Canine Pyometra – A Review

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ABSTRACT

Pyometra is frequently found as one of the clinical problems of the female reproductive system in the bitches. It is one of the life-threatening conditions, requiring immediate medical attention. The frequent causes for the occurrence of pyometra in female dogs often include hormonal imbalances in the bitches as well as pathogenic bacterial species like E. coli organisms. Further, other miscellaneous etiological agents like cysts in the uterus, thickened uterine wall, etc., were also implicated in pyometra. The frequent occurrence of clinical symptoms of multiple organ dysfunction, especially those related to the renal system, is also dealt with. The pathogenesis-related information has also been dealt with. Various symptoms like persistent vomiting, signs related to deranged renal functions, anorexia, lethargy, etc., have been detailed. The different treatment measures associated with the administration of drugs like Cabergoline, Cloprostenol, Mifepristone, etc., have been dealt with apart from the prophylactic measures.

Keywords: Pyometra, Kidney, E. coli, Vomiting

INTRODUCTION

Pyometra in canines have been encountered as one of the common reproductive disorders of bitches and literally, it means the accumulation of pus within the uterine lumen occurring either immediately during or following the phase of progesterone dominance and it affects either an open cervix or closed cervix pyometra; among this, it is a close pyometra which is dangerous due to the occurrence of septicemia and toxemia. According to Cohen (2024), pyometra is a severe and potentially life-threatening uterine infection characterized by the accumulation of bacteria and pus within the uterus. Affected dogs often exhibit symptoms such as vaginal discharge, loss of appetite, lethargy, vomiting, and occasionally increased thirst or urination. The most effective course of treatment is surgical removal of the uterus and ovaries, commonly referred to as an ovariohysterectomy or spay. While any unspayed female dog can develop pyometra, it is more frequently observed in middle-aged to older females who have undergone several heat cycles.

AGE, BREED, AND PARITY

Several studies have identified breed and age-related predispositions to pyometra in canines. Breeds with a higher susceptibility include the Rottweiler, Saint Bernard, Chow Chow, Golden Retriever, Miniature Schnauzer, Irish Terrier, and Spanish Callie. At the same time, Drevers, German Shepherds, Dachshunds, and Swedish Hounds have been reported to have a lower risk (Baithalu *et al.*, 2010). This condition is most commonly observed in middle-aged to older bitches, typically between 5 and 10 years of age (Martins *et al.*, 2015; Bhat *et al.*, 2018; Kumar *et al.*, 2019). Labrador and Pomeranian

breeds have been recorded as having the highest incidence rates, particularly in nulliparous animals; with open cervix pyometra being more prevalent than the closed cervix form (Juneja *et al.*, 2021; Verma *et al.*, 2022). Although pyometra is primarily observed in middle-aged animals, cases have also been documented in dogs as young as two years old (Baithalu *et al.*, 2010; Sethi *et al.*, 2020). Pham *et al.* (2023) found that dogs between 5 and 7 years had the highest incidence, followed by those aged 2 to 4 years, with the lowest occurrence in dogs under 2 years. Pyometra is comparatively more frequently studied in dogs than in cats, affecting mainly older bitches with an average age at diagnosis of around 7 years, but it can occur in dogs as young as 3 years to as old as 18 years (Hagman, 2023).

ETIOPATHOGENESIS

Fransson and Ragle (2003) suggested that while hormones play a key role in cystic endometrial hyperplasia (CEH), bacterial multiplication is the primary factor in pyometra, with CEH predisposing the uterus to infection. Other researchers, such as Chen et al. (2003) and Krekeler et al. (2012), indicated that progesterone suppresses the immune defenses of the canine uterus, facilitating the growth of bacteria, particularly uropathogenic strains. Dow (1957) emphasized that hormonal imbalances in the endocrine profile lead to CEH, which develops into pyometra due to subsequent bacterial infection. This interaction between hormones and bacteria may promote bacterial adhesion and proliferation on the uterine lining, ultimately causing severe complications such as organ dysfunction, endotoxemia, sepsis, and even death (Hagman and Kuhn, 2002; Fransson *et al.*, 2007; Kempisty *et al.*, 2013).

