

Hematological, Biochemical and Blood Gas Findings in a Calf with Cerebral Theileriosis

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Abstract – This case report aims to present the clinical and laboratory findings of cerebral theileriosis in a 1-month-old female Holstein calf. In the clinical examination of the calf, blindness, ataxia, opisthotonus, nystagmus and convulsions, anemia and petechial hemorrhage foci in the conjunctiva, upper palate, gingiva were observed, and asymmetrical enlargement of the left prescapular lymph node was detected. As a result of hematological examinations, it was determined that lymphocyte count, erythrocyte count, hemoglobin amount, mean erythrocyte diameter (MCV) and hematocrit values were lower than normal, but mean erythrocyte hemoglobin concentration (MCHC) and platelet values were lower than normal in the calf. higher than normal values. In terms of biochemical values, blood urea nitrogen (BUN), direct and indirect bilirubin, triglyceride and creatine kinase myocardial band (CK-MB) values were found to be higher than normal values. In blood gas analysis, blood pH and glucose values were lower than normal values, and lactate concentration was higher than reference values.

The parameters in this case report are reported to be helpful in the differential diagnosis of similar cases that veterinarians in the field may encounter.

Keywords – Calf; Cerebral Theileria; L-Lactate; Hematological Values

I. INTRODUCTION

Bovine Theileriosis is a serious disease that causes high morbidity and mortality, transmitted to cattle by Hyalomma ticks. Theileria annulata is the most pathogenic species in the theileria genus and causes this disease [1], [2]. Mechanical, natural (biological), and intrauterine transmission are the three ways of transmission for theileriosis. The agent multiplies after being transferred from the tick to the calf by infecting lymph nodes, lymphoid cells, macrophages, and finally, erythrocytes [3], [4], [5].

Infected erythrocytes undergoing intravascular or extravascular hemolysis are removed from the circulation [5], [6]. A nervous form of this disease is also cerebral Theileriosis [7], [8].

This case report aims both to describe a calf with Cerebral Theileria and to reveal the changes in hematological, biochemical, and blood gas values due to this disease.

II. CASE HISTORY

A 1-month-old female Holstein calf was brought to Bingöl University Veterinary Faculty Animal Hospital Internal Medicine Clinic with complaints of inappetency, weakness, depression, sudden fainting, and loss of consciousness. After routine clinical examination, blood samples were taken from the vena jugular of the animal to tubes with vacuum anticoagulant (BD, Plymouth, UK) and without anticoagulant (BD, Plymouth, UK) for hematological and biochemical analyzes and to heparin injectors (Wondfo BGA 101, China) for blood gas analysis in accordance with the technique. Blood cell counts have been performed in a hematology device (Benesphera H31, USA), biochemical parameters in an automated analyzer (Randox Monaco, England), and analyzes of blood gases in an automatic blood gas analyzer (Wondfo BGA 101, China).

A smear made to investigate the presence of blood parasites that may be the cause of the disease by dripping a drop of blood from an anticoagulant blood tube onto a slide was stained with giemsa and examined under a microscope at 100 objective magnification

In the clinical examination of the calf, in addition to blindness, ataxia, opisthotonus, nystagmus and convulsions, conjunctivae, anemia, and petechial hemorrhage foci in the upper palate, gums were observed, and an asymmetrical enlargement was detected in the left prescapular lymph node (Figure 1). It was observed that the body temperature of the calf was 37.5 °C, the heart rate was 180/min, and the respiratory frequency was 22'/min.

