RESEARCH ARTICLE
Open Access

Journal of Veterinary and Animal Sciences
ISSN (Print): 0971-0701, (Online): 2582-0605

Comparative analysis of closed and open-cervix canine pyometra*

V.K. Vidya[1], M.P. Unnikrishnan[2], M.O. Kurien[3], C. Jayakumar[4] and Surya Sankar[5]
Department of Animal Reproduction, Gynaecology and Obstetrics,
College of Veterinary and Animal Sciences, Mannuthy, Thrissur- 680 651
Kerala Veterinary and Animal Sciences University

Citation: Vidya, V.K., Unnikrishnan, M.P., Kurien, M.O., Jayakumar, C. and Surya, S. 2020. Comparative analysis of closed and open-cervix canine pyometra. *J. Vet. Anim. Sci.* **51**(2): 153-158.

Received : 14.08.2019 *Accepted : 25.09.2019* *Published : 01-07-2020*

Abstract

Canine pyometra is the most common uterine disease in intact, sexually mature female dogs. The disease is broadly classified as open and closed type, based on the patency of cervix. The study was conducted to evaluate the changes in clinical, physiological and haemato-biochemical parameters in open and closed-cervix pyometra. Physiological parameters were not altered among pyometra-affected dogs. Vomiting, dehydration and dullness were more frequently noticed in open-cervix pyometra cases. Significantly higher total leucocyte count and band cell per cent and significantly lower total erythrocyte count was recorded among dogs with open-cervix pyometra than closed-cervix pyometra. The present finding is contradictory to most of the previous reports.

Keywords: *open-cervix pyometra, closed-cervix pyometra, dog, haemato-biochal parameters*

Canine pyometra is a reproductive disease characterised by bacterial infection and inflammation, with pus accumulating in the uterus, in combination with systemic illness (Hardy and Osborne, 1974). The disease is mainly encountered among middle-aged to older dogs, usually during diestrus and affects over 25 per cent of all intact female dogs before 10 years of age, with mortality rate of 3-4 per cent (Egenvall *et al.,* 2001). High serum progesterone concentration during diestrus will promote bacterial adherence and growth in the endometrial epithelium, finally ending up in the most severe end stage condition known as pyometra (Hagman and Kuhn, 2002).

**Forms part of the MVSc thesis submitted by the first author to the Kerala Veterinary and Animal Sciences University, Pookode, Wayanad, Kerala.*

1. *MVSc Scholar and Corresponding author Email id: vidyaviswanath22@gmail.com 9633888658*
2. *Assistant Professor, Centre for Pig Production and Research, Mannuthy, Email id: unnikrishnan@kvasu.ac.in*
3. *Professor and Head (Retd.)*
4. *Assistant Professor and Head (i/c)*
5. *Assistant Professor, Department of Veterinary Microbiology*

Endotoxin, a lipopolysaccharide part of outer membrane of the cell wall of *Escherichia coli* and other Gram-negative bacteria, when released into circulation, as the bacteria grows or when destroyed, is thought to be responsible for the systemic symptoms of pyometra and sepsis in dogs (Asheim, 1965). The sepsis and endotoxeamia will alter the function of vital organs like liver, kidney and bone marrow and cause changes in haemato-biochemical parameters (De Schepper *et al.,* 1987). Wide variations in haematological and biochemical variables are reflections of systemic involvement of pyometra (Hagman, 2004).

Two forms of pyometra based on the cervical patency are recognised: open-cervix pyometra in dogs presented with vaginal discharge and closed-cervix pyometra in animals presented without vaginal discharge (Smith, 2006). More serious illness is reported among the dogs having closed- cervix pyometra, with pus and bacterial products retained in the uterus (Macphail, 2013). Physiological and haemato-biochemical changes in pyometra are considered significant to assess the severity of the disease condition (Singh *et al.,* 2006).

The aim of this study was to investigate the degree of severity among dogs with open and closed-cervix pyometra based on changes in physiological and haemato-biochemical parameters.

