Comparison of Systolic Cardiac Function Before and After Treatment of Atrial Fibrillation in Horses With and Without Additional Cardiac Valve Insufficiencies

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ABSTRACT

Clinical, electrocardiographic and echocardiographic examinations were conducted before therapy and 4 days after conversion to normal sinus rhythm in 15 horses with a history of atrial fibrillation of 2–6 months duration. Seven horses showed no other signs of cardiac disease. Four horses suffered additionally from mitral valve insufficiency, while six horses had aortic valve insufficiency, including two of the four horses with mitral valve insufficiency, but none had signs of congestive heart failure. Doppler echocardiographic estimates of various variables were made for assessment of systolic heart function. These included heart rate, stroke volume, cardiac output and cardiac output per kg of body weight (heart index). After conversion to normal sinus rhythm, the horses without heart valve insufficiency showed a statistically significant decrease of heart rate (−24%) and cardiac output (−3%), but an increase in stroke volume (+8.4%) and heart index (+9%). The horses with heart valve insufficiency experienced a statistically significant decrease in heart rate (−21%) after conversion to normal sinus rhythm, but showed an increase in all other variables. Cardiac output increased statistically significantly by 20%, stroke volume by 54% and heart index by 58%.

Keywords: aortic valve, atrial fibrillation, cardiac variables, echocardiography, heart, horse, mitral valve, sinus rhythm

Abbreviations: AOI, aortic valve insufficiency; Co, cardiac output; ECG, electrocardiograph; FS, fractional shortening; HI, heart index; HR, heart rate; LA, left atrium; LV, left ventricle; MVI, mitral valve insufficiency; SV, stroke volume; VTI, velocity–time integral

INTRODUCTION

Atrial fibrillation is a common arrhythmia in horses that can result in exercise intolerance (Sweeny and Reef, 1984; Deegen, 1986; Blissitt et al., 1997) and is characterized by a total arrhythmia in auscultation and irregular intervals of QRS-T complexes, as well as the absence of p waves in ECG (Muir and McGuirk, 1984). The prognosis for successful therapy of atrial fibrillation depends on the presence and severity of coexistent heart diseases (Muir and McGuirk, 1984; Reef et al., 1988; Stadler and Deegen, 1993). Therefore, additional echocardiographic examination provides a valuable tool for evaluation of further cardiac diseases in horses with atrial fibrillation (Stadler and Deegen, 1993).
Most horses with atrial fibrillation have evidence of left ventricular dysfunction (Muir and McGuirk, 1984; Reef et al., 1989; Marr et al., 1995). Various methods for assessing cardiac function, and especially for measuring of cardiac output, have been developed in equine medicine (Muir et al., 1976; Stadler et al., 1994b; Young et al., 1995; Young and Scott, 1998; Blissitt et al., 1997). Invasive methods for cardiac output measurements include indicator dilution techniques and thermodilution (Muir et al., 1976; Stadler et al., 1994b). Cardiac output measurements with echocardiographic Doppler techniques (Blissitt and Bonagura, 1995; Young et al., 1995; Young and Scott, 1998) have shown good correlation with the invasive methods in horses (Stadler et al., 1994a; Blissitt et al., 1997).

The purpose of the study reported here was to compare the non-invasive (echocardiographic) variables of systolic heart function (i.e. stroke volume, cardiac output, heart index) before and after conversion of atrial fibrillation in 8 horses with and in 7 horses without cardiac valve insufficiency.

MATERIALS AND METHODS

Horses

Fifteen mature, warmblood horses (Hannoverian and Holsteiner Warmblood) with a history of atrial fibrillation (9 geldings, 6 mares), age 5–18 years (mean 11 years), and weighing 460–620 kg (mean 550 kg) were examined. The probable duration of atrial fibrillation was between 2 and 6 months, derived from the last veterinarian’s examinations.

The horses were referred for further examination to the equine clinic, School of Veterinary Medicine of Hannover, with reported cardiac arrhythmia (n = 15), exercise intolerance (n = 6) and heart murmurs (n = 8).

Clinical examination

Complete physical and electrocardiographic examinations were performed during resting and after exercise on each horse. During the physical examination, all the horses presented an irregular heart rate and rhythm and a variable pulse. Six of the horses showed an additional systolic heart murmur, grade 1 to 3 (on a scale from 1 to 5, where grade 3 means as loud as the heart sounds; Stadler et al., 1994b), with the point of maximum intensity over the mitral valve. Three of these six horses also had a diastolic heart murmur grade 1 to 3 (on a scale from 1 to 5) over the whole diastole, with the point of maximum intensity over the aortic valve.

Two horses had a diastolic heart murmur, grade 2 to 4 (on a scale from 1 to 5) over the whole diastole, with the point of maximum intensity over the aortic valve. Definite diagnosis of atrial fibrillation was made by electrocardiography, where each horse showed a wide variation in R-R intervals, replacement of P waves and irregular f waves.