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RESEARCH ARTICLE

Evaluation of Some Blood Gas, Hemogram and Biochemical Parameters in Cats with Hemoplasmosis

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ABSTRACT

The aim of this study was to evaluate some blood gases, hemogram, and biochemical parameters in cats with hemoplasmosis. Ten healthy and fifteen infected cats were enrolled in the study. 7 mL of blood sample was taken once from all cats into tubes with and without anticoagulant. Blood gases, complete blood count, and biochemical analyzes were performed from blood samples. While pH, HCO_3 and BE levels of cats with hemoplasmosis were significantly lower than healthy cats, lactate levels were higher ($p< 0.05$). WBC, Mon, Gra, and RDW levels were found to be significantly higher than in healthy cats, while RBC, Hct, Hb, and PLT levels were found to be lower ($p< 0.05$). AST, T.Bil, D.Bil, P, TG, LDH, TP, and CK levels were significantly higher than healthy, while Alb and Ca levels and A:G ratio were found to be low ($p< 0.05$). As a result, it was determined that metabolic acidosis, hyperlactatemia, anemia, hypertriglyceridemia, hypoalbuminemia, hyperbilirubinemia developed in cats with hemoplasmosis. In addition, it can be concluded that the A:G ratio should be considered in the diagnosis of infected cats and it should be evaluated together with other diagnostic test results.

Keywords: A:G ratio, Biochemical parameters, Blood gas, Complete blood count, Hemoplasmosis

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Hemoplazmozlu Kedilerde Bazı Kan Gaz, Hemogram ve Biyokimyasal Parametrelerin Değerlendirilmesi

ÖZ

Sunulan çalışmanın amacı, hemoplazmozlu kedilerde bazı kan gazı, hemogram ve biyokimyasal parametrelerin değerlendirilmesidir. Çalışmaya on sağlıklı ve on beş hemoplazmozlu kedi dahil edildi. Çalışmaya dahil edilen tüm kedilerden antikoagülanlı ve antikoagülansız tüplere bir kez 7 mL kan alındı. Kan örneklerinden kan gazı, tam kan sayımı ve biyokimyasal analizler yapıldı. Hemoplazmozlu kedilerin pH, HCO_3 ve BE düzeyleri sağlıklı kedilere göre anlamlı olarak düşük iken, laktat düzeyleri yüksekti ($p< 0.05$). WBC, Mon, Gra ve RDW seviyeleri sağlıklı kedilere göre anlamlı olarak yüksek bulunurken, RBC, Hct, Hb ve PLT seviyeleri düşük bulundu ($p< 0.05$). AST, T.Bil, D.Bil, P, TG, LDH, TP ve CK düzeyleri sağlıklı bireylere göre anlamlı olarak yüksek bulunurken, Alb ve Ca düzeyleri ile A:G oranı düşük bulundu ($p< 0.05$). Sonuç olarak hemoplazmozlu kedilerde metabolik asidoz, hiperlaktatemi, anemi, hipertrigliseridemi, hipoalbuminemi, hiperbilirubinemi geliştiği tespit edildi. Ayrıca hemoplazmozlu kedilerin tanısında düşük A:G oranının dikkate alınması ve diğer tanısal test sonuçları ile birlikte değerlendirilmesi gerektiği sonucuna varıldı.

Anahtar Kelimeler: A:G oranı, Biyokimyasal parametreler, Kan gazları, Tam kan sayımı, Hemoplazmoz

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INTRODUCTION

Hemotropic *Mycoplasma spp.* are gram-negative microorganisms that do not have a cell wall, are small (0.3-0.8 μm), are found on the surface of erythrocytes, cause varying degrees of hemolytic anemia in infected hosts, and cannot be cultured in laboratory environments (Sykes 2010). Hemotropic Mycoplasmas infect a wide variety of mammalian species, including humans, and have a worldwide distribution. Domestic and wild cats are one of the animal groups most affected by hemoplasma infections (Sykes and Tasker 2013, Aslan 2016). *M. haemofelis* is the most pathogenic species that cause hemoplasmosis in cats and causes the disease called feline infectious anemia (Sykes 2010).