Materials and methods

Female dogs presented to University Veterinary Hospitals, Kokkalai and Mannuthy, attached to College of Veterinary and Animal Sciences, Mannuthy, Kerala were utilized for the study. Pyometra condition was diagnosed based on history, detailed clinico-gynaecological and ultrasonographical examination. Those having vaginal discharge on presentation were considered as open (Group I) and those without vaginal discharge were identified as closed-cervix (Group II) pyometra, while healthy dogs in diestrus were selected as control (Group III). Each group consisted of 14 female dogs each.

Signalment, anamnesis with special emphasis to detailed reproductive history, clinical signs and physiological parameters *viz.* rectal temperature (°F), respiratory rate (per minute) and heart rate (per minute) were recorded. Peripheral blood samples were collected and haematological parameters like total erythrocyte count (TEC, $\times 10^6/mm^3$), total leucocyte count (TLC, $\times 10^3/mm^3$), thrombocyte count (PLT, $\times 10^3/mm^3$), haemoglobin concentration (Hb, g/dL) and volume of packed red cells (VPRC, per cent) were recorded using automatic analyser (Mythic 18 Vet, Woodley, Switzerland). Blood smears were prepared after collecting blood by puncturing ear tip and stained by Leishman's stain for differential leucocyte count (DLC). Serum, after separation from whole blood, were centrifuged and a minimum of 1.5 mL serum sample was utilised for biochemical analysis of blood urea nitrogen (BUN, mg/dL) and creatinine (mg/dL) by using semi-automatic analyser (Master T biochemistry analyser, Hospitex diagnostics, Italy).

Analysis of variance was done to pyometra condition was diagnosed physiological and haematolo-biochemical compare parameters between groups.

Results and Discussion

Majority of pyometra affected dogs in group I and II were nulliparous dogs (64.29% each). Higher occurrence of pyometra observed in nulliparous dogs were reported earlier also (Unnikrishnan, 2018). In nulliparous dogs, repeated progesterone exposure during each dieostrus might lead to gradual development of CEH (Borrensen, 1979); subsequent fluid accumulation and bacterial infection would finally bring about pyometra (Hardy and Osborne, 1974).

Clinical findings in pyometra-affected dogs are presented in Table 1. Vaginal discharge, anorexia, dullness, dehydration, vomiting, polyuria and pale mucous membrane were the most frequently noticed clinical signs in Group I, whereas anorexia, dullness, congested mucous membrane, and polyuria were the predominant signs among Group II dogs. Clinical signs noticed in pyometra cases such as vomiting, anorexia and polyuria were

reflecting the systemic involvement of the disease. Gastro-intestinal disturbances are related to the adverse effects of endotoxemia and the presence of vomiting and diarrhoea indicates its severity (Hardie and Kruse- Elliott, 1990). Although Jitpean *et al.* (2017) reported more severe clinical signs among closed-cervix pyometra; in the present study, severe clinical signs were expressed more among dogs having open-cervix pyometra.

Data regarding physiological and haemato-biochemical evaluation of Group I, II and III dogs are presented in Table 2.

Temperature, heart rate and respiratory rate of dogs with either open or closed-cervix pyometra did not significantly differ from control. Similar observations were also made by Lakshmikanth *et al*. (2016). Hagman (2012) stated that higher body temperature, respiratory rate and heart rate were indicative of severe uterine inflammation, septicaemia, bacteraemia or a systemic inflammatory response in canines due to effects of endotoxins released from circulating bacteria. Findings in the present study indicate that endotoxemia was absent or not severe enough to cause changes in the physiological parameters.

Leucocytosis was noticed among pyometra-affected dogs; the value was highest among Group I and lowest in Group III; significant difference existed between groups. Similar changes were recorded for band cell per cent also, with significantly highest value among group I and lowest in Group III. Values among pyometra-affected dogs were higher than normal physiological limits. The findings are suggestive of inflammatory response among pyometra-affected dogs and higher degree of inflammatory response was noticed among dogs with open-cervix pyometra. The present observation differs from the findings of Jitpean *et al.* (2017), who reported that leucocytosis, neutrophilia and monocytosis were more commonly found in dogs with closed-cervix pyometra.

