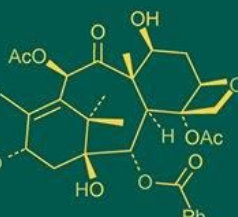
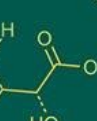
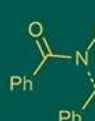


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Tushar Jain

(1) Veterinary Surgeon,
 Pet Animal Medical Centre,
 Sector 3, Panchkula, Haryana,
 India
 (2) Department of Animal
 Husbandry and Dairying,
 Government of Haryana,
 Haryana, India

Retrospective study on renal alterations in canine pyometra

Tushar JainDOI: <https://www.doi.org/10.33545/26174693.2026.v10.i1j.7087>**Abstract**

Pyometra is a common and potentially life-threatening reproductive disorder of intact female dogs, frequently associated with systemic inflammation and secondary organ involvement. Renal dysfunction represents one of the most clinically relevant complications and may influence perioperative risk and outcome. This retrospective study evaluated haematological and biochemical alterations in 50 dogs with pyometra at the time of diagnosis and following ovariohysterectomy. At presentation dogs exhibited inflammatory leukograms, mild to moderate anaemia, thrombocytopenia and biochemical evidence of renal and hepatic involvement, including increased blood urea nitrogen and creatinine concentrations. Postoperative evaluation demonstrated significant improvement in leukocytosis, platelet counts and partial improvement in renal parameters, although creatinine and blood urea nitrogen (BUN) values remained above reference ranges in several dogs. These findings indicate that renal dysfunction associated with canine pyometra is frequently at least partially reversible following surgical treatment, while highlighting the importance of continued postoperative renal monitoring.

Keywords: Canine pyometra, renal dysfunction, azotaemia, ovariohysterectomy**1. Introduction**

Pyometra is one of the most common reproductive diseases in intact female dogs, characterized by purulent bacterial endometritis occurring during the luteal phase of the oestrous cycle. Progesterone-dominated uterine conditions promote endometrial glandular hyperplasia, reduced myometrial contractility, cervical closure (partial or complete) and suppression of local immune defenses, creating an environment conducive to bacterial proliferation. *Escherichia coli* is the most frequently isolated pathogen, although other organisms may also be involved (Xavier *et al.*, 2023) ^[1].

Although historically regarded as a uterine disorder, pyometra is now recognized as a systemic inflammatory disease that may progress to sepsis and multiorgan dysfunction. Renal involvement is among the most common and clinically relevant extra-uterine complications, significantly influencing morbidity, perioperative risk, and prognosis (Hagman, 2018; Gasser *et al.*, 2020) ^[2, 15]. Epidemiological studies have demonstrated that susceptibility to pyometra varies across canine populations, with increased risk reported in certain breeds such as Rottweilers, Golden Retrievers and Cavalier King Charles Spaniels, suggesting a role for host-related factors including immune regulation and genetic predisposition (Egenvall *et al.*, 2001; Jitpean *et al.*, 2012) ^[3, 4].

Early physiological investigations demonstrated reduced glomerular filtration rate (GFR), impaired urine concentrating ability and polyuria, often preceding the development of azotaemia (Asheim, 1963) ^[6]. Subsequent clinical studies confirmed that a large proportion of dogs with pyometra exhibit subclinical renal dysfunction at presentation, highlighting the limited sensitivity of serum creatinine and BUN as early indicators of renal injury (Sevelius *et al.*, 1990; Braun *et al.*, 2003) ^[7, 8].

The pathophysiology of renal involvement in pyometra is multifactorial. Endotoxaemia resulting from bacterial infection triggers systemic inflammatory responses, cytokine release, endothelial dysfunction, and renal vasoconstriction, leading to reduced renal perfusion and tubular injury (Smith, 2006; Hagman, 2018) ^[9, 2]. Hemodynamic disturbances have been demonstrated using Doppler ultrasonography and contrast-enhanced ultrasound, supporting the role of altered renal perfusion in septic acute kidney injury associated with pyometra

Corresponding Author:**Tushar Jain**

(1) Veterinary Surgeon,
 Pet Animal Medical Centre,
 Sector 3, Panchkula, Haryana,
 India
 (2) Department of Animal
 Husbandry and Dairying,
 Government of Haryana,
 Haryana, India

(Gasser *et al.*, 2020) [15]. Closed-cervix pyometra is typically associated with greater systemic absorption of bacterial toxins and more severe clinical disease (Jitpean *et al.*, 2014) [5].

