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Parameters of biochemical serum test of pigs in sarcosporidiosis

Sarcocystoses (sarcosporidioses, sarcocystoses) are invasive diseases caused by protozoa — coccidia of the genus Sarcocystis, the family Sarcocystidae. The main damage the disease causes livestock. Being localized in the muscles and heart of intermediate hosts (cattle and small cattle, pigs) cause exhaustion, anemia, decreased productivity and even death. In 1843, the German scientist Miescher first described characteristic intramuscular formations in the skeletal muscles of a domestic mouse, believing that these were clusters of parasites of unknown nature. Subsequently, similar formations in the muscles of other animals began to be described under different names: “Misher's bags”, “Rhine bodies”, “psorospermia” (ie scabies sperm). It was only in 1882 that Lankester began to call them meat cysts, or sarcocists, and proposed for their designation the corresponding generic name — Sarcocystis. A change in the level of iron, zinc, total and ionizing calcium in pig blood was observed during the clinical symptoms of sarcosporidiosis, when the disease is transmitted to the muscle. The article analyzes the changes in minerals and the activity of enzymes in the blood.

Keywords: sarkosporidiosis, hyperthermia, hypercupremia, hypercalcemia, enzymes, dynamics, sarcocystosis, blood serum.

Introduction

Porcine sarkosporidiosis causes serious economic damage to livestock. With sarcosporidiosis, the growth and development of piglets deteriorates, fertility decreases, the death of young animals is often observed, and meat products also worsen. To date, clinical manifestations and pathological changes have been described [1, 2], but the dynamics of biochemical parameters are not well understood.

The aim of our research is to study the changes in minerals in pig blood and the catalytic activity of enzymes in sarcosporidiosis.

Materials and method of study

The experiments were carried out in 2018 in a peasant farm in the Almaty region on 10 piglets of large white breed of 3–4 months of age, divided into 2 groups: 6 experimental animals were infested with *Sorcocystis suicanis* sporocysts at a dose of 75×10^3 parasites (I), 4 control ones did not infect (II). Keeping and feeding of the animals were the same. Blood was taken for examination before infection (2–4 times), then on 7, 14, 21, 30, and 40 days after infection. Biochemical studies included: determination of total calcium according to F. Umland, K.I. Meckenstok, ionized calcium — by calculation method according to I. Todorov, chlorides — by Levinson, copper — by I.W. Landers, V. Zak, iron — by W.T. Caraway, activity alkaline and acid phosphatases — by Bodansky, aspartic (AST) and alanine (ALT) transaminases — according to Reitman and Frenkel. The obtained data were statistically processed using the constant method [3].

Results and discussion

Data on the dynamics of mineralization in the blood serum of experimental invasive piglets with spores of sarcocystis suicanis are shown in Table 1. The severe period of the disease was characterized by an increase in the total calcium content and subsequently, a decrease in the transitional stage. The actual increase in the index compared to the initial data was observed on the 7th day (+69.1 %, P>98.8). Subsequently, the lowest levels of total and ionized calcium were recorded at 53.9 and –63.3 % (P<99.9), respectively, compared with data 30 days before infection [4, 5].

At the end of the experiment (40 days), the level of total calcium normalized, while ionized calcium decreased from the initial level by 61.9 percent (P>98.8). Serum iron and copper levels increased, and the maximum value was determined after 14 days, i.e. during clinical manifestations of the disease gradually decreases to 21–30 days by 111.0 and 62.4 % (P>99.9). During the parasitic period (40 days), the initial level of iron was recorded, and the copper content exceeded the initial level by 29.5 % (P>92).

Table 1

The dynamics of the content of minerals in the serum of the pancreas with sarcoporroidosis (M±m), n=10

Days of observation	Total calcium, mmol/L	Ionized calcium, mmol/L	Iron, mmol/L	Copper, mmol/L	Chlorides, mmol/L
Before infection	1.52±0.32 1.43±0.21	1.21 ±0.13 0.98±0.03	11.10±2.10 9.40±2.30	25.80±2.30 27.30±3.21	73.72±5.93 74.80±4.20
7 days after infection	2.57±0.10 1.84±0.18	1.28±0.06 1.00±0.12	17.40±2.70 11.8±1.40	32.10±2.70 28.0±2.10	86.85±3.88 80.0±1.24
14 days after infection	1.36±0.07 1.26±0.04	0.69±0.06 1.18±0.10	25.50±3.80 11.40±2.30	41.90±3.20 29.10±1.71	79.84±5.24 60.46±6.21
21 days after infection	1.01±0.07 1.18±0.23	0,61±0,07 1.23±0.21	21.70±2.62 9.50±2.41	27.40±2.20 31.0±2.31	75.42±4.34 84.20±3.25
30 days after infection	0.70±0.23 1.20±0.31	0.42±0.11 1.74±0.21	15.67±1.50 8.70±1.73	36.40±3.80 25.40±2.61	96.86±3.86 93.0±2.36
40 days after infection	1.24±0.09 1.17±0.33	0.46±0.05 1.70±0.14	10.00±2.20 8.7 ±2.32	33.40±2.80 30.10±2.36	75.69±1.13 64.2±2.35

Note. In the field of the test group, figures for the control group are indicated.