Infections originating from hemoplasmosis are encountered more frequently in cases of various stress factors such as pregnancy, malnutrition, and lactation or co-infection, in addition to immunosuppression caused by various drugs used or retrovirus infections (Aslan 2016). Although it is known that blood-fed arthropods play an important role in the transmission of the disease, the transmission issue for Mycoplasmas is not fully clarified. It has been reported in some studies that the agent can be transmitted through blood transfusion, vertically, and even through saliva/spittle when cats bite each other (Woods et al. 2005, Willi et al. 2006, Willi et al. 2007).

The severity of clinical findings associated with *M. haemofelis* infection varies according to the period of infection, the virulence of the organism, and the severity of anemia. Lethargy, weakness, decreased appetite, dehydration, weight loss, pallor of the mucous membranes, and intermittent fever are usually determined as clinical findings in cats with hemoplasmosis (Tasker et al. 2018). As a result of hypoxia developing in severely anemic patients, dyspnea, tachypnea, tachycardia, heart murmur, and gallop rhythm may develop (Evans and Gruffydd-Jones 1984, Carney et al. 1993, Saki and Ozer 2011).

Hemoplasmas cause anemia through hemolysis and sequestration. The binding of the organism to erythrocytes directly damages the cell membrane, resulting in a shortening of the erythrocyte lifespan. Although intravascular hemolysis can occur with direct damage to erythrocytes, most hemolysis is thought to be extravascular. Cats that recover from the infection remain chronically infected with hemoplasmas for an indefinite period, which in some cases can last a lifetime. If the cat's carrier state is not successful in clearing the infection, it can also follow antibiotic treatment. Parasitemia is not seen on blood smears during this period and such animals are usually clinically normal, but infection can often be detected by Polymerase Chain Reaction (Tasker 2006).

For the diagnosis of hemoplasmosis cases, many studies have been encountered, which have been evaluated on different laboratory parameters (Kurtdede and Ural 2004, Akkan et al. 2005, Aslan et al. 2010, Sykes and Tasker 2013, Weingart and Kohn 2015). Although the findings of these studies are instructive, a definite conclusion has not been reached yet. This research was aimed to evaluate some blood gas, hemogram, and biochemical parameters in cats diagnosed with hemoplasmosis. It is aimed to contribute to a better understanding of the clinical-pathological changes that occur in hemoplasmosis cases and to expand the diagnostic approaches.

MATERIALS and METHODS

Animals

The animal material of the study consisted of 25 owned cats, aged 1-5 years, of different breeds and gender, 15 diagnosed with hemoplasmosis, and 10 healthy (bred to the clinic for general control without vaccination, antiparasitic application, or any disease). Cats with positive feline immunodeficiency virus (FIV), and feline leukemia virus (FeLV), feline infectious peritonitis (FIP) as a result of the rapid test kits (Asan Easy Test FIV Ab/FeLV Ag, and Asan Feline Corona Virüs (FCoV) Ab, ASANPharm, Korea) and other diseases were not included in the study. An informed consent form was received from the patient owners stating that they had accepted all the interventions to be performed before the applications.

Collecting and analyzing the blood samples

7 mL blood samples were taken once from all cats included in the study from the vena cephalica antebrachium into tubes with and without anticoagulant (1 mL into K_3-EDTA tubes for complete blood count and 1 mL into heparin syringe for blood gases analysis; 5mL for biochemical analysis) tubes using an appropriate IV cannula. Blood gases and complete blood count analyzes were performed within 5 minutes following blood collection. Blood power of hydrogen (pH), partial pressure of carbon dioxide (pCO_2), partial pressure of oxygen (pO_2), oxygen saturation (SO_2), potassium (K), sodium (Na), chlorine (Cl), lactate (Lac), base excess (BE), and bicarbonate (HCO_3) levels were measured in a blood gas device (ABL 90 Flex Blood Gas/Electrolyte Analyser, Model 5700 Radiometer, ABD). White blood cell (WBC), Lymphocyte (Lym), Monocyte (Mon), Granulocyte (Gra), red blood cell (RBC), mean corpuscular volume (MCV), haematocrit (Hct), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW),

