The prevalence of cardiac arrhythmias in horses of the Sanandaj area

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Key Words:
Cardiac arrhythmia; horse; Kurdish purebred horse; Sanandaj.

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Received: 30 August 2010,
Accepted: 30 November 2010

Abstract

Cardiac arrhythmias, caused by disorders in the generation and transmission of cardiac impulses, is included among the heart disorders that cause inefficient blood circulation. The most commonly-used method for diagnosing this disorder is electrocardiography. In this study, we aimed to identify and diagnose different types of arrhythmia prevalent among the seemingly-healthy horses of Sanandaj City, with particular regard to breeds specific to this region. The researcher took electrocardiograms of 50 horses in Base-Apex, including Kurdish purebreds (n = 4), Arab purebreds (n = 20), and hybrid horses (n = 26; 35 male and 15 female overall). The results of the electrocardiograms showed arrhythmias in 16 (32%) out of all the horses in this study. Of these, 23% of the stallions, 10% of mares, 40% of the Kurdish purebreds, 8% of the Arab purebreds, and 26% of hybrid horses suffered from arrhythmias. Different types of arrhythmia diagnosed included sinus arrhythmia (10%), sinus tachycardia (8%), wandering pacemaker (8%), and first degree atrioventricular block (6%). The frequencies of arrhythmia in horses found in this study were similar to the results of other researchers. It is important to distinguish between physiological and pathological arrhythmias in horses after diagnosis, since arrhythmias can have a great impact on exercise performance.

Introduction

Considerable progress has been made in the fields of heart pathology, physiology, and physiopathology as a result of great efforts in cardiac research. Consequently, various methods for the diagnosis and treatment of cardiac diseases have been developed. Electrocardiography is a useful and valid means of diagnosing cardiac diseases, including arrhythmias. Any disorder in generating and transmitting cardiac impulses produces an arrhythmia, which can disturb peripheral circulation by affecting the heart rhythm. Electrocardiography is the most important way of diagnosing arrhythmias. The detection of arrhythmias in horses has a great significance due to its important role in exercise efficiency (Alidady, 1995).

Horses are one of the most commonly examined animals in terms of assessing the function of the heart, and detecting anomalies (Alidady, 1995). In 1991, Louis *et al*. registered the first case of an abnormal electrocardiogram of a horse suffering from atrium fibrillation (AF). In 1993, Nour *et al*. studied cardiac arrhythmias in horses, and thereafter different specialists have employed various methods of electrocardiography to investigate conduction defects. Accordingly, Rezakhany *et al*. examined the heart arrhythmia of 1,380 horses in Tehran (Rezakhany and Bigdeli, 2001).

From the clinical viewpoint, arrhythmias are divided into two types: functional and organic arrhythmias. The first type of arrhythmia, which is not related to any cardiac disorder, could also be called non-pathological or non-organic arrhythmia. An example of these in cattle and horses is partly related to the vagus nerve. However, organic arrhythmias are due to heart disease or structural disorders (Mokhber Dezfuli *et al*., 2001).

The purpose of this study was to determine the rate of arrhythmias in apparently healthy horses of the Sanandaj region. Electrocardiography was conducted during rest, and the prevalence of arrhythmia was then evaluated.

Materials and Methods

In order to ensure of the health of each horse prior to testing, the records of anti-parasitic drug treatments were examined and clinical examinations, including general inspection, palpation and auscultation, were performed. The existence of edema, satiated jugular vein, and abnormal cardiac noises in horses were the exclusion criteria in this study (Alidady, 1995).

Overall, 50 horses of both sexes (35 male, 15 female) and of various breeds, including Kurdish purebreds, Arab purebreds and hybrids that were used for flat race polo and jumping, were identified and selected. Breed nobility was identified based on the cauterized-spot sign, which was made by experts of the horsemanship federation or based on biometrics characteristics and a history of the horse in a training center.

After identification and selection, the selected horses were studied via electrocardiography. In order to prevent stress and provide a natural environment as far as possible, horses were not restrained, which has negative effects on the heart. They were also prevented from entering examination boxes. Not only did we use comforting colors for examination instruments, we also wore soothing garment, and in some cases, we entered the site along with the training center employee or the horse owner himself to reassure the horse (Diniz, 2006). During electrocardiography, the floor of the examination box was covered by plastic plates. A portable single-channel electrocardiograph (Fukuda 501B, Cardisuny) was used for ECG. Alligator clips, with their sharp edges and high-pressure springs removed, were used as electrodes.

The use of standard lead is usually sufficient for the identification of cardiac arrhythmias. In other words, the Base-Apex lead in horses, which is similar to the lead II position in human beings and dogs, would adequately depict a variety of cardiac arrhythmias (Alidady *et al*., 2002).