Histopathological studies have consistently identified tubulointerstitial nephritis, tubular degeneration and tubular atrophy as the predominant renal lesions in dogs with pyometra. (Heiene *et al.*, 2007; Maddens *et al.*, 2011) [11, 12]. Advances in urinary biomarkers have further refined understanding of renal injury in this condition. Increased urinary protein-to-creatinine ratio (UPC) and elevated concentrations of tubular injury markers such as urinary gamma-glutamyl transferase, retinol-binding protein and N-acetyl- β -D-glucosaminidase have been reported even in non-azotaemic dogs, identifying proteinuria as both a marker of renal injury and a prognostic indicator (Sant'Anna *et al.*, 2019; Maddens *et al.*, 2011; Andrade *et al.*, 2023) [13, 12, 14].

Despite extensive evidence that renal dysfunction is common in canine pyometra, the natural course and reversibility of these alterations following surgical treatment remain incompletely characterized in larger clinical populations. Ovariohysterectomy is the treatment of choice and typically results in rapid clinical improvement by eliminating the primary source of infection and endotoxaemia (Smith, 2006; Hagman, 2018) [9, 2]. The present retrospective study aimed to evaluate renal alterations at diagnosis and to assess changes in renal parameters following ovariohysterectomy in 50 dogs with

pyometra, thereby contributing clinically relevant data on the reversibility and prognosis of pyometra-associated renal dysfunction.

2. Materials and Methods

This retrospective study included 50 intact female dogs diagnosed with pyometra and treated by ovariohysterectomy at Pet Animal Medical Centre, Panchkula. Diagnosis was based on history, clinical examination, radiographic/ultrasonographic findings consistent with pyometra and supportive haematological and biochemical abnormalities.

Ovariohysterectomy was performed following appropriate stabilization, including fluid therapy and antibiotic treatment as indicated. Haematological and biochemical data were recorded at the time of diagnosis (preoperative) and during postoperative follow-up when available. Haematological evaluation included red blood cell count, haemoglobin concentration, packed cell volume, total leukocyte count, and differential leukocyte count. Biochemical analysis included Blood urea nitrogen (BUN), creatinine, total protein, albumin, globulin, alanine aminotransferase (ALT), aspartate aminotransferase (AST) alkaline phosphatase (ALP) and other relevant parameters routinely assessed in dogs with systemic inflammatory disease.

3. Results

3.1 Haematological Findings

Table 1: Haematological parameters in dogs with pyometra before and after ovariohysterectomy.

Parameter	Reference Range	Preoperative (Mean $\pm$ SD)	Postoperative (Mean $\pm$ SD)
Haemoglobin (g/dL)	12.00-18.00	10.0 $\pm$ 1.8	10.3 $\pm$ 1.4
RBC ($\times 10^6/\mu\text{L}$)	5.5-8.5	4.3 $\pm$ 0.8	4.5 $\pm$ 0.7
PCV (%)	36.00-60.00	40 $\pm$ 9	46 $\pm$ 8
Total leukocyte count ($\times 10^3/\mu\text{L}$)	6.00-17.00	23 $\pm$ 6	12 $\pm$ 4
Neutrophils (%)	60.00-75.00	68 $\pm$ 12	60 $\pm$ 7
Lymphocytes (%)	12.00-30.00	20 $\pm$ 5	18 $\pm$ 5
Platelets ($\times 10^3/\mu\text{L}$)	170.00-400.00	170 $\pm$ 70	220 $\pm$ 80

Dogs with pyometra demonstrated marked inflammatory haematological changes at presentation (Table 1). Mean haemoglobin concentration (10.0 $\pm$ 1.8 g/dL) and red blood cell count (4.3 $\pm$ 0.8 $\times 10^6/\mu\text{L}$) were below reference ranges, indicating mild to moderate anaemia. Packed cell volume was variable but more toward the lower end of the reference interval.

A pronounced leukocytosis was observed preoperatively (23 $\pm$ 6 $\times 10^3/\mu\text{L}$), exceeding the upper reference limit, consistent with a systemic inflammatory response. Neutrophil percentages were increased and exhibited wide variability, while lymphocyte values remained within

reference ranges. Platelet counts were reduced preoperatively (170 $\pm$ 70 $\times 10^3/\mu\text{L}$), with several dogs exhibiting thrombocytopenia.

Following ovariohysterectomy, total leukocyte counts decreased substantially (12 $\pm$ 4 $\times 10^3/\mu\text{L}$), returning to within reference limits. Platelet counts increased postoperatively (220 $\pm$ 80 $\times 10^3/\mu\text{L}$). Mild improvements were observed in haemoglobin, red blood cell count, and packed cell volume, although values remained slightly below reference ranges in some dogs.

