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Hematological and Serum Chemical Characteristics of Open-Cervix and Closed-Cervix Pyometra in Bitches

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Abstract: The objective of this retrospective study was to evaluate hematological and serum chemical characteristics of Open-Cervix Pyometra (OCP) and Closed-Cervix Pyometra (CCP) in bitches. In terms of hematologic characteristics, bitches with OCP had mild normocytic, normochromic anemia and less leukocytosis. With regard to serum chemistry, a disproportionate increase in Blood Urea Nitrogen (BUN) was seen in CCP (BUN:creatinine ratios >30:1). The most prominent finding was the alkaline phosphatase level in CCP (307.5 u L^{-1}). A mildly elevated glucose concentration was seen in OCP (147.9 mg L^{-1}). The present study provides valuable characteristics of open-cervix and closed-cervix pyometra in bitches.

Key words: Open-cervix pyometra, closed-cervix pyometra, BUN, alkaline phosphatase, glucose concentration

INTRODUCTION

Pyometra is a disease of intact and mature bitches that is of particular importance to the veterinary practitioner because early recognition, diagnosis and appropriate intervention are required to avoid disastrous consequences (Pretzer, 2008). Bitches with pyometra may present either with vaginal discharge (open-cervix) or without vaginal discharge (closed-cervix). In particular, closed-pyometra is a medical emergency that requires rapid intervention to prevent both sepsis and potential patient death (Smith, 2006). Most studies of pyometra have described only the general presentation of pyometra without distinguishing between the open-cervix and closed-cervix types (Smith, 2006; Pretzer, 2008). The clinical presentations of open-cervix and closed-cervix pyometra in bitches are still not completely understood although, clinical manifestations to classify pyometra as either open-cervix or closed-cervix include vulvar discharge, abdominal distention, fever and vomiting (Kustritz and Barber, 2003).

Hagman *et al*. (2006) investigated hematological and blood chemistry data from bitches with open-cervix pyometra. As reported in earlier study, pyometra is associated with several hematological parameters. A common pathologic clinical findings in bitches with pyometra is peripheral leukocytosis and normocytic, normochromic anemia may be seen in cases of pyometra with packed cell volumes ranging from 21-48% (Wheaton *et al*., 1989). Abnormalities in serum chemistry include azotemia, hypergammaglobulinemia and hypoalbuminemia (Johnston *et al*., 2001). Given the lack of available data for distinguishing between open-cervix and closed-cervix pyometra, additional hematological parameters should be investigated to improve the differential diagnosis between these conditions since proper diagnosis of OCP and CCP may improve overall treatment success. In this study, researchers evaluated hematological and serum chemical characteristics for both open-cervix and closed-cervix pyometra.

MATERIALS AND METHODS

Researchers used data from a total of 49 bitches that were brought to the teaching hospital at Chonbuk National University, Jeonju from 2004-2010 and diagnosed with pyometra on the basis of their clinical signs, blood test and radiographic and ultrasonographic examination. Ages range from as young as 2 years to as old as 15 years. Breeds were Maltese (10), Yorkshire Terrier (9), Poodle (7), Mongrel (7), Shih-Tzu (4), Pug (2), Tosa Inu (2), Pointer (2), Alaskan Malamute (1), Chihuahua (1), Jindo (1), Miniature Pinscher (1), Pekingese (1) and Siberian Husky (1). Pyometra was divided into open-cervix and closed-cervix types according to the cervical patency. Hematological analysis (Forcyte™, USA) included as follows: White Blood Cells (WBC), Red Blood Cells (RBC), Hemoglobin (HGB), Hematocrit (HCT), Platelets (PLT), Mean Cell Volume (MCV), Mean Cell Hemoglobin (MCH), Mean Corpuscular Hemoglobin Con (MCHC), Red cell Distribution Width (RDW), Mean Platelet Volume (MPV), numbers of Lymphocyte (LYM#), No. of

Monocyte (MON#) and No. of Granulocyte (GRA#). Serum chemical analysis (Vet Test 8008, Japan) included as follows: Albumin (ALB), Alkaline Phosphate (ALP), Alanine Aminotransferase (ALT), Amylase (AMY), Total Bilirubin (TBIL), Blood Urea Nitrogen (BUN), Calcium, (Ca), Phosphorus (Phos), Creatinine (CRE), Glucose (GLU), sodium (Na^+), potassium (K^+), Total protein (TP) and Globulins (GLOB).

