

VETERINARY SCIENCE

Blood biochemical parameters and associated interpretations in sport horses

I. Maksymovych^{1*}, L. Slivinska¹, K. Buczek², M. Staniec², A. Milczak³

¹ Department of internal diseases and clinical diagnostics, Faculty of Veterinary Medicine, Lviv National University of Veterinary Medicine and Biotechnologies named after Gzhytskyj, Lviv, Ukraine

² Department of Epizootology and Clinic of Infectious Diseases, Faculty of Veterinary Medicine, University of Life Sciences, Lublin, Poland

³ Department of internal diseases and clinical diagnostics, Faculty of Veterinary Medicine, University of Life Sciences, Lublin, Poland

*Corresponding author. E-mail: maksym_vet@ukr.net

Paper received 17.11.15; Accepted for publication 30.11.15.

Abstract. In the article there are results of the study blood biochemical parameters in clinically healthy sport horses and compared them with the literature values set. The concentration of total protein, albumin, total bilirubin, glucose, urea nitrogen, creatinine, total calcium, inorganic phosphate, magnesium, potassium and sodium, activity of AST, ALT, GGT and ALP determined in serum 40 clinically healthy sport horses 4–15 years of age used in classical types of equestrian sports. All horses at the time of the study were clinically healthy and were at rest. In clinically healthy sport horses total protein, inorganic phosphate, magnesium and potassium in serum were lower, and the concentration of total bilirubin and glucose – higher compared to the defined limits of other authors. For the purpose of determine the level of disability sport horses in veterinary monitoring scheme should include studies of blood serum biochemical parameters.

Keywords: horse racing, blood serum, biochemical, physiological limits, diagnosis and monitoring

Introduction. Their impact horse has always been a special place among the livestock industries. After the domestication of the horse became a regular assistant to man, as used in various ways. And today the horse is a reliable assistant in everyday human of work, tourism, sport. Horse riding is one of the most exciting, colorful and dominant species present efforts [1].

In recent years Ukraine has increased the number of sports clubs and private owners of horses, competitions of different complexity. In this regard, it increases the demand for horse breeds sporting direction [2].

Classic equestrian of sports species characterized by considerable complexity and high requirements for animals. Insufficient training sport horses can lead to dysfunction of the cardiovascular system, damage muscles and joints, neurological disorders [3–5].

Laboratory research is a type of early diagnosis of diseases of internal organs and an essential part of clinical practice veterinary [6, 7]. Their use allows to diagnose diseases occurring latent or no characteristic symptoms [8]. Such studies are used to monitor the health of the animal and planning physical activities of sport horses [9].

It should be noted that morphological and biochemical blood parameters in horses that do the heavy lifting may vary within the same species. Although there are reports in the literature on studies of biochemical blood parameters in horses of various productive direction [10–12] but they are not covered or are limited to certain publications in clinically healthy sport horses [13–15].

The aim of this study was research some blood biochemical parameters in clinically healthy sport horses and compare the results with values set according to the literature.

Materials and methods. The material for the study were 40 clinically healthy sport horses (13 mares, 10 stallions and 17 geldings) 4–15 years old, which are used in classical types of equestrian sports. Horses kept in condi-

tions equestrian sports institutions in the city of Lviv and Lviv region.

Collection of blood samples was carried out before the morning feeding. All the horses were resting and at the time of the study were clinically healthy.

Blood samples were taken from the jugular vein using injection needles Ø 16 × 40 mm into the vacuum blood tubes, 10 ml (Vacutest, Italy). The biochemical blood tests carried out of sport horses at the Laboratory Department of Internal Diseases and Clinical Diagnostics of the Lviv National University of Veterinary Medicine and Biotechnologies.

After collection of blood samples into the vacutainer tube without EDTA they were centrifuged at 3000 U/min for 10 min. to fractionated blood separated serum was evaluated. Concentrations of serum total protein (TP), albumin (Alb), total bilirubin (TBIL), glucose (Glu), urea (Urea), creatinine (Crea), total calcium (Ca), inorganic phosphate, (P), magnesium (Mg), alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl transpeptidase (GGT) and the alkaline phosphatase (ALP) activities were measured using an automated blood biochemical analyzer BS-120 (Shenzhen Mindray Bio-Medical Electronics Co., Ltd., P.R. China) by using the PZ Cormay S.A. (Poland) reagents. Concentrations of serum potassium (K), sodium (Na) were measured using an semiautomatic blood biochemical analyzer BioChem SA (USA) by using the High Technology Inc., Production RD Walpole (USA) reagents.