3.2 Biochemical Findings

Table 2: Serum biochemical parameters in dogs with pyometra before and after ovariohysterectomy.

Parameter	Reference Range	Preoperative (Mean $\pm$ SD)	Postoperative (Mean $\pm$ SD)
BUN (mg/dL)	6.00-25.00	40 $\pm$ 12	30 $\pm$ 9
Creatinine (mg/dL)	0.50-1.60	2.60 $\pm$ 1.00	2.00 $\pm$ 0.60
Total protein (g/dL)	5.00-7.40	5.40 $\pm$ 0.80	5.50 $\pm$ 0.80
Albumin (g/dL)	2.70-4.40	3.1 $\pm$ 0.5	3.0 $\pm$ 0.6
ALT (U/L)	12.00-118.00	70 $\pm$ 13	62 $\pm$ 28
AST (U/L)	15.00-66.00	45 $\pm$ 12	41 $\pm$ 13
ALP (U/L)	5.00-131.00	121 $\pm$ 37	109 $\pm$ 23

Serum biochemical analysis revealed significant alterations consistent with renal and hepatic involvement (Table 2). Preoperatively, mean blood urea nitrogen (40 ± 12 mg/dL) and creatinine concentrations (2.60 ± 1.00 mg/dL) were elevated above reference ranges, indicating reduced renal function in a substantial proportion of dogs.

Total protein and albumin concentrations remained largely within reference ranges, although albumin values tended toward the lower end, consistent with inflammation-related hypoalbuminemia in some individuals. Liver enzyme activities, including ALT, AST, and ALP, were increased preoperatively but generally remained within or near reference limits, suggesting mild hepatic involvement.

Postoperatively, mean BUN (30 ± 9 mg/dL) and creatinine concentrations (2.00 ± 0.60 mg/dL) decreased compared with preoperative values, indicating partial improvement in renal function. However, creatinine values remained above the upper reference limit, suggesting incomplete recovery or persistent renal impairment in some dogs. Mild reductions in ALT, AST, and ALP activities were also observed following surgery.

4. Discussion

The present study confirms that canine pyometra is associated with significant systemic inflammatory and metabolic alterations, with renal dysfunction representing a frequent and clinically relevant complication. The marked preoperative leukocytosis and neutrophilia are consistent with previous reports and reflect the systemic inflammatory response induced by uterine infection and endotoxemia, most commonly associated with *Escherichia coli* infection (Hagman 2018; Xavier *et al.*, 2023) [2, 1]. Similar inflammatory leukograms have been consistently described in both open and closed-cervix pyometra, with higher leukocyte counts often reported in more severe or closed-cervix cases (Jitpean *et al.*, 2014; Kurban *et al.*, 2024) [5, 16]. Mild to moderate anaemia and thrombocytopenia were common at presentation in the present study. These findings are in agreement with earlier investigations reporting inflammation-associated anaemia, haemodilution and increased peripheral platelet consumption in dogs with pyometra (Sevelius *et al.*, 1990; Chitra 2025) [7, 17]. The postoperative improvement in leukocyte and platelet count supports the effectiveness of ovariohysterectomy in eliminating the primary source of infection and resolving systemic inflammation, as previously described (Smith 2006; Hagman 2018) [9, 2].

Renal involvement was evidenced by increased blood urea nitrogen and creatinine concentrations at diagnosis. Although renal dysfunction in pyometra is frequently subclinical and may precede overt azotaemia, the degree of elevation observed in this study indicates that a substantial proportion of dogs experienced clinically relevant reductions in glomerular filtration rate at presentation. Early physiological studies demonstrated impaired renal perfusion, reduced GFR and decreased urine concentrating ability in dogs with pyometra, even in the absence of azotaemia (Braun *et al.*, 2003) [8]. Subsequent clinical studies confirmed that azotaemia may develop in more severe cases or in association with prolonged disease duration.

Postoperative reductions in BUN and creatinine concentrations in the present study indicate partial recovery of renal function following ovariohysterectomy. This

finding is consistent with earlier reports suggesting that renal dysfunction associated with pyometra is often functional and reversible once the uterine source of infection is removed (Singh *et al.*, 2020; de Andrade *et al.*, 2023; Singh *et al.*, 2025) [10, 14, 18]. However, persistent elevations in creatinine observed in some dogs suggest incomplete recovery or underlying structural renal injury.

These findings underscore the importance of continued postoperative renal monitoring and the use of sensitive biomarkers to identify dogs at risk of long-term renal sequelae.