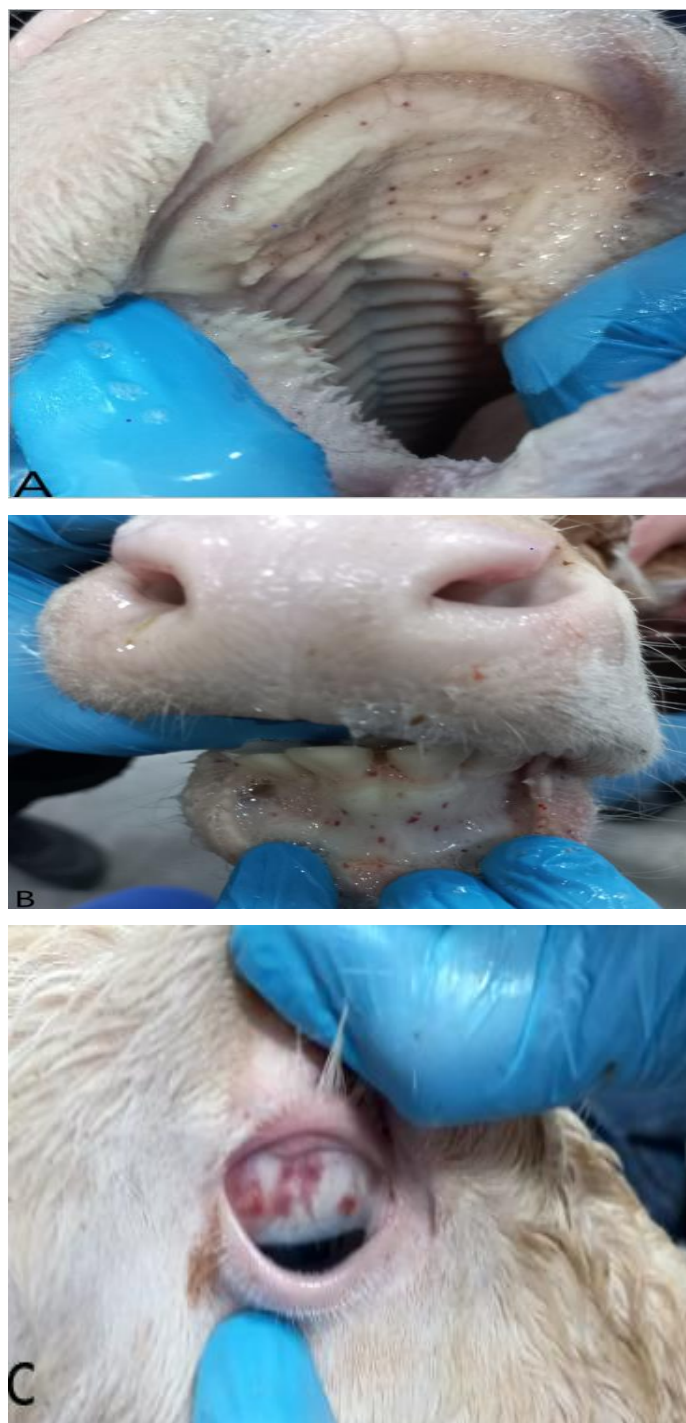


Figure 1. Upper palate (A), gums (B), and petechial hemorrhages in the sclera (C)

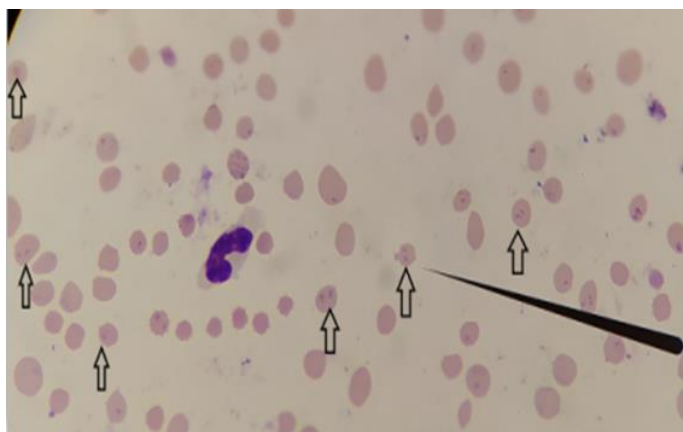


Figure 2. The ring form of *Theileria annulata* piroplasms in erythrocytes is shown by arrows in the figure.

Microscopic examination of peripheral blood smear performed for parasitological diagnosis revealed that *Theileria* piroplasms infect a significant number of erythrocytes (Figure 2). Besides, fecal samples taken from the calf were examined parasitologically by fecal flotation, whether there were any helminth eggs or coccidial oocysts. In consequence of hematological examinations, it was determined that lymphocyte count, erythrocyte count, hemoglobin amount, mean erythrocyte diameter (MCV), and hematocrit values were lower in calves compared to normal values, but mean erythrocyte hemoglobin concentration (MCHC) and platelet values were higher than normal values [9], [10] (Table 1). Blood urea nitrogen (BUN), direct and indirect bilirubin, triglyceride, and creatine kinase myocardial band (CK-MB) values were found to be increased compared to normal values in terms of biochemical values [11], [12] (Table 2). In blood gas analysis, it was observed that blood pH and glucose values were lower than normal values, while lactate concentration was higher than reference values [13], [14] (Table 3).

III. RESULTS

In this case report, clinical, hematological, biochemical and blood gas values that are thought to be necessary in the diagnosis of cerebral theileriosis were determined and presented in Tables 1,2,3.