Neutrophil per cent was highest among Group II and lowest among Group III; neutrophilia was noticed among Group II and was significantly higher than Group III but did not differ from Group I. The findings are suggestive of immune response to infection, among pyometra-affected dogs. Leucocytosis with neutrophilia and left shift in pyometra might be due to aggressive bone marrow response on account of increased stress on immune mechanism and diffused suppurative inflammation of uterus to combat the infection (Kustritz, 2005).

The per cent of lymphocytes was lowest among Group II and highest among Group III; although values were within normal range among all the groups, per cent among pyometra-affected groups were in lower physiological limits and significantly differed from control animals. Lymphopenia among pyometra-affected dogs were reported earlier also by Singh *et al.* (2006) and lymphopenia was either due to suppression of immune system, caused by endotoxaemia or due to an absolute neutrophilia caused by severe suppurative inflammation of the uterus.

Table 1. Per cent of dogs exhibiting different clinical signs, among dogs affected with open and closed -cervix pyometra

Clinical signs	Group I (Open-cervix pyometra)	Group II (Closed-cervix pyometra)
Presence of vaginal discharge	85.71	0
Anorexia	78.57	100.00
Dullness	78.57	100.00
Dehydration	78.57	35.71
Vomiting	64.29	28.57
Polyuria	57.14	42.85
Pale mucous membrane	50.00	28.57
Congested mucous membrane	35.71	57.14
Polydipsia	14.28	0

Table 2. Physiological and haemato-biochemical parameters among pyometra-affected and control dogs

Parameters	Group I (Open-cervix pyometra)	Group II (Closed-cervix pyometra)	Control	F value	p-value
Temperature (°F)	102.40±0.42	101.94±0.33	101.51±0.22	1.83	0.17
Heart rate (per minute)	105.00±5.69	95.93±4.05	90.71±3.35	2.62	0.09
Respiratory rate (per minute)	25.07±0.70	24.48±1.04	23.71±0.66	0.72	0.49
TLC ($\times10^3$/mm^3)	39.01±5.43^a	24.98±3.90^b	10.7±0.62^c	13.35	<0.001
Band cell (%)	6.79±0.83^a	3.36±0.41^b	1.00±0.21^c	28.25	<0.001
Neutrophil (%)	74.81±2.41^{ab}	78.91±1.53^a	70.89±2.26^b	3.64	0.04
Lymphocyte (%)	17.44±2.01^b	14.45±1.10^b	23.58±1.95^a	7.20	<0.001
Monocyte (%)	7.75±0.61^a	6.64±0.60^{ab}	5.54±0.46^b	3.88	0.03
TEC ($\times10^6$/mm^3)	3.87±0.28^c	4.76±0.32^b	5.66±0.25^a	9.88	<0.001
Hb (g/dL)	9.01±0.60^b	10.52±0.82^b	12.42±0.45^a	7.29	<0.001
VPRC (%)	26.23±2.13^b	27.06±1.88^b	32.85±1.33^a	3.96	0.03
PLT($\times10^3$/mm^3)	173.21±22.30^b	213.04±34.20^{ab}	289.93±37.17^a	3.46	0.04
BUN (ng/dL)	21.16±4.81	22.05±6.86	15.28±0.59	0.58	0.57
Creatinine (ng/dL)	1.76±0.30	1.69±0.45	1.05±0.07	1.55	0.22

Monocyte count was within normal range among all the three groups, although it was significantly higher among Group I than controls. Similar finding was reported by Lakshmikanth *et al.* (2016). Monocytosis among pyometra-affected dogs was described an indication of chronicity of the suppurative process (Singh *et al*., 2006).

The TEC was highest among Group III and lowest among Group I; significant difference existed between groups. Among Group I and II, values were lower than normal physiological range, indicating the existence of anaemia among pyometra-affected dogs, the intensity of which was highest among dogs with open-cervix pyometra. Since endotoxin- mediated suppression of bone marrow and shortening of life of circulating erythrocytes are attributed as reasons for low TEC (Hagman *et al.,* 2009), it may be assumed that, in the present study, effect of endotoxemia was more pronounced in open-cervix pyometra group.