Statistical analysis: The significance of hematological and serum chemical data between open-cervix and closed-cervix pyometra was analyzed by an unpaired Student's t-test using GraphPad InStat Version 3.00 (Graph Pad Software, San Diego, CA, USA). Differences were considered significant when $p<0.05$.

RESULTS

Hematological data: The result of hematological data between open-cervix and closed-cervix pyometra is shown in Table 1. The increase in WBC count was less extreme in open-cervix pyometra. Bitches with open-cervix pyometra had a mild, normocytic, normochromic anemia. However, the HCT value of closed-cervix pyometra was within the normal reference range of 37-54%.

Serum chemical data: The result of serum chemical data is shown in Table 2. The serum BUN concentration was elevated regardless of cervical patency. However, the creatinine concentration was in the normal range (0.3-1.4) in both open and closed-cervix pyometra. In this study disproportionate increases in BUN which lead to BUN: creatinine ratios >30:1 were found in closed-cervix pyometra. The most prominent finding was elevated ALP levels in closed-cervix pyometra without a significant difference according to cervical patency. Mildly elevated glucose concentrations were seen in open-cervix pyometra. However, all hematological and serum chemical data were not significantly different between open-cervix and closed-cervix types.

Table 1: Hematological characteristics of open-cervix and closed-cervix pyometra

Hematological variables	Open-cervix (Range)	Closed-cervix (Range)	Pyometra (Range)
WBC	28.7±3.4 (6.0-61.4)	30.7±5.9 (6.6-62.0)	29.3±2.9 (6.0-62.0)
RBC	5.3±0.3 (1.0-8.2)	6.2±0.4 (1.3-8.7)	5.6±0.3 (1.0-8.7)
HGB	11.8±0.7 (0.0-17.7)	12.3±1.3 (6.7-20.4)	12.0±0.6 (0.0-20.4)
HCT	34.1±2.4 (0.2-53.4)	39.0±2.6 (24.9-54.9)	35.6±1.9 (0.2-54.9)
PLT	226.4±21.7 (24-453)	251.0±63.8 (25-885)	234.0±26.2 (24-885)
MCV	64.8±1.0 (53-85)	63.0±1.5 (53-71)	64.3±0.9 (53-85)
MCH	21.5±1.4 (0.0-47.1)	18.5±3.3 (0.0-42)	20.5±1.5 (0.0-47.1)
MCHC	33.7±1.9 (0.0-71.9)	33.2±5.0 (0.0-82.7)	33.5±2.0 (0.0-82.7)
RDW	15.2±0.8 (7.1-35.1)	14.9±0.3 (12.9-14.8)	15.1±0.7 (7.1-35.1)
MPV	10.6±0.3 (7.8-14.8)	10.4±0.4 (8.3-13)	10.5±0.3 (7.8-14.8)
LYM#	1.9±0.4 (0.7-9.3)	1.2±0.2 (0.5-1.9)	1.7±2.5 (0.5-9.3)
MON#	0.6±0.2 (0.1-3.4)	0.4±0.1 (0.1-0.9)	0.6±0.1 (0.1-3.4)
GRA#	20.0±2.8 (3.5-44.5)	24.4±5.3 (4.5-44.9)	21.2±2.5 (3.5-44.9)

The data represent the mean±SE. Pyometra: mean of open-cervix and closed-cervix pyometra; WBC: White Blood Cells ($10^3/mm^3$); RBC: Red Blood Cells ($10^3/mm^3$); HGB: Hemoglobin (g dL^{-1}); HCT: Hematocrit (%); PLT: Platelets ($10^3/mm^3$); MCV: Mean Cell Volume (um^3); MCH: Mean Cell Hemoglobin (pg); MCHC: Mean Corpuscular Hemoglobin Con (g dL^{-1}); RDW: Red cell Distribution Width (%); MPV: Mean Platelet Volume (um^3); LYM#: Numbers of Lymphocyte; MON#: Numbers of Monocyte ($10^3/mm^3$); GRA#: Numbers of Granulocyte ($10^3/mm^3$)

