significant number of cases remain unexplained

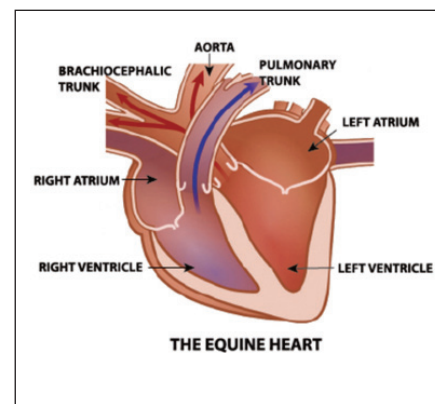
How Grayson-Funded Research Is Making a Difference

- Advancing the use of cardiac monitoring tools to detect risk earlier
- Supporting large-scale studies to identify patterns and risk factors
- Driving collaboration between veterinarians, researchers, and industry leaders
- Moving the field from reaction to prevention

And Why It Matters

Each breakthrough brings us closer to:

- Earlier detection
- Better decision-making
- Safer outcomes for horses across all disciplines



Grayson has funded the following research working to understand Equine Sudden Death

Predicting Exercising Arrhythmias With Resting ECGs (2021)

Molly McCue, University of Minnesota

This study used at rest ECGs to identify horses with irregular heart rhythms at exercise that can cause sudden cardiac death (SCD), allowing for increased monitoring and improved understanding of SCD.

Ketodoxapram As A Treatment For Atrial Fibrillation (2024)

Annelies Decloedt, Ghent University

An exploration of Ketodoxapram as a promising novel treatment method for horses with atrial fibrillation.

ECG Findings And Performance In Thoroughbred Racehorses (2026)

Sian Durward-Akhurst, University of Minnesota

This study uses ECGs to improve diagnosis of cardiac related poor performance allowing for increased monitoring to reduce the frequency of exercise-associated sudden death in Thoroughbred racehorses.

Sudden Death in Racehorses

Interview with Sian Durward-Akhurst, Assistant Professor and Principal Investigator, University of Minnesota

How do veterinarians define “sudden death” in racehorses, and why does it remain so difficult to explain?

Exercise Associated Sudden Death (EASD) was recently defined by a group of experts at the first meeting of the International Federation of Horseracing Authorities focus group on exercise associated sudden death as: “a fatal collapse in a closely monitored and previously presumed clinically healthy horse that occurs during exercise or within approximately one hour after exercise”. Sudden death includes EASD and would include horses that die suddenly outside of the one hour of exercise window.



There are several challenges to trying to explain sudden death and why it happens:

- *The fact that the horse is typically presumed to be clinically healthy before the fatal collapse makes it very difficult to identify horses at increased risk. Unlike catastrophic musculoskeletal injuries where there can be pain and/or lameness, most horses that develop EASD have no obvious clinical signs which makes it really difficult to predict.*
- *More than half of the horses with EASD have no significant findings at necropsy. This means that a definitive cause of death is hard to determine. We suspect that fatal arrhythmias are an important cause of fatality without a cause at necropsy because arrhythmias typically do not leave any detectable damage to the heart that can be recognized at necropsy.*
- *It is relatively simple to identify horses that have arrhythmias during exercise. However, knowing which arrhythmias lead to EASD is not well understood, although this is something that we are working on right now.*

Why is defining “normal” cardiac function in elite equine athletes such a central challenge?

To simply put it, if we don't know what normal is, we can't establish what abnormal is. There is strong evidence that cardiac abnormalities are an important contributor to EASD in racehorses. There were over 42,000 racehorse starters reported by the Jockey Club in the United States in 2025. That doesn't include all the horses that train but do not go on to race. It is simply not possible to do a full cardiac examination on all of these horses.

We need to be able to develop a method that will help identify horses that are at increased risk of developing arrhythmias that could lead to EASD so that those horses can be monitored more closely to reduce their risk of EASD. To do that, we need to first establish what is normal, so that we can find horses that are outside of the normal range that should be monitored more closely. To establish 'normal' we need to collect ECGs from thousands of horses which takes both time and funding to support the research, but is something that we are working on.

How is genetic research contributing to our understanding of sudden death risk, and what have researchers learned so far? And how could genetic data eventually be integrated with performance, training, and medical histories to improve risk assessment?

Our goal is to identify genetic markers that can be used to differentiate between horses at high and low risk of EASD and/or atrial fibrillation. At the moment, we are collecting whole genome sequencing data of racehorses with and without EASD so that we can perform a genome wide association study which helps to identify differences between cases and controls.

A group in Australia led by Drs. Nath and Franklin have also determined that there is evidence to support there being a genetic component to exercise associated sudden death attributed to cardiac issues, but that there are also multiple



“Our goal is to identify genetic markers...”

non genetic contributions as well. This is not surprising, as even in humans where the genetics of exercise associated sudden death have been studied for a longer time period, there are still no genetic tests available for individuals without a family history that suggests higher risk of EASD.

