

COMPARATIVE EVALUATION OF BIOCHEMICAL PARAMETERS DURING URINARY INFECTION IN MALTESE AND BELGIAN SHEPHERD DOGS

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ABSTRACT. Urinary tract infections can be uncomfortable, painful and even dangerous for most dog breeds. Clinical signs are often nonspecific and insufficient for diagnosis. Urinalysis in combination with biochemical parameters and urine culture is the best combination of clinical findings for diagnosis of urinary tract infections. The incidence of urinary tract infections in dogs population is growing and 27% of dogs develop an urinary tract infection through their life. Urinary infections occur more often in the elderly than in younger dogs. More than 70% of all urinary tract infections are infections with one bacterial species. Biochemical profile is important aspect for diagnosis establishment, but due to the nature of action infection by different agents may be considered as individual case. The main aim of this research was to analyse biochemical parameters of Maltese and Belgian Shepherd (Malinois) dog breed, who were affected by urinary tract infections. Urea concentration was elevated in Malinois,

while urea, phosphates, albumins and alkaline phosphatase activity were elevated in Maltese dogs. Statistical analysis showed differences in concentrations of urea, creatinine, phosphates, so as alanine aminotransferase, alkaline phosphatase and amylase activity between compared breeds during acute urinary infections. Maltese dogs are less resistant to bacteria, that causes urinary tract infections, and have lower chance to maintain homeostasis of biochemical parameters in blood during urinary bacterial infections, in comparison to Maltese dogs.

Keywords: alkaline phosphatase; canine; phosphates; urea; urinary disease.

INTRODUCTION

Urinary tract infections (UTI) are caused by bacteria and they often affect the bladder and sometimes kidneys. Urinary tract infections are

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the most common infectious disease and higher incidence is observed in females and in adult animals (Ling, 2000; Ling *et al.*, 2001). The diagnosis of urinary tract infections is based on clinical findings and urinalysis, while the final diagnosis is established after the analysis of urine culture (Primovic, 2002; Weese *et al.*, 2011). Clinical signs are nonspecific and insufficient for diagnosis. On the other hand, sedimentary analysis is not adequate for diagnosis, but it is a useful additional measure that should be considered in conjunction with clinical signs and the results of culture (Yuri *et al.*, 1996). Hematuria and proteinuria are often present in the infection, but they are nonspecific and may be caused by non-infectious conditions. Clinical signs of UTI include dysuria, pollakiuria, and/or increased urgency for urination. The clinical signs are not pathognomonic for infection (Smee *et al.*, 2013). If urinary tract diseases exist, increased urea (BUN-Blood urine nitrogen) and creatinine in the blood are elevated. Elevated concentrations of urea and creatinine are present in dogs at the same time during urinary tract obstruction (Fearnley *et al.*, 1990; Delacroix & Winters, 2010).

The biological effects of calcium primarily depend on its ionized form. If there is increasement of calcium present, it binds to the phosphate and thereby reduces the concentration of free phosphate in the blood (Nowiki *et al.*, 2008). Elevated and decreased calcium values can indicate kidney disease. Higher concentrations of

phosphates in blood are observed during chronic renal disease (Hruska *et al.*, 2008). According to some researches, proteinuria is present during the damage of the urinary system (Harley & Langston, 1998). The main aim of this research was to determine the differences between biochemical parameters of Maltese and Belgian Shepherd-Malinois dogs affected by urinary infections.

MATERIAL AND METHODS

Blood samples were collected from *v. cephalica antebrachii externa* and placed in tubes. Collected blood samples were transferred to test tubes without anticoagulants for serum analysis. The next step was centrifugation (Heraeus-Sepatech, Germany) at 2000 rpm for 5 min. Analyses of biochemical parameters (glucose, urea, creatinine, phosphates, calcium, total proteins, albumins, globulins, ALP, ALT, cholesterol and amylase) were done by autoanalyser VetTest 8008 (Westbrook, Maine, United States) in the laboratory of Internal diseases on the Veterinary Faculty, Sarajevo. All animals were treated in accordance with the "Declaration on the Rights of Animals" (UNESCO, 1978) and "Universal Declaration on Animal Welfare" (WSPA, 2000). Results were analyzed by using SPSS (v. 17; SPSS, Inc., Chicago, IL, United States) software for estimation mean values of different biochemical parameters and statistically significant differences of all parameters with regard to factors supposed to cause variation.

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RESULTS

Descriptive statistical analysis (mean values and standard deviation, as well as values range) of biochemical parameters in Maltese and Belgian Shepherd dogs, which suffer from urinary tract infections, are presented in *Table 1*.