hemoglobin (Hb), and platelet (PLT) levels in blood tubes with K_3-EDTA were determined in the complete blood count device (MS4 CFE 279, Haematology Analyser, France). Blood samples taken into gel tubes were centrifuged at 5000 rpm for 5 minutes and serum samples were extracted. Then blood urea nitrogen (BUN), creatinine (Cr), glucose (Glu), alanine transaminase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), amylase (AMY), cholesterol (Chol), triglyceride (TG), creatine kinase (CK), lactate dehydrogenase (LDH), gamma-glutamyl transferase (GGT) levels, total bilirubin (T.Bil), direct bilirubin (D.Bil), calcium (Ca), phosphorus (P), magnesium (Mg), total protein (TP), albumin (Alb), and albumin:globulin (A:G) ratio were measured with an autoanalyzer (Biotecnica BT 3000 Plus, Italy).

Diagnosis of Hemoplasmosis

Blood smears were prepared by taking one drop of blood from each of the anticoagulant (K_3-EDTA) blood samples. The smears fixed with methyl alcohol for 3-5 minutes were stained with Giemsa for 45 minutes. After the staining period was over, the smeared samples were washed for a minimum of 1 minute under the tap water to prevent the formation of stain residues and dried by placing them in an upright position on a dry surface. The dried smears were examined microscopically (Leica, Germany) under the light microscope by scanning more than 100 areas for about 5 minutes with a 100x magnification lens by dripping immersion oil. The Haemoplasma bacterias that settled in blood cells (erythrocyte) were determined (Figure 1).

Statistical analysis

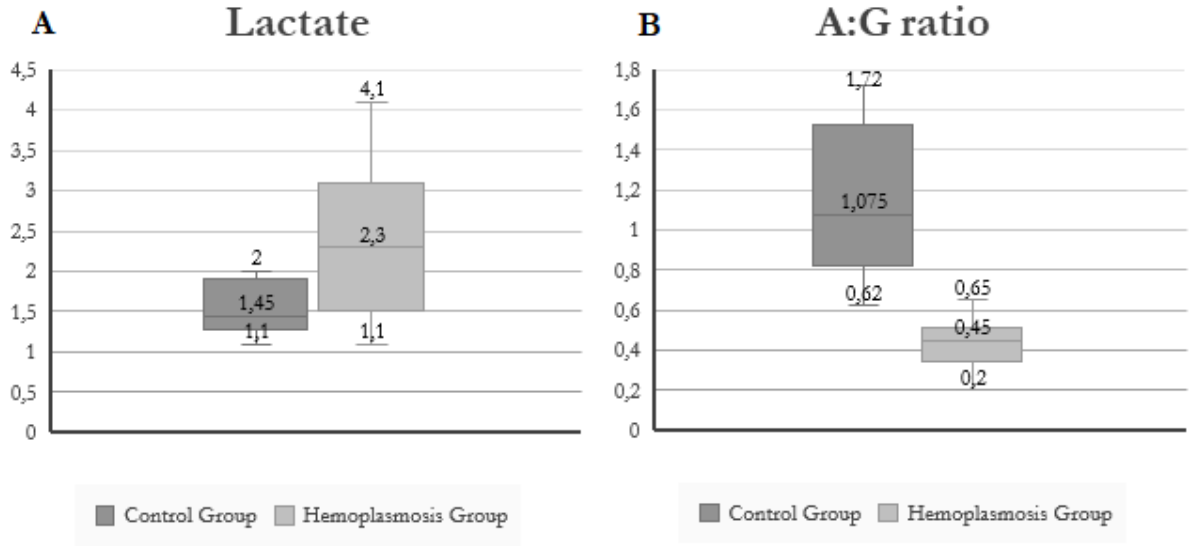
SPSS 25 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.) statistical program was used to evaluate the data. One-sample Kolmogorov-Smirnov test was applied to evaluate the normal distribution (parametric or nonparametric) preconditions of the data. The Mann-Whitney U test was used to compare the data with nonparametric distribution between groups and presented as median (min/max). The values of $p< 0.05$, $p< 0.01$, and $p< 0.001$ were accepted for the significance level of the tests.

