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# ELECTROCARDIOGRAPHIC CHANGES IN HORSES WITH PIROPLASMOSIS

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## ABSTRACT

Present study was done on 17 horses with Piroplasmosis. Horses were diagnosed based on their clinical and para-clinical evidences. After history taken, blood samples were obtained from jugular vein and sera were separated. Also, sampling from 16 healthy horses with same nutritional and management situations was done as normal control group. ECG was performed after recording heart beats and the type of heart arrhythmias was diagnosed. Increased HR and incidence of arrhythmias were seen more significantly in suffered horses ($P<0.05$). Different shapes of waves were recorded from each group but there was no significant difference was seen in this regard in exception of QRS altitude. In conclusion it can be mentioned that the ECG is changed in horses in consequence of Piroplasmosis which are physiologic.

**Keywords: Piroplasmosis, heart, ECG, Horse**

## INTRODUCTION

Piroplasmosis is a protozoan disease which is transmitted by ticks. The disease is worldwide and its agent in equine is Theileria equi and Babesia caballi which are intracellular parasites belonged to Apicomplexa superphylum (Mehlhorn and Schein, 1998; Rothschild and Knowles, 2007).

Hard ticks such as hyalomma, rhipicephalus and dermanyssus are considered as vector of Theileria equi and *Babesia caballi*. Infected needles and surgical instruments cause ease transmitting of Theileria equi. Intrauterine transmitting yields to fetus infestation too (De waal, 1992; Feiedhoff and Soule, 1996). The disease is diagnosed by fever, anemia, icterus, spleen and hepatic enlargement and existence of hemoglobin and bilirubin in urine. The disease is classified to hyperacute, acute, subacute and chronic forms. The most prevalent agent is Theileria equi and most of the infestations due to Babesia caballi is asymptomatic. The involved horses have shown disease in stressfulness conditions (De Waal, 1992; Feiedhoff and Soule, 1996; Friedhoff, 1990 ; Hailat et al. 1997s).

Detection of infestation with Babesia or Theileria is made based on direct and indirect methods. Direct methods are including microscopic detection of stained blood smears and molecular methods. Indirect methods are based on tracing of antibodies against Babesia and Theileria using serologic tests (Bose et al. 1995).

The most reasons of cardiac arrhythmias in horses which are due to gastrointestinal tract, respiratory tract and hematic disorders include: direct effects of endotoxins on myocardia, disturbance in nerves function because of gastrointestinal distention, electrolyte disturbance and acid-base imbalance, changes in hematocrit and fever (Schwarzwald et al. 2003). Piroplasmosis in horses can cause changes in electrocardiogram and biochemical factors because of above mentioned reasons. The aim of present study was to survey on the Piroplasmosis effects' on electrocardiogram and cardiac arrhythmias.

## MATERIALS AND METHODS

Present study was done on 17 horses (14 stallions and 3 mares) with Piroplasmosis. Considering that the disease is most incident in hot seasons, our study was done during summer. Horses were diagnosed based on their clinical and para-clinical evidences. After history taken, blood samples were obtained from jugular vein and sera were separated. Also, sampling from 16 healthy horses (13 stallions and 3 mares) with same nutritional and management situations was done as normal control group. ECG was performed after recording heart beats and the type of heart arrhythmias was diagnosed. ECG was done in resting state and using mono channel electrocardiography with base-apex Lead by inflow 1 mv and velocity 25mm/s for 30 seconds.

### Statistical analysis

Statistical population was consisted of 17 suffered and 16 healthy horses which was determined using following formula:

$$n = \frac{z^2(1-\frac{\alpha}{2}) \times \sigma^2}{d^2}$$

SPSS version 18 was used for data analyzing. We used t-test statistical method for comparing parameters among groups.

## RESULTS

**Comparison of heart rate mean value in groups**

The HR in healthy horses was varied in range of 25-61 beat per minute that mean of 41.48±5.92. The HR in suffered horses was varied in range of 40-95 beat per minute that mean of HR was 76.62±9.41. Comparison of data showed significance difference among groups in term of HR (p=0.000, **Diagram and Table 1)**.

**Heart rate distribution in groups**

Heart rate distribution in horses is given in **Table and Diagram 2**. As seen in **Table 2**, in healthy group, 13 (81.25%) of them had normal rhythm and only 3 of them (18.75%) had arrhythmia. Contrary in suffered horses, 8 (45.96%) of them had normal rhythm and 9 (54.04%) of them had arrhythmia. In suffered horses the number of normal rhythms was decreased which is showed significance difference in compared with healthy group ($p<0.05$). The number of arrhythmias was recorded and are given in **Table 2** in which the incidence of sinusal tachycardia is significantly higher in suffered horses ($P<0.05$).