Concentrations of urea, phosphates, albumines and ALP activity were higher than reference range in Maltese dogs suffering from

urinary infections. In Belgian Shepherd dogs, only concentration of urea was above reference range. Statistical analysis shows significant differences, which are noticeable when comparing concentrations of urea ($p=0.00$), creatinine ($p=0.04$), phosphate ($p=0.00$), as well as ALP ($p=0.00$), ALT ($p=0.00$) and amylase ($p=0.00$) activity between Maltese and Malinois dogs suffering from urinary infections.

Table 1 - Values of biochemical parameters of Maltese and Malinois dogs

Biochemical parameter	Maltese		Belgian Shepherd-Malinois		Laboratory reference range	Sig.
	Mean value±SD	Range	Mean value±SD	Range		
Glucose (mmol/l)	6.89±1.22	4.83-9.23	6.39±1.11	4.06-8.13	3.89-7.95	0.14
Urea (mmol/l)	33.05±12.85	11.40-48.20	18.99±12.58	4.50-46.40	2.50-9.60	0.00*
Creatinine (µmol/l)	144.92±23.11	97.00-184.00	124.67±33.81	62.00-178.00	44.00-159.00	0.04*
Phosphates (mmol/l)	3.30±1.41	1.15-5.20	2.32±1.24	1.08-5.20	0.81-2.20	0.03*
Calcium (mmol/l)	2.57±0.17	2.27-2.85	2.60±0.15	2.38-2.83	1.98-3,00	0.96
Total proteins (g/l)	69.23±7.76	62.00-92.00	68.00±7.42	57.00-79.00	52-82	0.88
Albumins (g/l)	38.46±11.10	28.00-64.00	33.50±5.82	26.00-43.00	22-39	0.08
Globulins (g/l)	32.92±9.93	14.00-60.00	34.25±4.69	27.00-41.00	25-45	0.33
Cholesterol (mmol/l)	5.30±0.68	4.66-6.68	5.12±1.06	4.21-7.15	2.84-8.26	0.31
Alanine aminotransferase (U/l)	50.08±13.41	24.00-69.00	34.42±16.75	10.00-71.00	10-100	0.00*
Alkaline phosphatase (U/l)	300.54±55.52	200.00-402.00	60.08±20.06	31.00-97.00	23-212	0.00*
Amylase (U/l)	1236.15±527.33	745.00-2500.00	658.08±126.53	450.00-910.00	500-1500	0.00*

Concentration of total proteins correlate with concentrations of urea, creatinine, albumins and globulins in Maltese and Belgian Shepherd dog

breeds. Spearman's coefficient of correlation between these parameters is presented in *Table 2*.

Table 2 - Spearman's coefficient of correlation in Maltese and Malinois dogs

Protein	Urea		Creatinine		Albumins		Globulines	
	Maltese	Malinois	Maltese	Malinois	Maltese	Malinois	Maltese	Malinois
R	0.03	-0.24	-0.11	0.18	0.43	-0.74**	0.04	0.64*
Sig.	0.90	0.43	0.97	0.56	0.14	0.00	0.88	0.02

Spearman's coefficient of correlation between total proteins and creatinine is negative in Maltese dogs and positive for albumins, globulins and urea. These differences are not statistically significant. Positive correlation is evident in Malinois dogs and significant differences are observed for globulins ($p < 0.05$), while negative correlation is observed in Maltese dogs for albumins ($p < 0.01$).

The highest variability of biochemical parameters was observed

for the value of amylase in both dogs breeds with very high standard deviation and coefficient of variation. P-plot chart (*Fig. 1*) shows normality of data distribution for amylase for both breeds. A greater degree of dispersion of the individual amylase values was observed in Maltese, while the values of amylase which refers to Belgian Shepherd dogs shows linear dispersion.

