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Cardiac Arrhythmia in Race-horses - Advanced Diagnostic approaches and therapeutic management

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Introduction

Cardiac Arrythmia **(dysrhythmias)** is an abnormal/irregular or changes in the rhythm of the heart-beat, heart-rate and conduction pattern of heart in horses. It is the most common cardiac disorder in **thoroughbred racing-horses**, which causes potential negative effects on their performance and an important cause for approximately **55%** of the **Sudden Cardiac Death (SCD)** during racing and training/exercise **(which includes 12% of all race day fatalities)** and they become problematic as they disrupt the blood circulation and subsequently reduces oxygen supply to the heart muscles.

Types of Cardiac arrhythmia:

The most common type of arrhythmia in race-horses is **Atrial Fibrillation** (erratic rhythm) which is pathological and occurs due to abnormal ventricular response during exercise. Other types include atrial tachycardia (pathological), ventricular tachycardia (pathological), ventricular fibrillation (pathological), first-degree atrio-ventricular Block (1AVB), sinus arrhythmia (physiological), second-degree atrio-ventricular block (2AVB) (physiological) and third-degree atrio-ventricular block (3AVB).

Causes

Cardiac arrhythmia in race horses can also be stimulated by **electrolyte imbalance**, dehydration, **agitation**, excitement, fever, toxaemia, colic, metabolic disorders, endocrine disorders, **congenital defects**, **myocarditis** and valvular heart disease.

Risk Factors

The risk-factors includes breed, sex, increased age **(mostly old and male racehorses)**,

race distance, racing in summer season, strenuous training over an extended period which leads to **"Athlete's Heart syndrome"**, formation of cardiac scar tissue has linked to the development of irregular heart rhythms and sudden cardiac death and increased risk in thoroughbred race-horses that raced 60 days prior to fatality.

Clinical Signs

Major symptoms noticed in race-horses are **exercise intolerance**, weakness, dizziness, **rapid heart-beat**, **profuse sweating**, collapse, increased respiratory rate and respiratory distress.

Diagnosis

- **Electrocardiogram** is the recommended and diagnostic method because it records the electrical activity of heart muscle throughout the cardiac cycle and it provides helpful details regarding heart rhythm, pace and function.
- Combination of Electrocardiography (ECG/EKG), **echocardiography**, MRI, CT scan, fluoroscopy, clinical pathologies, auscultation of heart, clinical history, differential diagnosis and cardiac indices, **exercise testing** are commonly used diagnostic methods for determining the treatment approach and evaluate the horses at rest or during and after exercise. In Post-mortem examination, the important finding noticed is myocardial fibrosis, myocardial hypertrophy and myocarditis in trained racehorses.

Advances in Diagnostic approaches and novel techniques

Emerging technologies has led to the development of new gadgets which has improved the level of monitoring the racehorses for cardiac arrhythmias which includes:

- **Equimeter device:** An innovative sensor wearable device (girth system) which records a number of **high-quality exercising ECGs at full speed** and the results were excellent for arrhythmia detection during exercise, which also records the cardiac indices such as heart-rate, heart-rate variability etc.
- **Carnation Ambulatory Monitor:** A novel long term ECG patch recorder (24 hrs holter monitor to detect arrhythmia and to evaluate heart-rate and rhythm), detection of paroxysmal atrial fibrillation with implantable loop recorders which is an useful ECG tool for long-term assessment of atrial fibrillation, records continuous ECG signals and check the heart-beat for long period of time (upto 3 years).
- **Short duration screening ECGs** at rest and hand-held non-continuous recording device before the race and post-race for diagnosing both physiological and pathological arrhythmias.
- **Echocardiography:** Which includes the 2D, 3D, M-mode and Doppler colour echocardiography as it address the morphological lesions in heart, motion

abnormalities, blood flow disturbances, cardiac valve functions etc. (for example turbulent backflow of blood from left ventricle to left atrium through mitral valve during systole is noticed during atrial fibrillation) and also helpful in guiding the placement of catheters inside the heart for treatment purpose also.

