IJBPAS, September, 2014, 3(9): 2108-2119

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

EVALUATION OF CHANGES IN ELECTROCARDIOGRAPHIC PARAMETERS IN ARABIAN STALLIONS BEFORE AND AFTER MATING

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ABSTRACT

Mating in horses may be cause abnormality in ECG so, present study is designed and carried out to investigate electrocardiograph changes in Arab stallion pre and post mating. Present study was carried out on 8 Arab stallions around Tabriz farms. All animals were examined before and after mating (20 minutes after) and after counting heart rate, ECG was done and the type of arrhythmia was recorded. The mean value of heart rate after mating showed significant difference (p=0.046). Before mating, 5 (62.5%) of them had normal rhythm, 1 (12.5%) of them had AV block II accompanied with sinusal arrhythmia, 1 (12.5%) of them had premature atrial contraction and 1 (12.5%) of them had sinusal bradycardia. After mating, 4(50%) of them had normal rhythm, 2 (25%) of them had premature atrial contraction, 1 (12.5%) of them had sinusal arrhythmia and 1 (12.5%) of them had sinusal tachycardia. After mating, the number of abnormal rhythms was had been increased which was statistically significant ($p<0.05$). There was no significant difference among groups in term of wave's duration. There was no statistical difference among groups in term of T and QRS waves but p wave was seen statistical difference (p=0.049). Also, there was no statistical difference among groups in term of waves shape. It can be concluded that mating cause changes in ECG of stallions which are mostly physiologic.

Keywords: Stallion, Mating, ECG Changes

INTRODUCTION

In horses, the causes of heart arrhythmias which is in consequence of gastrointestinal and respiratory tract disorders are including: direct effect of endotoxins on heart

myocardia, disorder in nerves function because of stomach and intestinal distention in result of decreased gastrointestinal motility, electrolyte disturbances and acid-base imbalances, fever and reduced respiratory ventilation **[1]**.

Kind of dysrhythmias such as sinusal arrhythmia, SA block, wandering pacemaker, AV block I and II occur without any sign and because of high vagal nerve tension which is most common in horse and commonly occur in animals in resting state.

Dysrhythmias failure is suspicious but if this dysrhythmia doesn't associate with heart failure and can be treated by exercise is not reason of a pathologic process.

In horses with SA and AV blocks, a series of perinodal lesions and disturbance in microcirculatory occurs which cause dysrhythmias. In horses, fibrous lesions are common in myocardia which are seen by 79% in understudying horses. These dysrhythmias shall be examined after a course of exercise. In a study on 50 foals, it has been shown that more than 90% of foals were suffered from arrhythmia at the time of birthing in which more than 50% of them were suffered from premature atrial contractions and about 30% of them had atrial fibrillation and 20% of them had premature ventricular contractions which are because of hypoxia at the time of parturition, as well as, other arrhythmias were seen which were rare.

Sinusal rhythms shall be continued 5 minutes after birth. The occurrence of arrhythmias in ruminants is more common than horses. Also, premature atrial and ventricular contractions and atrial fibrillation in apparently healthy dairy cows has been seen **[1, 2]**.

Mating in horses may be cause abnormality in ECG because of above mentioned factors so, present study is designed and carried out to investigate electrocardiograph changes in Arab stallion pre and post mating.

MATERIALS AND METHODS

Present study was carried out on 8 Arab stallions around Tabriz farms. All animals were examined before and after mating (20 minutes after) and after counting heart rate, ECG was done and the type of arrhythmia was recorded. ECG was done in resting state and using triple channel electrocardiography with base-apex and Lead I by inflow 1 mv and velocity 25mm/s for 30 seconds. In Base-apex lead, positive electrode was occupied in apex beat of the heart (to wit on the chest in parallel with elbow shadow) and negative electrode was occupied along the base of the heart. Left or right jugular groove or a desired area of the anterior shoulder is appropriate for apical electrode placement.

ECG interpretation was done using a magnifier. In interpretation of ECG following criteria was noticed:

No. of heart rate, shape of the P wave such as positive or negative shapes and width of p wave, existence of QRS wave per each PR wave, PR interval, RR interval and shape of QRS. In ECG investigation, shape and duration of waves, wave's interval, and wave's amplitude were measured and compared between two times. SPSS version 13 was used for data analyzing and heart arrhythmias were described. T-test was used for comparing mean values between two times.

