

BIOCHEMICAL DIAGNOSTICS OF OSTEODYSTROPHY OF GOATS

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Abstract

The purpose of this study was to research comparative analysis of data that have been obtained after clinical examination of goats and analysis of biochemical research of the level of metabolites of bone tissue metabolism in blood serum and urine for determination of criteria at diagnostics of osteodystrophy. The material of the study consisted of 20 adult goats. Diagnosis of was made according to physical examination of goats and analysis of biochemical research of the level of metabolites of bone tissue metabolism in blood serum and urine. Activity of aminotransferase (alanine aminotransferase, aspartate aminotransferase) and alkaline phosphatase and also concentration of glycoproteins (GP), chondroitin sulfate, fractional content of glucosaminoglycans, content of total and ionized calcium were assessed in blood serum. The content of hydroxyproline and total uronic acid were analyzed in urine. Comparative analysis of total clinical status of goats and level of biochemical components in blood serum and urine that characterize the state of connective tissue at diagnostics of osteodystrophy was conducted. The intergroup significant differences of some biochemical parameters (aspartate aminotransferase, alkaline phosphatase, chondroitin sulfate, fraction II mucopolysaccharides, sum of fractions glucosaminoglycans) were determined. Further investigation must be conducted to determine the biochemical parameters in goat with subclinical signs of osteodystrophy.

Key words: osteodystrophy, goats, blood serum, urine

INTRODUCTION

The problem of diagnostics of different stages of osteodystrophy is a relevant issue of modern veterinary science. One of the main directions of research in this field is working out and implementation of not complicated methods of diagnostics, including laboratory practice [1].

Conducting of biochemical analysis of blood serum is limited by facilities of regional veterinary laboratories in the farms, taking into account that for diagnostics of osteodystrophy they mainly determine only content of total calcium and inorganic phosphorus in the blood serum. These indexes characterize in a certain measure the state of mineral homeostasis that changes substantially only in view of abnormalities of metabolism and considerable impairment of structure of bone tissue. It is not always possible to define such pathology as

osteodystrophy, especially at the early stage. Methods for determination of content and resulting metabolites of organic matrix of connective tissue in blood serum and urine which reflect the state of bone tissue are more informative for diagnostics of early stage of osteodystrophy [2, 3, 4]. Information about the state of organic content of bone tissue of goats in the normal range and with osteodystrophy is quite limited [5].

Analysis of level of biochemical indicators in blood serum of goats is a relevant problem these days.

The purpose of the present study was to conduct comparative analysis of data that have been obtained after clinical examination of goats and analysis of biochemical research of the level of metabolites of bone tissue metabolism in blood serum and urine for determination of criteria at diagnostics of osteodystrophy.

MATERIALS AND METHODS

Twenty 2-3-year-old goats were examined for the study. They were bred in

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“Learning and scientific centre of plant growing and animal husbandry of Kharkiv State Zooveterinary academy”. Samples of blood serum and urine were taken for biochemical analysis.

Activity of aminotransferase (alanine aminotransferase, aspartate aminotransferase) and alkaline phosphatase [6] and also concentration of glycoproteins (GP), chondroitin sulfate and fractional content of glucosaminoglicans [7, 8] were determined in blood serum. Content of total and ionized calcium in blood serum were defined with the help of analyzer of electrolytes (AEK-01). The content of hydroxyproline and total uronic acid in urine were determined using the techniques by L.M. Furtseva [9] and N. Di Ferrante [10], respectively.

The results of the research were processed with biometric techniques using Microsoft Excel.

RESULTS

It was established on the basis of clinical examination that the average temperature was $39.2 \pm 0.1^\circ\text{C}$ (Lim 38.5-40.0) and pulse rate was 89.0 ± 6.0 (Lim 70.0-110.0). Fourteen animals (70%) had dullness of heart tones,

the number of respiratory movements per minute was 15.3 ± 0.9 (Lim 12.0-20.0), three goats (15%) had pain of liver on palpation. So biochemical investigations of blood serum and urine were conducted for objective assessment of clinical data (table 1).

