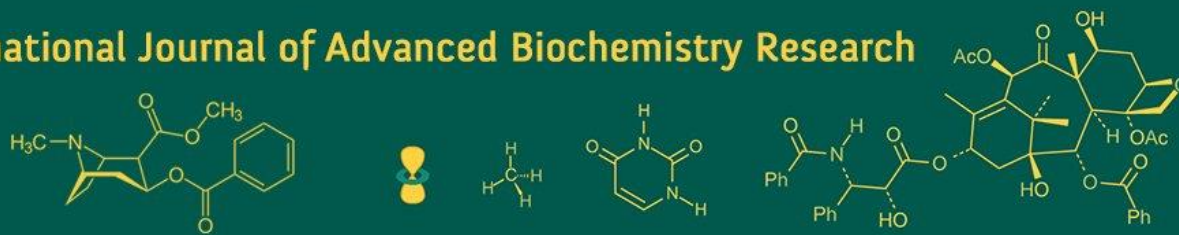


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Therapeutic aspects of cystic endometrial hyperplasia-pyometra syndrome in bitches with antiprogesterone and prostaglandin and broad spectrum antibiotics

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Abstract

Cystic endometrial hyperplasia-pyometra complex (CEH-P) is the most frequent uterine disorder observed in intact bitches. Pathophysiological aspects of CEH-P includes bacterial infection in endometrium due to the influence of progesterone. In the present case study 12 bitches with pyometra and endometritis were treated with hormonal treatment of antiprogesterone, prostaglandin and were given broad spectrum antibiotics. Out of 12 cases, 9 bitches recovered successfully while in 2, ovariohysterectomy was performed after the instituting treatment and one death was recorded. Response to the treatment was seen according to ultrasonography and general condition included termination of uterine discharge, reduced progesterone level, decline in uterine diameter and also WBC count within 15 days of treatment. All 9 recovered bitches subsequently experienced normal estrus. The result demonstrated that antiprogesterone drug along with prostaglandin and broad spectrum antibiotics was effective in 9 bitches (75%) with pyometra and endometritis causing no side effects. In conclusion antiprogesterone and prostaglandin and broad spectrum antibiotics is useful for treating bitches with pyometra and endometritis.

Keywords: Antiprogesterone, antibiotics, endometritis, prostaglandin, pyometra

Introduction

Cystic endometrial hyperplasia-pyometra complex is the most frequent endometrial disorder encountered in bitches during estrous phase, the canine uterus undergoes a number of morphologic changes due to frequent changes in the level of progesterone and estrogen (Barrau *et al.*, 1975) ^[1]. Cystic endometrial hyperplasia (CEH) is an abnormal response of the bitch's uterus to ovarian hormones (Miller-Liebl *et al.*, 1994) ^[12]. Several side effects have been observed after the administration of aglepristone such as anorexia, restlessness, depression, vomiting, diarrhoea, decrease in body temperature and local inflammatory reaction after injection (Fieni, 2006) ^[7]. Indeed, CEH is assumed to be an exaggerated response of the uterus to chronic or repeated progestational stimulation during the luteal phase of the estrous cycle, with accumulation of fluid within the endometrial glands and the uterine lumen (Feldman and Nelson 1996) ^[6] CEH/ P results from an infection, commonly *E. coli*, ascending from the vagina (Johnston *et al.*, 2001) ^[14] influenced by progesterone hormone progressing to pyometra resulting in infertility. The pathogenesis of the disease is related to the activity of progesterone (Feldman and Nelson, 1996) ^[6]. Cystic endometrial hyperplasia (CEH) is an abnormal response of the bitch's uterus to ovarian hormones (De Bosschere *et al.*, 2001) ^[5]. CEH is considered by many authors to be an exaggerated response of the uterus to chronic progestational stimulation during the luteal phase of the oestrous cycle, causing an abnormal accumulation of fluid within the endometrial glands and uterine lumen (De Bosschere *et al.*, 2001) ^[5]. The resulting lesions of pyometra are due to the interaction between bacteria and hormones. The source of the uterine bacteria probably is the urinary tract or a genital region. The most frequently isolated bacterium in canine pyometra is *Escherichia coli* (Fransson *et al.*, 1997) ^[8]. Specific endometrial and myometrial receptors for *E. coli* are present in the infected uterus, theoretically enhancing the colonization of