Schlafer and Gifford (2008) described how hyperplasia, local inflammation, glandular secretion buildup, and bacterial infection culminate in pyometra. While the precise mechanism between progesterone-primed endometrium and pathogenic bacteria remains unclear (Verstegen et al., 2008; Kempisty et al., 2013), it is widely accepted that bacterial invasion and hormonal disturbances are key factors in pyometra's development (Younis et al., 2014; Ros et al., 2014; Hagman, 2017, 2018).

Nomura and Nishida (1998) and De Bosschere *et al.* (2001) believed that bacteria act as irritants on the progesterone-stimulated endometrium, leading to CEH, which may then progress to pyometra. External factors such as uterine biopsies or suture material from prior surgeries, including cesarean sections, could also irritate the endometrium, triggering the CEH-pyometra complex (Noakes et al., 2001). Krekeler (2010) argued that CEH develops only in progesterone-primed endometrial tissues, with estrogen upregulating progesterone receptors, making the uterus more susceptible. Schlafer and Gifford (2008) and Sandholm et al. (1975) further noted that subacute endometritis can contribute to the development of CEH, predisposing the bitch to pyometra. Interestingly, while pyometra can occur in younger dogs, CEH was not always present in these cases (De Bosschere *et al.*, 2002; Hall, 2012).

Mukherjee et al. (2007) explained that progesterone stimulates the uterine lining to proliferate and secrete "uterine milk," creating an environment conducive to bacterial growth. During this period, the cervix remains closed, inhibiting the myometrium and allowing fluid buildup, which contributes to pyometra. In closed-cervix pyometra, the trapped fluid can act like

an abscess, producing toxins that lead to toxaemia. Baithalu *et al.* (2010) suggested that progesterone plays a significant role in the development of the CEH-pyometra complex, and the administration of estrogen during high progesterone levels can increase the risk of pyometra. Xavier *et al.* (2023) echoed this view, stating that progesterone inhibits uterine contractions and weakens immune responses, further encouraging bacterial colonization and the development of CEH, which predisposes dogs to pyometra.

Regarding renal effects, Stone *et al.* (1988) found that many dogs with pyometra exhibited reduced urine specific gravity and tubulointerstitial nephritis, often associated with urinary tract infections. Asheim (1964) also observed impaired renal concentration abilities in affected dogs. Gasser *et al.* (2020) concluded that bitches with pyometra commonly show signs of renal damage, with acute kidney injury being a frequent complication in cases of septic pyometra.

Several authors have identified Gram-negative bacteria, particularly Escherichia coli, as the predominant cause of pyometra. Agostinho *et al.* (2014), Rubio *et al.* (2014), and Unnikrishnan (2018) reported the prevalence of *E. coli* in pyometra cases as 60%, 73%, 67.8%, and 52.83%, respectively. Song *et al.* (2017), through sequencing of the 16S rRNA gene from bacterial isolates in pyometra cases, revealed a high diversity of bacterial species involved in the disease's pathogenesis, suggesting that *E. coli* may not always be the primary causative agent. They identified the three most prevalent bacterial families in pyometra cases as Pasteurellaceae, Fusobacteriaceae, and Porphyromonadaceae. Additionally, Staphylococcus and Streptococcus species were isolated in up to 15% and 23% of cases, respectively, as reported by Hagman (2018). Sant'Anna *et al.* (2014) cultured *E. coli* (52.5%) and Streptococcus spp. (13.6%) from uterine secretions, while Dos Anjos *et al.* (2021) found *E. coli* and Klebsiella sp. in 33.3% and 16.7% of samples, respectively. Lansubsakul *et al.* (2022) *K. pneumoniae* and *E. coli* were the most frequent causative bacteria isolated in closed-type and open-type pyometra, respectively. *E. coli* was consistently identified as the primary pathogen in pyometra uteri by Talukdar *et al.* (2022) and Achary *et al.* (2024). While pyometra often begins with mild local symptoms, it is noteworthy to mention that it can escalate into peritonitis, sepsis, and multi-organ dysfunction, therebyposing a significant threat to life.

