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EFFECT OF INTESTINAL COCCIDIA INFECTION OF RABBITS UPON RED AND WHITE BLOOD CELL NUMBERS, HEMOGLOBIN CONCENTRATION AND HEMATOCRIT

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Two groups of ten coprologically oocyst free rabbits were infected respectively with $2x10^5$ and $4x10^5$ coccidia oocysts composed of Eimeria flavescens (7%), E. matsubayashi (9%), E. magna (12%), E. neoleporis (19%), E. perforans (21%) and E. media (32%). A third group served as the control. Only three infected animals developed full-blown disease with diarrhea. The others suffered from a subclinical form of the disease. Shortly before and then on days 4, 7, and 10 after infection, red and white blood cell numbers, hemoglobin concentration and hematocrit values were determined. Following the infection, red blood cell numbers, hemoglobin concentration and hematocrit decreased. White blood cell numbers declined except in those rabbits infected with the higher number of oocysts in which a rise was detected on day 4 after infection.

Key words: blood cell, hematocrit, hemoglobin, intestinal coccidia, rabbits.

INTRODUCTION

Hepatic and intestinal coccidiosis are caused by several species of intestinal coccidia (Levin and Ivens, 1972; Catchpole and Norton, 1979), and it is difficult to find a coccidia free rabbit colony (Catchpole and Norton, 1979; Šerkov *et al.*, 1986; Hoop *et al.*, 1993; Polozowski, 1993). Most works on rabbit coccidiosis have focused on the morphology of oocysts, clinical presentation, pathologic changes, diagnosis, treatment and prophylaxis of disease. A few authors have dealt with alterations in biochemical parameters in the blood of rabbits with coccidiosis (Coudert *et al.*, 1978; Peeters *et al.*, 1984; Šerkov *et al.*, 1986; Coudert *et al.*, 1993; Fukata *et al.*, 1995). The aim of this study was to determine the effect of intestinal coccidia infection on rabbit red blood cell (RBC) and white blood cell (WBC) numbers, hemoglobin (HB) concentration and hematocrit (HT) values.

MATERIALS AND METHODS

Big Chinchilla male rabbits 52 days-old and weighing 1200-1300 g, were infected with a pool of intestinal coccidia oocysts composed of *Eimeria flavescens*

(7%), *E. matsubayashii* (9%), *E. magna* (12%), *E. neoleporis* (19%), *E. perforans* (21%) and *E. media* (32%). Prior to artificial infection, coprologic examination for intestinal coccidia oocysts was consistently negative in all selected rabbits.

The rabbits were divided into three groups of 10 animals each. One group served as the control (Group C). The other groups (Group A and Group B) were infected with $2x10^5$ and $4x10^5$ sporulated oocysts, respectively, by direct instillation through a tube into the empty stomach. On days 0, 4, 7, and 10 post-infection (PI), blood samples were drawn for examination.

RBC and WBC were counted in a Spencer chamber. Hemoglobin concentration was determined using Sahly's hemoglobinometer and hematocrit was measured by the microhematocrit method.

The results were analyzed on a PC IBM compatible computer (software program STATGRAPH ver. 4,2) by bi-directional variance analysis (ANOVA). The significance for intergroup statistical difference (C:A and C:B) was marked as follows: * $p<0.05$; ** $p<0.01$; *** $p<0.001$ and intergroup (A:B): a $p<0.05$; aa $p<0.01$; aaa $p<0.001$.

RESULTS AND DISCUSSION

Only three infected animals (one from treatment A and two from treatment B) developed complete clinical coccidiosis with diarrhea. The others displayed milder signs of the disease such as polydypsia, bristling hair and moderate weight loss. On day 10 PI, coprological examination confirmed the presence of intestinal coccidia oocysts in the stools of all the infected rabbits.