Changes in the amount of chloride in the blood serum in the experimental and control groups were not observed during the experiment, an average of 64.20±2.35 mmol/L.

The enzymatic activity of aspartic and alanine transaminases, alkaline and acid phosphatase in serum of pigs significantly changed with sarcosporidiosis (Table 2).

Table 2

Change in the activity of enzymes in the serum of pigs in experimental sarcosporidiosis (M ± m), n = 10

Days of observation	Aspartate aminotransferase, nmol/s. L	Alaninamino transferase, nmol/s. L	Alkaline phosphatase, nmol/s. L	Acidic phosphatase, nmol/s. L
Before infection	30.9±1.9 31.4±1.1	9,1±3.4 8,4±2.8	2.46±1.04 3.81 ±1.2	0.78±0.16 0.84±0.14
7 days after infection	25.5±3.8 31.3±06	14,2±3.1 6,2±1.7	11.19±1.84 4.04±2.1	0.59±0.19 0.81±0.22
14 days after infection	55.9±6.3 31.3±1.8	33.5±5.5 13.2±2.4	15.16±1.98 3.9±2.3	4.11±1.05 0.81±0.10
21 days after infection	59.3±2.5 32.5±2.1	17.8±2.9 10.2 ±1.5	16.61±2.67 2.7±1.7	1.64±0.17 1.7±0.12
30 days after infection	51.4±4.2 32.7±1.9	57.8±1.8 15.8±2.4	11.61±1.52 6.5±1.3	3.06±1.85 1.6±0.14
40 days after infection	40.2±3.8 26.0±4.1	29.2±6.04 19.1±2.8	9.03±1.52 5.5±1.2	1.38±0.33 1.21±0.32

Note. In the field of the test group, figures for the control group are indicated.

Thus, the actual growth of ACT and ALT — 67.6 and 268.1 % (P>99.9) was determined within 14 days, and the catalytic activity of alkaline and acid phosphatase in comparison with the initial data was 516.0 and 426, respectively, 0 % (all P>99.9). The highest activity of AKT and alkaline phosphatase on the 21st day was observed in the range from +91.6 to +575.2 % (P>99.9). High activity of these enzymes on the 40th day (+30.1 %, P>94); (+220.9 %, P>98); (+261.1 %, P>99) and acetic phosphatase remained in the original data. Actual changes in the control group of animals were not detected during the control.

Discussion of the study results

Thus, in a severe period of the disease, pancreatic disorders occur in the form of hyperkalemia, hyperbiliremia, hypercupremia. Detected hypercalcemia is a consequence of a kidney and urinary tract disorder; the decrease in the content of ionized calcium is due to a decrease in the biosynthesis of albumin proteins in serum, as well as a violation of the water balance and acid-base balance.

Hyperbiliremia can be associated with high hemolytic erythrocytes and, as a result, the growth of the gallbladder in the blood serum, hypercupremia, major muscle fibrosis due to liver damage, is the result of a high level of ceruloplasmin product. A sharp increases in the activity of transaminases. According to Y. Musil, the liver has deep lesions before necrosis [6]. Fluctuations in the chloride content in the experimental and control groups of animals were not observed.

Conclusions

Disruption in mineral metabolism in blood serum such as hyperdemia, hypercupremia, hypercalcemia, in the severe stage of sarcosporidiosis of the pig; an increase in the enzymatic activity of aspartic and alanine transaminases, alkaline and acid phosphatases is observed.

When the disease transitions into the chronic stage, the activity of AST, ALT, and alkaline phosphatase is maintained at a high level; the amount of ionized calcium is lower than the initial one; other indicators also are normalized.

A comparative study of the morphology of sarcocysts, cystozoites, and sporocysts under a light microscope of the sarcocysts we have identified from different mammalian species shows the presence of a wide variety of shapes and sizes of cysts, merozoites, and the structure of the cysts wall.

The size and shape of cysts depend largely on their age and degree of maturity.

The most stable diagnostic sign of Mature sarcocysts in different species of animals under a light microscope is the structure of the cystic wall and the size of Mature asexual stages of development of sarcocysts-merozoites.