RESULTS

Venous blood gases parameters of cats with hemoplasmosis and healthy cats are presented in Table 1. While blood gas pH, BE, and HCO_3 levels of cats with hemoplasmosis were significantly lower than healthy cats, lactate concentration (Graphic 1A) were higher ($p< 0.05$). Complete blood count results of cats with hemoplasmosis and healthy cats are presented in Table 2. WBC, Mon, Gra, and RDW levels of cats with hemoplasmosis were found to be significantly higher than healthy cats ($p< 0.05$). RBC, Hct, Hb, and PLT levels were found to be significantly lower ($p< 0.05$).

The results of serum biochemical analysis of cats with hemoplasmosis and healthy cats are presented in Table 3. AST, T.Bil, D.Bil, P, TG, LDH, TP, and CK levels were found to be significantly higher in cats with hemoplasmosis compared to healthy cats ($p< 0.05$). Alb and Ca levels from biochemical parameters and the A:G ratio (Graphic 1B) were found to be low ($p<0.05$).

Şekil 1. Sağlıklı ve hemoplazmozlu kedilerin laktat konsantrasyonu (A) ve A:G oranı (B).
Graphic 1. Lactate concentation (A) and A:G ratio (B) of healthy and hemoplasmosis cats.



Tablo 1. Sağlıklı ve hemoplasmoz ile enfekte kedilerin venöz kan gaz sonuçları (median (min/max).
Table 1. Venous blood gases results of healthy and hemoplasmosis-infected cats (median (min/max).

Parameters median (min/max)	**Control Group (n=10)**	**Hemoplasmosis Group (n=15)**	**P value**
pH	7.38 (7.33/7.41)	7.33 (7.22/7.40)	**0.016**
pCO_2 (mmHg)	34.7 (29.50/40.20)	31.7 (14.90/41.80)	0.080
pO_2 (mmHg)	41.6 (32.60/46.10)	37.2 (26.30/57.80)	0.892
SO_2 (mmHg)	61.15 (44.50/71.10)	54.2 (24.20/83.70)	0.567
K (mmol/L)	4.2 (3.60/5.30)	3.7 (2.80/4.60)	0.643
Na (mmol/L)	156.5 (151/158.00)	156 (152.00/168.00)	0.807
Cl (mmol/L)	121.5 (118/125.00)	123 (116.00/137.00)	0.216
Lac (mmol/L)	1.45 (1.10/2.00)	2.3 (1.10/4.10)	**0.026**
BE (mmol/L)	-4.8 (-8.30/-0.60)	-9 (-16.30/2.40)	**0.004**
HCO_3 (mmol/L)	20 (17.90/22.90)	17.1 (11.30/26.50)	**0.004**

pH: Power of hydrogen, pCO_2: partial pressure of carbon dioxide, pO_2: partial pressure of oxygen, SO_2: oxygen saturation, K: potassium, Na: sodium, Cl: chlorine, Lac: lactate BE: base excess, HCO_3: bicarbonate

Tablo 2. Sağlıklı ve hemoplasmoz ile enfekte kedilerin tam kan sayımı sonuçları (median (min/max).
Table 2. Complete blood count results of healthy and hemoplasmosis-infected cats (median (min/max).

Parameters median (min/max)	Control Group (n=10)	Hemoplasmosis Group (n=15)	P value
WBC (x 10^9 cells/L)	10.7 (5.80/18.60)	39.9 (10.93/125.10)	**0.000**
Lym (x 10^9 cells/L)	4.92 (2.23/33.80)	11.08 (2.01/17.76)	0.071
Mon (x 10^9 cells/L)	0.94 (0.61/1.64)	2.26 (0.48/6.13)	**0.016**
Gra (x 10^9 cells/L)	5.28 (2.58/11.27)	30.38 (3.28/101.21)	**0.000**
RBC (x 10^3 cells/mL)	10.5 (7.26/12.30)	5.5 (2.20/8.78)	**0.000**
MCV (fL)	49.4 (45.80/53.20)	43.4 (26.80/70.20)	0.397
Hct (%)	46.5 (35.40/52.50)	20.7 (12.90/38.10)	**0.000**
MCH (pg)	12 (7.40/15.70)	13.6 (0.60/17.30)	0.723
MCHC (g/dL)	23.6 (15.10/34.00)	28.7 (1.20/37.20)	0.285
RDW (%)	11.4 (10.30/17.70)	12.1 (10.80/19.60)	**0.031**
Hb (g/dL)	12 (8.40/16.60)	5.6 (0.20/14.20)	**0.000**
PLT (x 10^9 cells/L)	137 (97.00/186.00)	78 (10.00/102.00)	**0.000**