**Waves duration and intervals in groups**

Waves' duration and intervals by second are given in **Table 3**. It shown that p wave duration in healthy group was 0.11±0.03 second, QRS was 0.14±0.02 second, PR interval was 0.30±0.04 second and ST segment was 0.42±0.06 second. These values in suffered horses were 0.11±0.02, 0.14±0.04, 0.27±0.04 and 0.48±0.06 second respectively. There was no significant difference among groups in term of mentioned parameters

**Waves shape in groups**

In healthy group, in 9 (56.25%) of ECGs, p wave was positive biphasic and in 7 cases (43.75%) p wave was positive monophasic. QRS complex in 10 cases (62.5%) was QRs, in 4 cases (25%) was QRS and in 2 cases (12.5%) was qRs. T wave in 10 cases (62.5%) was negative, in 5 cases (31.25%) was negative-positive and in 1 case (6.25%) was positive **(Table 4)**.

In suffered horses, in 7 (43.01%) of cases, p wave was positive bi-phasic and in 10 cases (56.59%) p wave was positive monophasic. QRS complex in 2 cases (11.76%) was Qrs, in 3 cases (17.65%) was QRS and in 11 cases (64.71%) was qRS and in 1 case (5.88%) was QrS. T wave in 9 cases (52.94%) was negative, in 2 cases (11.76%) was negative-positive, in 5 cases (29.41%) was positive-negative and in 1 case (5.88%) was positive **(Table 5)**.

**The mean value of wave's altitude in groups**

The mean value of wave's altitude in term of p wave in healthy horses was 0.25±0.07 mv, QRS was 1.68±0.42mv, and p wave was 1.08±0.31 mv. But in suffered horses, these values were 0.26±0.04, 2.11±0.39 and

1.12±0.06 mv respectively in which there was no statistical difference among groups in term of T and P waves but QRS wave was statistically increased in suffered horses (p=0.039) **(Table 6)**.

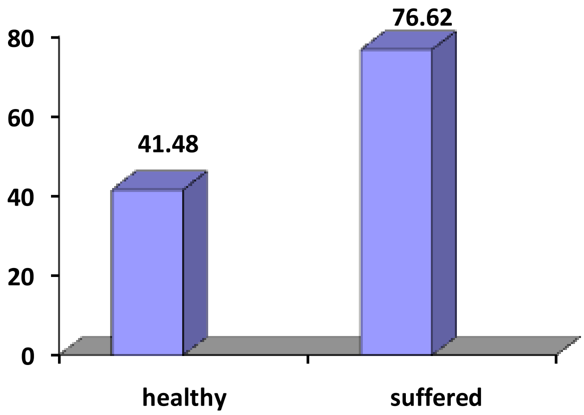


**Diagram 1: mean value of heart rate in healthy horses and suffered from Piroplasmosis**

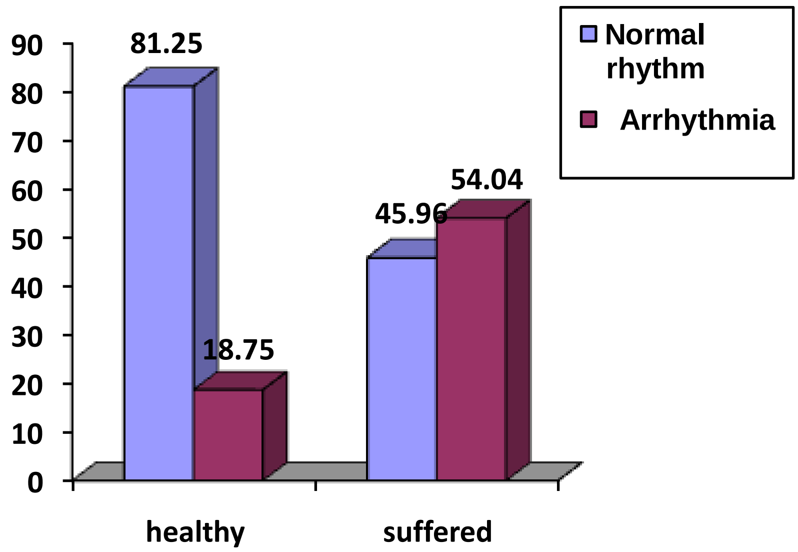


**Diagram 2: the percent of horses with normal and abnormal rhythms in both groups**

**Table 1: Comparison of heart rate mean value in groups**

| Group | No. | Mean | SE | SD | P-value |
|---|---|---|---|---|---|
| Healthy | 16 | 41.48 | 5.92 | 7.30 | 0.000 |
| Suffered | 17 | 76.62 | 9.41 | 12.71 | |