Mathematical analysis of the results was performed by using the software Microsoft Office Excel 2007.

Results and discussion. To assess the state of health of the animal, the analysis of the functional state of organs and systems, and diagnosis of diseases is recommended to determine the basic laboratory tests [16]. In practical work of veterinary specialists are situations where deviations in laboratory values are key in the diag-

nosis of diseases. In the interpretation of laboratory results of blood in animals, particularly horses, must take into account the breed, age, sex, physical activity [8].

The content of total protein in serum described as normo-, hyper- and hypoproteinemia. In the vast majority of internal diseases recorded hypoproteinemia, which has a secondary character [16].

Reduction of total protein in serum often develops insufficient receipt with food protein, the liver and kidney diseases. Less logged increase its concentration, particularly in protein overfeeding, dehydration, certain liver diseases [8].

The average value of total protein in serum sport horses were at the lower limit (Table) established for the animal species limits [8, 17, 18]. However, albumin content was high (Table), due to their sufficient synthesis in hepatocytes [19]. It should be noted that half of the total number of plasma proteins albumin falls on that in a healthy organism quickly updated. Owing to the large concentration of albumin, high their small size and hydrophilic molecules, they perform an important function in maintaining colloidal osmotic pressure of blood. Albumins have the ability to form chemical complexes with many biologically active substances, fulfilling the function of detoxification. Determining the level of albumin in the blood plays an important role for assessing the severity of diseases associated with hypoalbuminemia [16].

Research concentration of bilirubin in the blood is mainly used for the diagnosis of liver diseases in animals.

The concentration of total bilirubin in serum sport horses varies widely (Table) and went beyond the physiological limits cited in the literature [8, 17, 18]. The differences in terms of bilirubin, according to various authors [8], are in geographical, animal feed, terms of intake and blood tests, research methods, equipment used in laboratories.

In the study of glucose (Table) we found slightly higher value in serum sport horses compared with literature data [8, 17, 18]. In our opinion, hyperglycemia in sport horses associated with constant stress (exercise) [20].

In clinical practice, research concentrations of urea and creatinine are mainly used to diagnose kidney disease [19]. The concentration of urea in blood serum sport horses (Table) was slightly higher compared to published data [8, 17, 18]. However, we found the message [18], which indicates that the upper limit of urea concentration in healthy horses can be 9,6 mmol/l.

Increase in serum creatinine may be due to both increased its formation and delay metabolite in the body. The concentration of creatinine depends on body weight, level of feeding, muscle development [21]. In sport horses investigated concentration in serum creatinine was within physiological limits (Table).

The enzymes AST and ALT localized mainly in the liver cells, heart, skeletal muscles, but in normal myocardium and skeletal muscle activity AST exceeds ALT activity in 20 times, and in the liver – 3 times. Research aminotransferase activity used to diagnose diseases of the skeletal muscles, liver disease and heart [19].

Table – Biochemical parameters of blood of healthy sport horses (M±m, n=40)

Parameter	Blood biochemical parameters of sport horses		Reference indices from the literature		
	M±m	lim	Vlizo V., 2014 [8]	Winnicka A., 2008 [17]	Southwood L. 2013 [18]
Total protein, g/l	62,9±1,00	57,5–70,5	65,0–80,0	60,0–78,0	46,0–69,0
Albumin, g/l	38,6±0,64	33,8–41,7	25,0–37,0	29,0–59,0	25,0–42,0
Total bilirubin, µmol/l	25,3±2,98	10,5–42,9	7,0–17,0	13,7–25,6	1,7–32,5
Glucose, mmol/l	5,2±0,17	3,8–6,4	3,0–5,0	3,1–6,2	4,0–6,3
Urea, mmol/l	5,3±0,23	3,8–7,5	3,5–6,0	4,1–7,4	2,9–9,6
Creatinine, µmol/l	137,0±5,40	103,5–167,2	100,0–160,0	106,1–167,9	53,1–159,2
AST, U/l	265,0±10,66	196,0–333,0	50,0–200,0	205,0–555,0	205,0–555,0
ALT, U/l	6,4±0,65	3,0–11,0	5,0–15,0	3,0–25,0	–
GGT, U/l	112,2±8,45	63,0–175,0	100,0–250,0	109,0–315,0	109,0–315,0
ALP, U/l	12,8±1,10	8,0–23,0	20,0–40,0	12,0–45,0	12,0–45,0
Ca, mmol/l	2,87±0,036	2,67–3,08	2,5–3,5	2,25–3,12	2,7–3,4
P, mmol/l	0,88±0,057	0,60–1,33	1,2–1,8	1,13–1,90	0,6–1,7
Mg, mmol/l	0,77±0,022	0,61–0,88	0,7–1,0	0,70–1,15	0,7–1,0
Na, mmol/l	140,4±1,54	132,2–150,7	135,0–145,0	139,1–156,5	132,0–141,0
K, mmol/l	3,5±0,17	2,6–4,5	2,8–4,8	3,5–4,7	2,7–4,9