RESULTS

Comparison of Heart Rate Mean Value in Before and After Mating

The HR in stallions before mating was varied in range of 28-72 beat per minute that mean of HR was 52.50±3.32. The HR in stallions after mating was varied in range of 32-112 beat per minute that mean of HR was 66.50±5.75. Comparison of data showed significance difference among groups in term of HR **(p=0.046, Diagram and Table 1**)

Heart Rate Distribution in Stallions Before Mating

Heart rate distribution in stallions before mating was as bellow:

5 (62.5%) of them had normal rhythm, 1 (12.5%) of them had AV block II accompanied with sinusal arrhythmia, 1 (12.5%) of them had premature atrial contraction and 1 (12.5%) of them had sinusal bradycardia **(Table 2)**.

Heart Rate Distribution in Stallions After Mating

Heart rate distribution in stallions after mating is given in **Table 3**. 4(50%) of them had normal rhythm, 2 (25%) of them had premature atrial contraction, 1 (12.5%) of them had sinusal arrhythmia and 1 (12.5%) of them had sinusal tachycardia.

Percentage of Stallions with Abnormal Heart rate in Before and After Mating

Diagram 2 shows the number of stallions with abnormal heart rate. It shown that after mating the number of abnormal heart rates increased in which there is statistical difference among mentioned times ($p<0.05$). Describing that occurrence of atrial contraction was seen in two times but AV block II accompanied with sinusal arrhythmia was recorded in a stallion before mating which turned into the sinusal arrhythmia after mating. Both of recorded arrhythmias are physiologic.

Waves Duration and Intervals in Stallions Before and After Mating

Waves' duration and intervals by second are given in **Table 5**. It shown that p wave duration before mating was 0.11±0.01 second, QRS was 0.14±0.06 second, PR interval was 0.32±0.08 second and ST

segment was 0.49±0.11 second. These values after mating were 0.12±0.03, 0.15±0.04, 0.28±0.04 and 0.42±0.04 second respectively. There was no significant difference among groups in term of mentioned parameters.

Waves Shape in Stallions Before Mating

Before mating, in 6 (75%) of ECGs, p wave was biphasic and in 2 cases (25%) p wave was monophasic. QRS complex in 4 cases (50%) was qRs, in 2 cases (25%) was QRS and in 2 cases (25%) was qRS. T wave in 6 cases (75%) was negative and in 2 cases (25%) was negative-positive **(Table 6)**.

Waves Shape in Stallions After Mating

After mating, in 7 (87.5%) of cases, p wave was biphasic and in 1 case (12.5%) p wave was monophasic. QRS complex in 3 cases (37.5%) was qRs, in 1 case (12.5%) was QRS and in 2 cases (25%) was qRS and in 2 cases (25%) was qRs. T wave in 5 cases (62.5%) was negative and in 3 cases (37.5%) was negative-positive **(Table 7)**.

The Mean Value of Wave's Altitude in Stallions Before and After Mating

The mean value of wave's altitude in term of p wave was 0.24±0.07 mv, QRS was 1.81±0.38mv, and p wave was 1.12±0.21 mv. After mating these values were 0.33±0.05, 1.92±0.51 and 1.05±0.03 mv respectively in which there was no statistical difference among groups in term of T and QRS waves but p wave was seen statistical difference (p=0.049) **(Table 8)**.

Table 1: Comparison the Mean Value of HR in Stallions Before and After Mating

Group	Mean	SE	SD	P-value
Pre-mating	52.50	13.30	3.32	0.046
Post-mating	66.50	22.99	5.75	

Table 2: Heart Rate Distribution in Stallions Before Mating

Heart rhythm	No.	Percent	Age range 3-5 years old	Age range 5 years old and above
Normal	5	62.5	2	3
AV block II accompanied with sinusal arrhythmia	1	12.5	0	1
premature atrial contraction	1	12.5	0	1
sinusal bradycardia	1	12.5	0	1
Total	8	100	1	7

Table 3: Heart Rate Distribution in Stallions After Mating

Heart rhythm	No.	Percent	Age range 3-5 years old	Age range 5 years old and above
Normal	4	50	1	3
premature atrial contraction	2	25	1	1
sinusal arrhythmia	1	12.5	0	1
sinusal tachycardia	1	12.5	0	1
Total	8	100	2	6

