The cardiovascular prepurchase examination, like the rest of the prepurchase examination, is intended to help characterize the suitability of a horse for a specific purpose. Cardiac murmurs and arrhythmias are commonly encountered and may or may not affect a horse’s athletic performance, safety, life expectancy, or resale. Some murmurs and arrhythmias are physiologic and benign and some, while indicating structural heart disease, are unlikely to progress or result in performance issues in certain athletic disciplines. Excluding all horses with murmurs or arrhythmias would therefore not be in the best interest of the horse or potential buyers. Detecting and interpreting the significance of heart murmurs and arrhythmias and knowing when to recommend echocardiographic and ECG evaluation is part of the cardiovascular prepurchase examination. Guidelines from the recent ACVIM consensus statement on equine athletes with cardiovascular disease are helpful for understanding the effects of various cardiovascular disorders on safety, athletic performance and suitability for adult versus child riders.

AUSCULTATION

Cardiac auscultation should be divided into 3 areas of focus: rate, rhythm and murmur identification. While a normal heart rate, regular rhythm and absence of murmurs make things straightforward in the prepurchase setting, alterations in all three areas are common in normal horse. Up to four heart sounds can be heard normally, although S4, S1 and S2 are the easiest to hear. Recognizing the different heart sounds can aid in differentiation of certain arrhythmias (such as atrial fibrillation versus second degree AV block) and help with murmur description. Rhythm can be divided into regular and irregular. Irregular rhythms can be further subdivided into regularly irregular (occasional premature beats, second degree AV block) and irregularly irregular (atrial fibrillation).

Identification and characterization of heart murmurs requires auscultation of both sides of the horse’s chest, in all 4 valve areas. This can be facilitated by having the horse stand with the same side forelimb placed forward of the opposite forelimb, making it easier to reach the appropriate intercostal spaces. Murmur differentiation and ranking is performed with a grading system for loudness, and with knowledge of timing, quality, shape and point of maximal intensity. Murmurs over a certain valve area should not automatically be presumed to be caused by that valve. For example, mitral regurgitation is commonly loudest over the aortic valve region. Timing and location are critical for forming a differential list. Intensity, shape and quality of a murmur can help refine differentials but often requires an experienced ear. The loudest murmurs are not necessarily the most severe.
Describing murmurs

Grade (intensity): Palpation of a murmur is part of being able to grade it. Place the palm (not the back) of your hand over the point of maximal intensity.

1/6: very quiet murmur; requires careful auscultation in a quiet environment; murmur very localized
2/6: quiet murmur; requires careful auscultation; murmur very localized
3/6: murmur heard immediately upon putting stethoscope over point of maximal intensity
4/6: murmur heard immediately; faint thrill
5/6: murmur heard immediately; prominent thrill
6/6: very loud murmur; can be heard with stethoscope lifted slightly off chest wall (sometimes don’t need stethoscope at all); prominent thrill

Timing: At a minimum, murmurs need to be divided into systolic or diastolic. Simultaneous palpation of the pulse can aid in this differentiation if heart sounds are obscured by the murmur.

- Systolic: occurs with the pulse, between S1 and S2
- Diastolic: between S2 and S1 of the next beat, incorporates S3 & S4
- Continuous: throughout systole and diastole
- Holosystolic or holodiastolic: lasts throughout the entire phase but does not cover up the heart sounds
- Pansystolic or pandiastolic: lasts throughout the entire phase and covers up one or both (S1 and/or S2) heart sounds
- Early-, mid-, late-: murmurs that do not last through an entire phase can be described by the portion of the phase in which they do occur

Shape

<table>
<thead>
<tr>
<th>Band or plateau</th>
<th>Decrescendo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crescendo</td>
<td>Crescendo-decrescendo</td>
</tr>
</tbody>
</table>

Quality

<table>
<thead>
<tr>
<th>Blowing</th>
<th>Squeaky</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harsh/Coarse</td>
<td>Honking</td>
</tr>
<tr>
<td>Musical</td>
<td>Machinery</td>
</tr>
</tbody>
</table>

Location (point of maximal intensity)