DIAGNOSIS

It is an open secret that diagnosis of pyometra in bitches can easily be made in cases of open type of pyometra. However, in the absence of vaginal discharge i.e., close type of pyometra relies on patient history, clinical signs, imaging tests such as abdominal radiography and ultrasound, and findings of significant leukocytosis, especially neutrophils.

HISTORY

Most of the pyometra-affected cases were presented with a history of anorexia, abdominal distension, vomiting, polydipsia, polyuria, and, in a few cases, purulent vaginal discharges.

CLINICAL SYMPTOMS

Pyometra is a severe uterine infection commonly observed in unspayed bitches, with a wide range of clinical signs and complications. Fukuda (2001) noted key symptoms in Beagle dogs, including pus excretion from the cervix, a rapid rise in leukocyte count, and an enlarged uterus as

observed through radiography. Similarly, Murugavel *et al.* (2001) described chronic pyometra in a 10-year-old nulliparous bitch, where fever, shallow breathing, weak pulse, and foul-smelling hemorrhagic discharge from the vaginal passage were noted. Other early reports like that of Rao *et al.* (2002) in a Boxer and Troxel *et al.* (2002) in a German Shepherd highlighted symptoms like dullness, fever, vaginal discharge with fetid odour, and hemorrhagic vulvar discharge.

Further cases documented by Hernandez *et al.* (2003) and Bigliardi *et al.* (2004) emphasized gastrointestinal and systemic symptoms such as vomiting, polydipsia, polyuria, anorexia, and hyperthermia. Hernandez *et al.*(2003) reported a case of emphysematous pyometra in an eight-year-old dog with an enlarged abdomen and mild vulvar discharge, while Bigliardi *et al.* (2004) identified less common symptoms like diarrhoea and prostration. Additionally, cases like those by Nath *et al.* (2009) and Singh *et al.* (2010) provided more insight into varied vaginal discharge, ranging from purulent and brownish-red to pinkish and foul-smelling, reinforcing the diversity of pyometra presentations.

Gupta *et al.* (2013) quoted abdominal palpation as one of the diagnostic tools to reveal the canine pyometra in bitches. They quoted the apparent distension of the abdomen in 13.33% of the cases, in addition to inappetence, vomiting, and fever. Murthy *et al.* (2013) and Ramsingh *et al.* (2013) contributed to understanding physiological changes in pyometra-affected dogs, highlighting increased temperature, respiratory rate, and varied vulvar discharges. These reports indicated that fever is not always present in pyometra cases, as some dogs remained afebrile. Later studies like those of Mahesh *et al.* (2014) and Younis *et al.* (2014) described lethargy, polydipsia, and abdominal distension in affected dogs, with some cases of pyometra remaining undiagnosed until systemic illness became severe.

More recent observations by Ahamed *et al.* (2015), Kumar *et al.* (2016), Shah *et al.* (2016), and Solomon Singh (2018) reinforced the pattern of anorexia, vomiting, and vaginal discharge. Solomon Singh (2018) observed mucopurulent to haemorrhagic vaginal discharges with fetid odour. Kumar *et al.* (2021) revealed pyrexia and tachycardia with normal respiration rates in most of the pyometra-affected bitches. Hagman (2023) emphasised that pyometra can present with either an open or closed cervix. Open pyometra is characterized by mucopurulent or hemorrhagic discharge. In contrast, closed pyometra may show more severe systemic illness due to uterine distension, potentially leading to peritonitis, sepsis, and multi-organ dysfunction if untreated. These studies highlight the critical importance of early detection and treatment of pyometra in affected animals.