In order to set up an electrical connection between skin and electrodes, after cleaning the skin, a conducting jelly was applied. After ensuring the equal arrangement of limbs and the maximum comfort of the horse, electrocardiography was performed on horses, based on the Robertson method (1990).

The paper speed was 25 mm/sec and the calibration was 10 mm equal to 1 mV. All of the electrocardiograms were separately evaluated based on the existence of arrhythmias. The results were categorized into tables in the Results section and statistically analyzed by SPSS software and Chi-squared methods. The types of arrhythmia were analyzed and identified on the basis of the sex and breed of horses.

Results

After inspecting and analyzing the electrocardiograms, rhythmic disorders based on normal standards of cardiology were identified and classified on the basis of breed and sex of horses. As mentioned earlier, for this study, 50 horses, including 35 males and 15 females, with 20 Kurdish purebreds, four Arab purebreds and 26 hybrids, were selected and examined. The results of electrocardiography showed that 16 horses (32%) under study had varieties of arrhythmia, including sinus arrhythmia (Figure1), sinus tachycardia (Figure 2), wandering pacemaker (Figure 3) and first degree atrioventricular block (Figure 4) and normal electrocardiography was showed in figure 5.

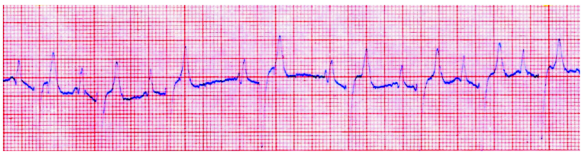

Figure 1: Sinus arrhythmia.

Figure 2: Sinus tachycardia.

Figure 3: Wandering pacemaker

Figure 4: First degree AV block.

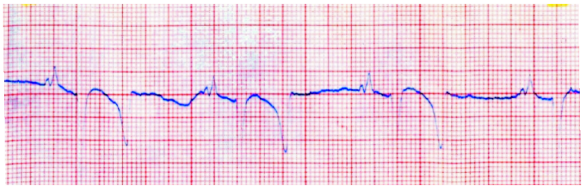

Figure 5: Normal equine electrocardiography.

Sinus arrhythmia (5/50; 10%) was the most frequent type of arrhythmia and first degree atrial arrhythmia (3/50; 6%) was the least frequent type. There were four cases (8% each) of both sinus tachycardia and wandering pacemaker (Table 1). Table

1 also shows representative examples of electrocardiograms of different arrhythmias.

Out of 35 males which consisted of 70% of the research sample, and out of 15 female which consisted 30% of the research sample, 11 (22%) and 5 (10%) horses, respectively, were diagnosed with arrhythmia. The number and percentage of occurrence of arrhythmias in all horses are presented separately according to sex in Table 2.

Out of the 20 Kurdish purebred horses, which consisted 40% of all horses, six cases were arrhythmic; only one of the four Arab purebreds was arrhythmic, and 9% of the 26 hybrid horses were arrhythmic. The number and incidence of arrhythmias are presented in Table 3 according to breed type. The statistical analysis to compare the incidence of arrhythmia with regards to sex and breed showed no significant difference ($P<0.05$).

Table 1: Number and percentage of arrhythmia in all horses in this study.

Arrhythmia	Number	Percentage
Sinus arrhythmia	5	10
Sinus tachycardia	4	8
Wandering pacemaker	4	8
Atrioventricular block I	3	6
Total	16	33

Table 2: Number and percentage of arrhythmias in all horses in this study according to sex.

Breed	Number	Arrhythmia	Normal
Male	35 (70%)	11 (22%)	24 (48%)
Female	15 (30%)	5 (10%)	10 (20%)
Total	50 (100%)	16 (32%)	34 (68%)

Table 3: Number and percentage of arrhythmias in all horses in this study according to breed.

Breed	Number	Arrhythmia	Normal
Kurd	20 (40%)	6 (12%)	14 (28%)
Arab	4 (8%)	1 (2%)	3 (6%)
Crossbred	26 (52%)	9 (18%)	17 (34%)
Total	50 (100%)	16 (32%)	34 (68%)

Discussion

Horses are usually examined with the aim of evaluating their exercise function and their efficiency in championship competitions. Although respiratory and neuromuscular system disorders are the most common cause of reduced ability in equine competitions, cardiovascular disorders should also be considered as an important limiting factor (Menzies, 2001). The diagnosis of cardiac abnormalities and assessing the impact of it on reducing the ability and efficiency of horses in races is a difficult task, since a high percentage of arrhythmias may not have any deleterious effects on a horse (Menzies, 2001). Cardiac arrhythmia is, to some extent, relatively common among horses and could result in a negligible effect (Mokhber Dezfuli *et al*., 2001; Radostits *et al*., 2007).