It is unlikely that a single genetic marker will explain all cases of EASD. We expect that we will find multiple genetic markers that contribute to a horse's risk of EASD. The goal will be for us to identify horses that are genetically at high risk of EASD. These horses can then be monitored more closely.



How have findings on arrhythmias in healthy racehorses reshaped current research priorities?

One of the most surprising findings of studies evaluating ECGs during exercise is the surprisingly high number of horses that have arrhythmias during exercise. This makes it quite challenging to decide which arrhythmias should be evaluated more closely as they may be having negative consequences on the horse, and which are just part of normal variation. This has led to more emphasis on defining ‘normal’ ECG findings so we can more easily identify horses that have more arrhythmias or a certain type of arrhythmia that may be at higher risk.

With the very large numbers of ECGs needed to understand normal ECG variation in horses, the time it takes for a clinician to read the ECGs is now a major rate limiting factor. This has led to a couple of new research directions:

- *With support from the Grayson Jockey Club Research Foundation, we sought to determine if it was possible to identify horses that had arrhythmias during exercise using computational analysis of resting ECGs. This method requires approximately one minute of resting ECG. We established that it was possible to differentiate between resting ECGs of Standardbred and Thoroughbred racehorses with and without exercising arrhythmias using pre-exercise ECGs.*

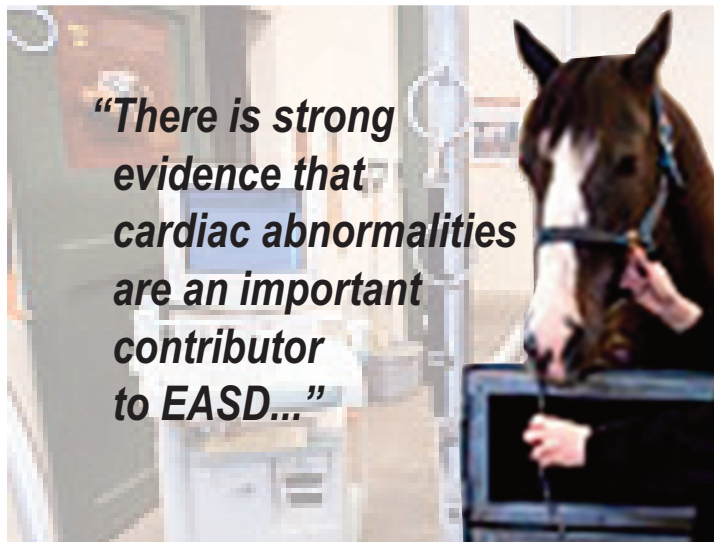
This method now needs to be refined and validated on a new population of racehorses with and without exercising arrhythmias. The goal would be a method of screening ECGs to identify those that should be looked at by a clinician.

- *We need to develop an algorithm that can read exercising ECGs and provide a summary of the type and frequency of arrhythmias present in the ECG.*

What questions remain about atrial fibrillation and its potential long-term effects on the equine heart?

We have been able to collect ECGs from 11 racehorses that developed EASD. Some horses were wearing the ECG device the day of death and others were wearing the ECG at some point prior to the day of death. One of the most surprising findings was that there were 4 horses that had atrial fibrillation (AF) from the start of the ECG (i.e., pre-exercise). Three of these horses died during that work out, and the fourth horse died within nine days of that ECG but was not wearing an ECG device at the time of death. This would suggest that AF may be contributing to horses developing EASD.

This was surprising, because although we know that AF causes poor performance, horses typically were not thought to be at higher risk of EASD unless they had structural cardiac abnormalities that were causing the AF. Although, we do recommend that horses in AF don't exercise maximally. We are working to collect additional ECGs from racehorses that develop EASD as well as those that don't so we can explore this further.



Most racehorses with AF do not have underlying structural cardiac abnormalities that lead to AF. So, at this time, we cannot predict why some horses develop AF and when it will happen. Previous work has shown that normal sinus rhythm ECGs are different between horses that have had AF and those that haven't. Work is ongoing to validate this study. Ideally we need to be able to predict horses that are at higher risk of AF.

AF without structural cardiac abnormalities is thought to have a genetic basis in humans, and we believe that the same is true in horses. So one of our goals is to identify genetic variants that could be contributing to AF development. Similar to EASD, this would allow us to identify and monitor more closely horses at high risk of AF developing.

We also don't know if a horse with AF will stay in normal sinus rhythm after the AF resolves, either spontaneously or following treatment. This makes it hard for owners and trainers to decide whether to continue training and racing the horse after the AF has resolved or if the horse has retired.