Talukdar *et al.* (2022) conducted a clinical examination of dogs with pyometra and observed signs such as lethargy, depression, loss of appetite, vaginal discharge, increased thirst, abnormal mucous membranes, distended uterus, frequent urination, vomiting, fever, and dehydration. The vaginal examination further revealed a foul-smelling, brown, chocolate-colored discharge. According to Pham *et al.* (2023), the most commonly observed clinical symptoms in bitches affected by pyometra include moodiness/proneness, vaginal discharge, abdominal distension, excessive thirst, loss of appetite, dehydration, fever, weight loss, polyuria, and vomiting. Mohan *et al.* (2023) quoted about the obvious uterine

enlargement in bitches with pyometra. Badgar *et al.* (2024) observed anorexia, purulent and blood-tinged discharge, and white foamy vomit in a dog affected with pyometra.

RADIOGRAPHY

Hernandez *et al.* (2003) observed that pyometra can be detected radiographically, showing a distended sacculated or tubular structure, especially in cases of closed pyometra, causing significant displacement of loops of intestines dorsally and cranially. Bigliardi *et al.* (2004) emphasized the usefulness of radiography in diagnosing pyometra in bitches. Further studies by Singh *et al.* (2010), Agrawal *et al.* (2015), and Dar *et al.* (2015) noted the presence of a fluid-dense tubular structure in the ventral and caudal abdomen, visible in radiographs. In cases with open cervix pyometra, where there is significant vaginal drainage, the uterus may not be visible radiographically (Baithalu *et al.* 2010). Additionally, Talukdar *et al.* (2022) revealed a cranio-dorsal displacement of the small intestine and a distended tubular opacity due to the enlarged uterus in the radiographic findings of pyometra-affected bitches.

ULTRASONOGRAPHY

Ultrasonography is considered the most accurate method for diagnosing pyometra in canines, as noted by Dennis and Hamm (2012), offering the advantage of detecting even small quantities of intrauterine fluid and identifying abnormalities in the ovaries and uterine tissue (Hagman, 2018). Ultrasonographic findings typically reveal an enlarged uterus with convoluted tubular horns filled with anechoic to hypoechoic fluid, along with a thickened uterine wall that is relatively hypoechoic (Baithalu *et al.*, 2010). The diagnosis can vary depending on whether the cervix is open or closed, and small echogenic particles may sometimes be visible in the luminal contents.

Several studies confirm these findings. Hadiya *et al.* (2021) described an enlarged uterus with sacculations filled with fluid and a thickened uterine wall. Talukdar *et al.* (2022) observed hyperplasia with echogenic material in the uterine wall and distended uterine horns containing a significant volume of cellular contents. Kumar *et al.* (2023) reported that the uterus appears as distended sacs due to pus accumulation, while Achary *et al.* (2024) noted an enlarged uterus with hypoechoic tubular structures containing mostly echogenic fluid. Overall, ultrasonography consistently reveals characteristic signs of pyometra, making it invaluable in diagnosing the condition.

HEMATOLOGICAL STUDIES

The extensive studies on hematological changes in pyometra-affected bitches demonstrate a consistent pattern of haematological abnormalities like anaemia, leukocytosis, neutrophilia with shift to the left, monocytosis, lymphopenia, and eosinopenia. Normocytic, normochromic regenerative anaemia might be encountered in pyometra-affected bitches (Hagman 2023 and Achary *et al.,* 2024), while, Fransson and Ragle (2003), Baithalu *et al.* (2010), and Babu *et al.* (2018) reported non-regenerative, normocytic, normochromic anaemia as well as microcytic hypochromic anaemia. Talukdar *et al.* (2022) revealed decreased haemoglobin (Hb), packed cell volume (PCV), total erythrocytic count (TEC), and lymphocyte count, indicating the microcytic hypochromic type of anaemia. Singh *et al.*(2010), Sahoo *et al.* (2012), Lakshmikanth *et al.* (2016), and Kumar *et al.* (2021) reported reduced haemoglobin (Hb), packed cell volume (PCV), and red blood cell counts (RBC). A reduction

in Hb and PCV is noted, as seen in studies like Dabrowski *et al.* (2007), Mudasir *et al.* (2011), Patil *et al.* (2013), Jitpean *et al.* (2014), Hadiya *et al.* (2020), and Maharathi *et al.* (2020).