Red blood cell count

Red blood cell numbers in the infected rabbits showed a gradual decline (Figure 1). The decline was more pronounced on day 4 PI. Rabbits in group A had a maximum decrease on the 7th day PI, which was maintained until day 10 PI. The greatest decline in the group which received the higher dose of infectious material was registered on day 10 PI. The mean decline of RBC numbers in both groups was statistically significant ($p<0.001$) when compared to the control group, as well as between the two groups of infected animals (10 days PI $p<0.01$). The decrease in RBC numbers in group B was about 10% and in group A more than 15 % in relation to the control group.

The decrease in RBC numbers on day 4 PI coincides with the development of the second generation of schizonts. Rupture of capillaries and hemorrhage occur on that day causing anemia. Erythrocytopenia on days 7 and 10 PI is dose-dependent, because a higher number of coccidia oocysts will induce greater damage to the capillary endothelium and subsequent hemorrhage. Our results are consistent with data in the literature on the dynamics of RBC numbers in poultry with coccidiosis (Fukata *et al.*, 1995). Moreover after artificial infection of rabbits with intestinal coccidia oocysts Peeters *et al.* (1984) registered a decreased number of red blood cells.

Hemoglobin concentration

A maximal and statistically significant ($p<0.01$) decline in hemoglobin concentration in group A was registered on day 7 PI in parallel with the decrease in RBC numbers. In group B, the significant ($p<0.01$) decrease in HB concentration was most pronounced on day 10 PI correlating with a decline in RBC numbers (Figure 2).

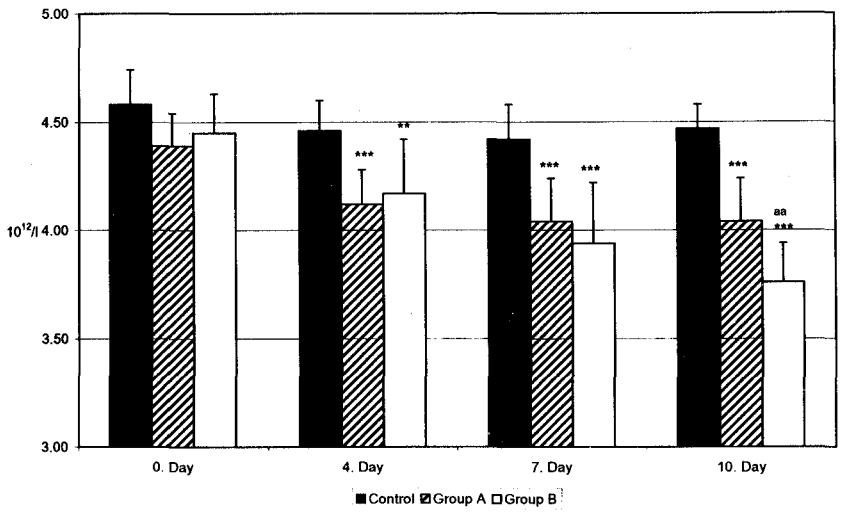

Figure 1. Red blood cell numbers (MV SD)*10^{12}/l in rabbits infected with intestinal coccidia
* p<0.05; ** p<0.01; *** p<0.001 - significance for intergroup statistical difference (C:A) and (C:B)
a p<0.05; aa p<0.01; aaa p<0.001 - significance for intergroup statistical difference (A:B)

