

**ELECTROCARDIOGRAPHIC AND HAEMATOLOGICAL
PARAMETERS AND HEART BEAT FREQUENCY IN ARABIAN
THOROUGHBRED HORSES ACCORDING TO THEIR
ADAPTABILITY TO EFFORT**

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Summary

The capacity of 4.5 years old Arabian thoroughbred horses' adaptability to standardised physical effort was determined. The electrocardiographic and haematological parameters and heart beat frequency were measured before and after the effort. At the end of the race, the racing horses displayed 10.7% longer PR interval and 23.5% longer duration of the electric ventricular systole compared to the horses that were not adapted to effort. Right after the effort, the horses with better physical condition had the erythrocyte to leukocyte ratio of 1-1.2 and 50% hematocrit value.

The adaptation of the horse to standardised physical effort requires complex physiological changes in the locomotor apparatus, as well as in the cardiovascular and respiratory apparatuses, accompanied by the intervention of the neurohormonal activity. The effect of the regular practice on the cardio-vascular and respiratory functions materialised in a maximal increase of O₂ transportation capacities towards the muscle tissue, an increase of the muscle tolerance towards the lactic acid following the anaerobe glycolysis and a reduction of the cardiac mechanical work under effort. The evolution of these functional changes monitored during the practice sessions through direct measuring or through laboratory measurements characterises the physiological profile of the racing horses (Sevestre J., 1998). The importance of this study resides in the evaluation of the sportive aptitudes by measurements of some physiological parameters both before and right after effort during the practice sessions.

Materials and methods

The experiment was conducted on 12 Arabian thoroughbred horses with an average age of 4.5 years, from a private horsemanship club, trained during the past six months for racing in standard competitions. In the race standing of last practice session, that included high-intensity exercises close to the conditions of the final race, the first four horses were evaluated as trained horses while the horses on the subsequent standings were evaluated as not trained. At the end of

the race all the horses return to the stables walking at normal pace for 10 minutes and thereafter they rest for another 20 minutes. The last 30 minutes represent the period of recovery after effort, which is characterised by a return to normal of the cardio-respiratory functions of the organism. These horses underwent electrocardiographic monitoring, before the practice, under conditions of rest and after 10 minutes of calm. The electrocardiogram was done with a portable Delta 1 PLUS electrocardiograph using the Dubois technique (25 mm/sec paper rolling speed and 10 mm millivolt amplitude. Heart beat rate was measured at rest and during the period of recovery by reading the pulse on the external maxillary artery. Blood samples were collected before and after the practice in syringes with heparin. The blood samples were assayed for hematocrit (using the micromethod), for haemoglobin (using the photocolorimetric method) and the leukocyte formula (using the May Grünwald-Giemsa staining method).

The experimental results were interpreted statistically using the Student method. The data were used to evaluate the adaptive physiological response to effort.

Results and discussions

The PR interval was 10.7% shorter in the trained horses compared to the untrained horses. The length of the PR interval was generally stable and it reflects the vagal tone of the animal. The longer duration of the PR interval can be related to a hypervagotony or to a less efficient training. The length of the QRS complex in the properly trained horses was 15.3% greater than in the untrained horses. This fact correlated positively to the mass of the ventricular myocardium, showing its hypertrophy, as shown in the electrocardiogram by the 8.3% increased amplitude of the QRS complex in the trained horses (Table 1).

Table 1
Amplitude (mv), duration (sec) of wave and intervals ECG
at arabian thoroughbred horses

ECG D _{II}		P sec.	PR sec.	QRS sec.	RT sec.	T sec.	P mV	QRS mV	S mV	T mon mV	T ₂ bifz mV
Adtp horses	M	0,12	0,25	0,15	0,42	0,18	0,46	0,78	1,82	0,55	0,32
	DS	0,02	0,04	0,03	0,05	0,06	0,09	0,60	0,42	0,35	0,20
Unadtp horses	M	0,13	0,28	0,13	0,34	0,22	0,44	0,72	1,60	0,45	0,40
	DS	0,02	0,06	0,02	0,03	0,08	0,05	0,46	0,36	0,26	0,26

This statement is controversial because some authors (Thomas and all, 1994) did not notice a positive relation between the duration, amplitude of the QRS complex and the sportive aptitudes. The RT interval corresponds to the ventricular electric systole showing the total duration of the ventricular depolarisation and