- Tricuspid valve area (right 3rd to 4th intercostal spaces)
- Pulmonic valve area (left 3rd intercostal space)
- Aortic valve area (left 4th intercostal space)
- Mitral valve area (left 5th intercostal space)

Radiation

Murmurs can radiate widely, especially those that are musical in quality. They can sometimes be heard over the entire thorax or even in the paralumbar fossa. In horses, nonmusical murmurs typically do not radiate across the chest to the opposite side. That means if you hear a blowing systolic murmur on the
left and one on the right they are very likely from different sources (ie, mitral and tricuspid regurgitation)

An example of appropriate murmur description: a grade 5/6 holodiastolic musical decrescendo murmur with the point of maximal intensity over the aortic valve; the murmur radiates to the tricuspid valve area where it can be heard as a grade 3/6

<table>
<thead>
<tr>
<th>COMMON MURMURS</th>
<th>Timing</th>
<th>PMI</th>
<th>Shape, Quality</th>
<th>Associations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitral regurgitation (general)</td>
<td>systolic</td>
<td>Mitral or aortic valve</td>
<td>variable depending on cause</td>
<td>Atrial fibrillation</td>
</tr>
<tr>
<td>MR-Degenerative valve</td>
<td>holosystolic</td>
<td></td>
<td>plateau, blowing or coarse</td>
<td></td>
</tr>
<tr>
<td>MR-Ruptured chord</td>
<td>holosystolic</td>
<td></td>
<td>honking or other musical sound</td>
<td></td>
</tr>
<tr>
<td>MR-Prolapse</td>
<td>mid to late systolic</td>
<td></td>
<td>crescendo, loudness variable over time</td>
<td>Often intermittent, excitement, colic, dehydration</td>
</tr>
<tr>
<td>Aortic regurgitation</td>
<td>holodiastolic</td>
<td>Aortic valve</td>
<td>decrescendo, blowing or musical</td>
<td>VPCs, bounding arterial pulses if moderate to severe</td>
</tr>
<tr>
<td>Tricuspid regurgitation</td>
<td>Holosystolic, rarely pansystolic</td>
<td>Tricuspid valve</td>
<td>blowing or coarse, plateau</td>
<td></td>
</tr>
<tr>
<td>VSD</td>
<td>2 murmurs: pansystolic over TV; holosystolic over PV</td>
<td>Tricuspid and pulmonic valves</td>
<td>coarse, plateau over TV; crescendo-decrescendo over PV</td>
<td>Mitral regurgitation, less commonly aortic regurgitation, complex congenital heart disease</td>
</tr>
<tr>
<td>Physiologic</td>
<td>systolic</td>
<td>Pulmonic valve</td>
<td>grade 3 or less, focal</td>
<td>Excitement</td>
</tr>
<tr>
<td>Physiologic</td>
<td>diastolic</td>
<td>Any valve area</td>
<td>squeaky, short duration</td>
<td>Young horse</td>
</tr>
<tr>
<td>Aortocardiac fistula</td>
<td>continuous</td>
<td>Tricuspid valve</td>
<td></td>
<td>Aortic regurgitation, ventricular arrhythmias, CHF</td>
</tr>
</tbody>
</table>
Significance of cardiac murmurs

In the pre-purchase setting, few murmurs can be completely ignored. Typical physiologic murmurs include systolic murmurs over the pulmonic valve region that are focal, grade 3 or less and not associated with right sided systolic murmurs. Short diastolic squeaks are much less common physiologic murmurs in “young” horses that are intermittent and disappear with age. These murmurs can be readily classified on auscultation as physiologic and are of unlikely clinical significance.

Other murmurs will require a more in depth discussion with potential buyers regarding likelihood of significant cardiac pathology. Identification of a typical tricuspid regurgitation (see chart) is fairly common particularly in young racehorses. TR murmurs are the only murmur were loudness has been associated with severity of regurgitation. Most horses can tolerate marked amounts of TR without it affecting even high intensity athletic performance. Progression is also typically slow. As with all things, what happens “typically” does not necessarily happen in any individual horse and echocardiographic evaluation is still the best means to grade severity and characterize valvular pathology.