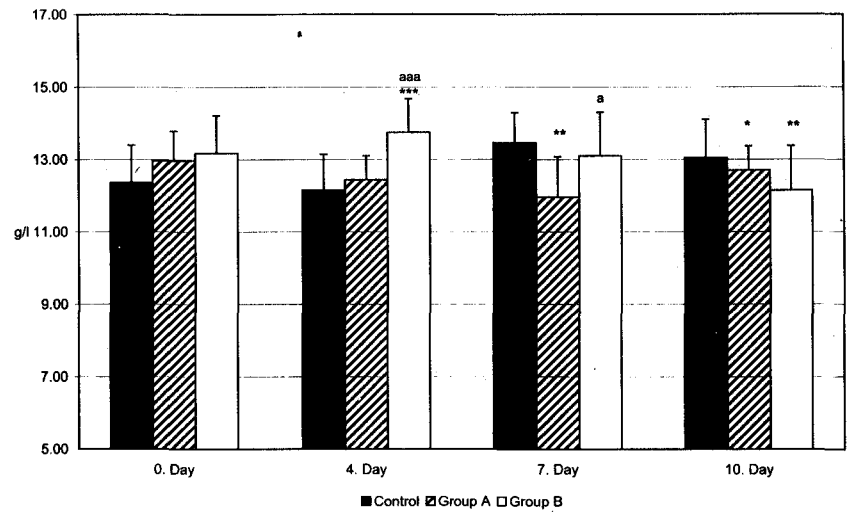

Figure 2. Hemoglobin concentrations (g/l) in the blood of rabbits infected with intestinal coccidia
* p<0.05; ** p<0.01; *** p<0.001 - significance for intergroup statistical difference (C:A) and (C:B)
a p<0.05; aa p<0.01; aaa p<0.001 - significance for intergroup statistical difference (A:B)

The change in HB concentration followed the dynamics of fluid loss caused by intestinal mucosa damage and subsequent dehydration. The rise in HB concentration on day 4 after infection is possibly a result of hemoconcentration. The decline occurring thereafter is probably caused by hemorrhage and blood loss through the intestines. Peeters *et al.* (1984) registered a decreased hemoglobin concentration in rabbits with intestinal coccidiosis.

White blood cell count

A biphasic change in WBC number was observed in the rabbits infected with the higher dose of oocysts (Figure 3). In group A were no significant changes in WBC numbers. After an initial decrease in WBC (4 days PI) WBC numbers increased at 7 days PI. After an initial increase in WBC numbers on day 4 PI in group B, a further dramatic decline was observed on day 7 PI, followed by a slight rise on day 10 PI. Intergroup variability was statistically significant on day 4 PI ($p<0.01$).

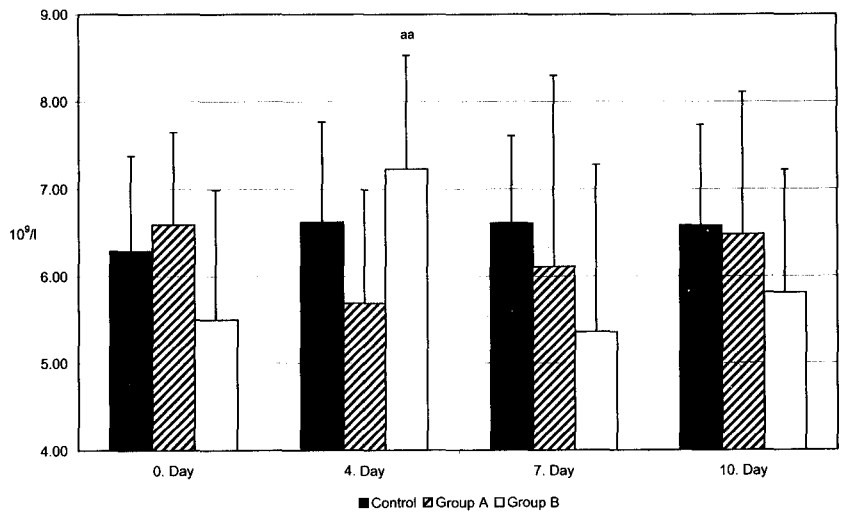

Figure 3. White blood cell numbers (MV SD)*10^9/l in rabbits infected with intestinal coccidia
* $p<0.05$; ** $p<0.01$; *** $p<0.001$ - significance for intergroup statistical difference (C:A) and (C:B)
a $p<0.05$; aa $p<0.01$; aaa $p<0.001$ - significance for intergroup statistical difference (A:B)

Changes in WBC numbers may be viewed as part of the clinical presentation of intestinal coccidiosis. Peeters *et al.* (1984) registered a decrease WBC numbers in rabbits with coccidiosis. The development of sporozoits in interepithelial lymphocytes, led to a reduced leukocytes number in the circulation (Licois *et al.*, 1978). A local inflammatory response recruits leukocytes which are lost through the injured intestinal mucosa, which is a possible cause of the decline in their numbers. The rise in WBC numbers could be explained by hemoconcentration resulting from fluid loss.