Table 2: Serum chemistry data of open-cervix and closed-cervix pyometra

Hematological variables	Open-cervix (Range)	Closed-cervix (Range)	Pyometra (Range)
ALB	3.0±0.2 (1.6-4.9)	2.8±0.2 (1.4-4.3)	3.0±0.1 (1.6-4.9)
ALP	179.5±38.3 (45-394)	307.5±100.9 (124-1005)	233.3±47.4 (45-1005)
ALT	38.2±5.3 (7-92)	58.9±22.2 (6-253)	46.8±10.4 (6-253)
AMY	562.4±58.7 (129-833)	522.9±81.5 (269-854)	546.1±49.5 (129-854)
TBIL	0.4±0.0 (0.1-1.1)	0.4±0.1 (0.2-0.8)	0.4±0.0 (0.1-1.1)
BUN	33.1±8.1 (6-128.7)	36.5±9.3 (9.3-66)	34.2±6.2 (6-128.7)
Ca	10.2±0.5 (5.7-14.9)	9.8±0.3 (7.8-10.5)	10.1±0.3 (5.7-14.9)
Phos	6.3±0.7 (3.4-16.3)	6.4±1.1 (2.9-12.5)	6.3±0.6 (2.9-16.3)
CRE	1.1±8.1 (0.3-3.9)	0.9±0.5 (0.3-5.4)	1.2±6.2 (0.3-5.4)
GLU	147.9±25.7 (57-656)	121.0±18.8 (35-291)	138.9±18.2 (35-656)
Na^+	139.1±2.5 (121-157)	134.1±2.8 (124-148)	136.9±1.9 (121-157)
K^+	4.7±0.4 (0.6-6.8)	4.6±0.1 (3.8-5.4)	4.6±0.2 (0.6-6.8)
TP	7.6±0.4 (5.7-10.5)	6.5±0.3 (4.7-9)	7.0±0.3 (4.7-10.5)
GLOB	4.7±0.4 (2.6-7.6)	3.8±0.3 (2.2-5.1)	4.3±0.3 (2.2-7.6)
BUN:CRE	29.7±4.3 (6.7-85)	37.6±11.0 (12.2-129.7)	32.3±4.9 (6.7-129.7)

The data represent the mean±SE. Pyometra: Mean of open-cervix and closed-cervix pyometra; ALB: Albumin (g dL^{-1}); ALP: Alkaline Phosphate (u L^{-1}); ALT: Alanine Aminotransferase (u L^{-1}); AMY: Amylase (u L^{-1}); TBIL: Total Bilirubin (mg L^{-1}); BUN: Blood Urea Nitrogen (mg L^{-1}); Ca: Calcium (mg L^{-1}); Phos: Phosphorus (mg L^{-1}); CRE: Creatinine (mg L^{-1}); GLU: Glucose (mg L^{-1}); Na^+: Sodium (mmol L^{-1}); K^+: Potassium (mmol L^{-1}); TP: Total Protein (g dL^{-1}); GLOB: Globulins (g dL^{-1})

DISCUSSION

Pyometra is associated with several biochemical and hematological parameters. Leukocytosis is a distinguishing hematologic indicator (Wheaton *et al*., 1989; Frasson *et al*., 1997). Most bitches in earlier studies presented with leukocytosis (Dow, 1958; Wheaton *et al*., 1989; Frasson *et al*., 1997; Smith, 2006; Verstegen *et al*., 2008). Leukocytosis is more dominant in closed-cervix pyometra (Feldman and Nelson, 1989; Gandotra *et al*., 1984). The result of this study is consistent with results from earlier studies, although there was no significant difference between open-cervix and closed-cervix pyometra. A normocytic, normochromic anemia may be seen in cases of pyometra (Pretzer, 2008). In the present study, bitches with only open-cervix pyometra had a mild, normocytic, normochromic anemia. This may be the result of blood loss through vaginal discharge in open-cervix pyometra. Abnormalities in serum chemistry include azotemia, hypergammaglobulin and hypoalbuminemia (Smith, 2006; Pretzer, 2008). Serum BUN and creatinine concentrations are not usually elevated, unless pre-renal azotemia develops as a consequence of dehydration (Hagman *et al*., 2006; Verstegen *et al*., 2008).

In the current study, disproportionate increases in BUN to creatinine were found in closed-cervix pyometra. In a patient for which finite variability in the BUN:creatinine ratio is expected, disproportionate increases in BUN may be indicative of dehydration or the accumulation of uremic toxins (Thrall *et al*., 2004a).