In addition to classifying arrhythmias into physiological or functional and pathological or organic arrhythmias, arrhythmias are also divided into two other types; i) arrhythmias that exist in the resting state but disappears if the heart rate increases with no negative effect on exercise efficiency; and ii) the arrhythymia reduces exercise inefficiency. Examples of the latter type include atrial fibrillation, acute bradycardia, advanced second degree atrioventricular blocks, third degree atrioventricular block, and premature atrioventricular contractions (Alidady, 1995; Razavizadeh *et al*., 2007).

Some researchers have also categorized arrhythmias into primary types, which relate to the abnormal cardiac structures, and secondary types, which relate to disorders of other systems of body, such as the digestive system. Both types have different treatment methods (Mokhber Dezfuli *et al*., 2001). Various elements can cause arrhythmias, such as high tonicity of the vagus nerve, and imbalances of electrolytes and acid-base balance. Myocardial diseases, bacterial infections, chemical and herbal toxins, respiratory system diseases, and central nervous system diseases are considered as some of these causes (Alidady, 1995).

Since no research has been performed with regards to the spread of arrhythmias in seemingly healthy horses, at least in Kurdish breeds, which represent 50% of the horses in this study, this is novel research.

Out of 50 horses in this study, 16 (32%) had arrhythmias. In a similar study, Dee Niz *et al*. (2006) out of 60 horses reported that 44% had arrhythmia (Jesty and Reef, 2006). Galen *et al*. (2007) reported 31% of arrhythmia in an 11-year longitudinal study by examining 555 heads of horses (Mary and Durando, 2003). Razavi-Zadeh *et al*. (2007) declared 36.2% of Arab horses of Khuzestan were affected by arrhythmias in a similar study (Rezakhani *et al*., 2005). Wibe Peterson *et al*. (1980) recorded and incidence of 16% of arrhythmia (Vibe-Peterson and Nielson, 1980). Alidadi *et al*. (2002), examining Turkman horses, recorded a lower frequency of arrhythmia in this breed than other breeds (Gehlen *et al*., 2007). Reza Khani *et al*. (1380) reported 37.5% of horses suffered from arrhythmias (Alidady, 1995). In similar studies the percentage of arrhythmia has the frequency of 16% to 44%, which is in accordance with the findings of this study.

Out of the 16 cases in this present study with arrhythmia (32%), five cases (10%) had sinus arrhythmia, four (8%) had sinus tachycardia, four (8%)

had the wandering pacemaker arrhythmia, and three (6%) had first degree atrioventricular block. In this study, three types of arrhythmia were identified that have had little attention in other studies: 1) sinus arrhythmia, 2) first degree atrioventricular block, where there is a longer P-R interval than the normal state, and 3) wandering pacemaker. All three cases were related to the Kurdish breed. A heart rate more than 44 per minute was considered tachycardia (Mokhber Dezfuli *et al*., 2006).

Sinus arrhythmia was observed independently of other arrhythmias, whereas in most other studies, it has been recorded along with other types of arrhythmia. Although sinus arrhythmia is common among healthy horses, it can be easily treated and cured by an increase in heart rate (Alidady, 1995). This particular type of recurring increase and decrease of the heart rate originates from sinoatrial (SA) node, which mainly results from vagus nerve tonus in horses. It is believed that, during inhalation, the vagal nerve tone is low. Therefore, the heart rate increases, whereas in exhalation, tonus it is high and the heart rate decreases. This is identified through changes in the R-R interval during the electrocardiograph wave.

In similar studies mentioned earlier, Dee Niz *et al*. (2006) recorded the rate of first degree atrioventricular block as 7% and Wibe Peterson et al. (1980) recorded wandering pacemaker as 1% (Jesty and Reef, 2006; Vibe-Peterson and Nielson, 1980).

In other studies, Rezakhani *et al*. (2005); Razavizadeh *et al*. (2007) and Dee Niz *et al*. (2006) showed that sinus tachycardia is the most frequent type of arrhythmia. However, the present study showed that sinus tachycardia was less common than sinus arrhythmia. In sinus tachycardia, all electrical contractions originate from the SA node and there is no obvious cause on electrocardiography except for the increase in heart rate. Important causes for this tachycardia in the resting state could be stress and excitement (Menzies, 2001).

