ВЕТЕРИНАРНІ НАУКИ

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CLINICAL COURSE OF PSOROPTOSIS IN RABBITS UNDER THEIR EXPERIMENTAL INFESTATION

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Hereby we provide the results of observation of clinical pathology of psoroptosis in rabbits and morphological changes in blood under experimental infesting. Directly proportional dependence of clinic from the intensity of infestation was established. In both groups we could observe erythropenia, decrease of hemoglobin, monocytosis, increase of the stab neutrophils
Keywords: *psoroptosis, rabbits, ear scab, Psoroptes cuniculi, experimental infestation, morphological blood parameters*

Наведено результати спостережень клінічної патології псороптозу кроликів та зміни морфологічних показників крові за експериментального зараження кліщами Psoroptes cuniculi. Встановлено прямопропорційну залежність клініки від інтенсивності інвазії. В кролів обох дослідних груп відзначали еритропенію, зниження концентрації гемоглобіну, моноцитоз та зростання паличкоядерних нейтрофілів
Ключові слова: *псороптоз, кролі, вушна короста, Psoroptes cuniculi, експериментальне зараження, морфологічні показники крові*

1. Introduction

Psoroptosis is a disease, which is represented by eczema-like inflammation of skin and exhaustion of the rabbits' organisms. It has been proved that psoroptosis suppresses the reproduction function of rabbits, the newly born rabbits die in the first days of life [1]. Damage caused by mites Psoroptes cuniculi consist mainly of the disorders of development of young animals, decrease of the rabbits' body weight up to 35 %, deterioration of the quality of products, and decrease of price of the breeding animals [2]. The disease is being registered all around the world [3]. People may also suffer from psoroptosis [4].

2. Analysis of published data

In recent years, great attention has been devoted to the relations in the parasite-host system [3–6]. However, considering psoroptosis in rabbits, the issue has not been thoroughly researched yet [4–8]. It has been proved that the relation between the parasite and the host causes the development of complex adaptation to existence of the parasites on the body of the host and their nutrition at the expense of the host's organism. In its turn, the host also develops different protection mechanisms against parasites, which act at the population-based, organizational, cellular and genetic levels [9, 10].

Systemic rearrangements in the organisms of rabbits have significant influence on pathogenesis of psoroptosis [3]. Research of blood tests of animals has been given consideration these days, aiming at finding objective data on regular connection between morphological pattern of blood and physiological and pathological processes in the animals' organisms, as well as between the direction and level of metabolism and productivity [7–9].

The obtained results confirm that the cutaneous mites Psoroptes cuniculi exert pathogenic influence on rabbits, which comes out in erythropenia, leukocytosis, eosinophilia [6, 7, 11–13]. In addition to this, Demiyanenko [12] found out basophilia, lymphopenia, monocytosis and decrease in erythrocyte sedimentation rate, Bankole [7] discovered monocytopenia and Vasylevych [13] – thrombocytopenia, while Jana and other researchers [6] observed decrease of hemoglobin. Considering the aforementioned, the research on influence of psoroptosis invasion of different intensity on dynamics of hematological data of rabbits under acute and chronic course of the disease has not been conducted.

3. The aim of study

The aim of our work was to conduct experimental research on the course of psoroptosis in 8-month rabbits of California breed from infesting till occurrence and development of symptoms of the disease under the term of low and high intensity of invasion with Psoroptes cuniculi, and on the dynamics of changes in morphological blood parameters.

4. Materials and methods

The research was conducted on the basis of the vivarium and the department of parasitology and ichtyopathology of the Stepan Gzhytskyi Lviv National University of Veterinary Medicine and Biotechnology during October-November 2014. Rabbits of California breed,

8 months old, weighing from 3,1 up to 3,5 kg had been kept in accordance with the general rules.

Selection of mites Psoroptes cuniculi was conducted in accordance with the method of Davletshyn in our modification [14]. The experimental infesting of the rabbits with the Psoroptes cuniculi was conducted by means of creation of artificial source of invasion [15].

The rabbits were divided into three groups, each one consisting of 10 animals (5 male and 5 female animals). At that, one group of rabbits was control group (group 1) and two other groups were experimental with different stages of invasion by cutaneous mites Psoroptes cuniculi, where group 2 are the rabbits infested with 10 mites per one animal (low intensity of invasion), and group 3 are the rabbits infested with 50 mites per one animal (high intensity of invasion). Control group of rabbits was kept separately in order to prevent contact with the infested rabbits.