bacteria in the uterus (Johnson 1995) [13], mediated through abnormalities in endometrial receptors for estrogen and/or progesterone. In CEH there is thickening and enlargement of endometrium due to increase in the size and number of endometrial glands. The hyperplastic and hypertrophic endometrial glands have an increased secretory activity, and sterile fluid may accumulate in the glands and in the lumen of the uterus, resulting in mucometra or hydrometra, depending on the viscosity of the uterine content considered mucometra an advanced CEH, with atrophy of the uterine wall and a mucus-filled lumen. By itself, cystic endometrial hyperplasia is not associated with clinical signs (a mucometra sometimes causes abdominal distention), unless the uterine content becomes infected; this is referred to as pyometra. Drug combination of antiprogesterone and PGF₂α has gained a new therapeutic possibility with substantial success in the treatment of pyometra (Shah *et al.*, 2016) [17].

The aim of this clinical study was to evaluate the efficacy and safety of the treatment of metritis /pyometra in bitches by the administration of aglepristone in bitches with various forms of infectious uterine diseases, that were presented at TVCC, Durg. Treatment aspect was designed to hasten the recovery process without the side effects often associated with the use of prostaglandins in bitches with open or closed pyometra.

Materials and Methods

The study was carried out at the Department of Teaching Veterinary Clinical Complex, College of Veterinary Science and Animal Husbandary Anjora, Durg, Chhattisgarh, India during January to December 2024. The study involved twelve female dogs of different breeds, age ranging from 3 to 14 years, were presented with open or closed forms of pyometra or endometritis in each case, main clinical symptoms were hyperthermia, polydipsia, vomit, diarrhoea, polyuria and prostration distended abdomen, continuous vomiting, dullness, recumbency, and history of estrus varying from 35 days to 60 days. The physical examination including rectal temperature, heart rate and respiration rate were recorded. In each suspected cases hematological and biochemical examination along with progesterone assay and ultrasound were carried out and data is given in (table no 1). Ultrasonographic examination demonstrated presence of fluid filled anechoic pockets in uterine horns.

Procedure

Whole blood samples were collected from the cephalic vein into a vacutainer tubes. The blood samples in ethylenediaminetetraacetic acid (EDTA) vials were processed within 3-4 h after collection: blood cell counts were performed using an automated cell count (Medonic CA 570-Delcon). The following parameters were evaluated: erythrocytes (RGB), mean corpuscular volume (MCV), packed cell volume (HCT), platelets (PLT), leucocytes (WBC), haemoglobin (HGB), mean corpuscular haemoglobin concentration (MCHC). Serum samples were analysed for urea, creatinine, SGPT and Albumin. Serum progesterone concentrations were determined by radioimmunoassay (RIA) technique.

Treatment protocol

Based on the diagnosis all the affected bitches were administered with Mifipristone (Antiprogesterone drug) @

2.5 mg/kg body weight on Day 1, Day 2 and Day 7 and PGF₂α tablet @ 200 mg per vaginum from day 1 to 4 in order to relax the cervix along with broad spectrum antibiotics X-ceft (ceftifur sodium) @ 2.2 mg/kg. Supportive treatment was given with Inj. Dextrose 5% and Inj. RL @ 20 ml /kg body weight.

Statistical analysis

The data were statically analyzed based on the percentage of animals recovered or unrecovered the efficacy of treatment was evaluated.

Results

When measuring efficacy 9 bitches were cured, the response to the above hormonal treatment was found to be 75% in all the bitches treated. The recovery was confirmed based on estimation of progesterone level along with hematological profile examination and ultrasonographically showing reduction in the diameter of the uterus. Among all twelve dogs, one died due to septicemia and elevated level of creatinine. In closed pyometra, 2 dogs were advised for ovariohysterectomy since they were not responding to the above treatment.