Table 1. Hematological Findings of the Calf

Parameters	Result	Reference Values*
WBC ($\times 10^3/\mu\text{L}$)	4.6	4-12
LYM ($\times 10^3/\mu\text{L}$)	2.2	2.5-7.5
RBC ($\times 10^6/\mu\text{L}$)	2.09	5-10
HGB (g/dL)	3.5	8-15
MCHC ($\times 10^3/\mu\text{L}$)	45.7	31-34
MCH ($\times 10^3/\mu\text{L}$)	16.8	11-17
MCV ($\times 10^3/\mu\text{L}$)	36.7	46-65
HCT (%)	15	24-46
PLT ($\times 10^3/\mu\text{L}$)	1516	300-800

WBC: white blood cell; LYM: lymphocyte; RBC: red blood cell; HGB: hemoglobin; MCHC: Mean corpuscular hemoglobin concentration; MCH: Mean corpuscular hemoglobin; MCV: Mean corpuscular volume; HCT: hematocrit; PLT: platelet * [9]

Table 2. Biochemical Findings of the Calf

Parameters	Result	Reference Values*
CK-MB (U/L)	336	189-235
BUN (mg/dL)	109.31	10-25
Crea (mg/dL)	0.02	0.5-2.2
T.BİL (mg/dL)	3.2	0-1.6
D.BİL (mg/dL)	2.1	0-0**
Chole (mg/dL)	115.09	163-397**
Trig (mg/dL)	34.229	10-19**
Alb (g/dL)	3.4	2.5-3.8

CK-MB: MB isoenzyme of creatine kinase; BUN: blood urea nitrogen; TBİL: total bilirubin; ALB: albumin; Crea: creatine; Chole: cholesterol; Trig: triglyceride * [11] ** [12]

It is thought that this information will contribute to the literature on cerebral theileria and may be useful for veterinarians in the field to recognize and distinguish similar cases that they may encounter.

Table 3. Blood Gas Findings of the Calf

Parameters	Result	Reference Values*
Blood Ph	7.24	7.37-7.46
Na (mmol/L)	135	133 – 140
K (mmol/L)	4.7	4.13-5.41
Cl (mmol/L)	101	93-101
Ca (mmol/L)	1.27	1.17-1.37
Glucose (mmol/L)	3.5	3.9- 8.4
L-Laktate (mmol/L)	9.95	2.0**

*[13] **[14]

For the treatment of the calf, 2.5 mg/kg of buparvaquone (Butalex; Intervet) as a single dose intramuscularly, 10 mg/kg dose of oxytetracycline (Primamycin; Zoetis) intramuscularly was used for 5 days. Despite the treatment, the animal died on the 3rd day of the treatment.

IV. DISCUSSION

Theileria annulata is an economically important disease that can be observed in tropical and subtropical regions of the world. The favorable conditions for ticks of the genus *Hyalomma*, which are vectors for *Theileria annulata*, are important in the prevalence of this disease [4]. In the animal husbandry industry, the disease results in large financial losses due to low productivity, death, tick control, diagnosis, and treatment costs [15].

In studies conducted on the existence of theileria species in Turkey, it was determined that *Theileria annulata* and *Theileria orientali/buffeli* agents are

commonly found [16], [17]. In serological studies conducted on the presence of *Theileria annulata* in cattle in different geographical regions of Turkey, the seroprevalence of this factor was found to vary between 10% and 91% [18], [19]. While there are many studies describing the clinical findings of theileriosis in cattle, there are very few studies on the presence and clinical findings of cerebral theileriosis [7], [20], [21], [22].

Body temperatures up to 42°C, growth in superficial lymph nodes, increase in heart and respiratory frequency, petechial hemorrhages with anemia in the mucous membranes and conjunctiva, and significant deconditioning are seen in cattle infected with *Theileria annulata*. The presence of

hemoglobinuria has also been reported in some cases of *Theileria* [23], [24]. Hemoglobinuria was not observed in this study either. In cases with cerebral theileriosis, it was reported that animals rotate around their axis, and neurological findings such as ataxia, hyperesthesia, blindness, head resting, nystagmus, hypermetry, nasal discharge, and depression are observed [7], [20], [25]. Ataxia, blindness, opisthotonus, nystagmus, and convulsion were all present in this case, as they had been reported in earlier cases. The age, clinical symptoms, and blood smear of the calf were all used to make the diagnosis of cerebral *theileriosis* in this study. The pathogenesis of this disease is not fully known. Besides, it was determined that the formation of the neurological symptoms occurs due to vasculitis and lymphocytic inflammation in the brain [8], [26]. On the other hand, postmortem findings such as occlusion of cerebral blood vessels,

bleeding, swelling and dark red color in the choroid plexuses of the ventricles, diffuse edema in the brain, necrosis, demyelination and perivascular lymphocytic infiltration in neurons have also been formed [21]. Since the owners of the deceased calf did not allow necropsy to be performed, we could not take any action.

