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Exophthalmus in a Calf Naturally Infected with *Theileria annulata*

Theileria annulata ile Doğal Enfekte Bir Buzağıda Ekzoftalmus

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ABSTRACT

Tropical theileriosis is a hemoprotozoan disease caused by *Theileria annulata* (*T. annulata*) transmitted to cattle by ticks of the genus Hyalomma. Purpose of this case report is to describe the exophthalmus findings observed in a calf that had a *T. annulata* infection. A 2 month old male calf was brought to Bingöl Veterinary Teaching Hospital Ruminant Clinic and had an anamnesis of 5 days of loss of appetite, weakness, vision loss that occurred 1 day ago, and two days before admission to the hospital, the right eyes protruded from the exophthalmus and had difficulty breathing. Clinical examination, the patient's signs showed exophthalmus in the right eye and edema in the left, a respiratory rate of 96 breaths/min, a heart rate of 128 beats/min, a body temperature of 41.6°C, lacrimation, icterus, and petechiae on the conjunctiva, oral mucosa, and skin. In addition, pyoplasmic agents were detected in erythrocytes of *T. annulata* by light microscopic examination of smear frotin prepared from peripheral blood. It was concluded that exophthalmus and edema findings should be taken into consideration in the differential diagnosis and treatment of *T. annulata* infection.

Keywords: Calf, Exophthalmus, *Theileria annulata*

ÖZ

Tropikal theileriosis, Hyalomma cinsi keneler tarafından sığırlara nakledilen *Theileria annulata*'nın (*T. annulata*) neden olduğu hemoprotozoan bir hastalıktır. Vaka raporunda *T. annulata* ile enfekte bir buzağı görülen ekzoftalmus bulgusunun sunulması amaçlanmıştır. Bingöl Veteriner Eğitim Hastanesi Ruminant Kliniği'ne getirilen 2 aylık, erkek buzağının 5 gündür devam eden iştahsızlık, halsizlik, 1 gün önce oluşan görme kaybı ve hastaneye başvurmadan iki gün önce sağ gözde ekzoftalmus şekillendiği, solunum güçlüğü yaşadığı bilgisi şeklinde anamnez alındı. Klinik muayenede solunum frekansı 96 solunum/dk, kalp frekansının 128 vurum/dk, vücut sıcaklığının 41.6 °C, sağ gözde ekzoftalmus, sol gözde ödem, göz yaşı akıntısı, ikterus, konjuktiva, ağız mukozası ve deri üzerinde peteşiler tespit edildi. Ayrıca periferal kandan hazırlanan yayma frotinin ışık mikroskobunda incelenmesiyle *T. annulata*'ya ait eritrositler içerisinde piroplazm formdaki etkenler tespit edildi. *T. annulata* enfeksiyonunun ayırıcı tanı ve tedavisinde ekzoftalmus ve ödem bulgularının dikkate alınması gerektiği sonucuna varıldı.

Anahtar Kelimeler: Buzağı, Ekzoftalmus, *Theileria annulata*

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INTRODUCTION

Tropical theileriosis is a hemoprotozoan disease caused by *Theileria annulata* (*T. annulata*) transmitted to cattle by ticks of the genus Hyalomma with high mortality and morbidity.[1,2,3] An estimated 250 million cattle in tropical and subtropical regions such as Turkiye, Southern Europe, North Africa, China, India, Central and East Asia are at risk and the disease causes high economic losses.[3,4]

T. annulata may be transmitted intrauterinally, mechanically, and spontaneously (biologically).[5] The life cycle of the agent consists of two stages one in the tick and one in the host.[1] According to one account, it multiplies by infecting lymph nodes, lymphoid cells, macrophages, and erythrocytes after being transmitted from the tick to the host.[2] The quantity of sporozoites secreted by the salivary gland, the host's immune system, and immunization all have a major impact on the disease's severity.[6,7] When cattle contract *T. annulata*, common clinical signs include fever, mild eye and nasal discharge, appetite loss, increased salivation, enlargement of superficial lymph nodes, dyspnea, and, in later stages, anemia, icterus, and petechial hemorrhages on the surface of the conjunctiva or the skin.[1,8,9] The disease can be diagnosed by microscopic examination of pyroplasma and macroschizonts in Giemsa stained blood or lymph node smears, indirect immunofluorescent antibody testing (IFAT) and polymerase chain reaction (PCR) methods.[4]

Even though the literature research stated that exophthalmus can be observed from ocular lesions in animals infected with *T. annulata*[10], it was discovered that there is little information available on this topic and that it was only observed in one case, which was reported by Kumar et al.[11] Furthermore, this is the first instance of *T. annulata* infection in a calf that has occurred naturally in Turkiye. Consequently, the purpose of this case report is to describe the exophthalmus findings observed in a calf that had a *T. annulata* infection.