The most stable diagnostic sign of mature sarcocysts in various animal species under a light microscope is the structure of the cyst wall and the size of the mature asexual stages of development of sarcocysts — merozoites.

According to the morphological characteristics of the cystic wall and Mature merozoites, in some cases, it is possible to distinguish species only with the help of an electron microscope.

When determining the type of sarcosporidium, the type of intermediate and definitive host is of great importance, along with the morphological and biological properties of the parasite.

Sarcosporidia, like other eimeriid spores, are parasites that are strictly specific to the intermediate host.

The dependence of the size of merozoites on the taxonomic affiliation of the final host was noted.

Analysis of morphological features of different types of sarcosporidia shows that the morphology of these parasites depends largely on the taxonomic affiliation of the final host.

In sarcosporidia, the final hosts of which are predatory mammals (Fox, Korsak, cat), merozoites are large, the wall of the cysts is thick with transverse striation, (under a light microscope).

The exception is sarcocysts from the house mouse, in which the wall of the cysts is smooth.

In sarcosporidia, the final hosts, which are birds of prey (Buzzard, owl, Kestrel), are merozoites smaller in size, the wall of the cysts is thin, smooth without transverse striation.

The selection of probable final hosts-predatory animals for setting up experiments to clarify the development cycle of detected sarcocysts is not an easy task, especially in wild animals.

Some help in selecting the likely final hosts of the sarcocysts under study can be provided by the regularities of the dependence of morphological features on the final host.

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Саркоспоридиоз кезінде шошқаның қан сарысуындағы биохимиялық көрсеткіштер

Саркоцистоздар (саркоспоридиоздар, sarcocystoses) — бұл кокцидиялардың Sarcocystis туысына, Sarcocystidae тұқымдасына жататын қарапайымдылар тудыратын инвазиялық аурулар. Негізгі зиянын мал шаруашылығына тигізеді. Аралық иелерінің бұлшық еттері мен жүрегінде (ірі және ұсақ малдарда, шошқада) оқшаулана отырып, малдың арықтауына, анемияға, өнімділіктің төмендеуіне және тіпті өлімге әкеледі. 1843 жылы неміс ғалымы Мишер (J.F. Miescher) үй тышқандарының (Mus musculus) бұлшық ет талшықтарынан саркоцисталарды тапты. Кейінірек осындай цисталар жануарлардың басқа да түрлерінің бұлшық еттерінен табылған. Олар әртүрлі атауларда сипаттала бастады: «мишер қапшықтары», «рейндік денелер», «псороспермалар» (яғни, қышыма спермалары). 1882 жылы Ланкестер шошқа саркоспоридиясын сипаттап, оларды Sarcocystis mischeri деп атады және осылайша Sarcocystis туысы атауы енгізілген. Саркоспоридиоз ауруының клиникалық белгілерін байқап, ауру бұлшық етке ауысқан кезеңде шошқа қанында темір, мырыш, жалпы және иониданған кальций мөлшерінде өзгерістер болатыны анықталған. Мақалада қандағы минералдық заттар мен ферменттердің белсенділіктерінің өзгерістері талданған.

Кілт сөздер: саркоспоридиоз, гиперсидеремия, гиперкупремия, гиперкальциемия, ферменттер, динамика, саркоцистоз, қан сарысуы.

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Биохимические показатели в сыворотке крови свиней при саркоспоридиозе

Саркоцистозы (саркоспоридиозы, sarcocystoses) — это инвазионные болезни, вызываемые простейшими — кокцидиями рода Sarcocystis, семейства Sarcocystidae. Основной урон болезнь наносит животноводству. Локализуясь в мышцах и сердце промежуточных хозяев (крупный и мелкий рогатый скот, свиньи), вызывают истощение, анемию, снижение продуктивности и даже падеж. В 1843 г. немецкий ученый Мишер (Miescher) впервые описал характерные внутримышечные образования в скелетной мускулатуре домашней мыши, полагая, что это были скопления паразитов неизвестной природы. Впоследствии сходные образования в мышцах других животных стали описываться под разными названиями: «мишеровы мешочки», «рейновские тела», «псороспермии» (т.е. чесоточные спермии). И лишь в 1882 г. Ланкестер стал называть их мясными цистами, или саркоцистами, и предложил для их обозначения соответствующее родовое название — Sarcocystis. Заметив клинические признаки заболевания саркоспоридиоза, он обнаружил, что в период перехода заболевания к мышцам в крови свиней происходит изменение содержания железа, цинка, общего и ионированного кальция. В статье проанализированы изменения активности минеральных веществ и ферментов в крови.

Ключевые слова: саркоспоридиоз, гиперсидеремия, гиперкупремия, гиперкальциемия, ферменты, динамика, саркоцистоз, сыворотка крови.

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