Changes linked with anemia are said to be the most important clinical findings in patients with *Theileria*. To the extent that, in a study conducted by Kızıllı et al. [27] on cattle with theileria, erythrocyte count, hemoglobin, and hematocrit levels were found to be significantly lower compared to the control group. Omer et al. [28], Abd Ellah et al. [29], and Sandhu et al. [30] also determined that there were significant decreases in hematological parameters in animals infected with theileria. It was determined by Omer et al. [28], Abd Ellah et al. [29], and Sandhu et al. [30] that there were significant decreases in hematological parameters in animals infected with theileria. It was stated that the possible cause of the decrease in erythrocyte, hemoglobin, and hematocrit values is a possible consequence of phagocytosis of parasite-infected erythrocytes of the spleen, lymph nodes, and reticuloendothelial system organs by macrophages in these organs [30]. It has been suggested by other researchers [31], [32]) that the reason for the decrease in hematological values is complement activation and immune-mediated mechanisms.

Regarding the biochemical findings, in a study conducted by Denizhan et al.[33] and Kılınç et

al.[34] on cattle with tropical theileriosis, CK-MB level was found to be significantly higher than the control group, on the other hand, by Fartashvand et al. [35], CK-MB level in cattle with theileriosis was found to be quite high compared to the control group. This is considered a sign that the heart muscle of infected calves is affected. The CK-MB level in this case was found to be consistent with the reported studies and was higher than the stated levels.

In a study conducted by Abd Ellah et al. [29] and Kızıllı et al. [27] on cattle with theileriosis, serum BUN concentration was found to be higher than the control group. In an experimental study conducted on *Theileria* calves, it was determined that the BUN concentration increased significantly at different times of the study [30]. The increase in BUN concentration in this study is consistent with BUN values in reported studies, and it is thought that the possible reason for this increase in BUN concentration may be due to renal damage.

It was demonstrated by many researchers [30], [31], [36] that total and direct bilirubin levels increase significantly in cattle infected with theileria *annulata*. The results of total and direct bilirubin obtained in our investigation were found to be consistent with those obtained in previous studies. It has been stated that there is an increase in total and direct bilirubin levels due to hemolytic anemia and possible damage to the liver [28].

It was determined by Kızıllı et al. [27] that the triglyceride level in cattle with theileria increased significantly compared to the control group. The

results obtained in this study also confirm this fact. The possible reason for this rise in triglyceride levels is caused by the low blood glucose concentration and, accordingly, the degradation of the animal's lipid metabolism.

In many studies conducted on cattle infected with Theileria blood gases have been measured and blood pH decreased significantly compared to the control group and metabolic acidosis developed [37], [38]. This finding is in agreement with the values stated in the case of our study. A possible cause of metabolic acidosis in animals with theileriosis is attributed to the decrease in hemoglobin and oxygen concentration in tissues due to developing anemia [39].

Although blood gas values have been investigated in Theileria-infected cattle, as far as we know, blood gas values and L-lactate concentration in cerebral theileriosis have not been evaluated in any way until now. In a study conducted on dogs with anemia, it was determined that the lactate concentration was significantly higher in these animals [40]. In a study conducted on dogs with acute babesiosis, it was observed that the lactate concentration increased significantly compared to the control group [41].

In a study conducted by Temiz et al. [38] on cattle with theileria, it was determined that there was a significant difference in the Na value compared to the control, and there was no difference in the K and Cl values. In this case, as for that, it was determined that the Na and Cl values were lower than the values in the reported study, and the K value was higher.

Similar to the results in the reported studies, the L-lactate concentration, in this case, was considerably higher than the reference value [14]. It was thought that the possible cause of this rise in anemia might be due to hypoxia due to decreased oxygen carrying capacity [40].

In the present case, PCR analyses could not be performed to determine the causative agent. However, for the diagnosis of cerebral theileriosis, it was sufficient to examine the blood smear and, as a result, the typical Theileria annulata pyroplasma to be seen clearly (Figure 2).

V. CONCLUSION

Bovine Theileriosis is a serious disease that causes high morbidity and mortality, transmitted to cattle by Hyalomma ticks. Infected erythrocytes undergoing intravascular or extravascular hemolysis are removed over time from the circulation. This case report aims both to describe a calf with Cerebral Theileria and to reveal the changes in hematological, biochemical, and blood gas values due to this disease.

It is important for such rare cases to be noticed by clinician veterinarians in the field.

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