Cardiovascular Response To Exercise In Iranian Athletic Horses

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Abstract

Various body systems or organs are responsible for successful performance in horses. The cardiovascular system has great role in the evaluation of exercise tolerance in 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 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 ($p<0.05$).

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.

MATERIALS AND METHODS

19 Iranian cross-bred 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

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 ($p<0.05$).

Figure 1

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

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

Figure 2

Table 2: Percentage of decreasing of heart rate after exercise

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

Figure 3

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 thorough bred 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 sixtieth 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 performan cefor 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 a 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 can 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 are 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 a evidence for good performance. Those

horses with more than 30% increase in PCV have good spleen potential for RBC

releasing.

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