Clinically the administration of antiprogesterone medication caused release of the vaginal discharge to change from purulent to mucous-like to serious to clear in colour, with a corresponding decrease in volume. The bitch's self-cleaning of the vulval region was the most significant clinical symptom noted. After the first two doses of antiprogesterone in treatments, cervical opening was achieved in all bitches with closed pyometra. Four to twenty-four hours was the average time to cervical opening. The least amount of time was four hours following the initial antiprogesterone medication administration; nonetheless, all of the bitches' cervical openings were finished in 48 hours. Large amounts of purulent discharge were able to be evacuated caused by cervical opening, which was associated to an instant improvement in overall health and, typically, an increase in appetite.

Additional treatment along with antiprogesterone, PGF₂α medications were applied vaginally from days 1 to 4 which increased the overall success rate for all bitches with open or closed pyometra. Alongside recovery, the uterine lumen's diameter gradually reduced to the point where it could no longer be seen on ultrasonography. Depending on the treatment, bitches receiving the combined antiprogesterone-PGF₂α treatment experienced a significantly higher mean decrease in uterine lumen diameter over time between days 8th and 14th. Throughout the course of treatment, the bitches with infection remained in good general condition. In each of the twelve cases, bitches with either open or closed pyometra were anorexic or inactive. By the second day of treatment, this criterion had significantly improved in all treated cases. On day 15, all bitches still receiving treatment were in good general condition, while only one showing any loss of appetite. No side effects were observed after treatment with PGF₂α in 9/12 bitches. None of the bitches had a noticeable change in red blood cell count. The mean white blood cell counts in bitches suffering from pyometra were elevated and remained same during the treatment. Leucocytosis significantly decreased during treatment in bitches recovering from pyometra. On days seven and eight, this mean decline was significant.

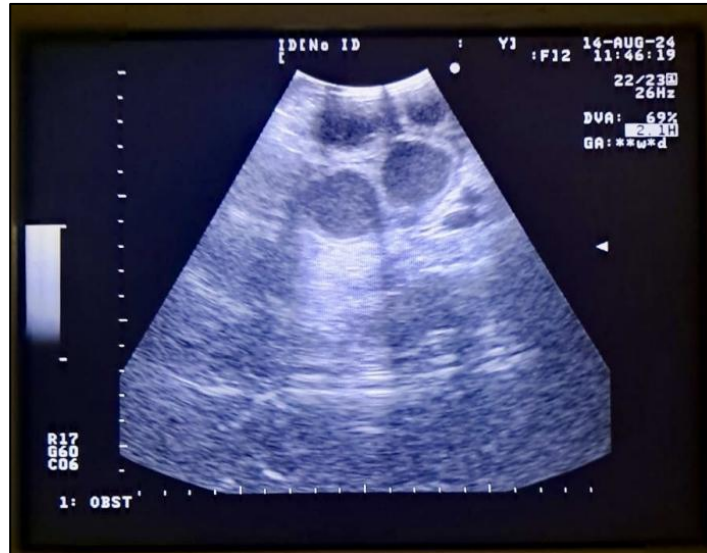


Fig 1: Fluid filled pockets were observed showing anechoic appearance.