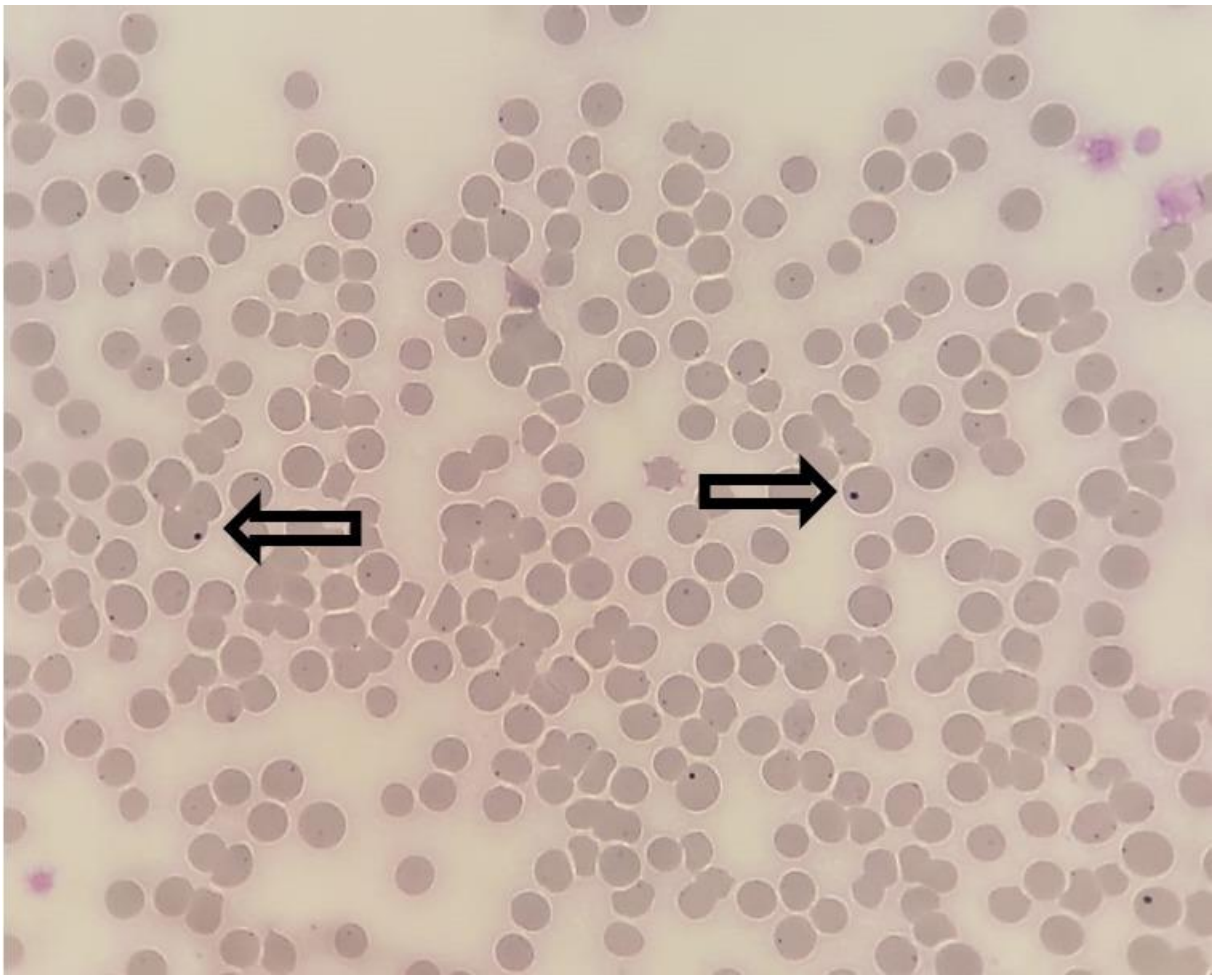
WBC: white blood cell, Lym: lymphocyte, Mon: monocyte, Gra: Granulocyte, RBC: red blood cell, MCV: mean corpuscular volume Hct: haematocrit, MCH: mean corpuscular hemoglobin, MCHC: mean corpuscular hemoglobin concentration, RDW: red cell distribution width, Hb: Hemoglobin, PLT: platelet

Tablo 3. Sağlıklı ve hemoplasmoz ile enfekte kedilerin biyokimyasal analiz sonuçları (median (min/max).
Table 3. Serum biochemical analysis results of healthy and hemoplasmosis-infected cats (median (min/max).