In the present study, the most prominent finding in closed-cervix pyometra was ALP levels. Verstegen *et al*. (2008) indicated that the most consistent clinical blood chemistry finding is elevated serum ALP which is present in approximately 50-75% of pyometra cases (Verstegen *et al*., 2008). This change reflects hepato-cellular damage in response to toxemia or diminished hepatic circulation due to dehydration. Mildly elevated glucose concentrations were seen in open-cervix pyometra in this study.

The association between pyometra and diestrus has been well explained and the secretion of the progesterone during diestrus is attributed to stimulation of endometrial glands which making the uterus a suitable environment for bacterial growth (Smith, 2006; Pretzer, 2008; Verstegen *et al*., 2008).

Progesterone stimulates the secretion of growth hormone which can result in hyperglycemia (Thrall *et al*., 2004b). The relationship between hyperglycermia and open-cervix pyometra should be considered in future studies by conducting a progesterone hormone assay or evaluating steroid receptors.

CONCLUSION

Bitches with closed-cervix pyometra presented disproportionate increases in BUN >30:1 and elevated ALP levels. On the other hand, bitches with open-cervix pyometra had mild normocytic, normochromic anemia and elevated glucose concentrations. The present study provides valuable characteristics of open-cervix and closed-cervix pyometra.

REFERENCES

Dow, C., 1958. The cystic endometrial hyperplasia-pyometra complex in the bitch. Vet. Rec., 70: 1102-1110.

Feldman, E.C. and R.W. Nelson, 1989. Diagnosis and treatment alternatives for pyometra in dogs and cats. Curr. Vet. Ther. Sm. Anim. Pract., 10: 1305-1310.

Frasson, B., A.S. Lagerstedt, E. Hellmen and P. Jonsson, 1997. Bateriological findings, blood, chemisty profile and plasma endotoxin levels in bitches with pyometra or other uterine diseases. Zentralbl. Veterinarmed. A., 44: 417-426.

Gandotra, V.K., V.K. Singla, H.B.S. Kochhar, F.S. Chauhan and P.N. Dwivedi, 1984. Haematological and bacteriological studies in canine pyometra. Indian Vet. J., 71: 816-818.

Hagman, B.R., H. Kindahl and A.S. Lagerstedt, 2006. Pyometra in bitches induces elevated plasma endotoxin and prostaglandin F2α metabolite levels. Acta. Vet. Scand., 47: 55-68.

Johnston, S.D., M.V.R. Kustriz and P.N.S. Olson, 2001. Disorders of the Canine Uterus and Terine Tubes (oviducts). In: Canine and Feline Theriogenology, Kersey, R. and D. LeMelledo (Eds.). WB Saunders, Company, Philadelphia, pp: 206-224.

Kustritz, M.V.R. and J.A. Barber, 2003. Chapter 12-Uterine Disorders. In: Small Animal Theriogenology, Kustritz, M.V.R. (Ed.). Butterworth-Heinemann, USA., pp: 367-394.

Pretzer, S.D., 2008. Clinical presentation of canine pyometra and mucometra: A review. Theriogenology, 70: 359-363.

Smith, F.O., 2006. Canine pyometra. Theriogenology, 66: 610-612.

Thrall, M.A., D.C. Baker, T.W. Campbell, E.D. Lassen and G. Weiser *et al*., 2004a. Laboratory Evaluation of Renal Function. In: Veterinary Hematology and Clinical Chemistry, Troy, D.B., R.A. Kerins and J.D.W. Glazer (Eds.). Lippincott Williams and Wilkins, Baltimore, pp: 301-327.

Thrall, M.A., D.C. Baker, T.W. Campbell, E.D. Lassen and G. Weiser., 2004b. Laboratory Evaluation of the Endocrine Pancreas and of Glucose Metabolism. In: Veterinary Hematology and Clinical Chemistry, Troy, D.B., R.A. Kerins and J.D.W. Glazer (Eds.)., Lippincott Williams and Wilkins, Baltimore, pp: 431-443.

Verstegen, J., G. Dhaliwal and K. Verstegen-Onclin, 2008. Mucometra, cystic endometrial hyperplasia and pyometra in the bitch: Advances in treatment and assessment of future reproductive success. Theriogenology, 70: 364-374.

Wheaton, L.G., A.L. Johnson, A.J. Parker and S.K. Kneller, 1989. Results and complication of surgical treatment of pyometra: A review of 80 cases. J. Am. Anim. Hosp. Assoc., 25: 563-568.