According to the research found that the average values of AST activity in serum of sport horses (Table) were within physiological limits [8, 17, 18]. However, our preliminary investigations it was found that the horses Hutsul breed AST activity varies within 358,0–574,0 U/l [21].

Indicators of activity in serum ALT sport horses (Table.) did not differ from those by other authors [8, 17, 18].

Research activity in serum GGT acquired great importance for the diagnosis of liver and hepatobiliary tract disease. GGT activity in serum sport horses (Table) is in the physiological limits [8, 17, 18].

ALP activity depends on the age and physiological state of animals. Research ALP is mainly used for diagnosis of bone disease and diseases of the liver and biliary tract [8,

16, 19]. In our studies ALP activity in serum sport horses do not exceed physiological limits [8, 17, 18].

Calcium plays an important role in vital processes of body. It affects the penetration of biological membranes, is involved in neuromuscular conduction, contraction and relaxation of muscles, including the heart muscle, cartilage and bone formation [16]. The obtained results in serum calcium sport horses (Table) consistent with other authors [8, 17, 18].

The concentration of inorganic phosphorus in serum parathyroid depends on the function and thyroid glands, kidney, exchange vitamin D [16].

Magnesium – electrolyte which metabolism is closely associated with calcium metabolism. In animals there is

no mechanism of regulation of the content of magnesium in the blood, so maintaining its normal level is possible only with the regular flow of food [16].

We found that the average content of inorganic phosphorus and magnesium in blood serum sport horses were low (Table) and is not consistent with the literature [8, 17, 18]. The discrepancy is probably related to climatic factors, natural features animal feeding sports horses, physical activity [20].

Among the minerals special attention should be paid to the research content of sodium and potassium in the blood. The content of sodium in the blood serum of sport horses varies widely (Table), but the average value does not exceed limits established by other authors [8, 17, 18].

Potassium ions are involved in the regulation of the heart, nervous system, skeletal and smooth muscles. The average value of content of potassium serum sport horses

approaching the lower limit physiological values (Table), apparently due to its insufficient intake of food [19].

Established limits on biochemical indicators of blood serum can serve as reference values for sport horses, used for the diagnosis and differential diagnosis of disease, predict outcome and effectiveness of treatment and to determine the level of efficiency in the scheme of veterinary animal health monitoring.

Conclusions

1. In clinically healthy sport horses total protein, inorganic phosphate, magnesium and potassium in serum were lower, and the concentration of total bilirubin and glucose – higher compared to the defined limits of other authors.

2. With a view to determine the level of disability sport horses in the scheme of veterinary health monitoring should include studies of blood serum biochemical parameters.