More detailed information about the state of bone-articular system we can get from determination of metabolites that characterize the state of components of organic matrix of connective tissue (table 2).

Other clinical signs of osteodystrophy were the following: sixteen goats (80%) had thinning and tuberosity of ribs, the incisor teeth of fourteen animals (70 %) were loose, four goats had partial lysis of the last pair of ribs. After clinical examination twenty goats were divided into two groups (four animals – clinically healthy, sixteen animals – with clinical signs of osteodystrophy).

In terms of obtained data we can conclude that the affected goats had clinical signs of osteodystrophy. It is known that acquired clinical signs can remain for the whole life of the animal (tuberosity of ribs) and clinical signs not always reflect the state of bone tissue at the moment of examination.

Table 1 Biochemical indicators of blood serum of goats with clinical signs of osteodystrophy

Indicator		Clinically healthy	Osteodystrophy
Alanine aminotransferase, U/L	M±m	28.50±1.04	33.80±2.71
	Confidence interval	25.7–31.3	27.8–39.8
Aspartate aminotransferase, U/L	M±m	26.00±1.08	38.90±1.56 ***
	Confidence interval	23.1–28.9	34.8–41.7
Alkaline phosphatase, m/L	M±m	3.78±0.63	8.31±1.09 *
	Confidence interval	2.08–5.48	5.85–10.77
Total calcium, m/L	M±m	2.67±0.08	2.78±0.05
	Confidence interval	2.45–2.89	2.68–2.88
Ionized calcium, m/L	M±m	1.28±0.04	1.32±0.04
	Confidence interval	1.18–1.38	1.24–1.40
Phosphorus, m/L	M±m	1.24±0.02	1.24±0.02
	Confidence interval	1.19–1.29	1.20–1.28
Chondroitin sulphate, g/L	M±m	0.11±0.01	0.24±0.04 *
	Confidence interval	0.09–0.13	0.16–0.32
Glycoprotein, m/L	M±m	0.60±0.01	0.67±0.05
	Confidence interval	0.58–0.62	0.44–0.70

Notes: * $p < 0.05$, *** $p < 0.001$

Indicators of mineral metabolism (total and ionized calcium, inorganic phosphorus) of affected goats were almost the same with another group of control that confirms low

level of informational content. At the same time affected goats had enlarged level of chondroitin sulphate and increased activity of alkaline phosphatase that can designate the

pathology of support-locomotion system. 50% of animals had increased activity of alanine aminotransferase in blood serum that made up 41.2 ± 1.9 U/L. Increased activity of aspartate aminotransferase of goats with clinical signs of osteodystrophy 38.90 ± 1.08 U/L on comparison with 26.00 ± 1.08 U/L in

the normal range might be the result of abnormality of myocardium and liver as it is known that functions of these organs decay at the postprimary osteodystrophy. In particular, it might be abnormality of cardiac muscle that coincides with such clinical sign as dullness of heart tones.

Table 2 Biochemical indicators of the state of connective tissue at osteodystrophy of goats (according to the analysis of blood serum)

Indicator		Clinically healthy	Osteodystrophy
Fraction I mucopolysaccharides, U/L	M $\pm$ m	5.9 $\pm$ 0.55	8.1 $\pm$ 0.52
	Confidence interval	4.4–7.4	6.9–9.27
Fraction II mucopolysaccharides, U/L	M $\pm$ m	2.63 $\pm$ 0.08	3.42 $\pm$ 0.17 *
	Confidence interval	2.41–2.85	3.04–3.8
Fraction III glucosaminoglicans, U/L	M $\pm$ m	2.0 $\pm$ 0.17	2.6 $\pm$ 0.31
	Confidence interval	1.53–2.47	1.92–3.28
Sum of fractions glucosaminoglicans, U/L	M $\pm$ m	10.2 $\pm$ 0.62	14.2 $\pm$ 0.84 *
	Confidence interval	8.5–11.9	12.4–16.0

Notes: *- p<0.05

Analysis of table 2 shows that goats with osteodystrophy had larger concentration of fraction II glucosaminoglicans, that led to increase of total glucosaminoglicans, in blood serum. Increase of level of fraction II that contains mostly chondroitin-4-sulphate is evidence of pathology of bone system in particular, as fraction chondroitin-4-sulphate dominates quantitatively in bones [11]. If indicators that were analyzed before cannot

be considered as specific only for diagnostics of osteodystrophy of animals, determination of excretion of hydroxyproline with urine is undoubtedly a marker of bone resorption and reflects its metabolism that with definition of level of excretion of glucosaminoglicans, and calcium with urine can give detailed information about direction of metabolism of bone tissue [2].