Table 4: Type of Heart Rhythm in Stallions by Number Before and After Mating

No of stallion	Age (year)	Heart rhythm	
		Before mating	After mating
1	6	premature atrial contraction	Normal
2	4	Normal	premature atrial contraction
3	7	AV block II accompanied with sinusal arrhythmia	Sinusal arrhythmia
4	6	Normal	premature atrial contraction
5	6	Normal	Normal
6	7	Sinusal bradycardia	Normal
7	7	Normal	Sinusal tachycardia
8	4	Normal	Normal

Table 5: Waves Duration and Intervals in Stallions Before and After Mating

Wave	Time	Mean	SD	P-value
P	Before mating	0.11	0.01	0.346
	After mating	0.12	0.03	
QRS	Before mating	0.14	0.06	0.953
	After mating	0.14	0.01	
PR interval	Before mating	0.32	0.08	0.277
	After mating	0.28	0.04	
ST segment	Before mating	0.49	0.11	0.205
	After mating	0.42	0.04	

Table 6: Waves Shape in Stallions Before Mating

Wave	Shape	No	Percent
P	Positive biphasic	6	75
	Positive monophasic	2	25
QRS	qRs	5	62.5
	QRS	2	25
	qRS	2	25
T	Negative	6	75
	Negative-Positive	2	25

Table 7: Waves Shape in Stallions After Mating

Wave	Shape	No	Percent
P	Positive biphasic	7	87.5
	Positive monophasic	1	12.5
QRS	qRs	3	37.5
	QRS	1	12.5
	qRS	2	25
	qRs	2	25
T	Negative	5	62.5
	Negative-Positive	3	37.5

Table 8: The Mean Value of Wave's Altitude in Stallions Before and After Mating

Wave	Group	Mean	SD	P-value
P	Before mating	0.24	0.07	0.049
	After mating	0.33	0.05	
QRS	Before mating	1.81	0.38	0.436
	After mating	1.92	0.51	
T	Before mating	1.12	0.21	0.674
	After mating	1.05	0.03	