First and second degree atrioventricular blocks have been reported to have various rates of frequency (Jesty and Reef, 2006; Menzies, 2001; Rezakhani *et al*., 2005; Rezakhany and Bigdeli, 2001; Vibe-Peterson and Nielson, 1980). Only first degree atrioventricular block was observed in just three heads of the Kurdish breed. This arrhythmia appears because of the high tonicity of the vagus nerve and occurs when there is a delay in the transmission of electrical waves from the atrium to the ventricle in the AV node. The only characteristic on electrocardiography is the increase in P-R interval, but this is not clinically significant.

Wandering pacemaker, which was diagnosed in four horses, is caused by waves that are from the different impulse sources from the atrium. The P wave form varies on electrocardiography.

In short, different arrhythmias, which mostly physiological, are common among healthy horses, and if they are removed by an increase in heart rate, then they have no significant clinical importance (Alidady, 1995). More attention should be paid to arrhythmias that occur or persist during exercise that decrease exercise efficiency. In studies by Schwarz Wald et al., (2003), atrial fibrillation was reported as the most common type of arrhythmia in exercise conditions and this was considered to be a pathological arrhythmia (Schwarzwald, 2003). In a physical exercise treadmill test with constant monitoring of 24 horses, Schifer *et al*. (1995) recorded arrhythmias (Scheffer *et al*., 1995). Therefore, in pathological arrhythmias, horses should not exercise without a full assessment by the veterinarian.

References

1. Alidady, N. (1995) Standardization of electrocardiography in Torkman (saka) horse.
2. Alidady, N.; Dezfouki, M.R.M.; Nadalian; M.G.; Rezakhani, A. and Nouroozian, I. (2002) The ECG of Turkman horse using the standard lead base apex. Veterinary Science. 22(5), pp: 182-184.
3. Diniz, M. (2006) Electrocardiographic profile of show jumping horses raised in SaoPaulo. Faculdade de Medicine Veterinaria e Zootecnia.
4. Gehlen, H.; Goltz, A.; Rohn, K. and Stadler, P. (2007) A survey of the frequency and development of heart disease in riding horses. Pferdehilkunde. 23(4), pp: 369-377.
5. Jesty, S.A.; Reef, V.B. (2006) Evaluation of the horse with acute cardiac crisis. Clinical techniques in equine practice. 5(2), pp: 93-103.
6. Mary, M.; Durando, (2003) Clinical techniques for diagnosis cardiovascular abnormalities in performance horses. Clinical Techniques in Equine Practice. 2(3), pp: 266-277.
7. Mokhber Dezfuli, M.R.; Alidady, N.; Nadalian, M.G.H.; Rezakhany, A.; Nowrouzian, I.; Kamal Hedayat, D. and Rezai, A.H. (2001) The characters of QRS complex in the ECG of Torkman (saka) horse. J. Faculty Vet. Med. Tehran. 56. No.1, pp: 7-12.
8. Mokhber Dezfuli, M.R.; Fakor, Sh.; Bahari, A.A.; Alidady, N. and Rezakhany, A. (2006) Electrocardiographic parameters of the Kurd Horse using Base-Apex lead. J. Appl. Anim. Res. 30: 89-92.
9. Menzies, N. (2001) ECG interpretation in the horse. Brit. Vet. Assoc. Pract. 23, pp: 454-459.
10. Radostits, O.M.; Blood, D.C. and Gay, C.C. (2007) Veterinary medicine. The textbook of the diseases of cattle, sheep, pigs, goats and horses. 10th edition, Baillier and Tindal, London, UK.
11. Razavizadeh, A.; Taghavi Mashhadi, A. and Ghadrdan Paphan, A. (2007) The prevalence of cardiac dysrhythmias in khozestan Arab horses. PJBS. 10(9), pp: 3430-3434.

12. Rezakhani, A.M. Godarzi, Tabatabaei, N. (2005) A combination of atrioventricular block and sinoatrial block in a horse. Acta Veterinaria Scandinavia, 46: 173-175.
13. Rezakhany, A.; Bigdeli, A. (2001) Survey of prevalence of cardiac arrhythmia in horses of Tehran region. J. Faculty Vet. Med. Tehran. No.56, pp: 47-50
14. Scheffer, C.W.; Robben, J.H. and Soletvan, M.M. (1995) Continuous monitoring of ECG in horses at rest and during exercise. Vet. Rec. 137(15), pp: 371-374.
15. Schwarzwald, C. (2003) Atrial and AV-nodal physiology in horses: electrocardiography and echocardiographic characterization and pharmacologic effects of diltiazem. J. Vet. Med.
16. Vibe-Peterson, G.; Nielson, K. (1980) Electrocardiography in the horse. (A report of finding in 138 horses.) Nord. Vet. Med. 32(3-4): 105-121.