repolarisation. The length of the RT interval varies with the heart beat frequency, increasing with the decrease of the cardiac frequency, which occurs as the training progresses. In the trained horses, the length of RT interval was 23.5% higher than in the untrained horses, which means a prolonged ventricular systole which provided for a complete discharge of the ventricles. T wave was monophasic and positive in 8 horses and biphasic with T_1 negative and T_2 positive in 4 horses. The following correlation was identified despite the very large individual variability of T wave morphology: in the trained horses the amplitude of the monophasic T wave was 22% higher and the amplitude of the biphasic T_2 wave was 20% lower. The length of T wave was 18% shorter in the trained horses than in the untrained horses. The amplitude of S wave was 13.8% higher in the trained horses than in the untrained horses. During the rest period, the average cardiac frequency in the 12 stallions was 36 heart beats per minute. During the first two minutes after effort, heart beat rate displayed a differential increase: it was 115 heart beats per minute in the horses adapted to effort and 146 heart beats per minute in the horses not adapted to effort. Over the following 5 minutes, the value of the cardiac frequency dropped suddenly by 17.4% in the adapted horses and by 14% in the horses not adapted to effort. The lower frequencies of the cardiac frequency noticed in the horses adapted to effort is accounted by the existence of a dominant vagal tonus which appeared as adaptative response to the repeated action of the long physical training sessions (Figure 1).

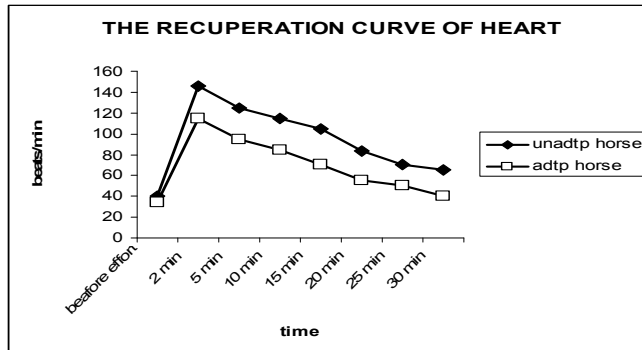


Figure 1 The recuperation curve of heart at Arabian thoroughbred horses

The evaluation of the sportive aptitudes using haematological parameters is very controversial (Chabchoub et al., 1999). Table 2 shows the average values of some haematological constants in the two groups of horses.

Table 2**Haematological parameters of arabian thoroughbred horses at rest**

at rest		GR 10 ⁶ /mm ³	PCV %	Hb g/dl	10 ³ /mm ³					
					GB	N	L	M	E	B
adtp horses	M	9,5	38	15	9	4,7	2,8	0,05	2,1	0,08
	DS	1,15	3,45	1,46	1,10	0,35	0,32	0,04	0,17	0,058
unadtp horses	M	8,6	42	14	6	5,2	3	0,40	1,8	0,22
	DS	1,10	3,62	1,30	0,74	0,55	0,45	0,28	0,15	0,15

Compared to the state of rest, the values of the erythrocyte and leukocyte series recorded after effort display significant increments in both groups (Table 3). The errors inherent to the method by counting are 10%.

Table 3**Haematological parameters of arabian thoroughbred horses after effort**

after effort		GR 10 ⁶ /mm ³	PCV %	Hb g/dl	10 ³ /mm ³					
					GB	N	L	M	E	B
adtp horses	M	12,0	50	18	10,8	5,5	2,6	0,46	0,80	0,01
	DS	1,10	4,22	1,66	0,98	0,42	0,32	0,26	0,68	0,02
unadtp horses	M	10,6	46	14,7	7,2	2,7	3,7	0,38	2,4	0,10
	DS	1,05	3,35	1,23	0,68	0,22	0,28	0,27	0,17	0,09

We observed a 32% increase of the hematocrit in the properly trained horses and a 9.5% increase in the poorly trained horses. The increase of the red blood cells count is due to their mobilisation from the spleen by the adrenaline secreted by the organism under conditions of intense and prolonged effort by stimulation of the hypothalamus-hypophysary-suprarenal axis. A 40% increase of the hematocrit may appear in the anxious subjects under conditions of prolonged stress. The large red blood cells count display important amounts of oxygen, mainly through haemoglobin, from the lungs to the muscles, to support the oxidative degradation of glycogen and tryglicerides within the process of cell respiration. The emotional stress or the physical effort caused the serum leukocytes to increase. The red blood cells to leukocyte count ratio can be an indicator of the state of adaptation to effort (Chabchoub et al., 1999). The value of this ratio ranges between 1-1.2 in the horses with good physical condition and exceeds this value in the other horses. Leokocytosis, neutrophilia, lymphopenia, eosinopenia, express the leukocytar response to the physiological release or corticosuprarenal hormones. In the case of the horses adapted to effort, leukocytes increased by 20%, neutrophils increased by 17%, lymphocytes decreased by 7%, while the eosinophils decreased by 62%.

Conclusions

1. The prolonged RT interval ensures a better oxygenation of the myocardium.
2. The longer duration of QRS complex and the monophasic and positive aspect of T wave are physiological parameters representative for the shape and performance of the racing horses.
3. The values of the cardiac frequency are lower in the horses adapted to effort because of the existence of a dominant vagal tonus.
4. The horses with racing aptitudes displayed an erythrocyte to leukocyte ratio of 1, maximum 1.3.

References

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