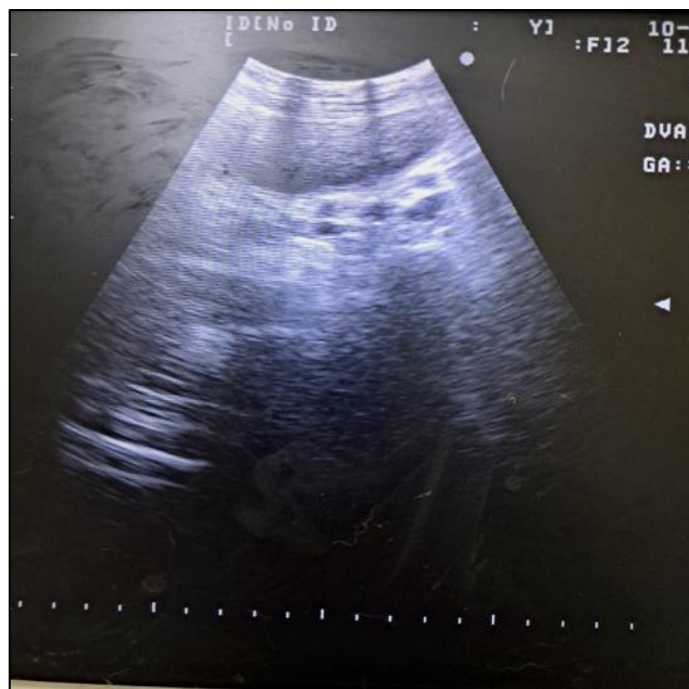


Fig 2: Reduction in the size of fluid filled pockets after 7 days (post treatment).

Ultrasonographic evaluation

On ultrasonographical examination on fifteenth day, the uterus looked normal and the anechoic uterine pockets disappeared as shown in fig. 1 and 2. Thus, on the fifteenth day of treatment, the animal recovered without issue.

Hematological evaluation

All of the animals hematological parameters were recorded both before and after therapy (Table 1). The cervix gradually relaxed, allowing exudates to flow from day two onward. This stopped on the seventh day of treatment. on Fifteen days treatment after therapy, hemoglobin concentration increased, on from the tenth day, the WBC count returned to normal.

Serum biochemistry

In all 12 cases kidney function and liver lunction tests were performed showing no abnormalities in liver function. While SGPT and albumin levels were within normal limits for all animals. Whereas bitches with increased BUN level gradually drops after therapy, it means that the animal is responding well to the medication and that the toxemia has been reduced. The plasma creatinine levels of six individuals (23%) were higher than 1.5 mg/dL when they were first seen which reduced post treatment. In this investigation, all of the animals responded well to medical therapy.

Table 1: Signalment of bitches with cystic endometrial hyperplasia-pyometra complex hematological biochemical and hormonal data in 12 bitches with CEH-P before and after treatment.