Hematocrit

A progressive decline in hematocrit values was observed in the infected rabbits (Figure 4). The decreases were statistically highly significant ($p<0.001$)

and more pronounced throughout the study period in the group of rabbits infected with the higher dose of oocysts, but without intergroup statistically significance. A maximal decline was found on day 10 PI (36.3%, base-line value 42.9%, relative decrease 15.5%). In group B the fall was even more evident (35.9%, base-line value 44.3%, relative decrease 19%).

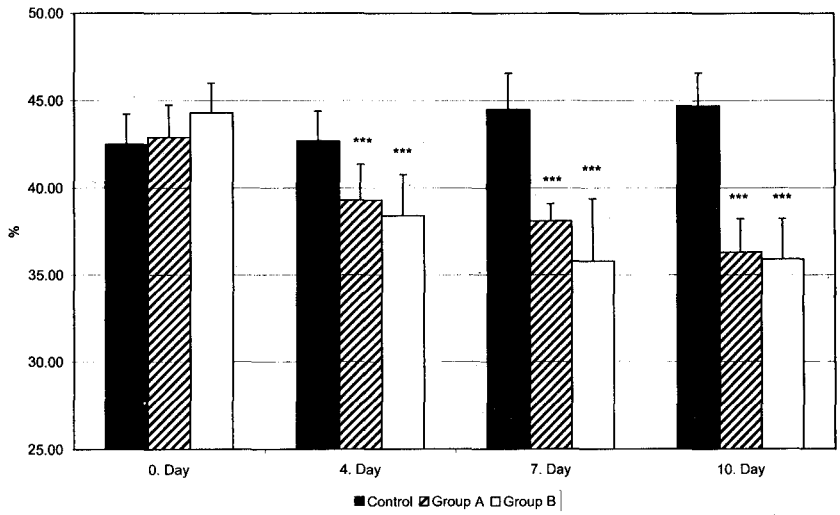

Figure 4. Hematocrit values (%) in rabbits infected with intestinal coccidia
* $p<0.05$; ** $p<0.01$; *** $p<0.001$ - significance for intergroup statistical difference (C:A) and (C:B)
a $p<0.05$; aa $p<0.01$; aaa $p<0.001$ - significance for intergroup statistical difference (A:B)

With the progression of coccidia infection hematocrit values in both groups of rabbits steadily decreased as shown by other authors (Hoop *et al.* , 1993; Licois *et al.*, 1978; Peeters *et al.*, 1984). As the decline in hematocrit values correlates with the fall in RBC numbers, it is obvious that a massive loss of erythrocytes occurs through the damaged intestinal mucosa.

CONCLUSION

Intestinal coccidiosis, induced in this way, has a low potential for inducing general defense mechanisms and the inflammatory process is localized with the involvement of the intestinal lymphatic tissues. The local inflammatory process mobilizes and dissipates leukocytes causing a fall in their numbers. Absorption of toxic intestinal products due to the damaged intestinal mucosa together with the absorption of products of metabolism of coccidia oocysts induce a systemic reaction.

On the basis of the results of our experiment, it can be concluded that in rabbits with intestinal coccidiosis the numbers of red blood cells, hemoglobin concentration and hematocrit decreased. At the same time the white blood cell numbers declined except in those rabbits infected with the higher number of oocysts where a rise of white blood cells was detected on day 4 after infection.