REFERENCES

1. Hopko, B.M. Unconventional horse (manual) / B.M. Hopka, V.D. Suday, V.Ye. Skotsyk. – Kyiv: Higher Education, 2008. – 191 p.
2. Shulga, I. Status of equestrian sports in Ukraine as a result of participation in major competitions in 2013 / I. Shulga, Kirichenko. // The first Ukrainian equestrian magazine. – 2015. – № 25 (31). – P. 9-15.
3. Shestakova, A.N. Cardiac activity under the influence of sport horses training: abstr. dis. cand. biol. sc.: spec. 03.00.13 "Physiology" / A.N. Shestakova – Moscow, 2009. – 20 p.
4. Change the resistance of red blood cells in peripheral blood sport horse under the influence of physical activity / [A.V. Andriychuk, I.V. Tkachova, H.M. Tkachenko et al.]. // Scientific and technical bulletin. – Lviv, 2012. – Vol. 13. – № 3-4. – P. 299-307.
5. Nizhegorodova, O.V. Myocardiodystrophy at trotting horses. Etiology, Diagnosis and Treatment: abstr. dis. cand. vet. sc.: spec. 16.00.01 "Diagnostics of illnesses and therapy of animals" / O.V. Nizhegorodova – Ekaterinburg, 2006. – 22 p.
6. Clinical diagnosis of internal diseases / [V.I. Levchenko, V.V. Vlizlo, I.P. Kondrahin et al.]; Ed. V.I. Levchenko. – White Church, 2004. – 608 p.
7. Sharandak, P.V. Informational CK and lactate dehydrogenase for the diagnosis of subclinical course miokardiodys in high-trophy cows / P.V. Sharandak, V.I. Levchenko, V.V. Sharandak. // Sc. Herald of Lviv National University of Veterinary Medicine and Biotechnology n.a. S.Z. Gzhytsky. – Lviv, 2010. – Vol. 12, number 2 (44), part. 1. – P. 330-335.
8. Laboratory diagnostics in veterinary medicine: Reference / [V.V. Vlizlo, L.H. Slivinska, I.A. Maksymovych et al.]. – Lviv: Poster, 2014. – 152 p.
9. Gurgoze, S.Y. The influence of age on clinical biochemical parameters in pure-bred Arabian mares / S.Y. Gurgoze, H. Icen // J. Equine Vet. Sci. – 2010. – Vol. 30 (10). – P. 569-574.
10. Shcherbaty, A.R. Diagnostic criteria and treatment and preventive measures for hypokobaltosys and hypokuprosys of Hutsul breed mares in biogeochemical province of Transcarpathia: Abstr. dis. cand. vet. sc., specials. 16.00.01 "Diagnosis and therapy of animals" / A.R. Scherbatyy. – Bila Tserkva, 2012. – 20 p.
11. Borovkov, S.B. Functional state of cardiovascular Ukrainian horse breed horses, depending on age / [S.B. Borovkov, M.I. Koronev, V.M. Borovkova] // Sc. Bulletin of Veterinary Medicine : Coll. Sc. Works. – Bila Tserkva, 2013. – Vol. 11 (101). – P. 22-25.
12. The influence of age and gender on haematological parameters in Lipizzan horses / N. Čebuli-Kaudune, M. Božic, M. Kosec, V. Cestnik. // Journal of veterinary medicine. – 2002. – Vol. 49. – P. 217–221.
13. Gorbunova, N.D. Effect of Doping micronutrient supplements to restore competition horses after intensive physical exertion: Abstr. dis. cand. biol. sc.: spec. 03.00.13 "Physiology" / N.D. Gorbunova. – Ryazan, 2009. – 20 p.
14. Holovakha, V.I. Functional state of the liver and its pathology in horses (etiology, pathogenesis and diagnosis): Abstr. dis. dr. vet. sc., specials: 16.00.01 "Diagnosis and therapy of animals" / V.I. Holovakha. – Bila Tserkva, 2004. – 43 p.
15. Kovalchuk, N.A. Metabolic profile of blood and the immune system of sport horses under the conditions of exercise: Abstr. dis. cand. sc. vet. sc., spec.: 03.00.04 "Biochemistry" / N.A. Kovalchuk. – Lviv, 2013. – 20 p.
16. Kamyshnikov, V.S. Guide to clinical and biochemical research and laboratory diagnostics / V.S. Kamyshnikov. – M. : MEDpress-Inform, 2004. – 920 p.
17. Winnicka, A. Wartości referencyjne podstawowych badań laboratoryjnych w weterynarii / A. Winnicka. – Warszawa: SGGW, 2008. – 122 p.
18. Southwood, L.L. Practical Guide to Equine Colic / L.L. Southwood. – Portland: Wiley-Blackwell Inc. Published, 2013. – 356 p. – (First Edition).
19. Veterinary Clinical Biochemistry / [V.I. Levchenko, V.V. Vlizlo, I.P. Kondrahin et al.]; Ed. V.I. Shevchenko and V.L. Halyas. – White Church, 2002. – 400 p.
20. Lindner, A. Use of blood biochemistry for positive performance diagnosis of sport horses in practice / A. Lindner. // Revue Méd. Vét. – 2000. – № 151 (7). – P. 611–618.
21. Hematological and serum biochemical reference values in healthy working horses Hutsul breed / [I. Maksymovych, L. Slivinska, S. Winiarczyk et al.]. // Science and Education a New Dimension Natural and Technical Sciences. – 2015. – № III (5). – P. 47-50.