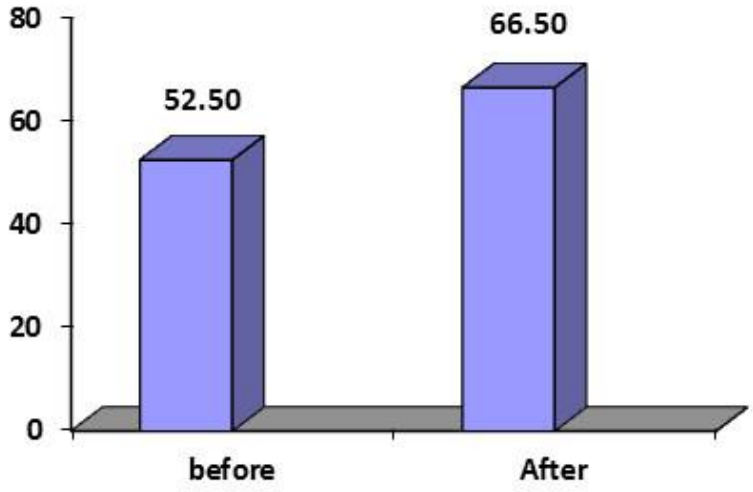

Diagram 1: Mean Value of HR in Stallions Before and After Mating

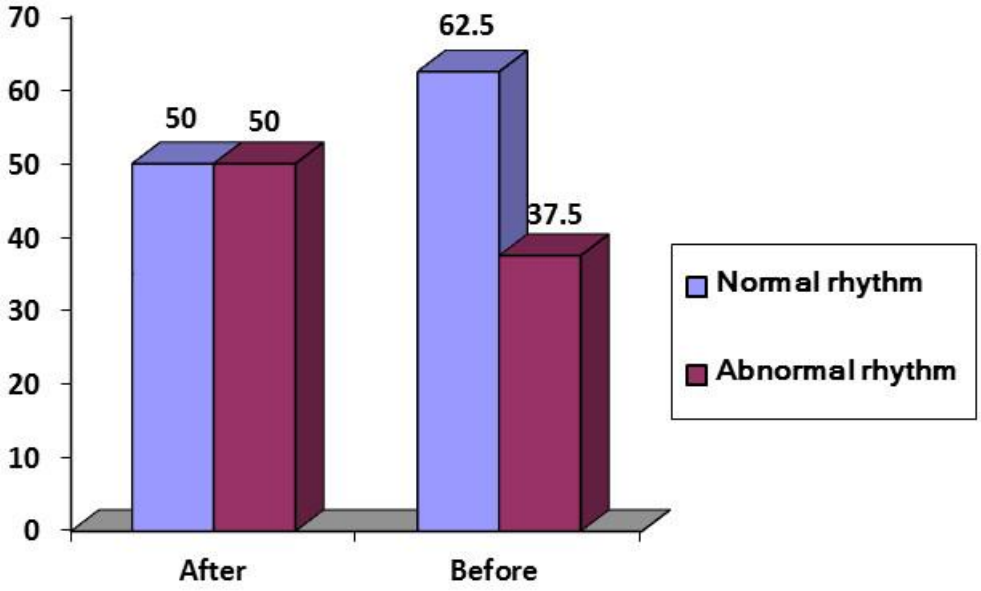

Diagram 2: Percentage of Stallions with Abnormal Heart Rate in Before and After Mating

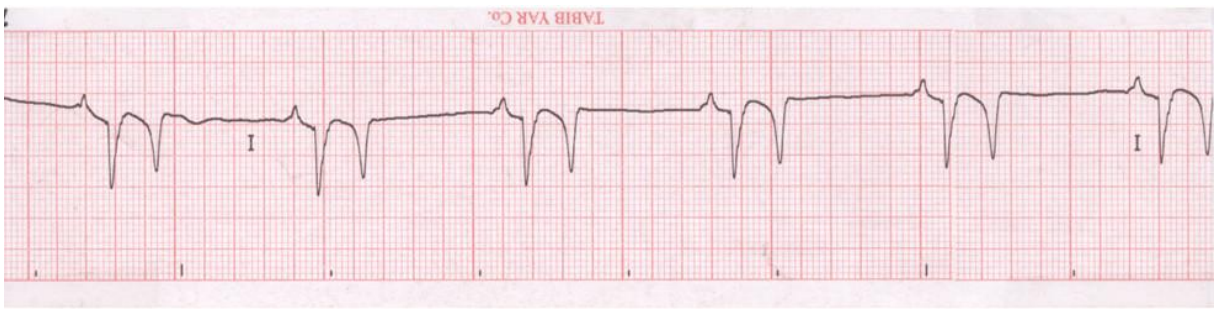

Figure 1: A Sample of Normal ECG of a Stallion

Figure 2: A Sample of ECG With Sinusal Bradycardia of a Stallion

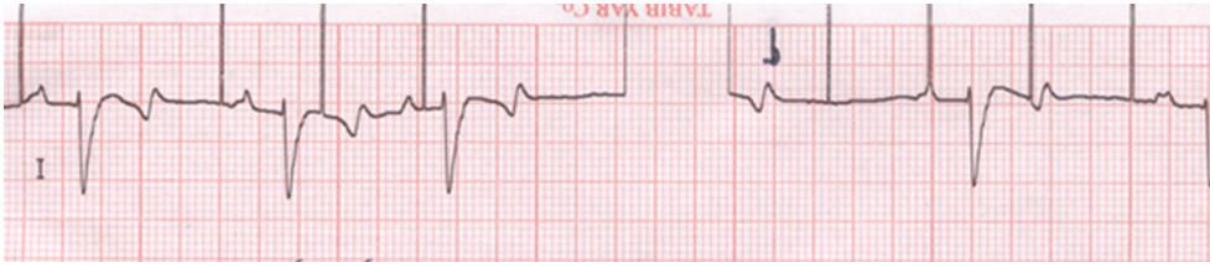

Figure 3: A Sample of ECG with AV Block I Accompanied with Sinusal Arrhythmia of a Stallion