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REFERENCES

1. *Catchpole J, Norton CC*, 1979, The species of *Eimeria* in rabbits for meat production in Britain. *Parasitol* , 79: 249-257.
2. *Coudert P, Licois D, Proovot F, Drouvet V*, 1993, *Eimeria* spp. from the rabbit (*Oryctolagus cuniculus*) pathogenicity and immunogenicity of *Eimeria intestinalis*. *Parasitol Res*, 79: 186-90,
3. *Coudert P, Vaissaire J, Licois D*, 1978, Etude de l'evolution de quelques parameters sanguines chez des lapereaux atteints de coccidiose intestinae, *Rec Med Vet*. 154: 437-40.
4. *Fukata T. Komba Y. Sasai K. Baba E. Arakawa A.*,1995, Hematological studies on chickens infected with *Eimeria tenella* and *Eimeria acervulina*. In: *Abstract of World Veterinary Congress* (WVA Scientific Program), Yokohama, Japan, 151.
5. *Hoop RK. Ehrsam R, Keller B*, 1993, 10 Years of rabbit autopsy. A review of frequent disease and mortality causes. *Schweitz Arch Tierheilkd*, 135: 212-6.
6. *Levin ND, Ivens V*, 1972, Coccidia of the *Leporidae*, *Protozoology*, 19: 572-81.
7. *Licois D, Coudert P, Mongin P*, 1978, Changes in hydromineral metabolism of diarrheic rabbits. 1. A study of the changes in water metabolism, *Ann Rech Vet*. 9: 1-10.
8. *Peeters BJE, Charlier G, Antoine Odette, Mamericlex M*, 1984, Clinical and pathological changes after *Eimeria intestinalis* infection in rabbits, *Zbl Vet Med B*, 31: 9-24.
9. *Polozowski A*, 1993, Coccidiosis of rabbits and its control, *Wiad Parazytol*, 39: 13-28.
10. *Serkov SN, Halačeva Marija, Kostova Tanja, Malčevski M*, 1986, Etiopatogeneza i epizootiologija na kokcidiozata do zakite. *Vet Med Nauki*, 23: 11-17.
11. *Tambur Z, Kulišić Z, Matić D, Pa'inović R, Mišić Z*, 1995, Endoparaziti kunića sa područja Pančeva, *Vet glasnik*, 49: 741-4.
12. *Tambur Z., Kulišić Z, Ivetić V, Maličević Ž*, 1997, Patomorfološke promene kod kunića veštački inficiranih crevnim kokcidijama, *Vet glasnik*, 51: 253-258.

UTICAJ INFEKCIJE CREVNIM KOKCIDIJAMA KUNIĆA NA BROJ ERITROCITA I LEUKOCITA, KONCENTRACIJU HEMOGLOBINA I HEMATOKRIT

TAMBUR Z, KULIŠIĆ Z, MALIČEVIĆ Ž. I MIHAILOVIĆ M.

SADRŽAJ

U ovom ogledu dve grupe od po 10 kunića bile su inficirane oocistama kokcidija i to: *Eimeria flavescens* (7%), *E. matsubayashi* (9%), *E. magna* (12%), *E. neoleporis* (19%), *E. perforans* (21%) i *E. media* (32%). Grupa A inficirana je sa 2 x 10^5, a grupa B sa 4 x 10^5 infektivnih oocista. Svi kunići su oboleli od subkliničkog oblika kokcidioze, izuzev tri jedinke kod kojih su bili ispoljeni klinički simptomi karakteristični za ovu bolest. Neposredno pre infekcije kao i 4, 7. i 10. dana posle infekcije praćeni su broj eritrocita i leukocita, koncentracija hemoglobina i hematokritska vrednost. Nakon infekcije broj eritrocita, koncentracija hemoglobina i hematokritska vrednost su bili u stalnom padu. Broj leukocita je varirao tokom infekcije a kod kunića inficiranih većom infektivnom dozom, registrovan je visok porast broja ovih ćelija 4. dana posle infekcije.