MR is the valvular pathology most likely to lead to congestive heart failure and MR increases the risk of atrial fibrillation once it progresses to the point of left atrial enlargement. Degenerative valve disease is the typical finding but ruptured chordae tendineae (major or minor), dysplasia, old endocarditis lesions or mitral valve prolapse are potential causes and each carries a different prognosis. For example MVP carries an excellent prognosis as it rarely progresses. Mitral valve prolapse murmurs are often intermittent and can occasionally be extremely loud and coarse. This loudness should not be correlated with poor prognosis. In contrast, ruptured chords often but not always carry a poorer prognosis with more rapid progression towards CHF. The murmur of a ruptured chord may be musical or honking in quality but it is not always possible to definitively distinguish a characteristic murmur. Bottom line: Systolic murmurs over the mitral valve or aortic valve regions deserve a recommendation for echocardiographic evaluation in the pre-purchase setting.

Aortic regurgitation is a common finding in older horses (>10 years) and is associated with a diastolic decrescendo murmur that can have a variety of grades and qualities. AR is most often secondary to degenerative valve disease but prolapse, fenestrations, endocarditis and rare congenital defects may be the cause and each carries a different likelihood of progression. AR is associated with ventricular arrhythmias prompting recommendation for an exercising ECG in horses with moderate to severe AR. Athletic animals with diastolic murmurs (other than physiologic squeak) should undergo echocardiographic and exercising ECG evaluation.

Ventricular septal defects have very characteristic murmurs, although these can be missed if both sides of the thorax are not ausculted or if the examiner does not listen far enough forward in the third intercostal spaces. Echocardiographic examination is critical for determining whether the horse with a VSD can perform at any athletic level and whether life expectancy will be shortened. Even small VSDs will prevent high intensity athletic performance but will often permit less cardiovascularly-demanding activities. Echocardiographic evaluation in all cases of suspected VSDs is recommended to determine size, need for exercising ECG (moderate to large VSDs) and rule out more complex congenital heart disease.

Rarely, serious cardiac defects such as complex congenital heart disease, aorto cardiac fistulas or aortopulmonary fistulas (in Freisians) will be first suspected on a pre-purchase examination. Unusual or
complex murmurs or signs of CHF (resting tachycardia, cough, peripheral edema, jugular vein distension) should always prompt caution and recommendation for further evaluation if the potential buyer wishes to continue.

ARRHYTHMIAS

Horses frequently have irregularities in resting rhythm secondary to high vagal tone. This is commonly manifested as second degree AV block, sinus arrhythmia and/or sinoatrial pauses. Careful auscultation in combination with brief exercise or excitement can, in most cases, differentiate vagal arrhythmias from more concerning arrhythmias such as atrial fibrillation or frequent premature depolarizations. The AliveCorVet™ recording device and free App for iPhones is available for brief ECG recordings in the ambulatory setting, allowing for documentation of cardiac rhythm during prepurchase examination. ECGs can also be saved and emailed for consultation.

Figure 1: AliveCor ECG of horse with atrial fibrillation

Horses with arrhythmias but no murmurs should still undergo echocardiographic evaluation looking for structural heart disease that may be clinically silent (cardiomyopathy without valvular regurgitation, myocardial fibrosis). Exercising ECGs may be indicated to determine if arrhythmias at rest are suppressed with exercise, to look for arrhythmias known to be associated with specific valvular abnormalities (aortic regurgitation and VPCs), or to determine exercise tolerance and safety (atrial fibrillation). Current recommendations from the consensus statement on equine athletes with cardiovascular disease can be used to guide potential buyers of horses with identified arrhythmias. As stated in the consensus, views on the clinical significance of certain arrhythmias, particularly those identified during exercise, are likely to evolve as new information regarding arrhythmias in apparently healthy horses becomes available.

Second degree AV block (without concurrent premature complexes or sinus arrhythmia) sounds like a regular rhythm that is occasionally interrupted by the absence of S1 and S2, a so called “dropped beat”. The first heart beat following the dropped beat occurs on-time, exactly when it would have, if the dropped beat had not occurred. If auscultation is performed in a quiet environment, S4 (also called the “A” sound for atrial contraction) can be heard as a soft “puh” during the period of the dropped beat. This can be helpful for differentiating second degree AV block and concurrent sinus arrhythmia (when
the rhythm is somewhat irregular) from atrial fibrillation. In atrial fibrillation, S4 is inaudible due to uncoordinated atrial contraction.