Table 3 Biochemical indicators of connective tissue at osteodystrophy of goats (according to the analysis of urine)

Indicator		Clinically healthy	Osteodystrophy
Hydroxyproline, mg/l	M $\pm$ m	50.6 $\pm$ 4.04	75.1 $\pm$ 4.82 *
	Confidence interval	39.5–61.7	64.1–86.1
Uronic acid, mg/l	M $\pm$ m	3.17 $\pm$ 0.34	8.08 $\pm$ 1.35 *
	Confidence interval	2.09–4.25	5.09–11.07
Calcium, mg/l	M $\pm$ m	92.5 $\pm$ 12.4	420.6 $\pm$ 60.43 **
	Confidence interval	59.0–126.0	284.1–557.1
Phosphorus, g/l	M $\pm$ m	0.17 $\pm$ 0.04	0.13 $\pm$ 0.02
	Confidence interval	0.06–0.28	0.09–0.17

Notes: *- p<0.05, **- p<0.01

In terms of table 3 it can be concluded that animals with osteodystrophy had larger excretion of hydroxyproline (by 33%), uronic acid (by 39%) and calcium (by 78%). From our point of view it is caused by different correlation of osteosynthesis and resorption of bone tissue during examination.

DISCUSSION

Biochemical studies on farms are limited possibilities of regional veterinary laboratories, where usually determine only the content of total calcium and inorganic phosphorus in serum for diagnostics osteodystrophy. These indicators characterize the state of mineral homeostasis, which

significantly changes only in disorders of the endocrine metabolism and a significant degree of damage bone structure. It is not always possible to detect pathologies such as osteodystrophy, especially in early term. A more informative for the diagnosis of early stage osteodystrophy are methods of determining the content of components and final metabolites organic matrix of connective tissue in blood serum and urine, reflecting the bone tissue of the animal for a period of examination [12, 13, 14]. Information about the state of the organic component of bone tissue in clinically healthy goat and goat with osteodystrophy very limited [15, 16], and the establishment of biochemical parameters in serum of goats remains an actual problem.

The most common indicators used in the diagnosis of osteodystrophy in animals is to determine the concentration of total calcium, inorganic phosphorus in serum and alkaline phosphatase activity, bone isoenzyme which is actively involved in the process of bone mineralization [17]. The results of our studies on the activity of alkaline phosphatase in osteodystrophy of goats coincide with data of L.A. Cruz [18].

In addition to the study of mineral components in serum in humane medicine for the diagnosis of osteodystrophy proposed determination of indicators of the organic matrix of connective tissue. In veterinary medicine also has some information about their use for diagnosing osteodystrophy goats [19, 20, 21]; concentration the total number of GAG in serum and urine. In addition to the above tests are widely used also determine the concentration of individual fractions of glycosaminoglycans in the substrate, which enables to obtain more information about the metabolism of these biopolymers. According to the data of our research, the excretion of hydroxyproline in the urine increased in the case of osteodystrophy in goats. The same results were obtained by U. Braun [22].

CONCLUSION

On the basis of clinical examination of goats and taking into account data from biochemical analysis of blood serum and urine it was established that level of clinical

appearance of osteodystrophy of goats coincide with changes in some of biochemical indicators in blood serum and urine.

Among biochemical components of blood serum the most informative for diagnostics of osteodystrophy is determination of content of chondroitin sulphate, fraction II glucosaminoglycans, and activity of alkaline phosphatase, and in urine – level of excretion of hydroxyproline, uronic acid and calcium.

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