Leukocytosis with neutrophilia shift to the left was the most common finding in pyometra-affected dogs. This occurs due to intense bone marrow response because of increased stress on the immune mechanism and diffused suppurative uterine inflammation as a means of combating the infection (Kustritz, 2005). Several studies, including those by Bigliardi *et al.*(2004), Hagman *et al.* (2006), Dabrowski *et al.* (2007), Verstegen *et al.* (2008), Dabhi *et al.* (2009), Baithalu *et al.* (2010), Mudasir *et al.* (2011), Hagman (2012), Shah *et al.* (2016), Shah *et al.* (2017), Hadiya *et al.* (2020), Maharathi *et al.* (2020), Kumar *et al.* (2021), Santana and Santos (2021), Talukdar *et al.* (2022), Hagman (2023), and Achary *et al.* (2024), reported leukocytosis in pyometra cases. The TLC values typically range from moderate to extreme, with some cases exceeding 75,000 cells/mm^3. Studies like Jena *et al.* (2013a) and Shah *et al.* (2017) showed higher TLC values in closed-cervix pyometra compared to open-cervix pyometra. Apart from these, pyometra cases frequently present with toxic degeneration of neutrophils as reported by Dabrowski *et al.* (2007) and Baithalu *et al.* (2010), which points to severe systemic infection or sepsis. Monocytosis was observed in pyometra-affected dogs (Dabrowski *et al.* (2007), Singh *et al.* (2010), Kumar *et al.* (2016), Hagman (2018) and Hagman (2023)), indicating an inflammatory or immune response. Lakshmikanth *et al.* (2016), Shah *et al.* (2017), and Kumar *et al.* (2021) observed lymphopenia and eosinopenia in pyometra cases, while lymphocytosis was noticed in Talukdar *et al.* (2022).

Biochemical studies

Hagman (2005) observed that pyometra-affected bitches exhibit consistently higher total plasma cholesterol levels compared to healthy dogs, with closed-cervix pyometra cases showing even greater cholesterol levels than open-cervix cases, which suggests intrahepatic cholestasis. Bigliardi*et al.*(2004) found that elevated blood levels of AST and creatinine in pyometra cases could be linked to liver dysfunction caused by E. coli endotoxins.

Singh *et al.* (2006) studied the hematological and biochemical changes in dogs with cystic endometrial hyperplasia-pyometra complex and found increased BUN levels, though plasma creatinine levels remained largely unaffected. The changes were more pronounced in cases with a closed cervix. Verstegen *et al.* (2008) and Baithalu *et al.* (2010) highlighted that the most consistent blood chemistry alteration in pyometra-affected bitches is the elevation of serum ALP and ALT levels, which suggests hepatocellular damage resulting from either toxaemia or dehydration. Moreover, Baithalu *et al.* (2010) revealed hyperproteinemia and hyperglobinemia due to chronic antigenic stimulation of the immune system. Maddens *et al.* (2011) observed renal lesions, including tubular and glomerular lesions, which resulted in blood biochemical changes in pyometra-affected dogs.

Mudasir *et al.* (2011) reported significantly elevated serum alkaline phosphatase, creatinine, and BUN levels in bitches with pyometra, which were attributed to kidney damage from bacterial endotoxins and dehydration. Gupta *et al.* (2013) identified elevated levels of plasma urea nitrogen, creatinine, transaminases, alkaline phosphatase, cholesterol, proteins, and progesterone, as well as hypoalbuminemia

and hyperglobulinemia, in pyometra cases. These changes reflected vital organ damage caused by bacterial endotoxins and indicated a lack of uterine luteolysin production, predisposing the animals to pyometra.