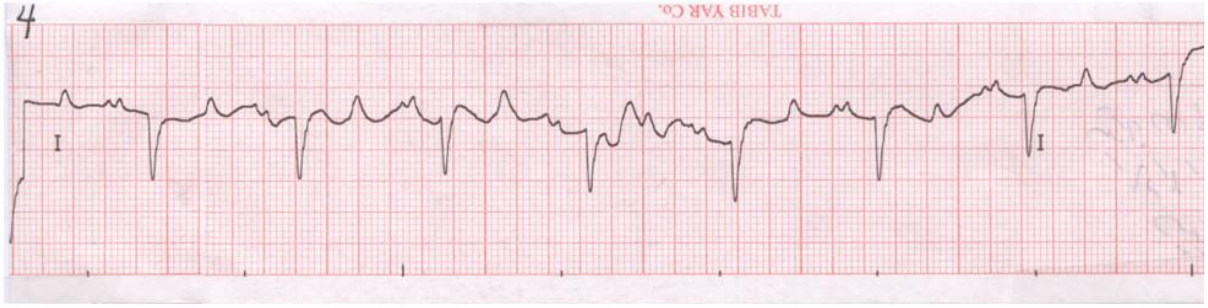

Figure 4: A Sample of ECG with Premature Atrial Contraction of a Stallion

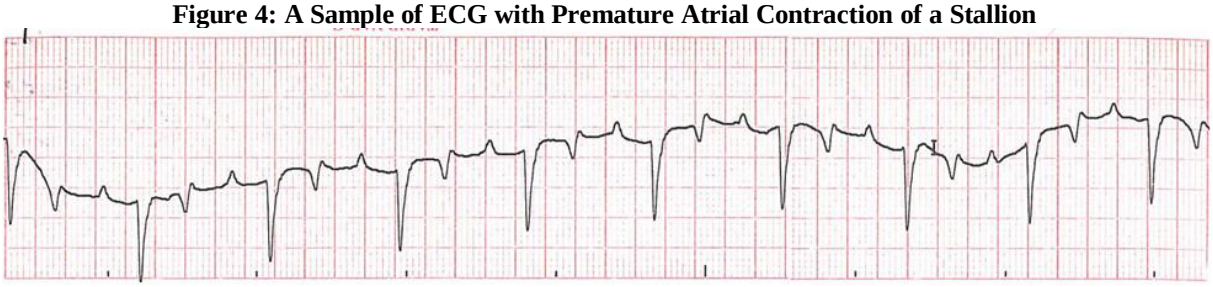

Figure 5: A Sample of ECG With Sinusal Tachycardia of a Stallion

DISCUSSION AND CONCLUSION

Heart arrhythmias are disturbances in the normal cardiac rate, heart rhythm or pattern of electrical conductivity. Cardiac arrhythmias are including physiological and pathological forms. In physiologic form, there is no organic disorder in heart tissue but also it is in other organ of the body which affects the heart. For example, factors such as fever, exciting, digestive and electrolyte disorders, pneumonia and lung congestion cause physiological arrhythmias which are curable with treating the primary agent.

In pathologic form, the heart tissue is sick and needs direct and specific treatment.

Such pathologic arrhythmias are including atrial fibrillation, ventricular fibrillation and AV block III **[3]**. The mean value of heart rate showed increase after mating (p=0.046). Stimulation because of mating increases the heart rate. Mating yields to increased HR and sinusal tachycardia. 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 **[1]**. In a study on 13 stallions, HR in resting time was 35.3±0.9, at the time of jumping for mating was 162.1±5.4 and at the time of ejaculation was 145.7±5.1. in those horses, the plasma concentration of epinephrine and norepinephrine was increased 1.9 and 4.7 folds respectively. This shows the sympathetic stimulation at the time of mating. Also, it seems that is mixed with a psychological stress and it is a potential factor in changing heart function **[4]**.

In another study on young and old rats it shown that after ejaculation HR in old and young rats was increased 54.2±3.5 and 41.7±2.79 percent respectively which was statistical higher than basal level and indicate that mating in old individuals increases the risk of death **[4]**.

In human it has been reported that HR and BP are increased because of sexual intercourse and returns to its previous status rapidly therefore, the occurrence of sudden cardiac death is increased in persons with history of cardiac dysfunction **[5]**.

In a research on human, increased HR and BP in response to the sexual intercourse has been reported and demonstrated that in this status myocardial oxygen demand is increased and sudden death probability also increased in case of coronary vessels obstruction **[6]**.

In another research it shown that in a men who use drugs such as sildenafil for preventing of erectile dysfunction the risk of sudden death is increased because this drug is vasodilator **[7]**.

In a study on male dogs it revealed that HR at the time of resting is 125.8±6.0 and mating is 195.2±8.2 and returns to normal state 3 minutes after mating. In these dogs, serum concentration of adrenalin and noradrenalin does not differ before and after

mating so sympathetic stimulation in dog is suspicious **[8]**.

In present study, before mating, 5 cases had normal rhythm, 1 case had AV block II accompanied with sinusal arrhythmia, 1 case had premature atrial contraction and 1 case had sinusal bradycardia. After mating, 4 cases had normal rhythm, 2 cases had premature atrial contraction, 1 case had sinusal arrhythmia and 1 case had sinusal tachycardia. After mating, the number of abnormal rhythms was had been increased which was statistically significant ($p<0.05$).