The dynamics of changes of the affected areas of ears had been observed with the help of otoscope (USB-microscope Delta Optical Smart, Poland) and photo camera (Canon IOS 1000D; Japan).

Blood samples of rabbits had been taken from the marginal auricular vein before morning feeding on the 0, 10^{th}, 20^{th}, and the 30^{th} days of infesting. The following blood parameters were being defined: the number of red blood cells (RBC) and white blood cells (WBC) in hemocytometer, the concentration of hemoglobin (HB) by means of cyanmethemoglobin method with the help of test-system Simko Ltd. (Ukraine) and calculated the color index (CI) [16]. The leukogram had been defined by means of microscopic investigation of the blood smears, which had been fixed and stained with the reagent set LDF 200 (Erba Lachema, the Czech Republic).

The obtained digital data had been statistically processed. The results of sample average numbers (M) w ere considered to be statistically valid at $p<0,05$ –*, $p<0,01$ – ** and $p<0,001$ – ***.

5. Results and discussions

The attempts to infest the rabbits with cutaneous mites Psoroptes cuniculi by means of intake (release) of live mites and their water suspension into the ears of rabbits in June-July were not successful. The successful infesting had been reached by means of creation of artificial source of invasion in October-November. For that purpose, ear scab with the cutaneous mites Psoroptes cuniculi had been taken from the ears of spontaneously ill rabbits, and then placed on the fabric and left at the room temperature for 12 hours. During that time the mites had moved on the fabric. After the number of mites and their activity had been examined under the microscope, the material had been placed in the cages of rabbits under research.

Incubation period upon infesting of rabbits with the mites Psoroptes cuniculi under invasion intensity of 10 parasites per animal was 2–3 days for the first research group, and under invasion intensity of 50 parasites per animal the incubation period comprised one day with the rabbits of the second research group. The clinical symptoms of the disease started with the formation of the 'scaly plug' with live mites in external ear canal of rabbits in both research groups (Fig. 1). Herewith, we could observe local hyperthermia, anxiety and severe itchiness.

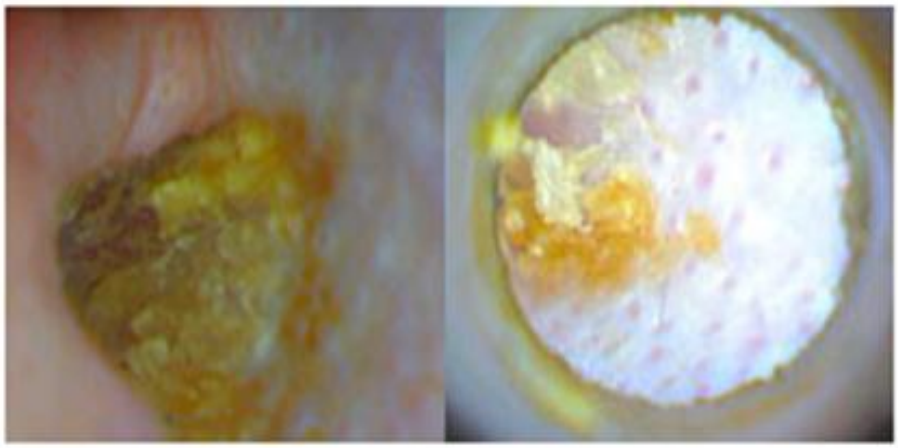

Fig. 1. Appearance of scaly crusts which form the plug in the ear canal of the rabbit

Further on, we observed the stages of dry (appearing on the 7^{th} day after infesting) and wet (appearing on the 18^{th} day after infesting) scab, which were more evident in the animals of the second research group (Fig. 2, 3).

Fig. 2. State of external ear of the rabbit of the second research group on the 10^{th} day after infesting

During the first three weeks of the experiment rabbits of both research groups had been maintaining appetite and bore live offspring. The disease of rabbits from the first research group ended in the phenomenon of self-healing on the 21^{st}–23^{rd} days after infesting; however, at the parasitological autopsy live mites Psoroptes cuniculi at various stages of their development had been found in the middle ear of the rabbits (Fig. 4).