CASE PRESENTATION

A 2 month old male calf was brought to the Bingöl Veterinary Teaching Hospital Ruminant Clinic and had an anamnesis of 5 days of loss of appetite, weakness, vision loss that occurred 1 day ago, and two days before admission to the hospital, the eyes protruded from the orbital pit and had difficulty breathing. Following the physical examination, 5 mL of blood was collected into a gel serum tube devoid of anticoagulant for biochemical analysis, and 2 mL of blood was drawn from the jugular vein into a lithium heparin syringe for blood gas analysis. Using microhematocrit tubes, blood samples were extracted from the outer edge of the ear, and the hematocrit (HCT) value was ascertained following a 5 minute centrifugation at 5000 rpm. A drop of blood from the peripheral end of the ear was used to create a thin blood smear. The smears were allowed to air dry, fixed for five minutes with methyl alcohol, and then stained for thirty minutes using a 10% Giemsa solution. Upon staining, the smears were dried, rinsed with tap water, and then magnified 100 times using immersion oil to view the intraerythrocytic form of *T. annulata*. This protozoan was identified by scanning at least fifty different locations. Using a blood gas analyzer (Wondfo BGA 101, China), the concentrations of pH, bicarbonate (HCO_3^-), sodium (Na^+), potassium (K^+), chloride (Cl^-), calcium (Ca^+), glucose, and lactate were measured.

Clinical examination, the patient's signs showed exophthalmus in the right eye and edema in the left, a respiratory rate of 96 breaths/min, a heart rate 128 beats/min, a body temperature of 41.6 °C, tear discharge, icterus, and petechiae on the conjunctiva, oral mucosa, and skin (Figure 1-2). Furthermore, pyroplasmic agents were found in *T. annulata* erythrocytes during light microscopic analysis of the smear (Figure 3).

Figure 1. Calf infected with *Theileria annulata*
A: Exophthalmus in the right eye, **B:** Edema in the left eye

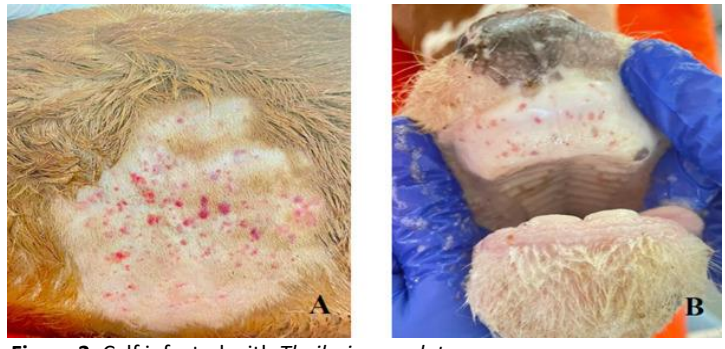

Figure 2. Calf infected with *Theileria annulata*
A: Petechial hemorrhages at different points of the skin
B: Petechial hemorrhages in the oral mucosa

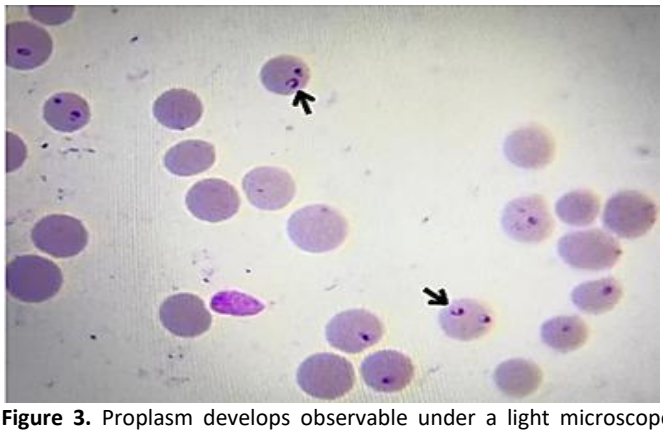

Figure 3. Proplasm develops observable under a light microscope in *Theileria annulata* erythrocytes. **Black arrow:** Piroplasm form of *Theileria annulata*

In comparison to reference values, drops in pH, HCO_3^-, Na^+, Ca^+ and glucose concentrations as well as increases in K^+ and lactate concentrations were found in blood gas analysis. Table 1 shows the findings of the blood gas analysis.[12-15] After diagnosis, the owner assessed the cost of treatment and the chances of success and decided to euthanize the patient.

