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CARDIOVASCULAR RESPONSE TO HIGH SPEED EXERCISE IN ATHLETIC HORSES

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Abstract

Various body systems or organs are responsible for successful performance in the horses. The cardiovascular system has great role in the evaluation of exercise tolerance in the horses. In this study ,cardiovascular response of 19 Iranian race-horses, before and after exercise in 1600 meter race-track were studied .Heart rate before and after exercise and pattern of its reduction after exercise and correlation between these data's and poor performance were evaluated. The mean of resting heart rate was 36.10+_5.54 bpm.the mean of maximum heart rate and heart rate after sixty minutes of exercise or HR(60), were 131.89+_16.83 and 42.36+_11.70 bpm respectively. The maximum heart rate showed significant increase to resting heart rate ($p<0.05$).The mean decrease of heart rate in first minute was 15.38 percent. Eleven horses (60 %) had HR of 60 bpm after twenty minutes.21.1 percent of horses had normal HR after thirty minutes. The mean values of PCV (paced cell volume) and RBC (red blood cell) were 36.60± 3.3 % and 6.8± 0.88 M/ul at rest and 44.73± 4.7 % and 9.28± 1.32M/ul after exercise respectively. These values showed significant increase after exercise ($p<0.05$).

Key Words: Exercise, Horse, Heart, Hematocrit, cardiac response

INTRODUCTION:

Exercise intolerance is a suboptimum capacity to perform at the expected or previously attained intensity of exercise. The expectations of the owner or trainer are inherent in the definition of exercise intolerance, thus factors other than diseases must be considered. Exercise intolerance and poor performance are signs that may be referable to diseases in many body systems. However, the respiratory, cardiovascular and locomotor systems are of primary interest. They play a central role in the integrated response of the body to the increased demand of muscle for oxygen and energy substrates during exercise. The cardiovascular system plays a central role in the oxygenation of blood by the lungs and in the delivery of oxygen and other energy substrates to, and removal of metabolic products from exercising muscles. Physical examination of the heart for detection of heart rate at rest and post-exercise, vagal effect on heart rate after exercise, taking the pulse, presence of dysrhythmias,PCV and RBC volumes are used to evaluation of cardiovascular system.

MATERIAL AND METHODS

19 Iranian crossbred race horses aged between 5 to 10 years old and 350 to 450 Kg weight were selected for this study. Two blood samples were taken at rest and after exercise in 1600-meter race- track. Auscultation of heart for heart rate and possible dysrhythmias carried out at rest and immediately after exercise, every minute up to 15 minutes, and then every 5 minutes up to 60 minutes. Blood samples submitted to the laboratory for hematological analysis and heart rate data is analyzed for decreasing rate in certain periods. The statistical analysis carried out by t-student test and anova test with SPSS computer program.

RESULTS:

Table 1 show the mean of resting heart rate (HR), maximum HR and heart rate after sixty minutes of exercise HR(60).There is significant increase of HR after exercise ($p<0.05$).The mean percentage decrease of HR in first, second and fifth minutes after exercise are shown in table 2.Table 3 shows the hematocrit and red blood cell values before and after exercise. The values showed significant increase after exercise ($p<0.05$).

Table 1.pre- and post exercise heart rate and HR(60) of horses

Parameter	Mean(bpm)	Min.	Max.
Resting-HR	36.1± 5.34	28	48
Max-HR	131.89± 16.83	107	160
HR(60)	36± 11.72	30	70

Table 2. Percentage of decreasing of heart rate after exercise

Time	Mean	Min.	Max.
First minute	15.37 (%)	5.77	30
Second minute	29.18(%)	12.50	50
Fifth minute	50.62(%)	18.42	77.78

Table 3. Pre- and post exercise hematological values

Parameter	Mean	Min.	Max.
Pre-exercise-RBC	6.88± 0.88 (M/ul)	5.55	8.64
Postexercise-RBC	9.28± 1.02 (M/ul)	7.80	12.33
Pre-exercise PCV	36.68± 3.33 (%)	30.00	43.00
Postexercise PCV	44.73± 4.7 (%)	38.00	53.00

DISCUSSION:

Among the adaptive cardiovascular responses to training are lowered heart rate, which is necessary to achieve a set speed, increased red cell volume, and increased capillarisation of muscle. Increase in heart rate is primarily responsible for increasing cardiac output during exercise at submaximal heart rates (<210 bpm).At maximum heart rates (210 to