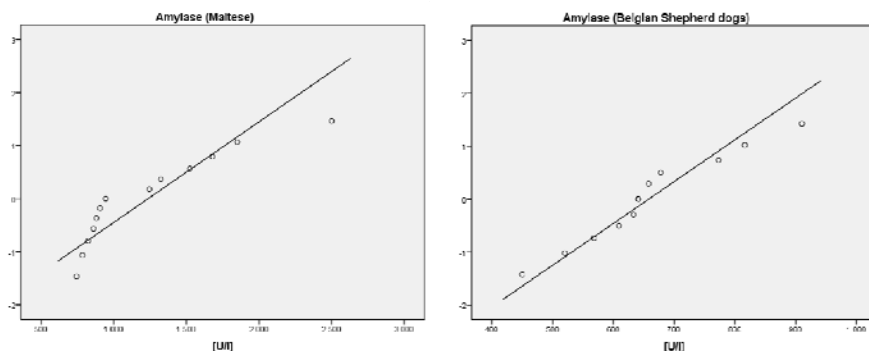


Figure 1 - Amylase values dispersion in Maltese (left) and Belgian Shepherd (right) dogs

DISCUSSION

The incidence of urinary tract infections in dogs population is growing and according to recent studies, about 27% of dogs through their lives develop an urinary tract infection. Infections usually occur in castrated females and rarely in castrated males, while in intact males it occur the least (Smee *et al.*, 2013). Considering the age, urinary infections occur more often in the elderly than in younger dogs. More than 70% of all urinary tract infections are infections with one bacterial species, while the rest is caused by multi-resistant bacterial species (Buberik *et al.*, 2007). A large number of studies, which refers to analysis of biochemical profile during urinary infections, are based on the analysis of proteins. Changes in the concentrations of blood proteins are the result of various clinical symptoms and are associated with pathophysiological processes and synthesis of acute-phase proteins (McGroddy & Knottenbelt, 2002).

Acute-phase proteins may be synthesized due to the infection, inflammation, tissue damage and stress. During the acute-phase response, cytokines are released from the macrophages and monocytes in place of inflammation (Jain *et al.*, 2011). One of the multiple effects of cytokines is a dramatic change in the liver protein synthesis. Infection with *Staphylococcus aureus* increases the concentration of acute-phase proteins (fibrinogen) and the reduction of

acute-plasma proteins (albumin) (Jain *et al.*, 2011). The half-life of albumin in dogs is 8.2 days and it decreases during infection or inflammation. Normal range of plasma albumin concentration in dogs are between 29 and 39 g/l (McGroddy & Knottenbelt, 2002). Globulin concentrations in dogs varies from 15 to 35 g/l according to Kaneko (1995) and 18-39 g/l according to Hines (2009).

Our study indicate higher values of serum albumin in Maltese and greater range, while the values of globulins were slightly lower. Individual albumin concentrations showed both hypo- and hyperalbuminemia. Zapryanova *et al.* (2013) observed a different daily protein value profile in dogs infected with *S. aureus*. Total protein and globulin recorded a gradual growth during the first day of infection with maximum values of total proteins after seven days and lower values of globulin, in comparison to the beginning of infection. Georgieva *et al.* (2011) reported cascade rise of globulin during a period of infection and reduction of serum albumin. Martinez-Subiela & Ceron (2005) and Valladares *et al.* (2001) reported that plasma total protein concentrations were closely related to the upper limits of the usual ranges defined in outpatient adult dogs. Hypoalbuminemia may occur due to the reduction in amino acids resorbtion or increased catabolism of amino acids. Low albumin level may result as preferential synthesis of positive acute-phase protein in the

liver, as an important component of systemic defense mechanisms (Gruys *et al.*, 1998).

Biochemical profil is important aspect for diganosis establishment, but due to the nature of action infection by different agents may be considered as individual case (Orhue *et al.*, 2005). Convulsions of protein suggest to infection and hypoalbuminemia is a sure sign. High globulin values further confirm the diagnosis. The existence of correlation between protein and its fractions certainly indicate a particular infection. Depending on the degree of infection, urea and creatinine concentration are changed. Significant increase of urea, phosphate, albumin and alkaline phosphatase activity was observed in Maltese dogs in our research. Belgian shepherds had increased urea value in the blood. Same results on German Shepherd dogs were observed in study of Shadia (2009), who is relatively similar in terms of physiological characteristics to Belgian Shepherd dog. Reduced renal filtration of creatinine occurs in cases of various acute and chronic kidney disease, reduced blood flow through the kidneys due to shock, dehydration and after administration of nephrotoxic drugs.

CONCLUSIONS

It is observed that well trained dogs, such as Malinois, do not show significant deviation of biochemical parameters during UTI, in comparison

to Maltese dogs. Significant differences were observed in biochemical parameters between these two breeds, as well as correlation between total proteins concentration and urea, creatinine, albumins and globulins in Maltese and Belgian Shepherd dog breeds. This leads to a conclusion that Maltese dogs are less resistant to bacterias that causes UTI, as well as they have lower chance to maintain homeostasis of blood parameters during pathological conditions.

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