

# Research Measures the Heart of the Endurance Horse

Research investigating the performance and pathophysiology of endurance horses is mandated in the AERC Mission Statement: "to actively promote and conduct educational activities efforts and research projects that will foster a high level of safety and enjoyment of all horses and riders." The following is the final report on the AERC-funded research project which was undertaken in 2009 by Drs. Mary Durando, Meg Sleeper and Todd Holbrook which investigated

heart characteristics in elite and non-elite endurance horses. A total of \$12,000 in AERC research grants went towards this project.

Background information on the research project, this article and the formal paper presented at the American College of Veterinary Internal Medicine's 2012 conference in New Orleans will be posted on the Education/Research Grants section of the AERC website, [www.aerc.org](http://www.aerc.org). —Olin Balch, DVM, PhD, Chair, AERC Research Committee

## Comparison of Echocardiographic Measurements in Elite and Non-Elite Arabian Endurance Horses, by MM Durando, T Holbrook, MM Sleeper, M Payton, and EK Birks

The objective of this study was to determine if endurance horse performance is related to heart size or function, as determined by echocardiography (cardiac ultrasound).

**Hypothesis:** Successful 100-mile endurance horses would have different echocardiographic variables than less successful competitors.

**Background:** Heart size has long been suspected to be linked to performance in the horse. Specifically, in young Thoroughbred racehorses, an association has been made between caliber of racehorse and certain echocardiographic variables. In humans, left ventricular mass (another estimate of heart size) has been linked to oxygen consumption, which is a measure of aerobic capacity, and thus athletic ability, and elite human athletes competing at aerobic events have higher oxygen consumption than healthy, nonathletic individuals. Studies in horses have shown that echocardiography correlates well with heart size based on measurements obtained at necropsy, and several equine studies have previously demonstrated that heart size correlates with oxygen consumption.

Echocardiography, a non-invasive way to assess cardiac size, may help to predict performance in young Thoroughbred racehorses, although its value as a predictor of athletic performance has been debated. However, one study evaluating a large group of Thoroughbreds found a statistically significant difference in echocardiographic heart size between groups of horses with different race earnings. Likewise, another study evaluating performance and echocardiographic param-



Dr. Mary Durando prepares to perform an echocardiogram on a horse as part of the AERC-funded research study.

eters in British Thoroughbreds competing in either flat or jump racing demonstrated an association between left ventricular size and function and athletic ability.

Interestingly, the relationship appears to be strongest for equine athletes racing at longer distances. These data suggest that aerobic capacity may have a greater influence on ability in longer distance races than in sprint races. While several factors may influence oxygen consumption and aerobic capacity, heart size and function are undoubtedly important. Endurance riding is a long distance, primarily aerobic sport in which heart size, function, and oxygen consumption may play a particularly important role. Conversely, any abnormalities in cardiac function or structure would likely adversely affect top performance potential.

**Methodology:** We evaluated actively performing purebred Arabian horses, 7 to

17 years old. Age and breed specifications were used in order to reduce inherent variability in different populations of horses. Horses were chosen, with owner permission and proper client consent, based on the results of specific AERC-sanctioned 100-mile (160 km) rides.

Horses were assigned to either the elite or non-elite group based on results from specified competitions. Horses were considered elite if they won or finished within 10% of the winning time or within 30 minutes of the winner in 100-mile endurance rides. Horses were considered non-elite if they

had never placed within two hours of the winning time.

In addition, seven purebred Arabian horses 4 to 17 years old that were not actively competing in endurance events, and used as riding horses, were evaluated. These horses were combined with the non-elite endurance horses to form the non-elite group.

Endurance horses were evaluated in their home environment one to four weeks after the competition chosen to determine groups. This time frame was chosen to allow horses time to recover from the effects of the ride and transportation to and from the ride, but to avoid any possible effect of de-training, if they were not to continue actively competing after the ride.

A cardiovascular examination, ambulatory electrocardiogram and a standardized echocardiogram were performed on all horses.

To reduce individual variability, the same individual performed all echocardiograms. The exams were all digitally recorded, to be measured at a later date in a blinded fashion. One individual performed all measurements, also done to reduce individual variability.

**Summary:** A total of 45 horses were evaluated, aged 4 to 17 years old. There were 14 mares and 31 geldings. Of these, 22 horses were considered elite (six females, 16 males), and 23 horses were in the non-elite group, made up of non-elite endurance and non-endurance horses (eight females, 15 males).

Five horses were eliminated from the study, so data from 40 horses were analyzed. The horses were eliminated either because of significant heart disease (severe valvular insufficiencies) and pathologically enlarged hearts (two non-endurance) or inadequate quality of the exam (three non-elite horses).

Therefore, the elite group had 22 horses, and the non-elite group had 18 horses. There were no significant differences in either age or sex between the two final groups. We are only reporting the echocardiographic summary here except to state that two of the horses (one non-elite and one non-endurance horse) had arrhythmias that could negatively impact performance, and perhaps rider safety.

**Echocardiogram findings:** The majority of horses had some degree of valvular insufficiency (36 horses), however the majority of these were trace or mild leaks. Two horses had mild to moderate leaks at the aortic valve: one of these was an elite horse, and one a non-elite horse. Two horses in the non-endurance group had severe leaks at the aortic valve, and

one had a moderate leak at the mitral valve, as well. Overall, four horses in the non-elite group had abnormalities that could significantly impact performance or rider safety. No horses in the elite group had significant cardiac abnormalities.

**Echocardiographic measurements:** No significant differences were seen in most variables between the non-elite and the non-endurance groups, so those two groups were combined to compare with the elite group's measurements.

Measurements of left ventricular size (the main pumping chamber of the heart) were significantly greater in the elite group when compared to the non-elite group. These included the internal diameter of the left ventricle, the left ventricular mass and the stroke volume of the left ventricle (the amount of blood pumped per heart beat).

**Conclusions:** Because elite endurance Arabians had significantly larger left ventricular dimensions and stroke volume than other Arabians we theorized that this may correspond to a greater oxygen consumption (aerobic capacity), better cardiovascular ability, and aid in superior performance. To our knowledge, this is the first time that heart size has been evaluated as a possible predictor of performance in endurance horses.

A large proportion of horses had some degree of valvular insufficiency, however most were clinically not important. This has been observed by others in performance horses of different breeds. Horses in the elite group did not have clinically significant cardiac abnormalities. Therefore, it seems likely that good to excellent cardiac function

is required for optimal performance in the sport of endurance riding.

However, clinically significant abnormalities were found in some of the horses in the non-elite group. These horses were not suspected to have cardiac problems, therefore, it may be of benefit to have a thorough cardiac evaluation by an experienced veterinarian in horses that are not performing as expected.

It must be emphasized that these are preliminary findings. There are important caveats to keep in mind, regarding the results of this study.

- First, and importantly, a relatively small number of horses was evaluated. The results should be confirmed with both a larger number of horses and by different clinicians performing the evaluations. Evaluations in different regions, performed by different people on larger numbers of horses may yield different results.
- In addition, success in endurance riding, similar to other sports, is complex and dependent on many factors. We could not control for these factors, which could have influenced overall results. These include differences in training methods, horse fitness, rider goals, and other physical strengths or weaknesses of the individual horse that could strongly influence performance success. For instance, a horse with a musculoskeletal or metabolic unsoundness might never excel in the sport although his cardiac size suggests he should be an elite athlete.

These data warrant further studies with larger numbers of horses, to try to overcome some of these limitations. ■