240 bpm) subsequent increments in cardiac output were thought to result from increased stroke volume as in humans, but this is now not thought to be the case in horses. The rate of decrease of heart rate following exercise and the time required to reach resting levels depends upon the severity of the exercise even in fit horses. Heart rate falls rapidly over the first minute and then more slowly over the ensuing 10 to 15 minutes period. In this study the mean of resting heart rate was 36.10+-5.54 bpm.The mean of maximum HR and the HR of sixty minutes after exercise were 131.89+_16.83 bpm and 42.36+_11.70 bpm respectively, showing significant increase of resting heart rate ($p<0.05$).The mean decrease of heart rate in first minute was 15.38 percent indicating good cardiovascular response in some of the horses. The mean of resting HR of this study is similar to studies of Steel (35.9+_5.81 bpm) and Lank et al (42.6bpm) on warm blood horses. The maximum HR between horses do not show any significant differences ($p>0.05$) and the mean of maximum HR (131.89+_16.83 bpm) indicates submaximal exercise in these horses.Manohar (1993) reported maximum HR of 213 bpm in race horses.Hiragan et al (1997) reported maximum HR of 229.3+_11.4 before initiation of training program in thoroughbred horses.Boden (1991) reported maximum HR of 250 bpm in young horses and showed that after a standard training program, there is a decreasing rate in HR at rest and also maximum HR. The mean of maximum HR in standard bred horses was reported 227+_2.4 bpm and 228+_3 bpm in thoroubred horses (Mooris1991).In this study the mean of decreasing HR in first minute was 15.37 percent, with range of 5.77 to 30 percent. Nearly 42 percent of horses showed decreases of more than the mean. The mean decrease in the second and fifth minutes were 29.18 and 50.62 percent respectively.
Eleven horses (60 %) had HR of 60 bpm after twenty minutes.21.1 percent of horses had normal HR after thirty minutes and it reached to mean of 36.8 after forty minutes. Only 63.2 percent of horses recovered to normal resting heart rates after sixty minutes. The mean of HR after sixty minutes was 42.36+_11.72 bpm.In the study of Physick-sheard (1985) on thoroughbred race horses with mean velocity of 886+_49 m/min ,the mean of returning to resting HR,was 45+_7 bpm at sixteenth minutes and was not followed after it.Although the rate of decreasing of HR is much valuable in endurance horses, but in race Horses, the decrease rate of HR in few first minutes after exercise is very significant and decreasing rate of fifty percent or more, suggestive of possible good performance. If HR does not return to normal after sixty minutes, there is possibly an evidence of poor performance in the horse.

Hodgson and Rose (1994) suggested that recovery of HR to 60+_4 bpm in ten minutes after high speed exercise is a good benchmark for high compatibility of the heart to exercise.Radostits et al (2000) suggested that horses which have not HR of 60 bpm or were twenty minutes after exercise, are not suitable for performance. Taylor and Hillyer (1997) suggested a general guide that HR should reach to more than 10% of normal HR after 15 minutes at canter and after 30 minutes in gallop. Eleven horses (60 %) of this study had HR of 60 bpm after twenty minutes.21.1 percent of horses had normal HR after thirty minutes. Only 63.2 percent of horses recovered to normal resting heart rates after sixty minutes. In this study, fourteen horses have a good slope of decrease for HR. Five horses have not a good performance for example, two of them did not reach normal HR even after 60 minutes. Six horses (31.57%) have HR more than 10% greater than resting HR. The mean of decreasing HR in first five minutes was 50.62% and 57.8% of horses had recovery rate more than the mean. Whenever nearly

60 % of horses have decreasing rate, more than the mean decrease, possibly there is an evidence for good performance.

The spleen of horses is densely innervated and normally can deposit up to one third of total red blood cell in the blood. After exercise or hemorrhage, the spleen can release this deposition and therefore hematocrit(PCV) value can show up to a fifty percent increase(Hodgson 1994).The RBC and PCV mean values of this study showed significant increase after exercise($p<0.05$).The mean increasing percentage for RBC was more than 30% and for PCV was more than 20%.Meetay et.al (1992) showed 58-61 % increase in RBC and PCV values after competitive racing in thoroughbreds.Hirage et.al (1997) revealed significant difference of PCV values after a training period. In a study by Gill et.al (1987) on 3-day events and show jumps, there was a significant increase in PCV and RBC values. Person and Alberg (1979) suggested that a low stimulus could produce 10 to 15 percent increase in RBC values. They suggested individual susceptibility among horses that will become higher as increasing of age.

In a study on splenectomized horses, there was no increase of PCV values after physical stress or injection of epinephrine(Person et.al 1973).Radostits and Blood (2000) suggested that an increase of 26 % in RBC values reveal good capacity of the spleen. The increase of whole blood volume during the exercise is dependent on intensity of exercise, age, sex, breed and type of training. Up to 200% difference in the weight of spleen in various breeds may cause differences in whole blood volume.

CONCLUSION:

The maximum HR of the horse, the speed of timely reduction, RBC and spleen reservation to increase the PCV value is good indicators for cardiovascular assessment of poor performance evaluation. The mean decrease of heart rate in first minute indicates good cardiovascular response in some of the horses.12 horses (63.15%) had a normal heart rate at sixty minutes after exercise, possibly due to irregular training and the rest did not return to their resting heart rate after 60 minutes. Fourteen horses of this study have a good slope of decreasing HR. The rest did not show a good decreasing rate curve. The mean of decreasing HR in first five minutes was suitable and nearly 60 % of horses have decreasing rate of more than the mean, possibly an evidence for good performance. Those horses with more than 30% increase in PCV have good spleen potential for RBC releasing.

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