Patil *et al.* (2013) recorded significant increases in serum ALT, AST, ALP, total bilirubin, GGT, BUN, and creatinine, along with reduced protein and albumin concentrations in pyometra-affected dogs. Shah *et al.* (2017) noted elevated BUN and creatinine levels in pyometra cases, indicating impaired kidney function, alongside a significant increase in total protein, suggestive of an acute phase response. Manokaran *et al.* (2018) also reported elevated BUN and creatinine levels, indicative of kidney damage, and observed increased total protein, albumin, and globulin levels due to the acute phase response and antibody synthesis triggered by the infection.

Hadiya *et al.* (2020) highlighted elevated plasma urea nitrogen, creatinine, total protein, globulin, and AST/ALT enzyme levels, reflecting vital organ damage from pyometra/toxaemia, which normalized after ovariohysterectomy. Maharathi *et al.* (2020) observed higher cholesterol, total protein, hypoalbuminemia, and hyperglobulinemia in pyometra-affected bitches compared to healthy ones. Pati *et al.* (2021) also found significantly increased levels of BUN, creatinine, and ALP in pyometra cases. Dos Anjos *et al.* (2021) reported hyper-proteinemia in bitches with pyometra, likely due to dehydration or chronic antigenic stimulation, resulting in increased production of immunoglobulins and complement proteins. Talukdar *et al.* (2022) noted significant increases in blood urea nitrogen, creatinine, transaminases, alkaline phosphatase, and total proteins in pyometra cases, which were diagnostically and prognostically relevant and indicated organ damage from bacterial endotoxins. Achary *et al.* (2024) similarly found elevated AST, ALT, ALP, and BUN levels in pyometra-affected bitches.

Hence, it is that additional tests, including blood counts, leukograms, and liver function evaluations, can also provide valuable information. Leukocytosis and anaemia, along with signs of azotemia, are frequently observed in affected animals. This is because renal dysfunction can result from endotoxemia, glomerular dysfunction, renal tubular damage, and a decreased response to the antidiuretic hormone.

TREATMENT

Medical treatment was recommended for breeding females, old or weak females where anesthesia posed significant risks, and in situations where owners sought to minimize the cost of treatment. (Fieni *et al.,* 2014).

It is important to highlight common supportive clinical approaches in pyometra cases, such as the use of Elizabethan collars to prevent the ingestion of purulent vaginal discharge. Additionally, antibiotics free from nephrotoxic agents, like Amoxicillin-Clavulanic acid @ 25 mg/kg/day, were administered to avoid septicemia. Fluid therapy was also provided to address dehydration and mitigate toxic effects associated with pyometra (Fieni *et al.,* 2014).

PGF2α therapy was considered an effective treatment for open pyometra when future reproduction was desired. According to Baithalu *et al.* (2010), this treatment facilitated luteolysis (corpus luteum breakdown), cervical relaxation to allow exudate drainage, and enhanced myometrial contractions. However, it was not recommended for closed pyometra due to the risk of peritonitis, as noted by Nelson *et*

al. (1982). This risk arose from the forced movement of purulent fluid through the uterine tubes into the ovarian bursae or peritoneal cavity, or from a rupture of the uterine wall.

Natural prostaglandins @ 0.25 mg/kg or synthetic prostaglandins @ 10 µg/kg were administered daily for 5-7 days. The treatment's efficacy was assessed 10 to 14 days after the initial dose, with a second course of therapy being initiated if necessary (Fieni *et al.,* 2014). Dogs receiving injectable prostaglandins often exhibited adverse reactions, including abdominal discomfort, vomiting, defecation, urination, tachycardia, restlessness, anxiety, fever, excessive salivation, dyspnea, or panting (Feldman and Nelson, 2014).To mitigate the side effects of prostaglandins, Atropine was administered subcutaneously at a dosage of 0.025 mg/kg.