Fig. 3. State of external ear of the rabbit of the first research group on the 10th day after infesting

With the second research group of rabbits from the 25th day after infesting we observed transformation of the acute form of psoroptosis into the chronic one, which was accompanied by the decrease of lesion and itchiness (scratching of ear), absence of strong bad odor from the ear, decreased breeding activity in males, mortality of newborns.

The Tables 1–4 provide data of the dynamics of hematological parameters of rabbits under low and high intensity of invasion with the mites Psoroptes cuniculi. As seen from the data provided in the table 1, the number of red blood cells in groups of rabbits before their infesting with mites Psoroptes cuniculi comprises from 4,55± ±0,51 T/l up to 5,28±0,50 T/l, concentration of hemoglobin was from 131,70±11,00 g/l to 134,2±8,05 g/l, color index was between 0,75±0,46 and 0,89±0,12, and the number of white blood cells was between 6,18±0,62 G/l and 6,58±1,21 G/l. While research of the leukogram (white blood cell differential) of the rabbits before their infesting with the cutaneous mites Psoroptes cuniculi the percentage of eosinophils was defined between 1,30±0,48 and 1,60±0,70, stab neutrophils was defined between 1,80± ±1,03 % and 2,20±1,40 %, segmented neutrophils was defined between 18,50±1,96 % and 22,80±3,80 %, lymphocytes was defined between 71,50±4,88 % and 76,20± ±2,97 % and the monocytes was defined between 1,40± ±0,52 % and 1,90±0,99 %.

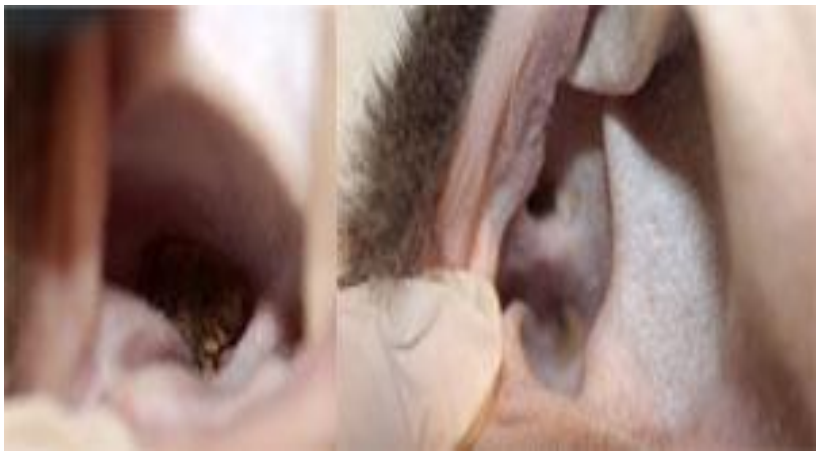

Fig. 4. Phenomenon of self-healing of the rabbits of the first research group on the 23rd day after infesting

Table 1

Hematological parameters of rabbits before infesting with mites Psoroptes cuniculi (M±m, n=10)

Parameters	Groups of rabbits		
	1	2	3
	control (clinically healthy)	intensity of invasion is 10 mites per animal	intensity of invasion is 50 mites per animal
RBC, T/l	5,05±0,32	4,55±0,51	5,28±0,50
HB, g/l	134,2±8,05	133,42±13,06	131,70±11,00
CI	0,80±0,05	0,89±0,12	0,75±0,46
WBC, G/l	6,58±1,21	6,18±0,62	6,28±1,85
Leukogram, %			
EOS	1,30±0,48	1,50±0,71	1,60±0,70
Stab NEU	1,80±1,03	2,00±1,05	2,20±1,40
Segmented NEU	19,60±5,87	18,50±1,96	22,80±3,80
LYM	75,90±5,34	76,20±2,97	71,50±4,88
MON	1,40±0,52	1,80±0,92	1,90±0,99

Table 2 provides the results of hematological parameters of healthy rabbits compared to the ones infested with the common scab mites on the 10th day of the experiment. These results suggest that the infesting of rabbits with mites Ps. cuniculi leads to possible decrease of hemoglobin concentration, number of RBC and to the increase of the percentage of stab neutrophils and monocytes.