**Physiologic second degree AV block should have no more than 2 dropped beats in a row and should disappear with exercise or excitement. Failure to disappear with exercise, more than 2 dropped beats in a row or marked bradycardia should prompt further evaluation** that may include continuous heart rate monitoring (24 hour Holter).

![Figure 2: physiologic second degree AV block and sinus arrhythmia consistent with normal vagal tone](image2)

**Figure 3: advanced second degree AV block indicating AV node disease rather than just high vagal tone**

**Atrial fibrillation** is an irregularly irregular rhythm without predictable pattern. Heart sounds are variable in intensity and there is absence of S4. The irregularity will persist with exercise or excitement. Suspicion of AF should also prompt careful auscultation for murmurs, particularly murmurs associated with mitral regurgitation. In the prepurchase setting, auscultation findings should be supported by a confirmatory ECG.

Lone AF may occur in young racehorses or other athletes working at high cardiovascular intensity but concurrent heart disease is much more common in older horses and those working at lower intensity. Horses with persistent AF are not suitable for high intensity exercise (racing, endurance, mid-upper level eventing, most foxhunting) and some may not be able to perform at the uppermost levels of dressage or show jumping. AF does not necessarily prevent a horse from performing successfully in certain sports and lone AF does not increase risk of heart failure over time. Horses with AF do not get atrial thrombi or strokes unlike humans with AF. Some horses are, however, profoundly exercise intolerant in AF, even at low intensity exercise, and some will have concurrent ventricular arrhythmias, affecting safety.

**Horses with atrial fibrillation should undergo echocardiographic and exercising ECG evaluation if any level of athletic activity is intended.** For breeding animals, lone atrial fibrillation (absence of a murmur) is unlikely to affect breeding performance or longevity. The presence of a murmur should prompt echocardiographic evaluation and, in stallions, breeding ECG evaluation may be necessary to determine breeding soundness (safety).
Premature Depolarizations can be divided in supraventricular (including atrial premature depolarizations and junctional premature depolarizations) and ventricular. On auscultation single premature depolarizations interrupt the underlying regular rhythm with an early heartbeat. Differentiation can sometimes be made on the basis of the loudness of the premature beat (bruit de cannon associated with VPDs) but should not be relied upon. Normal horses can have up to 1 SPD or VPD per hour on average and it is possible to randomly hear a few premature beats in a perfectly normal horse.

Frequent single premature heart beats, salvos of premature beats, concurrent murmurs or rate abnormalities should prompt further investigation in the prepurchase setting. This may include a brief resting ECG, continuous resting ECG (Holter) or exercising ECG. Echocardiographic evaluation looking for structural changes in heart that predispose to arrhythmias is also recommended, if frequent ectopy is confirmed on ECG.
Post Exercise Arrhythmias are fairly frequent findings in normal horses particularly following medium to high intensity exercise or following a burst of excitement/high sympathetic tone. Second degree AV block, sinus arrhythmia, sinus pauses, APDs and VPDs can all occur secondary to changes in autonomic tone in the first 1-2 minutes following exercise. The rhythm should be regular thereafter until the resting rate returns.

REFERRAL: what to expect

Individuals that specialize in equine cardiology may have a variety of credentials and backgrounds. Whatever the qualifications, it is reasonable to expect certain specific information from echocardiographic and ECG evaluations performed in a prepurchase setting. The echocardiogram should be used to provide information about more than just the source of a murmur (since this may be quite apparent on auscultation alone). The report should include the specific abnormality (degenerative valve disease, valvular prolapse, valvular dysplasia, etc.), severity of the disease as it appears currently, likely progression of the problem and summary interpretation of physical examination, echocardiographic and ECG findings as they relate to life expectancy, athletic performance and safety for rider, driver or handler. Recommendations for any future monitoring of the heart disease should also be included.

References