***Looking ahead, what research breakthroughs are most likely to lead to effective prevention strategies?
What are the most significant knowledge gaps researchers are trying to address right now?***

The most significant knowledge gaps are probably:

- *How do we identify horses at increased risk of EASD/AF?*

- *What monitoring is needed for horses at higher risk of EASD/AF, without necessarily stopping them from performing?*
- *Can we use computational tools to read exercising ECGs?*

Why is communication and data sharing between veterinarians and trainers critical when investigating these cases in order to advance this work?

As researchers that focus on using horses that are continuing to train and perform, communication is absolutely key. The work that we do involves collecting ECGs and other information from racehorses in training. We could not do this work without the support of trainers and the regulatory and attending racetrack veterinarians. We are so grateful for all the help and support that we have received so far.

While we need horses that are 'normal', we also need horses that may have a history of poor performance that doesn't appear to have a musculoskeletal cause, those that have exercise induced pulmonary hemorrhage, those with collapse, and those with EASD as well. We also are working to collect the race/performance histories and medical histories of all these horses so that we can try and find markers that can be used to identify horses at higher risk of EASD/AF.

Likewise, we need to be open about the data we are collecting, who will have access to it, and that the data collected is considered confidential to our research group and cannot be shared with other individuals without specific request from the trainer. We are also working to share the key findings from our research as we go along as well, so that the research conclusions can be used by trainers and veterinarians at the track as soon as possible. ❤️

***"Atrial fibrillation
may be contributing
to horses developing
EASD."***





Grayson-Jockey Club Research Foundation appreciates the generous support of these projects by the United States Eventing Association.



Non Invasive Evaluation of Host Micro-biota Interaction (2019)

Dr. Cannan Whitfield-Cargile, University of Georgia

This proof-of-principle work has had broad implications in the field of equine gastroenterology and increases our ability to identify specific metabolites and/or bacterial probiotics that impact equine GI health. This is used to indicate a variety of GI conditions, diseases and inflammatory agents to ulcer detection. It has proven accurate in detecting these through analysis of gene expression in the feces.

Enhancing the efficacy of Mesenchymal Stromal Cells (MSCs) for Tendon Healing (2020)

Dr. Lauren Schnabel, North Carolina State University

This study improved our knowledge of the temporal tendon cytokine microenvironment following injury, which can be beneficial for the development and determining optimal timing of administration of regenerative therapies.

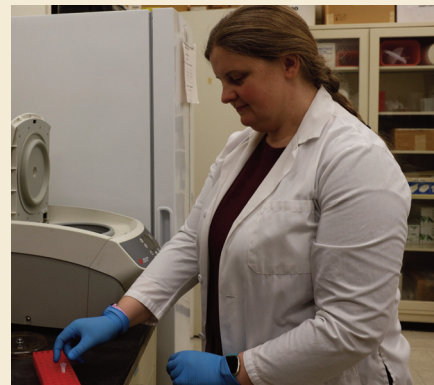
MSCs licensed in vitro with 33 IL-1, but not IL-6, at a concentration identified from the in vivo study induced upregulation of multiple genes beneficial to tendon healing as identified by RNA-sequencing. Specifically, vascular development, ECM synthesis and remodeling, chemokine and growth factor function alteration, and immunomodulation and tissue reparative genes were significantly upregulated. The data from this supports the need to further study the benefit of MSCs administered within the inflamed tendon (48 hrs) of exogenously licensed MSC, with IL-1 in vitro prior to treatment as licensed MSCs could enhance their therapeutic benefit in the healing tendon.



Predicting Exercising Arrhythmias with Resting Electrocardiograms (ECGs) (2021)

Mollie McCue, Sian Durward-Akhurst, University of Minnesota

The data collected from this project demonstrated that complexity analysis can be used to differentiate between horses that have cardiac arrhythmia at exercise and those that don't, using one-minute segments of normal sinus rhythm ECGs at submaximal heart rates. Also demonstrated was the feasibility of using non-linear analysis as a predictor of cardiac arrhythmias in the horse. This suggests that this could be a useful tool for screening pre-exercise ECGs to identify horses at risk of arrhythmias in exercise.



PET/MRI of the Sport Horse Fetlock (2023)

Mathieu Spriet, University of California-Davis

This project was designed to take PET scans of injuries of the fetlock and compare with MRI images of the same injury. This was then altered to also include CT scans. The project expanded in numbers and included images taken at several private practices and institutions. The results of examining and comparing these different modalities have led to a much higher level of understanding of the diagnostic capabilities of PET. Furthermore, PET has proven to be an accurate indicator of the healing process of these injuries.

Treatment of Meniscal Injuries with MSCs (2023)

Aimee Colbath, Cornell University

This project is still in progress with final histological analysis of the joint tissues and menisci after treatment with MSCs. The study was very successful in the proof of a meniscal injury model. This model has been adopted as an excellent soft tissue related osteo- arthritis model as well.



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821 Corporate Drive • Lexington, KY 40503 • 859.224.2850
grayson-jockeyclub.org • contactus@grayson-jockeyclub.org