The Hb concentration was highest among Group III and lowest among Group I; the values among pyometra-affected dogs were lower than normal physiological range and significantly differed from control group. In pyometra affected dog, low level of Hb was due to iron deficiency as a consequence of iron sequestration in the bone marrow and withdrawal of iron from the normal erythropoiesis (Grimes and Fry, 2014).

The VPRC per cent was highest among Group III and lowest among Group I; the values among pyometra-affected dogs significantly differed from control group. The VPRC per cent among pyometra-affected dogs are suggestive of marginal anaemia. Low VPRC might be a reflection of reduced TEC, caused by toxic suppression of the bone marrow and consequent reduction in erythropoiesis (Unnikrishnan, 2018).

Although platelet count was within physiological limits among all the groups, value was highest among Group III and lowest among Group I, with significant difference between

these values. Values among pyometra-affected dogs were in the lower limits of physiological range, especially among open-cervix pyometra group. Thrombocytopenia among pyometra-affected dogs was explained earlier (Hagman, 2004). Marked thrombocytopenia in pyometric dogs might be due to endometrial bleeding or decreased production of thrombocytes in the bone marrow, mediated by endotoxin through production of thrombocyte activation factor. Lower platelet count might also occur as a result of disseminated intravascular coagulation (Sabine, 2015). Values in the lower physiological range among pyometra-affected dogs in the present study indicate that dogs were not under severe toxaemia.

Serum creatinine and BUN concentrations were within the normal range among all the groups and no significant difference existed between groups. The observation was similar to previous reports (Lakshmikanth *et al*., 2016; Jitpean *et al.*, 2017). Altered functions of organs such as kidney and liver were indicated by increased creatinine and BUN concentrations, hypoalbuminemia and proteinuria, among pyometra affected dogs (Maddens *et al*., 2011)

In the present study, no differentiation in physiological parameters could be made between open and closed-cervix-pyometra. Similarly, no differentiation could be made between open and closed-cervix pyometra, based on neutrophil, lymphocyte, monocyte counts and VPRC per cent. The serum creatinine, BUN and Hb concentration as well as platelet count also did not reveal any variation between open and closed-cervix pyometra. Volpato *et al*. (2012) reported that haematological and biochemical parameters had no significant difference between open and closed-cervix pyometra. Lakshmikanth *et al.,* (2016) reported that haematological parameters like haemoglobin, PCV, neutrophil, lymphocyte, eosinophil, and band cell did not vary significantly between open and closed type of pyometra; however, the values differed significantly when compared with healthy control dogs. In the present study also, most of the haematological parameters differed significantly from the control group.

Clinical signs were more severely expressed among dogs with open-cervix pyometra. Also, TLC, band cell per cent and TEC indicates that inflammatory response is more among dogs with open-cervix pyometra than closed cervix-pyometra. These findings are contradictory to most of the previous reports (Yu, 2012; Jitpean *et al.,* 2017). This could probably be due to many of the cases presented as open-cervix pyometra in the study might be closed cases initially, which might have been noticed by the owners only when the vaginal discharge commenced. Failure to recognise early signs of closed-cervix pyometra by the owner would lead to delayed presentation of cases; by this time, relaxation of cervix due to increased intrauterine pressure could occur and subsequently being classified as open- cervix cases, by the clinician (Anna *et al*., 2014).

Reference

Anna, M.C.S., Giordano, L.G.P., Flaiban, K.K.M.C., Muller, E.E. and Martins, M.I.M. 2014. Prognostic markers of canine pyometra. *Arq. Bras. Med. Vet. Zootec*. **66**: 1711-1717.

Asheim, A. 1965. Pathogenesis of renal damage and polydipsia in dogs with pyometra. *J. Am. Vet. Med. Assoc*. **147**:736–45.

Borresen, B. 1979. Pyometra in the dog- a pathophysiological investigation. II. Anamnestic, clinical and reproductive aspects. *Nord. Vet. Med*. **31**:251–257.

De Schepper, J., Van Der Stock, J. and Capiau, C. 1987. The characteristic pattern of aspartate aminotransferase and alanine aminotransferase in the bitch with the cystic endometrial hyperplasia-pyometra complex. Effect on medical or surgical treatment. *Vet. Res. Commun.* **11**: 65-75.