Table 1. Blood gas analysis result of calf infected with *Theileria annulata*

Parameters	Result	Reference Ranges
pH (mm/Hg)	7.13 **(L)**	7.35-7.50[12]
HCO_3^- (mmol/L)	8.2 **(L)**	20-30[12]
Na^+ (mmol/L)	133 **(L)**	136–144[13]
K^+ (mmol/L)	7 **(H)**	3.6–4.9[13]
Cl^- (mmol/L)	103	99–107[13]
Ca^+ (mmol/L)	1.06 **(L)**	2.0–2.8[13]
Glucose (mmol/L	1.1 **(L)**	2.2-5.6[13]
L-Lactate (mmol/L)	8.52 **(H)**	2.0[14]
HCT (%)	17 **(L)**	24-46[15]

HCO_3^-: Bicarbonate, Na+: Sodium, K^+: Potassium, Cl^-: Chlorine, Ca^+: Calcium, L; Low, H; High

DISCUSSION

T. annulata is an important hemoprotozoan disease affecting cattle with various clinical signs.[16] Common clinical manifestations include icterus, anemia, enlarged superficial lymph nodes, loss of appetite, and elevated body temperature.[8,9] This case report, however, reports the unusual discovery of exophthalmus in *T. annulata* infected cattle a condition that has never before been reported in Turkiye.

In blood gas analysis, pH, HCO_3^-, HCT were detected below the reference value reported for cattle and anemia and metabolic acidosis were detected. It is known that metabolic acidosis can be seen in 2 types, secretory and titrational. It is stated that hypoxia will occur due to the decrease in tissue perfusion due to anemia formed in *T. annulata* and that the production of lactic acid and other metabolites acids, which are products of anaerobic metabolism, will increase as a result of severe liver and kidney dysfunction, thus the acidosis caused by the presence of non CO2 acids leading to a decrease in HCO_3^- is of the titrational type.[17] Although the metabolic acidosis detected in this case report is consistent with some studies[2,17,18] evaluating blood gas parameters in *T. annulata*, a case in which metabolic acidosis and anemia were not observed was reported by Ünal and Uztimür.[19] The reason for the variable findings between cases is considered to be the severity of the infection and the differences in the general condition and immune systems of the infected animals.

Although there are limited studies evaluating lactate concentration in cattle infected with *T. annulata*, hyperlactatemia was reported by Uztimür and Keçeci[2] as 9.95 mmol/L and Ünal and Uztimür[19] as 5.61 mmol/L, which is consistent with the results in this case. It has been stated that hyperlactatemia in cattle infected with *T. annulata* may occur as a result of tissue anoxia due to anemia triggering the lactic acid mechanism.[17]

As reported in many studies on *T. annulata*[8,9,19], the clinical examination in this instance revealed the usual signs of respiratory frequency, body temperature rising by 41.6 °C, icterus, conjunctiva, oral mucosa, and skin petechiae. There are many different clinical manifestations of *T. annulata*, and uncommon clinical signs have also been documented. Cattle infected with *T. annulata* may exhibit uncommon clinical signs such as ulcerative hemorrhagic lesions[16], skin nodules[20], ocular edema[16], and epistaxis.[19] This case report describes the clinical observation of exophthalmus, a rare occurrence in previous reports. The exophthalmus associated with the disease was first described by Kumar et al.[11] and may have resulted from increased production of tumor necrosis factor-α and lymphocyte infiltration. Similarly, Sivajothi et al.[21] reported that it was caused by inflammatory cell infiltration and glycosaminoglycan accumulation in the cells, which led to the expansion of the extraocular muscles. Lastly, Sudan et al.[22] reported a case of proptosis, wherein *T. annulata* may have entered the cerebral circulation through the uteroplacental route and that increased vascular permeability negatively impacted vascular nutrition to the orbits. It is possible that these mechanisms may contribute to the observed case, even if the pathophysiology of exophthalmus in *T. annulata* is uncertain.

In this case report, rare findings of exophthalmus and edema in *T. annulata* were demonstrated. It was concluded that exophthalmus and edema findings should be taken into consideration in the differential diagnosis and treatment of *T. annulata* infection and that these findings should be better understood with further research.

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