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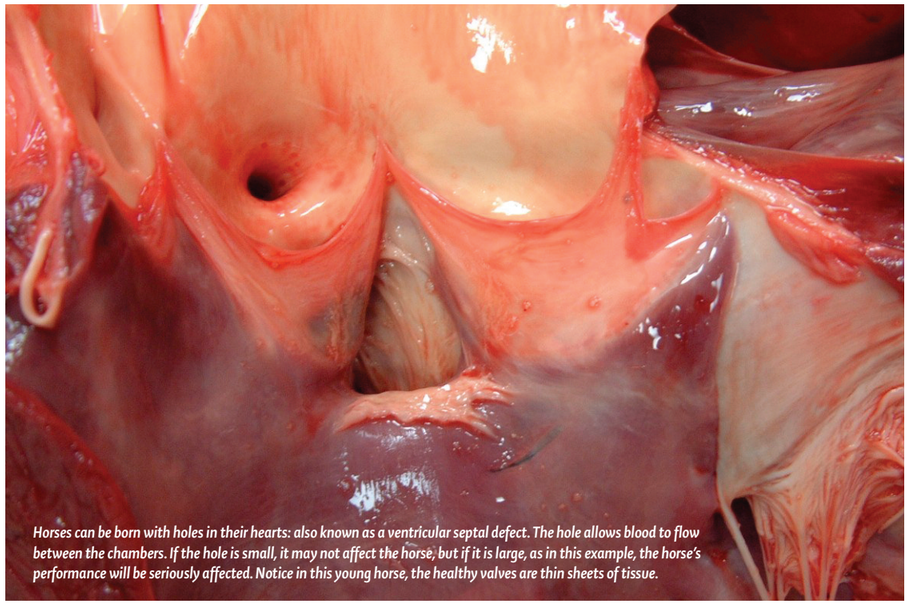
Matters of the heart: diagnosing and assessing heart murmurs

By Professor Celia M. Marr MRCVS

While many horse owners' hearts will sink on hearing the news "your horse has a heart murmur", this news is often not quite as bad as it first sounds. The heart is a very efficient organ and minor changes in heart function may have no impact at all on the horse's quality of life or its exercise tolerance.

Horses have amazing cardiovascular systems when compared to their human riders. Every element of the equine cardiovascular is designed for maximum efficiency. Like many features of equine anatomy and physiology, it is all part of their evolution as a flight species when the choice is fight or flight. The purpose of the cardiovascular is to deliver fuel, primarily oxygen to the muscles and other tissues so that they can first support the minute-by-minute processes which keeps the body alive and in the case of the muscles, oxygen is the fuel that can propel the horse at running speeds of up to 55mph, the maximum speed it is claimed an American Quarter horse can reach. Oxygen reaches the blood stream via the lungs. The red blood cell numbers and function determine the oxygen carrying capacity of the blood; equine athletes (hot-blooded types) will typically have a higher red blood cell count than the more sedentary breed (cold bloods). But horses have a natural ability to increase their red blood cell numbers when needed; the spleen acts as a reservoir of red blood cells and, under the influence of adrenaline and its related compound, nor-adrenaline, the capsule of the spleen can contract to inject large numbers of red blood cells into circulation. Humans do not have this capacity and some sportsmen have been tempted to increase their red blood cell counts illegally by storing their own blood during breaks between competitions.This is then re-injected by the athlete pre-race - so called blood doping.Horses do their own blood doping naturally whenever they exercise.



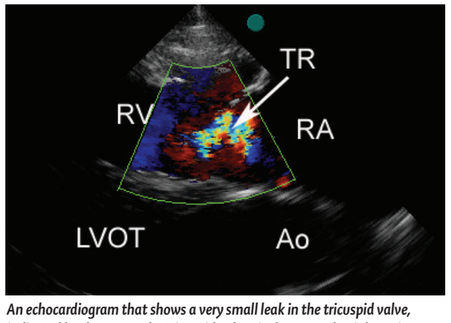
Horses can be born with holes in their hearts: also known as a ventricular septal defect. The hole allows blood to flow between the chambers. If the hole is small, it may not affect the horse, but if it is large, as in this example, the horse's performance will be seriously affected. Notice in this young horse, the healthy valves are thin sheets of tissue.

Then we come to the pump, the heart. The horse's heart is an amazing and massive organ. In Thoroughbreds it represents about 1% of its body weight. Heart size is related to its maximal output and there are several examples of superlative Thoroughbred athletes who have exceptionally large hearts. Eclipse, Phar Lap and Secretariat were all believed to have had unusually large hearts.

The horse has a very wide range in its heart rate: most horses have a resting heart rate of around 30-40 beats per minute, at the trot this rises to around 100 but at maximal gallop the heart rate may be as high as 230 beats per minute. With each beat around 900-950mls of blood leaves the heart such that at its maximum, the equine heart is capable of pumping an amazing 250-280 litres of blood per minute.