**Table 2: recorded changes in heart rhythms in ECG in both groups**

| Group | Heart rhythm | No. | Types of arrhythmias |
|---|---|---|---|
| Healthy | Normal | 13 | - |
| | Arrhythmia | 3 | Sinus tachycardia (2 cases), sinus arrhythmia (1 case) |
| Suffered | Normal | 8 | - |
| | Arrhythmia | 9 | Sinus tachycardia (6 cases), sinus arrhythmia (2 cases), sinus arrest (1 case) |

**Table 3: comparison of wave's duration and intervals in groups**

| Wave | Group | Mean | SD | P-value |
|---|---|---|---|---|
| P | Healthy | 0.11 | 0.03 | 0.967 |
| | Suffered | 0.11 | 0.02 | |
| QRS | Healthy | 0.14 | 0.02 | 0.985 |
| | Suffered | 0.14 | 0.04 | |
| P-R | Healthy | 0.30 | 0.04 | 0.608 |
| | Suffered | 0.27 | 0.04 | |
| S-T | Healthy | 0.42 | 0.06 | 0.321 |
| | Suffered | 0.48 | 0.06 | |

**Table 4: Wave's shape in healthy horses**

| Wave | Shape | No. | Percent |
|---|---|---|---|
| P | Positive bi-phasic | 9 | 56.25 |
| | Positive mono-phasic | 7 | 43.75 |
| QRS | QRs | 10 | 62.5 |
| | QRS | 4 | 25 |
| | qRs | 2 | 12.5 |
| T | Negative | 10 | 62.5 |
| | Negative-Positive | 5 | 31.25 |
| | Positive | 1 | 6.25 |

**Table 5: Wave's shape in suffered horses**

| Wave | Shape | No. | Percent |
|---|---|---|---|
| P | Positive bi-phasic | 7 | 43.01 |
| | Positive mono-phasic | 10 | 56.59 |
| QRS | Qrs | 2 | 11.76 |
| | QRS | 3 | 17.65 |
| | Qrs | 11 | 64.71 |
| | QrS | 1 | 5.88 |
| T | Negative | 9 | 52.94 |
| | Negative-Positive | 2 | 11.76 |
| | Positive- Negative | 5 | 29.41 |
| | Positive | 1 | 5.88 |

**Table 6: comparison of the mean value of wave's altitude in groups**

| Wave | Group | Mean | SD | P-value |
|---|---|---|---|---|
| P | Healthy | 0.25 | 0.04 | 0.753 |
| | Suffered | 0.26 | 0.04 | |
| QRS | Healthy | 1.68 | 0.42 | 0.042 |
| | Suffered | 2.11 | 0.39 | |
| T | Healthy | 1.08 | 0.31 | 0.287 |
| | Suffered | 1.12 | 0.06 | |