5. Conclusion

Renal dysfunction is a frequent and clinically important complication of canine pyometra. Ovariohysterectomy results in marked improvement of inflammatory haematological abnormalities and partial recovery of renal function in most dogs. However, persistent azotaemia in a subset of cases indicates that renal dysfunction is not always fully reversible. Early diagnosis, prompt surgical intervention, and continued postoperative renal monitoring are essential to optimize long-term outcomes in dogs affected by pyometra.

6. References

- Xavier RG, Santana CH, de Castro YG, de Souza TG, do Amarante VS, Santos RL, *et al.* Canine pyometra: A short review of current advances. *Animals*. 2023 Oct 25;13(21):3310.
- Hagman R. Pyometra in small animals. *Vet Clin North Am Small Anim Pract*. 2018 Jul 1;48(4):639-661.
- Egenvall A, Hagman R, Bonnett BN, Hedhammar A, Olson P, Lagerstedt AS. Breed risk of pyometra in insured dogs in Sweden. *J Vet Intern Med*. 2001 Nov;15(6):530-538.
- Jitpean S, Hagman R, Ström Holst B, Höglund OV, Pettersson A, Egenvall A. Breed variations in the incidence of pyometra and mammary tumours in Swedish dogs. *Reprod Domest Anim*. 2012 Dec;47:347-350.
- Jitpean S, Ström-Holst B, Emanuelson U, Höglund OV, Pettersson A, Alneryd-Bull C, *et al.* Outcome of pyometra in female dogs and predictors of peritonitis and prolonged postoperative hospitalization in surgically treated cases. *BMC Vet Res*. 2014 Jan 7;10(1):6.
- Asheim A. Renal function in dogs with pyometra. *Acta Vet Scand*. 1963;4:293-306.
- Sevelius E, Tidholm A, Thoren-Tolling K. Pyometra in the dog. *J Am Anim Hosp Assoc*. 1990;26(1):33-38.
- Braun JP, Lefebvre HP, Watson AD. Creatinine in the dog: a review. *Vet Clin Pathol*. 2003 Dec;32(4):162-179.
- Smith FO. Canine pyometra. *Theriogenology*. 2006 Aug 1;66(3):610-612.
- Singh LK, Patra MK, Mishra GK, Saxena AC, De UK, Singh SK, *et al.* Prospects of diagnostic and prognostic biomarkers of pyometra in canine. *Asian Pac J Reprod*. 2020 Jul 1;9(4):166-173.
- Heiene R, Kristiansen V, Teige J, Jansen JH. Renal histomorphology in dogs with pyometra and control dogs, and long-term clinical outcome with respect to signs of kidney disease. *Acta Vet Scand*. 2007 May 4;49(1):13.

12. Maddens B, Heiene R, Smets P, Svensson M, Aresu L, Van der Lugt J, *et al.* Evaluation of kidney injury in dogs with pyometra based on proteinuria, renal histomorphology, and urinary biomarkers. *J Vet Intern Med.* 2011 Sep;25(5):1075-1083.
13. Sant'Anna MC, Martins GF, Flaiban KK, Trautwein LG, Martins MI. Protein-to-creatinine urinary ratio in the early diagnosis of renal injury in canine pyometra. *Pesq Vet Bras.* 2019;39:186-191.
14. de Andrade AC, da Silva ÉP, dos Santos JD, Oliveira KP, da Silva KP, Notomi MK. Evaluation of kidney injury through early markers in canine pyometra. *Braz J Vet Res Anim Sci.* 2023 May 15;60:e199954.
15. Gasser B, Uscategui RA, Maronezi MC, Pavan L, Simões AP, Martinato F, *et al.* Clinical and ultrasound variables for early diagnosis of septic acute kidney injury in bitches with pyometra. *Sci Rep.* 2020 Jun 2;10(1):8994.
16. Kurban İ, İslamoğlu S, Uçmak ZG, Namlı E, Türkan YS. Evaluation of calcium, phosphorus and some biochemical parameters in dogs with open and closed cervix pyometra. *Pol J Vet Sci.* 2024;241-247.
17. Chitra P. Microbiological and haemato-biochemical studies in canine pyometra. *Indian J Anim Res.* 2025 Sep 1;59(9).
18. Singh R, Preet GS, Singh R, Singh R, Yadav V, Singh B, *et al.* Management of closed pyometra-induced acute kidney injury by intermittent hemodialysis in a Labrador Retriever dog. *Arch Curr Res Int.* 2025 Aug 2;25(8):199-205.