The phenomenon of leukocytosis had been defined in the rabbits of the second group, and leukopenia appeared in the rabbits of the third research group. At that, the number of RBC in the rabbits of the second research group decreased in 1,27 times ($p<0.001$) compared to the control group, and the hemoglobin concentration decreased in 1,64 times ($p<0.001$). At the same time, the number of WBC increased in 1,50 times ($p<0.001$) compared to the control group, the number of stab neutrophils increased in 2,85 times ($p<0.001$), and the number of monocytes increased in 2,57 times ($p<0.001$). The difference between the respective parameters under experimental psoroptosis in rabbits of the third research group revealed a greater extent. In particular, hemoglobin concentration decreased in 1,76 times ($p<0.05$), the number of RBC decreased in 1,28 times ($p<0.01$), the number of WBC decreased in 1,51 times ($p<0.001$) in comparison with the control group. Herewith, the percentage of stab neutrophils and monocytes increased in 2,42 times ($p<0.001$) and 1,93 times ($p<0.05$) accordingly. Presumably, the phenomenon of leukopenia in rabbits from the third research group is indicative of the intensive migration of the WBC to the inflammatory foci in response to severe invasion. The color index decreased in 1,26 times in rabbits of the second group compared to the control group, and in the third group it decreased in 1,32 times, however, the results occurred not to be statistically plausible.

Table 2

Hematological parameters of rabbits under experimental psoroptosis on the 10th day of the experiment (M±m, n=10)

Parameters	Groups of rabbits		
	1	2	3
	control (healthy animals)	intensity of invasion is 10 mites per animal	intensity of invasion is 50 mites per animal
RBC, T/l	4,85±0,59	3,83±0,33***	3,79±0,43**
HB, g/l	137,65±11,75	83,72±6,02***	78,14±9,00*
CI	0,83±0,07	0,66±0,09	0,63±0,10
WBC, G/l	6,48±0,95	9,74±1,16***	4,28±0,68***
Leukogram, %			
EOS	1,40±0,70	2,20±0,79	2,80±1,32
Stab NEU	2,60±0,97	7,40±4,25**	6,30±2,11***
Segmented NEU	19,30±3,56	17,20±4,37	23,80±3,55
LYM	75,30±3,34	69,60±6,00	64,40±2,50
MON	1,40±0,52	3,60±1,43***	2,70±1,06*

Table 3 provides the results of hematological parameters of healthy rabbits compared to the ones infested with the common scab mites on the 20th day of the experiment. At that, concentration of hemoglobin was 1,20 times lower ($p<0.01$) in rabbits of the second group compared to the control group, the number of RBC was 1,24 times lower ($p<0.001$), segmented neutrophils reduced in 1,30 times ($p<0.001$). At the same time, the number of WBC was 1,22 times higher ($p<0.001$), the number of stab neutrophils was 3,14 times higher ($p<0.001$), and the number of monocytes was 2,85 times higher ($p<0.001$) compared to the respective parameters of the control group. The number of RBC and concentration of hemoglobin in the rabbits of the third research group had reduced to a greater extent, which was 1,31 times ($p<0.01$) and 1,42 times ($p<0.001$) lower accordingly. Herewith, the number of WBC was higher up to 1,51 times ($p<0.01$), stab neutrophils increased in 1,79 times ($p<0.01$), segmented neutrophils increased in 1,31 times ($p<0.01$), and monocytes increased in 2,9 times ($p<0.001$) compared to the respective parameters of the control group.

The directly-proportional, although statistically not certain, relation between the color index and the clinical state of research rabbits had been established. Thus, in the second research group the color index increased up to 1,04 times in comparison with the control group, which concurred with the rapid recovery of the animals. In rabbits of the third research group we observed evident clinical course of psoroptosis, and the color index was 1,21 times lower than the respective parameter of the control group.

Table 4 provides the results of hematological parameters of healthy rabbits compared to the ones infested with the common scab mites on the 30th day of the experiment. In particular, the recovery of morphological blood parameters had been established in rabbits of the second research group, and the transformation of acute course of the disease into the chronic form could be observed in rabbits of the third research group. Thus, concentration of hemoglobin was 1,09 times lower ($p<0.05$) in rabbits of the second research group compared to the control group, the number of RBC was also 1,09 times lower ($p<0.05$). It is worth mentioning, that the number of WBC and the per cent of stab neutrophils and monocytes were 1,08 times ($p<0.05$), 2,24 times ($p<0.001$) and 1,5 times ($p<0.05$) higher accordingly.