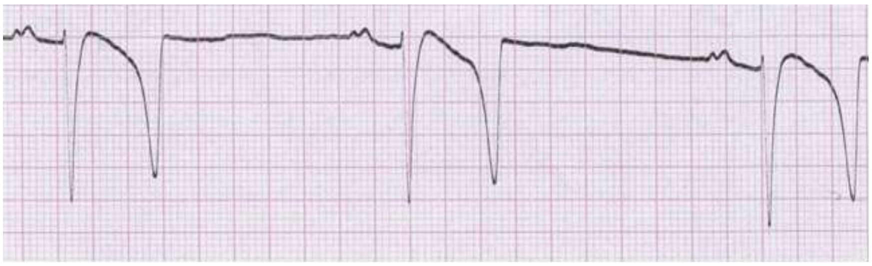

**Figure 1: an ECG of normal heart in horse**

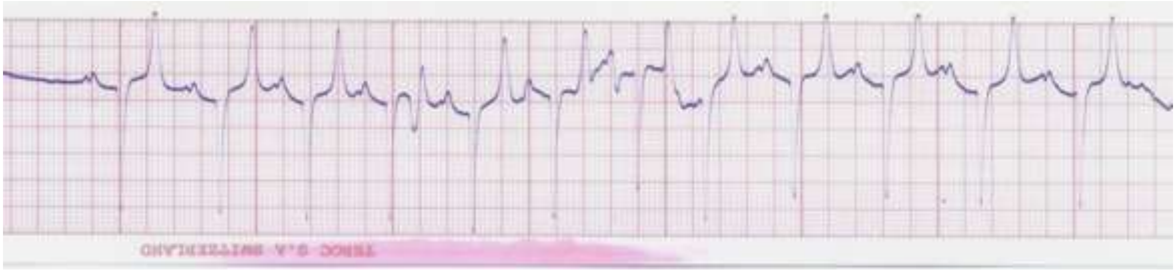

**Figure 2: A sample of ECG of a suffered stallion with sinus tachycardia diagnosis (102/min)**

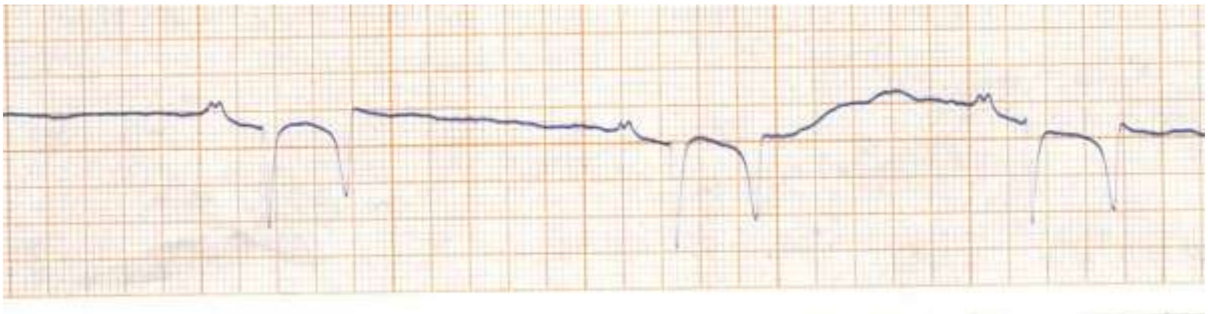

**Figure 3: A sample of ECG of a suffered mare (6 years old) with sinus arrhythmia diagnosis**

## DISCUSSION AND CONCLUSION

The mean value of HR in suffered horses was increased significantly (P<0.001). Sinusal tachycardia represents an increase in heart rate in response to the pain, agitation, anxiety and other stressors agents. Pathological tachycardia may be occur secondarily because of common diseases or primarily because of disorders specific to the heart tissue. Fever, hypoxia, hemorrhage and anemia cause sinusal tachycardia secondarily and agents such as congestive heart failure, myocardial infarction are the primary pathological causes of sinus tachycardia.

In equine and cattle it have been proven that toxicity with high doses of Nerium oleander induces tachycardia due to sympathetic stimulation (Robertson et al.1990). The biochemical changes in suffered horses indicate this context. There was a sinusal bradycardia in one horse with pneumonia. The incidence of bradycardia in most cases have exogenous cardiac origin and factors such as drugs, the imbalance in the autonomic nervous system, hypothermia, hyperkalemia are played role in its development. Sinusal bradycardia also is seen in enhancement of the activity of the Vagus nerve or decrease the activity of the sympathetic nervous system caused by anatomical changes in the sinus node. Perhaps the most important role in this case is attributed to the effect of the Vagus nerve (Rose et al. 1995). In mentioned horse the serum level of Calcium, Glucose and Sodium was lesser than normal levels which justify the incidence of sinusal bradycardia which is physiologic.

In the case of horses in suffered group, sinus arrhythmia was observed which was not significant. Sinus arrhythmia is a kind of physiological arrhythmias in which impulses coming from atrial-sinus node get fast and slow. In some animals such as horses, the incidence of this kind of arrhythmias is attributed to animal's respiration and Vagus nerve (Rezakhani et al. 1997).

In healthy group, AV blocks type I and II were seen in 3 and 1 cases respectively. But in suffered group, only in one case AV block type I was seen. AV blocks type I and II are physiologic in horses but are consider pathologic if case disturbance in animal function. Therefore, because in present study these types of AV block did not affect animal function so we consider physiologic and can be attributed to electrolytes changes because 3 cases were suffered from hypercalcemia. Nowadays, frequent existence of AV block type II is considered as pathologic because disturbance in atrioventricular conductivity because of electrolytes imbalance, administration of high percentage of calcium salts, toxicity with digitaline and olender, cardiomyopathies and infectious and nourishment myocarditis.