The heart comprises four chambers: there are two ventricles, one serving the right side and the other the left side of the circulation. These are the main pumping chambers; the left one pumps blood out to the body while the right ventricle pumps blood towards the lungs. When the ventricles relax, blood rushes in to fill them passively and the other two chambers, the atria serve as pump primers, making sure their respective ventricles are filled effectively.

The main blood vessel that carries blood out of the left ventricle to the body is called the aorta while the vessel that carries blood from the right ventricles to the lungs is the pulmonary artery. The aorta connects to the arteries of the body that are then filled with blood that is rich in oxygen, the small blood vessels within the muscle and other tissues are the capillaries. These are thin-walled and thus allow oxygen to diffuse out of the blood stream towards the cells. Once depleted of oxygen, blood leaves the capillary beds to return towards the heart in the veins. Veins from the body return to the right side of the heart, from where blood can then go to the lungs to replenish the red blood cells stores of oxygen. Veins from the lungs carry blood that is rich in oxygen to the left side of the heart and from there, out to the body for fuel.



An echocardiogram that shows a very small leak in the tricuspid valve, indicated by the arrow. The tricuspid valve sits between the right atrium (RA) and the right ventricle (RV). This leak was found in an advanced Eventer and it does not affect the horse's performance at all. The image also shows how the echocardiography unit is able to "slice" through the heart and show the structures on the left ventricle (LVOT) and Aorta (AR).

What is a heart murmur?

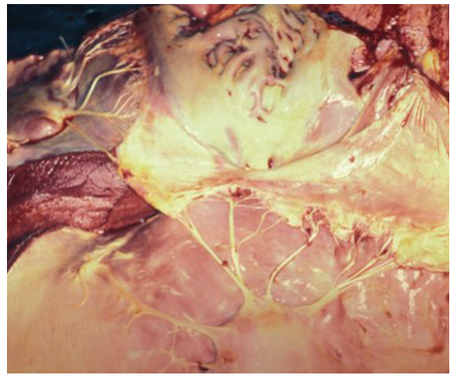
Heart valves sit between each atrium and its respective ventricle and between the ventricle and the major vessel it supplies. There are four heart valves and these are thin sheets of tissue that open and close to allow the heart to fill and then empty at the appropriate time. As the valves are opening and closing, heart sounds are generated. The term heart murmur simply refers to any extra sound that occurs in addition to the normal heart sounds.

One of the most important features of horses' hearts from a veterinary point of view is that heart murmurs commonly occur in horses with completely normal hearts. The heart is large and powerful and blood flowing through a heart with an entirely normal structure and function can generate a sound which is picked up with a stethoscope. We don't often hear that process in our small animal patients – the parallel is that standing next to a large river, you will not be surprised to hear water flowing but next to a small stream, flow might not be audible. Vets use various terms to describe this form of heart murmur but "physiological" or "flow" murmur is often mentioned.

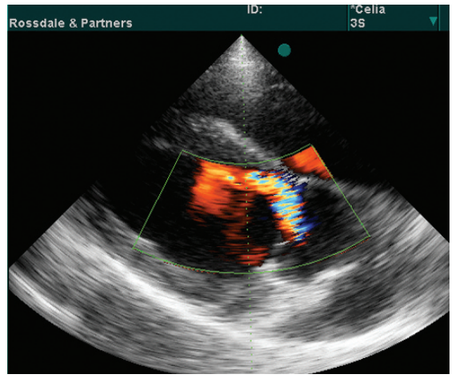
The second commonest cause of heart murmurs is leaking, or regurgitation, in one or more of the heart valves. You might expect that heart valves would form a tight seal allowing blood to flow in one direction only. But echocardiographic imaging has revealed that actually, at rest, equine heart valves can often have small leaks. This is particularly so in racehorses and large scale studies have shown that these leaks and the murmurs they are associated with have no impact on racing performance.

On the other hand, leaks can be due to disease in the heart valves. There are various possible disease processes that can affect the valves, but the most common is due to degeneration linked to the ageing process. Over many months and years, the heart valves can gradually become a little thickened, particularly towards their edges and this affects the seal that they may and allows progressively more and more blood to leak, or regurgitate through the valve.

This may all sound rather alarming but although the heart can fail, in fact most horses that have degenerative valvular regurgitation are not very severely affected. There is a steady increase in the prevalence of this form of murmur with increasing age such that they are found in around 3% of horses aged less than 7 years; 8% of horses aged 8–14 years, around 14% of horses aged 15–23 years and about 15% of those older than 24 years. The good news is that degenerative valvular disease rarely affects the horse's lifespan and a study of a group of over 1100 horses in south east England showed that horses with these murmurs were no more likely to die than those without them. Most of the horses with cardiac murmurs eventually succumbed to non-cardiac related illnesses.



The heart of a 30 year-old gelding which has developed thickening of the mitral valve due to degenerative valvular disease. This valve sits between the left ventricle, the main pumping chamber supplying the body and the left atrium. Because blood is flowing backwards (regurgitating) through the mitral valve for many years, the walls of the atrium have developed scars on their surface, the heart has enlarged and eventually heart failure developed.