Table 3

Hematological parameters of rabbits under experimental psoroptosis on the 20th day of the experiment (M±m, n=10)

Parameters	Groups of rabbits		
	1	2	3
	control (healthy animals)	intensity of invasion is 10 mites per animal	intensity of invasion is 50 mites per animal
RBC, T/l	4,93±0,51	3,99±0,57***	3,77±0,36**
HB, g/l	140,92±13,13	117,37±9,47**	99,28±7,84***
CI	0,86±0,06	0,90±0,15	0,71±0,24
WBC, G/l	6,99±0,60	8,53±1,26***	10,57±1,53**
Leukogram, %			
EOS	1,40±0,70	2,20±1,32	3,50±1,58
Stab NEU	2,80±1,55	8,80±3,16***	5,00±1,83**
Segmented NEU	18,90±2,60	14,50±2,46***	24,70±3,02**
LYM	74,90±4,01	68,80±3,97	61,00±4,64
MON	2,00±1,05	5,70±1,89***	5,80±2,39***

Table 4

Hematological parameters of rabbits under experimental psoroptosis on the 30th day of the experiment (M±m, n=10)

Parameters	Groups of rabbits		
	1	2	3
	control (healthy animals)	intensity of invasion is 10 mites per animal	intensity of invasion is 50 mites per animal
RBC, T/l	5,23±0,62	4,78±0,29*	4,48±0,32***
HB, g/l	133,06±12,32	122,20±10,06*	103,79±5,44***
CI	0,77±0,09	0,77±0,06	0,70±0,59
WBC, G/l	7,09±0,44	7,68±0,80*	8,24±0,57***
Leukogram, %			
EOS	1,60±0,84	2,00±1,25	10,60±3,72
Stab NEU	2,10±1,45	4,70±1,77***	4,90±1,45***
Segmented NEU	18,40±3,37	17,00±2,26	19,20±3,68
LYM	75,90±3,51	73,30±3,50	62,00±4,62
MON	2,00±1,05	3,00±1,05*	3,30±1,16**

Statistically certain erythropenia, decrease of hemoglobin concentration, leukocytosis, monocytosis and neutrophilia with a shift to the left had been established in rabbits of the third research group. In particular, the number of RBC was 1,17 times lower ($p<0.001$) compared to the control group, and concentration of hemoglobin was 1,28 times lower ($p<0.001$). Herewith, the number of WBC was 1,16 times ($p<0.001$) higher compared to the control group, the number of stab neutrophils was 2,33 times ($p<0.001$) higher, and the number of monocytes was 1,65 times ($p<0.01$) higher accordingly.

CI maintained directly-proportional correlation to the state of health of rabbits under research. Thus, during acute stage of the disease both groups of rabbits had color index that was lower than in the control group, and starting from the 20th day after infesting it returned to the norm in rabbits of the second research group and remained lower than the norm in rabbits of the third group. However, the results occurred not to be statistically plausible.

6. Conclusions

1. Upon infestation of rabbits with 10 live mites Ps. cuniculi (low intensity of invasion) pathogenic influence of the parasite on the host animal is expressed by mild clinical signs and self-recovery of the animal on the 21st–23rd day after infesting, however, upon the parasitological autopsy live mites Ps. cuniculi at various stages of their development had been found in the middle ear of rabbits.

2. Upon infestation of rabbits with 50 mites Ps. cuniculi (high intensity of invasion) we observed the apparent clinical presentation of psoroptosis, which had transformed itself from acute (primary) form into chronic infection on the 25th day after infesting. The acute form of the disease is represented by the development of lesion stages, such as redness and scratches (from the 1st till the 7th day after infesting), dry scab (from the 7th day after infesting), wet scab (from the 18th day after infesting). The chronic form of the disease is represented by the decrease of inflammation and drying of the scab.

3. Decrease of hemoglobin concentration, erythropenia, neutrophilia with the shift to the left, and monocytosis had been defined in 8-month old rabbits of California breed under low and high intensity invasion by mites Ps. cuniculi.

4. Upon experimental psoroptosis of rabbits under low intensity of invasion by mites Ps. cuniculi and in acute stage of the disease leukocytosis had been defined, and under high intensity of invasion by mites Ps. cuniculi and chronic form of the disease lymphopenia had been defined.

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