Atrial fibrillation

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Atrial fibrillation is a disease of the atria of the heart. The heart is divided into 4 chambers (see figure 1). Both the left and right sides of the heart have an atrium and a ventricle. The atria are responsible for collecting blood returning to the heart, whilst the ventricles are the strong, muscular parts of the heart that pump blood into the arteries. When the horse is exercising, the atrium pumps a little extra blood into the ventricle to increase the volume of blood ejected from the heart with each beat. This is an important mechanism to increase cardiac output (amount of blood pushed out of the heart per beat).



Figure 1. Ultrasound of the 4 chambers of the heart imaged from the right side of the thorax. RA is the right atrium, LA is the left atrium, RV is the right ventricle, LV is the left ventricle.

Atrial fibrillation is the most common performance limiting arrhythmia seen in horses. It is associated with abnormal electrical activity in the atria of the heart, which prevents the normal contraction of the atrial heart muscle. Without this contraction, cardiac output is reduced. In equine athletes, poor performance is often the earliest sign of atrial fibrillation. Trainers may typically report that the horse 'raced well but failed to finish', or that the horse will race well one week and dismally the next. In a horse that is not exercising heavily, atrial fibrillation may go unnoticed.

Atrial fibrillation may be *sustained/chronic* (meaning that the arrhythmia is present all the time), or *paroxysmal/acute onset* (meaning that the arrhythmia is intermittent, usually only occurring during strenuous exercise, and then converts spontaneously to a normal rhythm). Sustained atrial fibrillation is relatively easy to diagnose.

Auscultation of the heart with a stethoscope (or palpation of the pulse) will reveal an "irregularly irregular" heart rhythm (there is no pattern to the heart rhythm at all). Furthermore, the normal sound associated with contraction of the atria (s4) will not be audible. Electrocardiography (ecg) will reveal that the normal electrical activity associated with the atria (p wave) is absent (see figure 2). Instead, sustained electrical activity in the atria (f wave) is seen (see figure 3). Paroxysmal (acute onset/intermittent) atrial fibrillation is much more difficult to diagnose as it occurs only with strenuous exercise. Veterinarians attending a race meeting may be suspicious of atrial fibrillation if they hear an "irregularly irregular" rhythm immediately after exercise, but this may then return to normal within 30 minutes. Further investigation into these cases requires ecg on the treadmill or on the racetrack (requires a holter or telemetric monitor- see figure 4).



Figure 2. Normal heart rhythm. Black arrows point to regularly spaced p waves associated with electrical activity in the atria. Red arrow points to electrical activity associated with the ventricles.



Figure 3. Atrial fibrillation. Black arrows point to f waves showing ongoing electrical activity in the atria. Red arrows point to irregularly spaced ventricular contractions.



Figure 4. Telemetric monitoring of the ecg during exercise on the treadmill.

Horses are predisposed to atrial fibrillation because of their large heart size. Furthermore, horses that have a dilated heart because of underlying heart disease (valvular regurgitation) are more likely to suffer atrial fibrillation. Horses without underlying heart disease have a good prognosis for conversion (>95% using therapeutic drugs such as quinidine sulphate) and have approximately 25% chance of atrial fibrillation recurring. A poorer prognosis for conversion (80%), and higher recurrence rate (60%), is seen in horses with atrial fibrillation in combination with any of the following; resting heart rate >60bpm, duration longer than 4 months, or cardiac murmur grade 4-6/6.

The best tool to diagnose underlying cardiac disease is echocardiography (ultrasound of the heart- see figure 5). This allows us to establish whether there is mitral valve regurgitation (leakiness) or increased left atrial size. The tricuspid, aortic and pulmonic valves are also evaluated. Measurement of cardiac troponin (a blood test), may help to establish whether there is underlying cardiac muscle damage.



Figure 5. Ultrsound of the heart from the right side showing regurgitation of blood through the mitral valve (colour flash).

As mentioned, conversion to normal rhythm involves administration of antiarrhythmic drugs. The most commonly used drug is quinidine sulphate, and this is given by nasogastric tube. Conversions are not always successful, and a normal protocol would involve administration of the drug every 2 hours until conversion occurs, or until the threshold for toxic levels (typically 5 doses) is administered. Safety may be improved through close monitoring of clinical signs and continuous recording of the ecg. At the Equine Centre, University of Melbourne, Werribee the ecg is continuously recorded with telemetry (recording device sends Bluetooth signal to a remote computer outside the stall), which improves safety during the conversion.

In summary, atrial fibrillation is a cardiac disorder that may cause poor performance in racehorses. In cases of sustained atrial fibrillation of short duration without underlying heart disease, diagnosis and treatment is straightforward. However, a diagnosis in cases of paroxysmal (intermittent) atrial fibrillation may be elusive using routine diagnostic tools and a holter ecg is useful in these cases. Furthermore, horses with underlying heart disease are predisposed to atrial fibrillation and have a poorer prognosis for conversion to normal rhythm.

*The Equine Centre, Werribee is currently conducting research into atrial fibrillation and heart arrhythmias in racehorses. Veterinarians, owners and trainers with confirmed cases are encouraged to contact Dr Laura Fennell BVSc (Hons), MACVSc (Medicine of Horses) or Dr Kate Savage BVSc (Hons), MS, PhD, Diplomate ACVIM (Specialist in Equine Medicine) at the Equine Centre on 03 9731 2268.