In 2 cases of sheep suffered from sarcosporidiosis, arrhythmias were observed (Robert and Sonnehblick, 2007).

In a study, of 50 horses were underwent celiotomy operation, ECG showed that 8 cases (23%) had premature ventricular beat, 4 cases (11%) had sudden ventricular tachycardia and 11 cases (31%) had supraventricular premature beats (Stephen et al., 2004). According to investigators of that study, the most common causes of these secondary arrhythmias is contributed to the effects of endotoxin on myocardia and autonomic nervous system, acid-base disturbances and electrolyte imbalance (Radostits, et al. 2007).

In one of the suffered horses, sinus arrest or sinoatrial block was recorded. The sinus node or atrioventricular block, sinus discharge or impulse cannot be transferred to the atrial myocardium. In SA block, either sinus node cannot be decharged or impulse cannot be passed into atrial myocardia. This situation is diagnosed with absence of heart sounds, jugular beat and arterial pulse. In ECG, the absence of P-QRS-T complex is seen in a beat and intervals of P waves in before and after block is enhanced two folds may be a little lesser than two folds in compared with normal interval of P-P. This kind of arrhythmia is most prevalent in fatty sport horses in resting status and can induce this arrhythmia in those animals by increasing Vagus nerve tonicity which is physiologic. Electrolytes disturbances are the most reason of it (Kojouri et al. 2007).

The mean value of duration and intervals of waves in both groups showed non-significant difference. In suffered group, in 7 cases (43.01%) p wave was positive bi-phasic and in 10 cases (56.59%) was positive mono-polar. P wave in large animals like horses is mostly biphasic which is not considered as arrhythmia but this condition in small animals is because of premature atrial contraction, atrial tachycardia and finally atrial fibrillation (Rezakhani et al. 1977).

QRS shape was different among groups which is compatible with other studies. In Fregin study frequency of QRS waves were not evaluated (Fregin, 1982). But Hajinejhad (1988) recorded QRS in 7 leads (I, II, III, aVR, aVL, aVF and V10) on 100 mixed-breed horses. At glance to results of Hajinejhad (1988) shows significant similarity (especially leads I, aVF and V10) to results related to Turkmen horses in term of number and diversity of QRS waves.

So that, Hajinejhad in lead I has showed different forms of QS, QR, qR, qRs, Qr, qr, Rs, qrs and R by the frequency of 4, 4, 15, 21, 7, 10, 10, 10, 9 and 10 percent respectively. He also mentioned the forms of qR, qRs, Qr, qRS, qr, Rs and rS by the frequency of 23, 22, 2, 16, 14, 2, 5 and 4 respectively in aVF lead. But Hajinejhad has shown in V10 lead in 100% of cases only one form of qR.Fregin, (1982) demonstrated the mean value of QRS duration for Troubled and Standardbred in lead II by 0.130 seconds. Hajinejhad demonstrated the mean value of QRS duration for mixed-breed horses in lead II by 0.106 seconds. Jahani (1995) showed this value in base-apex lead by 0.10 seconds.

T wave in term of positivity showed significant difference in both groups. Positive or negative T wave is not considered as arrhythmia and can be recorded in any form in horses. Waves altitude was not statistical significant in term of P and T waves in healthy horses but was increased significantly in QRS waves in suffered horses ($p<0.05$). Changes in QRS wave altitude can be attributed to increased ventricular contractility because of anemia .

In a study on 25 horses with pneumonia and 25 health horses it has been shown that HR in sick horses is significantly more than health animals ($P<0.05$). Abnormal rhythm was seen in 8 and 12 cases of healthy and sick animals respectively. Sinusal tachycardia was the most common arrhythmia in sick group. Wave's duration and intervals were not significant statistically in groups. Also, waves altitude was not statistical significant in term of P and T waves but was increased significantly in QRS waves ($p<0.05$). in both groups, the most common shape of p waves were positive biphasic while T and QRS waves were recorded in different shapes (Hakimzadeghan, et al. 2013). In a study on 30 horses with Gourm disease and 29 healthy horses, the mean value of HR and incidence of aryhtmias in suffered group were increased significantly in compared to healthy group (P<0.05) (Hassanpour, 2014). In conclusion it can be mentioned that the ECG is changed in horses in consequence of Piroplasmosis which are physiologic.

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