S. N	Case details Age and body weight	CBC		Biochemical values		Progesterone level		Recovery days and type of pyometra
		Before	After	Before	After	Before	After	
1	Spitz, 11 yr Weight: 10 kg	Before Hb: 10.3 gm% TLC: 52, 000/cumm N-88%	After Hb: 11.9 gm% TLC: 15770/cumm N-75%	Before SGPT 27U/L Creatinine:1.96 mg/dl BUN: 54 mg/dl Albumin: 2.3 g/dl	After SGPT 27U/L Creatinine:1.96 mg/dl BUN: 54 mg/dl Albumin: 2.3 g/dl	Before 21.66 ng/ml	After 1.72 ng/ml	Open pyometra 15 days
2	Pitbull, 5 yr Weight:28 kg	Before Hb: 13.2 gm% TLC: 13500/cumm N-85%	After Hb: 12.4 gm% TLC: 6700/cumm N-60%	Before SGPT 29 U/L Creatinine:0.65 mg/dl BUN: 15 mg/dl Albumin: 3.85 g/dl	After SGPT 29 U/L Creatinine:0.65 mg/dl BUN: 15 mg/dl Albumin: 3.85 g/dl	Before 8.75 ng/ml	After 2.45 ng/ml	Open pyometra 15 days
3	Labrador, 4 yr Weight: 10 kg	Before Hb: 8.1 gm% TLC: 32, 000/cumm N-86%	After Hb: 9.3 gm% TLC: 9220/cumm N-61%	Before SGPT 14U/L Creatinine:0.70 mg/dl BUN: 20 mg/dl Albumin: 2.17 g/dl	After SGPT 14U/L Creatinine:0.70 mg/dl BUN: 20 mg/dl Albumin: 2.17 g/dl	Before 40.66 ng/ml	After 0.67ng/ml	Open pyometra 10 days
4	Spitz, 8 yr Weight: 12 kg	Before Hb: 13.2 gm% TLC: 12630/cumm N-95%	After Hb: 10.3 gm% TLC: 7590/cumm N-44%	Before SGPT 74U/L Creatinine:1.04 mg/dl BUN: 22 mg/dl Albumin:3.76 g	After SGPT 74U/L Creatinine:1.04 mg/dl BUN: 22 mg/dl Albumin:3.76 g	Before 14.65 ng/ml		Closed pyometra Referred to surgery for OVH
5	Non descriptive, 9 yr Weight: 15 kg	Before Hb: 11 gm% TLC: 10270/cumm N-89%	After Hb: 10 gm% TLC: 5200/cumm N-65%	Before SGPT 34 U/L Creatinine:0.76 mg/dl BUN: 40 mg/dl Albumin: 2.8 g	After SGPT 34 U/L Creatinine:0.76 mg/dl BUN: 40 mg/dl Albumin: 2.8 g	Before 11.78 ng/ml	After 1.23 ng/ml	Open pyometra 15 days
6	Labrador, 6 yr Weight: 30 kg	Before Hb: 12 gm% TLC: 32000/cumm N-85%	After Hb: 14 gm% TLC: 5480/cumm N-70%	Before SGPT 47 U/L Creatinine:1.00 mg/dl BUN: 64 mg/dl Albumin: 3.56 g	After SGPT 35 U/L Creatinine:0.67 mg/dl BUN: 42 mg/dl Albumin: 3.56 g/dl	Before 22 ng/ml	After 0.66 ng/ml	Closed pyometra 15 days
7	Labrador, 3 yr Weight: 35 kg	Before Hb: 10.3 gm% TLC: 52, 000/cumm N-88%	After Hb: 17.2 gm% TLC: 5850/cumm N-54%	Before SGPT 17 U/L Creatinine:0.50 mg/dl BUN: 18 mg/dl Albumin: 3.16 g/dl	After SGPT 17 U/L Creatinine:0.50 mg/dl BUN: 18 mg/dl Albumin: 3.16 g/dl	Before 5.76 ng/ml	After 1.04 ng/ml	Open pyometra 7 days
8	German shepherd, 10 yr Weight: 10 kg	Before Hb: 9 gm% TLC: 28010/cumm N-60%	After Hb: 10.5 gm% TLC: 6.500/cumm N-55%	Before SGPT 30 U/L Creatinine:0.59 mg/dl BUN: 26 mg/dl Albumin: 2 g/dl	After SGPT 33 U/L Creatinine:1.4 mg/dl BUN: 19 mg/dl Albumin: 2.4 g/dl	Before 12.60 ng/ml		Referred for OVH Closed pyometra
9	Golden retriever, 6 yr Weight: 10 kg	Before Hb: 10.5 gm% TLC: 32, 000/cumm N-75%	After Hb:14.4 10.3 gm% TLC: 13770/cumm N-65%	Before SGPT 32 U/L Creatinine:1.03 mg/dl BUN: 43 mg/dl Albumin: 1.83 g	After SGPT 28U/L Creatinine:1.95 mg/dl BUN: 50 mg/dl Albumin: 2.5 g/dl	Before 20.75 ng/ml	After 1.66 ng/ml	Closed pyometra 10 days
10	Labrador, 8 yr Weight: 32kg	Before Hb: 12 gm% TLC: 75, 000/cumm N-85%		Before SGPT 230 U/L Creatinine:5.06 mg/dl BUN: 126 mg/dl Albumin: 1.85 g/dl		Before 15.85 ng/ml		Death Open pyometra
11	Spitz, 7 yr Weight: 7 kg	Before Hb: 8.3 gm% TLC: 43, 000/cumm N-85%	After Hb: 10.4 gm% TLC: 17, 000/cumm N-79%	Before SGPT 65 U/L Creatinine:2.06 mg/dl BUN: 35 mg/dl Albumin: 1.7 g/dl	After SGPT 55 U/L Creatinine:1.40 mg/dl BUN: 30 mg/dl Albumin: 2.8 g/dl	Before 6.56 ng/ml	After 2.06 ng/ml	15 days Closed pyometra