An echocardiogram that shows a moderately large leak at the aortic valve. The Doppler technique displays blood flowing in an abnormal direction in a mosaic of yellow and turquoise. The size of the leak gives an indication of its severity. This image was recorded from a 13 year-old riding horse that had a murmur but no other problems.

Diagnosis of heart murmurs

So, the statistics are on the horse's side, but how can a vet tell whether a heart murmur is significant or not? Armed with a stethoscope alone, the veterinary practitioner can often rule out serious heart disease in many horses. They do this by carefully listening to the heart murmur, assessing its position relative to the structures of the heart and considering its timing: specific forms of heart disease are associated with characteristic murmurs in terms of both timing and position. The loudness or grade of the murmur is also taken into account, with louder murmurs being more likely to be problematic and thus justify investigation.

Echocardiography is the primary tool used to identify the cause of murmurs and evaluate the severity. Echocardiography is a form of ultrasonographic imaging that provides a two-dimensional image of the heart and its internal structures. This is coupled with a technique called Doppler echocardiography that allows the speed and direction of blood flowing through the heart to be documented. It is based on the Doppler shift, which is a physical principle whereby the frequency of sound is altered when it is reflected off a moving structure. It is the same principle used by

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Vet Profile

Name: Celia M. Marr
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Celia joined the team at Rossdales Equine Hospital and Diagnostic Centre in 2003. She is a Specialist in Equine Internal Medicine and works with both inpatients and outpatients with medical problems.

She graduated from the Glasgow University Veterinary School in 1985, then remained in Glasgow to complete both Masters and PhD degrees. She then held a Fulbright Scholarship studying equine cardiology and internal medicine at the New Bolton Center, University of Pennsylvania. Before joining Rossdales, she held positions at the University of Cambridge Veterinary School, Valley Equine Hospital, Lambourn and the Royal Veterinary College. Her clinical and research interests are in Cardiovascular Medicine, Internal Medicine, Adult and Neonatal Intensive Care & Medical Imaging. She has published over 50 research papers and educational material relating to a range of medical disorders of the horse, concentrating on cardiovascular disease and diagnostic methods in medical disorders including editing a book on Cardiology of the Horse, the 2nd edition of which was published in 2010.

Celia is an Honorary Professor of the University of Glasgow, Editor-in-Chief of Equine Veterinary Journal, Chairman of the European College of Equine Internal Medicine's Advanced Training Advisory Committee, Deputy Chairman of the Veterinary Advisory Committee of the Horserace Betting Levy Board and Chairman of the HBLB's Thoroughbred Research Consultation Group.

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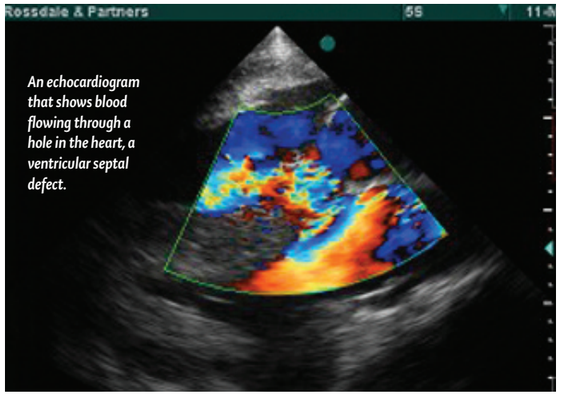
Vetwatch



An echocardiogram that shows blood flowing through a hole in the heart, a ventricular septal defect.

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Police speed traps.
In a horse with valvular regurgitation, echocardiography will demonstrate how thickened the valve has become and how large the leak is. The heart size will also be taken into account because just like any other muscle, the heart will tend to get larger if it is working harder. Up to a point, this can be a good thing, but if the heart becomes excessively large, it will begin to loose its efficiency.
Valvular regurgitation is not the only cause of murmurs. Horses can be born with holes in their heart, just as children can. With small holes, the horse can be unaffected so that the hole is only picked up when the horse or pony has already started use as a riding animal.
Occasionally foals are born with major structural deformations that sadly will leave them unlikely to survive. When there is serious heart disease, the horse, pony or foal may be showing signs of lethargy, particularly with exercise, it may become breathless and sometimes, because the circulation is failing, the veins may become distended and fluid swellings may develop around the sheath and lower aspect of the abdomen.
Fortunately, it is a very uncommon for horses to develop severe heart disease, but if a horse owner does become worried that their horse might have heart disease, the first step is to have a vet listen to the heart so that they can either reassure you that all is well, or organise further investigations if appropriate.

This middle-aged gelding has developed swelling of his sheath, distension of the veins and a fluidy, oedematous swelling along the lower aspect of his abdomen. He has heart failure due to severe valvular regurgitation affecting all four heart valves.

This Welsh pony foal was born with multiple congenital cardiac defects. It is depressed and poorly grown with a distended abdomen due to fluid accumulation.