- Minimally invasive catheter based electrical interventions which includes **three-dimensional electro-anatomical mapping**, these techniques help the clinicians to determine precise anatomical location and underlying mechanism of an arrhythmia and also helpful in collection of biopsies by placing biopsy forceps with the mapping catheter.
- **Cardiac bio-markers** a novel diagnostic method, various recent research studies have shown that increase in the level of blood parameters such as **Cardiac Troponin I (cTnI), α-hydroxybutyrate-dehydrogenase, Lactate Dehydrogenase (LDH), Symmetric-dimethylarginine (SMDA) and Asymmetric-dimethylarginine (AMDA)** are associated with cardiac disorders in race-horses.

Therapeutic Management

Appropriate treatment plan for specific type of arrhythmia is necessary to improve the overall health and performance of the race horses.

A) Pharmacological method:

- **Quinidine sulphate** which is an class-1 anti-arrhythmic drug which works by slowing down the electrical impulse of the heart to restore the normal sinus rhythm and administered as the drug of choice for treating atrial fibrillation in in horses, given at the dose-rate of **10g for every 2 hours orally** until the heart rhythm converts back to normal sinus rhythm and has an success rate of **88%.**
- **Digoxin and amidarone** can also be used to treat chronic conditions of atrial fibrillation which has **60%** reported efficacy.
- Various anti-arrhythmic drugs like **Lidocaine, magnesium sulphate, procainamide, Quinidine gluconate, Esmolol, Propafenone and Bretylium tosylate** can be used to treat various ventricular arrhythmia in race-horses.

B) Non-pharmocological methods (Minimally invasive catheter-based techniques) includes:

- **Transvenous Electrical Cardioversion (TVEC):** It is a minimally invasive catheter-based interventions and most efficient treatment for **atrial fibrilliation** to restore hearts normal rhythm by placing two cardiovrsion catheters inside the left pulmonary artery and right atrium respectively via jugular vein under general anaesthesia and electrodes are placed

through the catheters and shock is administered. **TVEC has a success rate of ≥95%** and used when the action of quinidine suphate is not effective.

- **Intra-cardiac Radio-frequency Ablation:** It is a novel and most efficient treatment procedure to treat **atrial tachycardia**, where catheters with electrodes are placed in the area of heart tissue causing arrhythmia guided by fluoroscopy and current is produced using radio waves to heat and damage that tissue to form scar tissues and blocks conduction signals and reduces recurrence.
- **Cardiac pacing:** In this technique the catheters with one or multiple electrodes are placed inside the heart to perform electrical stimulation of myocardium. It can be used therapeutically to treat **brady-arrhythmias such as second and third degree atrio-ventricular block** in horses. Catheter is connected with a pacing device (for temporary use) and implantation of pace-maker via cephalic vein (for permanent use).

Conclusion

Due to the fact that race-horses train at **high intensities** and during race the heart-beat can elevate upto **250 beats/min** and **leads to pump more volume of blood and structural changes of heart** happens, all these causes disruptions in the **cardiac rhythm** and arrhythmias may be more likely to occur in this population when compared to other horses. A good prognosis for return to normal performance is noticed in race horses, if sinus rhythm can be restored with proper and advanced diagnostic methods for cardiac evaluation and therapeutic management.

References:

1. Camryn McNeill and Priska Darani (2023) Arrhythmias in Performance Horses: Causes, Symptoms & Treatments. https://madbarn.com/arrhythmias-in-performance-horses/
2. M Kimberly J McGurrin (2015). The diagnosis and management of atrial fibrillation in the horse. Vet Med (Auckl). 2015; 6: 83-90. Published online 2015 Feb 26. Doi: 10.2147/VMRR.S46304. PMCID: PMC6067668 |PMID: 30101098.
3. Eva Hesselkilde et al., 2019. First catheter-based high-density endocardial 3D electroanatomical mapping of the right atrium in standing horses. DOI: 10.1111/evj.13265.
4. Gunther van Loon, Glenn Van Steenkiste et al.2020. Catheter-based electrical interventions to study, diagnose and treat arrhythmias in horses: The Veterinary Journal, Volume 263, 105519, 2020, ISSN 1090-0233, https://doi.org/10.1016/j.tvjl.2020.105519.