Heart muscle scarring: a cause of sudden death in thoroughbreds

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May 2020
Aims/objectives

To find out whether heart muscle scarring occurs in thoroughbred racehorses and if it may cause abnormal heart rhythm.

Methods used

This research was a cadaver study of thoroughbred horses that died during racing or training in Victoria or South Australia during 2018-2019. There were 10 thoroughbred horses that died from suspected sudden cardiac death and 16 that were euthanased due to an injury unrelated to the heart. These horses acted as controls, as they had also been trained for racing prior to euthanasia. Eight brumbies of similar age and sex served as controls that had not been trained.

Cardiac tissues from four atrial sites and six ventricular sites in the heart were stained with Masson’s trichrome to identify myocardial fibrosis (heart muscle scarring), which was measured using specialised computer software. Tissues from four atrial sites and four ventricular sites were also stained with Haematoxylin and Eosin to assess the presence of inflammatory cell types.

Results/key findings

Changes to the heart muscle of thoroughbred horses in race training were identified through microscopic analysis of the heart tissue. In the ventricular muscle more scarring was observed in thoroughbred horses compared to untrained control horses.

In comparison, changes were not observed in the atrial muscle of thoroughbred horses compared to untrained horses. Scarring in the ventricular muscle occurred more often in thoroughbred horses that died from sudden cardiac death as compared to thoroughbred horses that died from a non-cardiac injury.

The increase in scarring in horses with sudden cardiac death was most significant in the left ventricular anterior papillary muscle (Figure 2). These results provide evidence of heart muscle scarring in thoroughbred horses as a cause of sudden cardiac death.

Background

Abnormal heart rhythm causes approximately half of sudden deaths during or immediately after racing in thoroughbred horses. Athletic training causes changes in the heart which are known as athletic heart syndrome. These changes include increased heart size, increased leakiness of the heart valves, reduced heart rate and reduced strength of heart contractions when resting. Although these changes haven’t been of concern in the past, investigations in humans and rodents suggest that athletic heart syndrome also increases risk for cardiac rhythm abnormalities. This is thought to be caused by heart muscle inflammation and scarring in response to the extreme stress placed on the heart during exercise.

Thoroughbred horses develop athletic heart syndrome similarly to humans. High vascular pressures (pressure in the circulatory system, including the heart) are generated during galloping; therefore, it is expected that heart muscle inflammation and scarring could occur in this species leading to abnormal heart rhythm and sudden cardiac death.

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Implications for relevant stakeholders

Heart enlargement due to athletic training occurs in racehorses and is not usually a problem. However, some horses develop heart muscle scarring that could cause abnormal heart rhythm, in the worst cases resulting in sudden cardiac death.

The results of this research could contribute to a reduction in the incidence and impact of abnormal heart rhythm in racehorses through changes to training programs or administration of certain anti-scar medications. A reduction in the incidence of abnormal heart rhythm would improve the safety of industry participants, the welfare of horses and enhance the sustainability of the industry.

Recommendations

This research provides evidence that high-intensity training in thoroughbred racehorses causes changes to the heart muscle that could promote abnormal heart rhythm development. Racing industry regulators and horse trainers should be aware of these findings and further investigate horses that are known to have an abnormal heart rhythm. The potential for heart muscle inflammation (myocarditis) caused by viruses and toxins in causing heart muscle scarring needs to be explored. More research is needed to find out the specific changes within the muscle that cause scarring and how they affect electrical conduction in the heart and heart muscle function. This could inform the development of novel management or treatment strategies to maintain normal heart rhythm and function in these horses. The effect of gender and genetics on risk for sudden cardiac death also needs further investigation.
Final report summary:
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AgriFutures Australia Publication No. 20-035
AgriFutures Australia Project No. PRJ-011357

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