12	Golden retriever, 5.5 yr Weight: 42 kg	Before Hb: 11.02 gm% TLC: 30,000/cumm N-95%	After Hb: 12.3 gm% TLC: 14,000/cumm N-67%	Before SGPT 17 U/L Creatinine:1.23 mg/dl BUN: 32 mg/dl Albumin: 2.8 g	After SGPT 25 U/L Creatinine:1.44 mg/dl BUN: 44 mg/dl Albumin: 2.8 g/dl	Before 9.06 ng/ml	After 1.03 ng/ml	10 days Closed pyometra
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9	Golden retriever, 6 yr Weight: 10 kg	Before Hb: 10.5 gm% TLC: 32,000/cumm N-75%	After Hb: 14.4 gm% TLC: 10.3/cumm N-65%	Before SGPT 32 U/L Creatinine:1.03 mg/dl BUN: 43 mg/dl Albumin: 1.83 g	After SGPT 28U/L Creatinine:1.95 mg/dl BUN: 50 mg/dl Albumin: 2.5 g/dl	Before 20.75 ng/ml	After 1.66 ng/ml	Closed pyometra 10 days
11	Spitz, 7 yr Weight: 7 kg	Before Hb: 8.3 gm% TLC: 43,000/cumm N-85%	After Hb: 10.4 gm% TLC: 17,000/cumm N-79%	Before SGPT 65 U/L Creatinine:2.06 mg/dl BUN: 35 mg/dl Albumin: 1.7 g/dl	After SGPT 55 U/L Creatinine:1.40 mg/dl BUN: 30 mg/dl Albumin: 2.8 g/dl	Before 6.56 ng/ml	After 2.06 ng/ml	15 days Closed pyometra
12	Golden retriever, 5.5 yr Weight: 42 kg	Before Hb: 11.02 gm% TLC: 30,000/cumm N-95%	After Hb: 12.3 gm% TLC: 14,000/cumm N-67%	Before SGPT 17 U/L Creatinine:1.23 mg/dl BUN: 32 mg/dl Albumin: 2.8 g	After SGPT 25 U/L Creatinine:1.44 mg/dl BUN: 44 mg/dl Albumin: 2.8 g/dl	Before 9.06 ng/ml	After 1.03 ng/ml	10 days Closed pyometra

Discussion

According to Nelson and Kelly (1976)^[9] and Hardy and Osborne (1994), progesterone is a key factor in the development of CEH, and it makes sense that using exogenous progestins could raise the risk of pyometra (Blendinger *et al.*, 1997; Kooistra *et al.*, 1997)^[2, 10]. Oestrogen and progesterone receptors are altered in cases of cystic endometrial hyperplasia, according to recent research (Niskanen and Thrusfield 1988)^[11]. Cystic endometrial gland distortion and peripheral fibroblast proliferation with an inflammatory response cause endometrial hyperplasia (DeBosschere *et al.*, 2001)^[5]. Ultrasonography may readily detect uterine exudate; however, because the lesions were moderately severe and indistinguishable, it was not always possible to differentiate between CEH in bitches of groups A and B using ultrasonography. Bitches had cystic endometrial hyperplasia, which was clearly detected by ultrasound due to the amount of tissue alterations. In this investigation, bitches with varying degrees of CEH were observed. It is possible that bitches with CEH-mucometra may be more likely to have endometritis-pyometra, even though DeBosschere *et al.* (2001)^[5] have proposed that these two conditions may be distinct. According to Bigliardiet *et al.* (2004)^[3], ultrasonography is a practical and reliable technique for identifying abnormal uterine changes. According to Sethi *et al.* (2020)^[16], antiprogestone therapy was the most successful treatment for canine pyometra, followed by PGF₂α alone and PGF₂α plus antiprogestone therapy. This was because the animals' uterine lumens evacuated pus, and all hematobiochemical parameters returned to normal after treatment.

Conclusion

In conclusion the treatment of canine pyometra with antiprogestone therapy and PGF₂α, and fluid therapy was successful because it caused pus to be evacuated from the uterus lumen, and all hematological biochemical parameters returned to normal in all of the animals. To find abnormal uterine changes, ultrasound examination is a practical and reliable technique.