Parameters median (min/max)	Control Group (n=10)	Hemoplasmosis Group (n=15)	P value
BUN (mg/dL)	18.90 (4.69/23.58)	27.18 (8.70/90.17)	0.055
Cr (mg/dL)	1.27 (0.75/1.50)	1.2 (0.39/5.10)	0.935
Glu (mg/dL)	106.02 (12.10/186.86)	108.51 (14.00/167.00)	0.978
ALT (U/L)	45.60 (24.00/81.29)	62 (21.09/279.99)	0.103
AST (U/L)	21.33 (15.33/87.00)	80.92 (17.48/134.00)	**0.001**
ALP (U/L)	41.73 (24.62/113.00)	33.72 (2.86/156.08)	0.285
AMY (U/L)	1443.98 (904.00/2453.10)	1551.83 (204.77/2898.05)	0.495
Chol (mg/dL)	193.47 (82.00/279.46)	173.76 (86.87/439.42)	0.367
TG (mg/dL)	43.84 (24.00/148.16)	73.41 (44.75/488.00)	**0.012**
CK (U/L)	169.59 (61.97/324.07)	320.56 (149.55/1544.00)	**0.004**
LDH (U/L)	121.69 (84.00/267.40)	437.89 (111.49/2127.13)	**0.000**
GGT (U/L)	3.02 (1.43/3.36)	3.75 (1.00/10.47)	0.160
T.Bil (mg/dL)	0.38 (0.10/1.35)	1.62 (0.18/10.10)	**0.001**
D.Bil (mg/dL)	0.26 (0.10/1.35)	1.18 (0.15/3.40)	**0.001**

Ca (mg/dL)	10.67 (6.12/12.75)	7.98 (6.10/14.10)	**0.026**
P (mg/dL)	4.48 (3.46/8.69)	6.26 (2.55/12.39)	**0.014**
Mg (mg/dL)	1.83 (1.55/2.07)	1.71 (1.10/3.60)	0.165
TP (g/dL)	7.19 (5.90/7.92)	8.6 (4.38/10.90)	**0.004**
Alb (g/dL)	3.63 (2.80/4.12)	2.56 (1.40/3.30)	**0.000**
A:G ratio	1.07 (0.62/1.72)	0.45 (0.20/0.65)	**0.000**

BUN: blood urea nitrogen, Cr: creatinine, Glu: glucose, ALT: alanine transaminase, AST: aspartate aminotransferase, ALP: alkaline phosphatase, AMY: amylase, Chol: cholesterol, TG: triglyceride, CK: creatine kinase, LDH: lactate dehydrogenase, GGT: gamma-glutamyl transferase, T.Bil: total bilirubin, D.Bil: direct bilirubin, Ca: calcium, P: phosphorus, Mg: magnesium, TP: total protein, Alb: albumin, A:G ratio: albumin globulin ratio



Resim 1. Giemsa ile boyanmış kan frotisinde eritrositlerde *Mycoplasma spp.*'nin görünümü. Siyah oklar, kırmızı kan hücrelerinin yüzeyinde bulunan etkenleri göstermektedir (x100).
Figure 1. Appearance of *Mycoplasma spp.* in the erythrocytes on a Giemsa-stained blood smear. The black arrows indicate the organisms positioned on the surface of the red blood cells (x100).

DISCUSSION

In the present study, blood gas, complete blood count, and biochemical analysis parameters were evaluated in cats with hemoplasmosis, and it was determined that metabolic acidosis, anemia, and changes in biochemical parameters occurred in cats with hemoplasmosis. It was evaluated that the A:G ratio should be considered in the diagnosis of hemoplasmosis.

To the authors' knowledge, no study has been found evaluating blood gases in cats with hemoplasmosis. In the present study, blood pH, BE, and HCO_3 levels of cats with hemoplasmosis were significantly lower than those of healthy cats, while lactate concentration were found to be higher ($p< 0.05$). The findings show that metabolic acidosis and hyperlactatemia develop in cats with hemoplasmosis. Studies in anemic patients infected with Plasmodium species have reported that systemic hypoxia due to anemia may lead to an increase in anaerobic glycolysis, higher lactate production, and lactic acidosis (English et al. 1997, Dabadghao et al. 2015). It has also been reported that malaria-infected erythrocytes produce up to 100 times more lactate than uninfected erythrocytes (Vander Jagt et al. 1990, Mehta et al. 2005). In our study, it was evaluated that hyperlactatemia occurring in cats with hemoplasmosis may be associated with decreased tissue perfusion due to anemia and increased lactate production from infected red blood cells.

Although it has been reported that the WBC and granulocyte levels of cats with hemoplasmosis may be normal, high, or low, it is stated that there is an increase in monocyte levels (Kurtdede and Ural 2004, Akkan et al. 2005, Aslan et al. 2010, Sykes 2010, Evans and Gruffydd-Jones 1984, Carney et al. 1993, Saki and Ozer 2011). Erythrophagocytosis by monocytes or macrophages may be observed if blood films are scanned at low magnification (Messick and Harvey 2012). In the present study, the increase in total leukocyte count, granulocytosis, and monocytosis in cats with hemoplasmosis was interpreted as an indicator of active inflammation due

to infection. The most common abnormality in whole blood analysis of cats with hemoplasmosis is regenerative anemia. Regenerative anemia is characterized by the presence of an adequate reticulocyte response for the current degree of anemia (Tasker 2006). Non-regenerative anemia can also be seen in cases where sufficient time has not passed yet for a regenerative response. In addition, the release of uninfected red blood cells from the spleen can cause a rapid increase in packed cell volume seen in some infected cats (Sykes and Tasker 2013). In a study on Van cats (Akkan et al. 2005), normochromic anemia was determined in cats with haemobartonellosis, and it was reported that Hct and Hb levels were low in a *Mycoplasma spp.* positive Persian cat (Senthil et al. 2014). Alan et al. (2022) found that the platelet count (PLT), platelet indices plateletcrit (PCT), RBC, Hct, and Hb levels were lower in infected cats than in healthy animals, and platelet volume (MPV) was higher. In the present study, it was determined that while the RBC, Hct, Hb, and PLT levels of cats with hemoplasmosis were significantly lower, RDW levels were significantly higher than healthy cats. It was determined that regenerative anemia developed in cats with hemoplasmosis, which resulted in similar results to the studies conducted in our research (Kurtdede and Ural 2004, Tasker 2006, Alan et al. 2022).

It has been reported that the main biochemical changes in cats with hemoplasmosis are a moderate increase in ALT and AST enzyme activities due to hepatic hypoxia resulting from anemia and an increase in bilirubin concentrations due to extravascular and intravascular hemolysis (Tasker 2006, Fathi et al. 2009, Saqib et al. 2016, Weingart and Kohn 2015). It has been reported that the development of hepatic lipidosis together with anorexia may contribute to the increase in liver enzyme activities (Harvey 1998). Akkan et al. (2005) reported that there was no significant difference in ALT, AST, and bilirubin levels in their study of Van cats, contrary to the researchers mentioned above. Hypertriglyceridemia has been described in various diseases with hemophagocytosis (Visser et al. 2013). In humans, *P. falciparum* infection is characterized by hypertriglyceridemia and hypocholesterolemia, and hypocholesterolemia has been associated with cholesterol depletion by the malaria parasite, whereas hypertriglyceridemia has been associated with hemolysis of infected red blood cells (Bouyou-Akotet et al. 2014). In the present study, serum AST enzyme activity, bilirubin, and triglyceride concentrations were found to be higher in cats with hemoplasmosis compared to the control group. It was evaluated that the high bilirubin and triglyceride concentrations were caused by intravascular and extravascular hemolysis in these patients, while the increase in AST activity was interpreted to be due to hepatic lipidosis resulting from anemia-induced hepatic hypoxia and anorexia. (Harvey 1998, Fathi et al. 2009, Weingart and Kohn 2015, Saqib et al. 2016)