Egenvall, A., Hagman, R., Bonnett, B.N., Hedhammar, A., Olson, P. and Lagerstedt, A.S. 2001. Breed risk of pyometra in insured dogs in Sweden. *J. Vet. Intern. Med*. **15**: 530–538.

Grimes, C.N. and Fry, M.M. 2014. Non-regenerative Anaemia: Mechanisms of decreased or Ineffective Erythropoiesis. *Vet. Path.* **10**: 1-14.

Hagman, R. 2004. New Aspects of Canine Pyometra: Studies on Epidemiology and Pathogenesis. *Doctoral thesis*, The Swedish University of Agricultural Sciences, Uppsala, Sweden, 55p.

Hagman, R, Reezigt, B.J, Ledin, H.B. and Karlstam, E. 2009. Blood lactate levels in 31 female dogs with pyometra. *Acta Veterinaria Scandinavica.* **51**:2-10.

Hagman, R. 2012. Clinical and molecular characteristics of pyometra in female dogs. *Reprod. Domestic Anim*. **47**:323–325.

Hagman, R. and Kuhn, I. 2002. *Escherichia coli* strains isolated from the uterus and urinary bladder of bitches suffering from pyometra: comparison by restriction enzyme digestion and pulsed-field gel electrophoresis. *Vet. Microbiol.* **84:** 143–153.

Hardie, E.M. and Kruse-Elliott, K. 1990. Endotoxic shock. Part 1. A review of causes. *J. Vet. Int. Med.* **4**: 258-266.

Hardy, R.M. and Osborne, C.A. 1974. Canine pyometra: pathophysiology, diagnosis and treatment of uterine and extra-uterine lesions. *J. Am. Anim. Hosp. Assoc*. **10**: 245– 267.

Jitpean, S., Ambrosen, A., Emanuelson, U. and Hagman, R. 2017. Closed cervix is associated with more severe illness in dogs with pyometra. *BMC Vet. Res*. **13**: 1-7.

Kustritz, M.V.R. 2005. Cystic endometrial hyperplasia and pyometra. In: Ettinger, S.J. and Feldman, E.C. (ed.). *Textbook of Veterinary Internal Medicine. Diseases of the dog and cat*. (5th Ed.). Elsevier Saunders, Missouri, pp: 1676-1680.

Lakshmikanth, T.R., Murthy, V.C., Honnappa, T.G., Narayanaswamy, H.D., Rathnamma and Kantharaj, S. 2016. Physiological and hematobiochemical changes in open and closed-cervix pyometra in female dogs. *Int. J. Appl. Pure Sci. Agric*. **2**: 95-97.

Macphail, C. Pyometra. 2013. In: Fossum, T. (ed.), *Small animal surgery*. (4th Ed.). Missouri, Elsevier Inc, p. 818–24.

Maddens, B., Heiene, R. and Smets, P. 2011. Evaluation of kidney injury in dogs with pyometra based on proteinuria, renal histomorphology, and urinary biomarkers. *J. Vet. Int. Med*. **25**: 75–83.

Sabine, S. 2015. Common uterine disorders in the bitch: challenges to diagnosis and treatment. *Rev. Bras. Reprod. Anim. Belo Horizonte.* **39**: 234-239.

Singh, S., Dadhich, H. and Sharma, G.D. 2006. Haemato-biochemical studies in cystic endometrial hyperplasiapyometra complex in canine. *Indian J. Vet. Pathol*. **30:** 46-48.

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

Unnikrishnan, M. P. 2018. Diagnosis and therapeutic management of canine pyometra for restoring breeding efficiency. *Doctrol thesis,* Kerala Veterinary and Animal Sciences University, Pookode, 249p.

Volpato, R., Rodello, L., Abibe, R.B. and Lopes, M.D. 2012. Lactate in bitches with pyometra. *Reprod. Domestic. Anim.* **47:** *335-336.*

Yu, I. 2012. Hematological and serum chemical characteristics of open-cervix and closed-cervix pyometra in bitches. *J. Anim. Vet. Adv*. **11**:3658-3661. ■