References

1. Barrau MD, Abel JH Jr, Verhage HG, Tietz WJ. Development of the endometrium during the estrous cycle in the bitch. *Am J Anat.* 1975;142(1):47-66.
2. Blendinger K, Bostedt H, Hoffman B. Proceedings of the 3rd International Symposium on Canine and Feline Reproduction. *J Reprod Fertil.* 1997;51(Suppl):317-318.
3. Bigliardi E, Parmigiani E, Cavirani S, Luppi A, Bonati L, Corradi A. Ultrasonography and cystic hyperplasia-pyometra complex in the bitch. *Reprod Dom Anim.* 2004;39(3):136-140.
4. Dow C. Experimental reproduction of the cystic hyperplasia-pyometra complex in the bitch. *J Pathol Bacteriol.* 1959;78(1):267-278.
5. De Bosschere H, Ducatelle R, Vermeirsch H, Van Den Broeck W, Coryn M. Cystic endometrial hyperplasia-pyometra complex in the bitch: Should the two entities be disconnected? *Theriogenology.* 2001;55(8):1509-1519.
6. Feldman EC, Nelson RW. Chapter 21: Cystic endometrial hyperplasia/pyometra complex. In: *Canine and Feline Endocrinology and Reproduction.* 2nd ed. Philadelphia: W.B. Saunders; 1996. p. 605-618.
7. Fieni F. Clinical evaluation of the use of aglepristone, with or without cloprostenol, to treat cystic endometrial hyperplasia-pyometra complex in female dogs. *Theriogenology.* 2006;66(7):1550-1556.
8. Fransson B, Lagerstedt A-S, Hellmen E, Jonsson P. Bacteriological findings, blood chemistry profile and plasma endotoxin levels in bitches with pyometra or other uterine diseases. *J Vet Med.* 1997;44(8):417-426.
9. Nelson LW, Kelly WA. Progesterone-related gross and microscopic changes in female beagles. *Vet Pathol.* 1976;13(2):143-156.
10. Kooistra HS, Okkens AC, Mol JA, Van Garderen E, Kirpensteijn J, Runberk A. Proceedings of the 3rd International Symposium on Canine and Feline Reproduction. *J Reprod Fertil.* 1997;51(Suppl):355-356.

11. Niskanen M, Thrusfield MV. Association between parity, hormonal therapy, breed, and pyometra in Finnish dogs. *Vet Rec.* 1988;143(2):493-498.
12. Miller-Liebl D, Fayer-Hosken R, Caudle A, Downs M. Reproductive tract diseases that cause infertility in the bitch. *Vet Med.* 1994;89(11):1047-1054.
13. Johnson CA. Chapter 125: Cystic endometrial hyperplasia, pyometra, and infertility. In: Ettinger SJ, Feldman EC, editors. *Textbook of Veterinary Internal Medicine.* 4th ed. Philadelphia: W.B. Saunders; 1995. p. 1636-1642.
14. Johnston SD, *et al.* Disorders of the canine uterus and uterine tubes (oviducts). In: *Canine and Feline Theriogenology.* Kersey R, editor. W.B. Saunders Company; 2001. p. 206-224.
15. Hardy RM, Osborne CA. Canine pyometra: Pathophysiology, diagnosis and treatment of uterine and extra-uterine lesions. *J Am Anim Hosp Assoc.* 1994;10(3):245-268.
16. Sethi GPS, Gandotra VK, Honparkhe M, Singh AK, Arora AK, Ghuman SPS. Efficacy of antiprogestone and PGF 2α therapy for treating canine pyometra. *Int J Curr Microbiol App Sci.* 2020;9(2):2117-2123.
17. Shah MA, Pande N, Shah IA, Agrawal R, Sharma U, Ghuman SPS. Treatment of pyometra in female dogs using prostaglandin PGF 2α ±antiprogestin (mifepristone). *Indian J Anim Reprod.* 2016;37(1):23-26.