Trasch *et al.* (2003), Fieni (2006), and Jurka *et al.* (2010) described aglepristone as a progesterone receptor antagonist that binds competitively to progesterone receptors, reducing intrauterine progesterone levels and this therapy was recommended for both open and closed pyometra cases**.** Breitkopf *et al.*(1997) reported that successful treatment of pyometra involved two subcutaneous injections of 5-6 mg/kg aglepristone administered 12 hours apart on the first day, followed by a subcutaneous injection of 3 mg/kg on days 2, 3, and 4, and then an additional injection every four days. In contrast, Blendinger *et al.* (1997) recommended two subcutaneous injections of 6 mg/kg aglepristone 12 hours apart on the first day, followed by a 3 mg/kg injection for the next three days. Fieni (2006) suggested a dosage of 10 mg/kg aglepristone administered subcutaneously on days 1, 2, and 8, with an additional injection on day 15 if ultrasonography still detected the presence of the uterine lumen.

In bitches, prolactin was identified as a key luteotropic hormone. Therefore, dopamine agonists or prolactin inhibitors, such as Bromocriptine (20 mcg/kg) or Cabergoline (5 mcg/kg), were used alongside natural or synthetic prostaglandins (low doses) in the treatment of pyometra. These combinations enhanced the luteolytic effect of each drug, leading to more rapid luteolysis (Baithalu *et al.,* 2010). Meherl *et al.* (2018) stated that the use of low doses of Cloprostenol, a synthetic prostaglandin, alongside cabergoline was found to be a more effective treatment regimen. This combination resulted in the fastest reduction in uterine diameter, the quickest normalization of hemato-biochemical parameters, the highest conception rate, and the lowest recurrence rate. Additionally, it led to a more rapid decrease in serum progesterone levels, which helped to prevent an increase in endometrial thickness.Corrada *et al.*(2006), England *et al.*(2007), and Jena *et al.*(2013b) reported recovery rates of 92.85%, 95.45%, and 100%, respectively, following treatment with a combination of Cloprostenol and Cabergoline. Mifepristone, Cabergoline, Misoprostol/Dinoprostone (oral/vaginal prostaglandin), along with antibiotics and other supportive therapy, was found to be effective in canine pyometra (Verma *et al.*, 2022).

Surgical intervention, specifically ovariohysterectomy, has been identified as an effective treatment for canine pyometra (Pham *et al.,* 2023), as it provides a permanent solution by removing both the ovaries and uterus, thereby eliminating the infection and preventing future recurrences. This procedure was especially important in severe or life-threatening cases, such as

closed pyometra, when the risk of uterine rupture and peritonitis was high. Although medical management could be effective in some cases, ovariohysterectomy remained the most reliable treatment, with a higher survival rate and the assurance that the dog's condition would not recur. Furthermore, it removed the hormonal factors that contribute to pyometra, resulting in long-term health benefits.

It is also important that, in addition to the specific treatment in pyometra-affected bitches, the veterinarian should also carry out therapies like the usage of broad-spectrum antibacterial agents, anti-inflammatory drugs like Flunixin Meglumine, which is a fast-acting and most potent NSAID that helps manage the endotoxemia as well as inflammatory status, blood-transfusion therapy esp. in severely anaemic dogs, etc.

PREVENTION

Baithalu *et al.* (2010) suggested that extending the anestrus phase promotes endometrial regeneration through apoptosis, and administering an androgen receptor agonist can delay the onset of estrus for 2-3 months. According to Hagman (2023), it is advisable to breed during the next estrus cycle following medical treatment to prevent the recurrence of pyometra. Additionally, elective spaying in healthy animals can be beneficial in preventing pyometra and other uterine diseases, though it's important to be mindful of the potential negative side effects associated with the procedure.

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