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# Management of Intestinal Leakage Induced Peritonitis in Small Animals

**Sanjay Paudel[1*], Manish Gautam[2], and Manoj Kumar Shah[3]**

*[1]Department of Animal Science, Veterinary Science and Fisheries (FAVF), Agriculture and Forestry University (AFU), Nepal*

*[2]Departments of Physiology, Veterinary Science, Bangladesh Agricultural University (BAU), Mymensingh-2202, Bangladesh*

*[3]Department of Veterinary Surgery and Pharmacology, Veterinary Science and Fisheries (FAVF), Agriculture and Forestry University (AFU), Nepal*

[*]**Corresponding author:** Sanjay Paudel, Department of Animal Science, Veterinary Science and Fisheries (FAVF), Agriculture and Forestry University (AFU), Nepal, Tel: 9779843203534; E-mail: mgautam305@gmail.com

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## Abstract

Inflammation of peritoneum is known as peritonitis which is serious and often fatal condition in dogs and cats. It may be short or long term, localized or generalized, primary or secondary, aseptic or septic. Secondary septic peritonitis is the more common form in the dog and cat, most commonly resulting from leakage of Gastrointestinal (GI) contents from a compromised GI tract. GI tract may be compromised due to dehiscence of intestinal surgical wound, ulcerative lesions, ischemic intestinal injury, penetrating abdominal wound, intraluminal obstruction etc. Tentative diagnosis can be made through history, physical findings, clinical signs, biochemistry, diagnostic imaging but for confirmation abdominocentesis is the method of choice. Survival of patient is more rely on early prompt diagnosis and management. For treatment, stabilization of patient in terms of fluid, pain, oxygen level along with broad spectrum antimicrobial therapy is needed as soon as animal is suspected for peritonitis. Surgical intervention after stabilization of patient for correction or removal of cause is the definitive treatment for peritonitis. Thorough lavage and open drainage of peritoneal fluid is necessary for generalized peritonitis for better results along with sterile abdominal bandaging which is changed twice daily or even more based on condition. Closure of wound is performed once there is no drainage from wound for at least 24 hours.

**Keywords:** Peritonitis; Leakage; Lavage; Drainage

## Introduction

Peritonitis is the inflammation of peritoneum. It is a serious and often fatal condition in dogs, with mortality ranging from 50% to 70% [1]. Peritonitis may be short or long term, localized or widespread. It may occur as complication of abdominal surgery, a consequence of blunt abdominal trauma or following disease of abdominal organs. