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Pyometra in Queens - Changes in Haemato-Biochemical Parameters

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ABSTRACT

***Background*:** Pyometra is a bacterial and hormone-induced reproductive disease that occurs in the post-estrus luteal phase in intact queens. Pyometra is more common in the diestrus period due to the high progesterone concentration (in queens that mated, spontaneously ovulated, or were induced to ovulate). However, it can also be seen due to the use of exogenous hormones such as progesterone for the suppression of estrus. More research is needed in cases of pyometra in queens, as well as in bitches. Because, considering that the pathogenesis and characteristics of feline pyometra is similar to bitches, studies on pyometra-affected bitches are taken as reference in studies and applications on queens. From this point of view, the aims of this study were to reveal the changes in complete blood count, blood gas, and serum biochemistry parameters in feline pyometra cases and to determine the correlation between the mentioned parameters.

***Materials, Methods & Results*:** In the study, a total of 25 female cats of different breeds were used, between the ages of 6 months and 7 years, 15 were diagnosed with pyometra, and 10 healthy. Anamnesis, clinical findings, and ultrasonographic examinations were used in the diagnosis of pyometra. Abdominal ultrasonography was performed on queens brought to the clinic with complaints such as anorexia, polydipsia, polyuria, abdominal tension, and fever. The control group (n =10) consisted of queens that were introduced to the clinic and were reproductively healthy. Before any treatment in queens with pyometra and the control group, 1 mL blood samples were taken from v. cephalica to evaluate complete blood count, blood gases and serum biochemistry parameters. In complete WBC, Lym, Mon, Gra, RBC, Hb, HCT, MCV, MCH and PLT parameters and, blood gas parameters such as pH, pCO_2, pO_2, sO_2, Na, K, Cl, lactate, glucose, HCO_3, and BE were also evaluated in taken blood samples. Biochemical parameters BUN, creatinine, ALT, AST, ALP, amylase, T.BIL, D.BIL, P, CHOL, TG, LDH, TP, CPK, ALP, Ca, GGT were measured in serum samples. After examination and laboratory analysis, ovariohysterectomy was performed on queens as a treatment. Granulocyte, WBC, HCT and MCH levels of the pyometra group were higher ($P < 0.05$) and Lym levels were lower ($P < 0.05$) compared to the control group. According to these results, pH, HCO_3, and BE were lower ($P < 0.05$) in queens with pyometra than those in the control group, while Na and lactate parameters were higher ($P < 0.05$). According to the results of biochemical analysis, it was determined that BUN, creatinine levels, GGT, and LDH enzyme activities were found to be higher in the pyometra group compared to the control group, while the Ca level was found to be low ($P < 0.05$). A positive correlation was observed between BUN and creatinine and LDH, WBC, granulocyte, HCT, and lactate, and a negative correlation between lymphocytes, pH, and BE in the correlation analysis performed on queens with pyometra and control group. However, a positive correlation was observed between creatinine and LDH and HCT, and a negative correlation between lymphocyte, pH and BE.

***Discussion*:** There is not enough information about pyometra in queens. As a result, it was determined that there were significant changes in complete blood count, blood gases and serum biochemical parameters in queens with pyometra in this study. These changes were generally thought to be related to dehydration and sepsis or endotoxemia. In addition, it was evaluated that prerenal azotemia occurring in pyometra affected queens may cause renal dysfunction. For this reason, it is thought that the results obtained in the presented study may contribute to the diagnosis, treatment, and prognosis of pyometra cases in queens.

Keywords: female cats, blood gas analysis, complete blood count, correlation, serum biochemistry.

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INTRODUCTION

Pyometra is a bacterial and hormone-induced reproductive disease that occurs in the post-estrus luteal phase in intact queens and is characterized by the accumulation of pus in the uterus [13]. Pyometra is more common in the diestrus period due to the high progesterone concentration. However, it can also be seen due to the use of exogenous hormones such as progesterone for the suppression of estrus [4,17,43]. Because queens are seasonal polyestrous animals and show provoking ovulation, they are less exposed to the effects of progesterone and are less likely to have pyometra than bitches [17]. However, in recent years, it has been stated that the probability of pyometra is higher, especially in pure-breed queens. Because queens show estrus throughout the year, inter-estrus intervals are quite short and more likely to experience increased spontaneous ovulation. Therefore, these queens are more frequently exposed to the priming effect of estrogen and higher concentrations of progesterone. Anamnesis, clinical and ultrasonographic examination, laboratory analysis and, if necessary, radiography is used in the diagnosis and prognosis of pyometra cases [3,8]. However, the biochemical changes seen in pyometra infection in queens are less obvious than in bitches. Considering that the pathogenesis and characteristics of queen pyometra are similar to bitches, studies on pyometra-affected bitches are taken as references in studies and applications on queens. From this point of view, the aims of this study were to reveal the changes in complete blood count, blood gas, and serum biochemistry parameters in queen pyometra and to determine the correlation between these parameters.

MATERIALS AND METHODS

Animals

In the study, a total of 25 female cats of different breeds, between the ages of 6 months and 7 years, 15 diagnosed with pyometra, and 10 healthy (introduced to the clinic for genital organ examination) were used. The informed consent form was obtained from the patients before the examination and treatments to confirm that they approved all the interventions.

Anamnesis, clinical findings, and ultrasonographic examinations were used in the diagnosis of pyometra. Abdominal ultrasonography was performed on queens brought to the clinic with complaints such as anorexia, polydipsia, polyuria, abdominal tension and fever. Queens (n = 15) whose uterine contents were filled with hypoechoic to hyperechoic fluid with or without flocculation during the ultrasonographic examination were evaluated as pyometra. The control group (n = 10) consisted of queens that were introduced to the clinic and were reproductively healthy.

Blood samples

Before any treatment in queens with pyometra and control group, 1 mL blood samples were taken from v. cephalica to evaluate complete blood count, blood gases and serum biochemistry parameters. In complete blood counts including white blood cell (WBC), lymphocyte (Lym), monocyte (Mon), granulocyte (Gra), red blood cell (RBC), hemoglobin (Hb), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and platelet (PLT) parameters were evaluated using an automatic cell counter[1]. In addition, blood gas parameters including such as pH, partial pressure of carbon dioxide (pCO_2), partial pressure of oxygen (pO_2), sO_2, sodium (Na), potassium (K), chlorine (Cl), lactate, glucose (Glu), bicarbonate (HCO_3) and base excess (BE) were performed using an automatic blood gas analyzer[2]. Biochemical parameters blood urea nitrogen (BUN), creatinine, alanine transaminase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), amylase, total bilirubin, direct bilirubin, phosphor, cholesterol, triglyceride, lactate dehydrogenase (LDH), total protein, creatine phosphokinase, albumin, calcium, gamma-glutamyl transferase (GGT) were measured analyzed in an automated analyzer[3] in the separated serum samples. Blood samples taken for serum biochemical analyzes were centrifuged at 20 *g* for 15 min and their serums were separated and stored under appropriate conditions.

Surgical treatment of pyometra

After examination and laboratory analysis, ovariohysterectomy was performed on queens as a treatment and all operative interventions were performed under general anesthesia. For anesthesia induction, medetomidin[4] [Domitor® - 0.08 mL/kg, IV], ketamine[5] [Ketasol 10%® - 5-7.5 mg/kg, IV], and butorfanol[5] [Butomidor® - 0.4 mg/kg, IV, SID] were administered. During the operation, mixed fluid therapy containing IV medetomidine-ketamine-meloxicam was applied to the queens for pain management and treatment. Antimicrobial therapy with cefazolin sodium[6] [Sefazol® - 25 mg/kg, IV, BID] was administered to the queens for 1 week following the operation.

Statistical analysis

The data were analyzed using SPPS 25 statistical software package[7]. Data were evaluated after controlling for normal distribution prerequisites (Kolmogorov-Smirnov). The Mann-Whitney U test was used because the differences between the 2 independent groups did not meet the parametric test prerequisites. Variables were expressed as mean (min/max) values. For the detection of correlation between variables, Spearman correlation test was used. $P < 0.05$, $P < 0.01$, and $P < 0.001$ values were accepted for the significance level of the tests.

RESULTS

The descriptive information of the queens diagnosed with pyometra in the study was given in Table 1. The queens were followed up after the operation and no death was observed in any of the patients. Anorexia, lethargy, polyuria, and polydipsia were observed in most of the queens with pyometra. The mean age (months) and weight (kg) of queens with pyometra were determined as 35 (6-85) and 3.3 (1.6-5), respectively. Although the majority of pyometra affected queens (n = 8) were cross-breeds, the disease was also observed in Scottish, Persian, Van, and Tabby breeds. In addition, 6 of the queens in the pyometra group had previously been administered progesterone hormones exogenously to suppress estrus. While vaginal discharge (open-cervix pyometra) was observed in 13 of the queens with pyometra, vaginal discharge was not detected in 2 (closed-cervix pyometra).

Findings of complete blood counts of the queens in the pyometra and control groups were given in Table 2. WBC, granulocyte, HCT and MCH levels of pyometra group were higher ($P < 0.05$) and lymphocyte levels were lower ($P < 0.05$) compared to the control group.

The blood gas parameters of pyometra and control groups were given in Table 3. According to these results, pH, HCO_3, and BE were lower ($P < 0.05$) in queens with pyometra than those in the control group, while Na and lactate parameters were higher ($P < 0.05$).

The data showing the changes in the biochemical parameters of the pyometra and control groups were given in Table 4. According to the results of biochemical analysis, it was determined that BUN, creatinine levels, GGT, and LDH enzyme activities were found to be higher in the pyometra group compared to the control group, while the Ca level was found to be low ($P < 0.05$). In addition, a positive correlation was observed between BUN and creatinine and LDH, WBC, granulocyte, HCT, and lactate, and a negative correlation between lymphocytes, pH and BE in the correlation analysis performed on queens with pyometra and control group. However, a positive correlation was observed between creatinine and LDH and HCT, and a negative correlation between lymphocyte, pH and BE (Table 5). Correlations between other parameters were also given in Table 5.

Table 1. The descriptive information about 15 queens diagnosed with pyometra.

Age (Month)	Breed	Exogenous hormones	Parturition	Vaginal Discharge	Antibiotics	Weight (kg)
46	Persian	+	+	-	-	4.1
25	Cross	-	-	+	-	2.7
12	Cross	+	-	+	-	3.6
15	Scottish	+	-	+	+	3.2
85	Cross	-	-	+	+	4
6	Cross	+	-	-	-	2.8
59	Tabby	-	+	+	+	4.7
63	Cross	-	-	+	-	1.6
22	Scottish	-	-	+	-	2.5
11	Tabby	+	-	+	-	2.8
35	Cross	-	-	+	-	5
26	Van	+	-	+	-	3
10	Cross	-	-	+	-	2.7
27	Cross	-	-	+	-	3.2
83	Tabby	-	-	+	-	3.6

Table 2. CBC results of healthy and pyometra affected queens (mean = min/max).

Parameters	Control group (n = 10)	Pyometra group (n = 15)	*P* value
WBC (cells/μL)	9.13 (6.22 - 13.60)	22.71 (3.20 - 43.21)	0.001
Lym (m/mm^3)	4.50 (1.46 - 5.77)	2.07 (1.03 - 3.69)	0.003
Mon (m/mm^3)	0.60 (0.30 - 8.20)	0.86 (0.27 - 6.72)	0.216
Gra (m/mm^3)	5.47 (2.88 - 10.51)	17.98 (1.02 - 47.92)	0.001
RBC (x106/μL)	9.75 (4.07 - 12.19)	9.54 (4.83 - 13.90)	0.605
Hb (g/dL)	11.15 (5.60 - 15.60)	12.80 (6.60 - 18.80)	0.311
HCT (%)	27.20 (20.10 - 50.00)	45.30 (24.90 - 61.40)	0.016
MCV (fL)	48.45 (42.10 - 57.50)	48.70 (41.90 - 55.40)	0.723
MCH (pg)	11.15 (9.00 - 15.10)	13.50 (11.80 - 17.10)	0.048
PLT (X 103/μL)	76.00 (30.00 - 266.00)	91.00 (43.00 - 202.00)	0.397

CBC: complete blood count; WBC: white blood cell; Lym: lymphocyte; Mon: monocyte; Gra: granulocyte; RBC: red blood cell; MCV: mean corpuscular volume; HCT: hematocrit; MCH: mean corpuscular hemoglobin; HB: hemoglobin; PLT: platelets.

Table 3. Blood gas analysis results of healthy and pyometra affected queens (mean = min/max).

Parameters	Control group (n = 10)	Pyometra group (n = 15)	*P* value
pH	7.37 (7.34 - 7.43)	7.34 (7.23 - 7.38)	0.001
pCO_2 (mmHg)	35.05 (22.40 - 39.10)	32.30 (14.20 - 39.00)	0.238
pO_2 (mmHg)	40.10 (26.80 - 62.00)	38.90 (30.90 - 120.00)	0.978
sO_2 (%)	60.80 (39.20 - 87.60)	55.85 (34.80 - 91.60)	0.371
Na (mmol/L)	155.50 (152.00 - 158.00)	160.00 (153.00 - 177.00)	0.004
K mmol/L	3.80 (3.40 - 4.20)	3.90 (3.30 - 5.00)	0.683
Cl (mmol/L)	122.00 (118.00 - 128.00)	124.00 (118.00 - 132.00)	0.144
Lac (mmol/L)	1.60 (0.70 - 2.30)	2.80 (1.80 - 5.20)	0.000
Glu (mg/dL)	100.00 (74.00 - 113.00)	86.00 (60.00 - 178.00)	0.849
HCO_3 std (mmol/L)	18.65 (17.50 - 23.50)	17.10 (9.10 - 20.70)	0.008
BE (mmol/L)	- 1.25 (- 5.10 - 1.70)	- 9.50 (-15.40 - - 6.30)	0.000

pCO_2: partial pressure of carbon dioxide; pO_2: partial pressure of oxygen; Na: sodium; K: potassium; Cl: chlorine; Lac: lactate; Glu: glucose; HCO_3: bicarbonate; BE: base excess.

Table 4. Serum biochemical analysis results of healthy and pyometra affected queens (mean = min/max).

Parameters	Healthy group (n = 10)	Pyometra group (n = 15)	*P* value
BUN (mg/dL)	19.77 (4.69 - 21.40)	25.50 (18.50 - 82.10)	0.004
Cr (mg/dL)	1.42 (0.90 - 1.60)	1.80 (1.00 - 3.00)	0.005
ALP (U/L)	40.50 (14.00 - 74.00)	41.00 (8.00 - 192.00)	0.765
AST (U/L)	31.50 (17.85 - 65.00)	27.00 (16.00 - 172.00)	0.531
ALT (U/L)	62.00 (20.00 - 83.00)	47.00 (25.00 - 208.00)	0.238
TP (g/dL)	6.90 (5.80 - 9.00)	7.90 (6.30 - 9.10)	0.103
GGT (U/L)	1.00 (1.00 - 3.36)	3.00 (1.00 - 5.00)	0.026
LDH (U/L)	164.37 (82.00 - 400.00)	326.0 (85.0 - 2,699.0)	0.036
AMS (U/L)	1,269.5 (744.0 - 1,518.0)	1,209.0 (522.0 - 2,204.0)	0.935
CPK (U/L)	137.14 (69.00 - 713.00)	300.0 (117.0 - 2,480.0)	0.91
ALB (g/dL)	3.50 (2.80 - 4.10)	3.40 (2.20 - 5.20)	1.00
T.BIL (mg/dL)	0.54 (0.10 - 1.50)	0.60 (0.30 - 5.50)	0.531
D.BIL (mg/dL)	0.20 (0.10 - 0.70)	0.30 (0.10 - 3.40)	0.160
CHOL (mg/dL)	154.20 (106.0 - 196.66)	119.0 (76.00 - 262.00)	0.261
TG (mg/dL)	51.81 (15.00 - 122.00)	62.00 (25.00 - 575.00)	0.216
Mg (mg/dL)	1.90 (1.40 - 3.10)	1.80 (1.30 - 2.70)	0.495
Ca (mg/dL)	10.45 (8.80 - 12.75)	9.10 (3.90 - 15.40)	0.048
P (mg/dL)	4.63 (2.20 - 7.69)	5.30 (2.40 - 11.60)	0.311

BUN: blood urea nitrogen,; CR: creatinine; ALT: alanine transaminase; AST: aspartate aminotransferase; ALP: alkaline phosphatase; AMS: amylase; TBIL: total bilirubin; DBIL: direct bilirubin; P: phosphor; CHOL: cholesterol; TG: triglyceride; LDH: lactate dehydrogenase; TP: total protein; CPK: creatine phosphokinase; ALB: albumin; Ca: calcium; GGT: gamma - glutamyl transferase.

Table 5. Spearman correlation test results comparing blood parameters concentrations in 15 queens with pyometra with control group (10 healthy ones).

	WBC	Lym	Gra	HCT	pH	Na	Lac	HCO_3	BE	BUN	Cr	GGT	LDH
WBC	1	-.423*	.711**	.415*	-0.322	0.080	.471*	0.001	-0.332	.433*	0.270	0.285	.484*
Lym		1	-.512**	-0.288	.447*	-0.246	-.448*	.442*	.501*	-.454*	-.428*	-.505*	-0.255
Gra			1	0.345	-0.378	0.058	.500*	-0.020	-0.328	.538**	0.359	.448*	.420*
HCT				1	-.469*	0.310	.422*	-0.374	-.418*	.495*	.490*	0.076	.438*
pH					1	-0.234	-.540**	.645**	.712**	-.526**	-.600**	-0.064	-.619**
Na						1	0.377	-.580**	-.672**	0.018	0.294	0.263	0.178
Lac							1	-.575**	-.693**	.450*	0.245	0.331	0.372
HCO_3								1	.790**	-0.268	-0.321	-0.154	-0.253
BE									1	-.448*	-.437*	-0.251	-.475*
BUN										1	.636**	0.244	.489*
Cr											1	0.152	.451*
GGT												1	-0.018
LDH													1

*Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

Pyometra is a pathology that can cause loss of reproductive performance and even life-threatening in queens. Studies on the pathogenesis of pyometra and changes in blood and biochemical parameters have generally been conducted in bitches, but there is not enough information on this subject in queens [17].

The most common abnormality observed in complete blood count analyses of queens and bitches with pyometra is neutrophilic leukocytosis [33]. However, it is also stated that leukogram parameters may be normal in pyometra affected queens [17,33]. In this study, WBC and granulocyte levels were found to be higher in queens with pyometra compared to control group, while lymphocyte levels were found to be lower. It has been reported that the main reason for the increase in WBC is the infection due to increased bacterial colonization in the uterus [35]. Since neutrophils are the most common and dominant among white blood cells, increase in WBC is associated with neutrophilia, and it has been reported that an increase in the number of immature neutrophils is first observed with WBC in the presence of pyometra [33]. Many studies on pyometra in bitches confirm these findings [41,44]. In addition, it has been reported that lymphocytopenia can be seen with an increase in the total leukocyte count in bitches with pyometra, and this situation is directly proportional to the severity of the disease [12,39]. Previous data [12,39] associated the decrease in lymphocyte levels with immunosuppression and endotoxemia in pyometra affected bitches. In the present study, leukocytosis and granulocytosis determined in queens with pyometra were interpreted as indicators of active inflammation due to infection. It was evaluated that lymphocytopenia might be associated with suppression of the immune system [12].

Bitches with pyometra usually have normocytic normochromic or microcytic hypochromic nonregenerative anemia. The cause of anemia in pyometra is generally thought to be the passage of erythrocytes to the uterus via diapedesis, suppression of bone marrow and vaginal discharges [1,5,18]. However, it was determined that RBC, Hb, MCV and MCH levels remained within reference ranges and anemia did not occur in pyometra affected queens in the presented study. It has been evaluated that this situation may be related to the presence of less bloody vaginal discharge in pyometra cases in queens than in bitches. In addition, in this study, an increase in HCT levels was also observed in pyometra group, which was associated with dehydration.

Abnormalities such as polyuria, polydipsia, anorexia, dehydration, and body temperature increase observed in pyometra cases in bitches may cause acid-base and electrolyte disorders [21,32]. In a retrospective study reported [32] on 16 bitches with pyometra, it was found that metabolic acidosis was observed in 56% of the bitches, metabolic alkalosis was determined in 6.5%, and acid-base levels remained in the normal range in 37.5%. Previous data [14], have reported on the other hand, found that the average pH levels in bitches with pyometra were higher than in healthy ones, but pH levels remained within the reference range. The same researchers found that pCO_2, bicarbonate and BE levels were low in bitches with pyometra and interpreted this situation as mild metabolic acidosis compensated by respiration. In this study, a decrease in pH, HCO_3 and BE levels were determined in queens with pyometra. In addition, it was determined that the pH level showed a positive correlation with HCO3 and BE. These data obtained in the study show that there are significant changes in the acid-base balance of queens with pyometra.

Blood lactate concentrations increase due to factors such as decreased tissue perfusion in sepsis cases in bitches, hypermetabolism during inflammatory processes, and changes in the glycolytic enzyme system [6]. Although it has been reported that lactate levels are elevated in critically ill dogs and that lactate levels are useful in predicting prognosis [16,24,25,30,35,40] some researchers found that lactate levels in bitches with pyometra remained within reference ranges and had no prognostic significance [11,14,26,37]. The prognostic significance of lactate has not been demonstrated in critically ill cats [36]. In the present study, lactate levels were found to be higher in the pyometra group than in the control group. In addition, lactate levels were positively correlated with WBC, Gra, HCT, and BUN levels and negatively correlated with Lym, pH, HCO_3 and BE levels. The findings show that hyperlactatemia in queens with pyometra may be associated with decreased tissue perfusion and septicemia. It has also been reported that disorders in the liver, kidney and other organs due to pyometra may be effective in increasing lactate levels [6].

The calcium levels of the queens with pyometra were low, while the sodium levels were high in the present study. Previous data [31] found low Ca levels in 45% of cats with pyometra, and reported that abnormal serum Ca concentrations and depression caused a prolonged hospital stay. Researchers stated that these parameters can be used for postoperative care of pyometra affected queens. Previous data [14] reported that Ca concentrations decreased in bitches with pyometra due to endotoxemia. Hypernatremia in cats and dogs is usually caused by acute or chronic renal problems [42]. However, hypernatremia in pyometra affected bitches is generally associated with dehydration [34]. In this study, hypocalcemia detected in queens with pyometra was thought to be associated with endotoxemia [14] and hypernatremia associated with dehydration [38].

Especially in canine pyometra cases, it has been reported that hepatic and renal dysfunction was observed, and significant changes were detected in renal and hepatic parameters [27,29,37]. However, studies evaluating renal and hepatic profiles in queens with pyometra are quite inadequate. It has been reported that BUN and creatinine levels increase significantly in bitches with both open- and closed-cervix pyometra [39]. High BUN and creatinine levels are directly associated with renal disfunction and it is stated that it negatively affects the prognosis [23]. In another study, it was reported that serum BUN and creatinine concentrations would remain within the reference range unless dehydration-related prerenal azotemia develops [33]. In queens, it is reported that creatinine level increases in 12% of pyometra cases [23,28]. In this study, BUN and creatinine levels were found to be higher in pyometra group than in control group. In addition, a positive correlation was observed between BUN and creatinine levels in the presented study ($P < 0.01$). This was associated with prerenal azotemia induced by dehydration [33]. In addition, BUN and creatinine levels were found to be positively correlated with WBC, Gra HCT, lactate and negatively correlated with Lym, pH and BE. When the findings were evaluated, the increase in BUN and creatinine levels in pyometra cases was associated with stress, shock and formation of nephropathy due to toxemia caused by the purulent-derived content accumulating in the uterine lumen [41]. Studies in pyometra affected bitches reported interstitial fibrosis and renal tubular atrophy and this situation may lead to the development of renal failure in the long term [15]. These correlations and findings may be indicative of the development of renal dysfunction and even renal failure in pyometra affected queens.

Besides, GGT and LDH enzyme activities were found to be high in pyometra group in the study. In addition, a positive correlation was determined between LDH enzyme activity, BUN and creatinine levels. The elevation in GGT and LDH enzyme activities in canine pyometra cases has generally been associated with hepatic dysfunction [2,22]. However, it has been reported that the presence of hepatic dysfunction in bitches with pyometra should be evaluated together with other liver enzyme activities such as ALP, ALT and AST [9,10,41]. Although GGT and LDH enzyme activities are high in the presented study, hepatic dysfunction is not thought to develop in queens with pyometra, since ALT, AST and ALP enzyme activities are within normal limits [42]. Apart from the liver, LDH is also found at high levels in the heart, skeletal muscle, erythrocyte, intestine, and renal cortex. Urinary GGT levels increase in renal damage in cats and dogs [7,19,20]. In the presented study, the observed increase in GGT and LDH enzyme activities and the positive correlation between LDH and BUN and creatinine suggested that this situation may be associated with sepsis, dehydration and renal dysfunction.

CONCLUSIONS

As a result, it was determined that there were significant changes in complete blood count, blood gases and serum biochemical parameters in queens with pyometra. These changes were generally thought to be related to dehydration and sepsis or endotoxemia. In addition, it was evaluated that prerenal azotemia occurring in pyometra affected queens may cause renal dysfunction. For this reason, it is thought that the results obtained in the presented study may contribute to the diagnosis, treatment and prognosis of pyometra cases in queens.

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***Ethical approval*.** The study was conducted with the approval and permission of the Ethics Committee of Selcuk University Faculty of Veterinary Medicine, Experimental Animals Production and Research Center (Approval Number: 2022/48). Before the study, the owners of the queens provided informed consent and accepted all interventions to be performed.

***Declaration of interest*.** No conflicts of interest have been declared. The authors alone are responsible for the content and writing of the paper.

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