CK and LDH are intracellular enzymes widely used in the detection of tissue damage (Kristjansson et al. 2016). CK is an enzyme that catalyzes the ATP-dependent phosphorylation of creatine and is important for energy buffering in tissues with variable energy demands, particularly skeletal and cardiac muscle (Wallimann et al. 1992). LDH is a widely distributed enzyme in the cells of various living systems where it is involved in carbohydrate metabolism that catalyzes the interconversion of lactate and pyruvate with NAD^+. LDH levels in blood serum are increased in various hematological and neoplastic disorders as well as heart, liver, skeletal muscle, and kidney diseases (Klein et al. 2020). LDH together with AST have higher activity in erythrocytes compared to plasma, and its levels increase in vivo or in vitro hemolysis. AST, ALT, LDH, and CK levels may increase in hemolysis cases (Terlizzi 2012). While elevated CK and LDH levels in cattle with babesiosis are associated with anoxia and muscle damage as a result of perfusion disorder (Wright et al. 1981), it has been reported that hemolysis is effective in addition to muscle damage in plasmodium-infected humans (Garba and Ubom 2005). Akkan et al. (2005) reported that there was no significant difference in CK enzyme activity in cats with hemoplasmosis compared to healthy cats. In the present study, LDH and CK levels were found to be higher in cats with hemoplasmosis compared to healthy cats. It was evaluated that high LDH and CK levels in our study may be associated with hemolysis rather than muscle damage (Garba and Ubom 2005, Terlizzi 2012).

When the mineral profile was evaluated in the present study, the phosphorus levels of the cats with hemoplasmosis were higher than the healthy cats, while the calcium levels were found to be lower. While high phosphorus levels in cats with hemoplasmosis were considered to be associated with intravascular hemolysis, low calcium levels were interpreted as a result of decreased albumin concentrations and decreased calcium binding to albumin in infected cats (Martin et al. 2015, Sharp et al. 2009).

Changes in albumin, total protein, and A:G ratio in infectious diseases are generally associated with the inflammatory response that develops during the progress of the disease. Hyperglobulinemia and hypoalbuminemia have been identified in studies in cats with hemoplasmosis (Kurtdede and Ural 2004, Weingart and Kohn 2015). In the present study, it was determined that while TP levels of cats with Hemoplasmosis were significantly higher compared to healthy cats, Alb and A:G ratios were lower. Although the findings were consistent with the findings of other investigators, it was remarkable that the A:G ratio was <0.6 in infected cats, except for one case. Hyperglobulinemia and low A:G ratio have been reported to be an important diagnostic

parameter in cats with FIP (Paltrinieri et al. 2002, Addie et al. 2009, Pedersen et al. 2009, Riemer et al. 2016). A:G ratio less than 0.6 has been reported to be an important diagnostic parameter in patients infected with FIP (Hirschberger et al. 1995). The low A:G ratio in cats with hemobartonellosis in our study is similar to the studies in cats with FIP (Paltrinieri et al. 2002, Addie et al. 2009, Pedersen et al. 2009, Riemer et al. 2016). Therefore, we think that hemoplasmosis should be considered in addition to FIP in cats with a low A:G ratio.

CONCLUSION

In this study, the small number of animals and the lack of molecular confirmation of hemoplasmosis were important limiting factors. Despite limitations, our findings show that there are significant changes in cats with hemoplasmosis, such as metabolic acidosis, hyperlactatemia, anemia, hypertriglyceridemia, hypoalbuminemia, and hyperbilirubinemia. In addition, it was concluded that low A:G ratio should be considered in the diagnosis of cats with hemoplasmosis and should be evaluated together with other diagnostic test results.

Conflict of Interest: The authors declare that there is no actual, potential or perceived conflict of interest for this article.

Authorship Contributions: Mİ:%30, MKD:%20, SSİ: %20, CC:%15, MCK:%15

Ethical Approval: This study was approved by Selcuk University, Institutional Ethics Committee of the Faculty of Veterinary Medicine (2022/45).

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