In one of the stallions there was sinusal bradycardia before mating. sinusal bradycardia cause decrease HR because of decreased ejection from SA node. This is common in fat animals which is treated with injection of atropine **[3]**.

Before mating, in one case there was AV block type I accompanied with sinusal arrhythmia. 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 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 **[10]**.

According to investigators, the most common causes of these secondary arrhythmias iscontributed to the effects of endotoxin on myocardia and autonomic nervous system, acid-base disturbances and electrolyte imbalance **[3]**.

Sinusal arrhythmia is one of the physiologic arrhythmias. A slow heart rate occurs at resting time because of intensive vagal stimulation. Sinusal arrhythmia is correlated with respiration and in horses is not coordinate with animal respiration. In most large animals sinus arrhythmia in dogs is more evident than in dogs which is not diagnosed without ECG and this status in sheep and gout and young animals of all species is correlated with respiration and can be treated with aspirin and atropine. In sinusal arrhythmia there was different RR intervals which is not pathologic and is seen in 30% of animals in resting time. If it is not

resolved by exercise is considered as pathologic **[11]**.

Premature atrial contraction is seen in one case before and in 2 cases after mating. These beats are because of sinus node discharge. If these beats don't affect on ventricular rhythm, can not be diagnosed in physical examination. Because of low diastolic filling and decreased amplitude related with these premature contractions, ventricular contractions which are induced by premature atrial contractions were low intensity.

Two styles would be occurred; sometimes sinusal node is being worked after occurrence of premature atrial beat and turns to regular rhythm after this contraction. The sign of this kind of premature atrial contractions is periods of regular rhythms. In other cases SA node won't be regulated after premature atrial contraction and in this case next atrial or ventricular contraction don't occur and the specific sign of this kind of contractions is early ventricle contractions with cessation and normal function after that. This is most likely to situation that make by premature ventricle beats. In slow heartbeat, periodical stopping of a sinusal rhythm is indicator of premature atrial beats. Differential diagnosis of present status is to the SA block and AV block type II which have its own characteristics. In ECG, p wave of premature atrial beats is occurred too early and is malformed. QRS complex in premature atrial beats is normal **[12]**.

In a research during 2001-2005 in Korea the reason of sudden death in 14 cases was sexual activity in which 6 case were aneurism, 6 cases were arrhythmias related to AV node and 2 cases were unknown **[13]**.

In another study on human, the risk of myocardial infarction at the time of sexual intercourse has been calculated near 2.5% more than normal state and it has been suggested to use aspirin and beta blockers in persons with coronary or other heart problems and doing exercise to prevent sudden cardiac death **[14]**.

Arrhythmias recorded before and after mating are physiologic but increase animal susceptibility to heart failures. In a research in healthy human and human with history of myocardial infarction, the sexual activity was assayed. It shown that in persons with history of MI, the risk of MI increased by 2 folds. Regular exercise may be preventive of heart risk during the sexual activity **[15]**.

Before mating, in 6 (75%) of ECGs, p wave was biphasic and in 2 cases (25%) p wave was monophasic. QRS complex in 4 cases (50%) was qRs, in 2 cases (25%) was QRS and in 2 cases (25%) was qRS. T wave in 6 cases (75%) was negative and in 2 cases (25%) was negative-positive while after

mating, in 7 (87.5%) of cases, p wave was biphasic and in 1 case (12.5%) p wave was monophasic. QRS complex in 3 cases (37.5%) was qRs, in 1 case (12.5%) was QRS and in 2 cases (25%) was qRS and in 2 cases (25%) was qRs. T wave in 5 cases (62.5%) was negative and in 3 cases (37.5%) was negative-positive.

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 **[12]**.

QRS shape was different among groups which is compatible with other studies. In Fregin study frequency of QRS waves do not evaluated **[16]**. Fregin demonstrated the mean value of QRS duration for Troubled and Standardbred in lead II by 0.130 seconds. 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 biphasic while T and QRS waves were recorded in different shapes **[17]**. Positive or negative T wave is not considered as arrhythmia in horses and may be recorded in different shapes. **[16]** reported the altitude of QRS wave in troubled breed by 1.86 mv. It can be concluded that mating cause changes in ECG of stallions which are mostly physiologic.

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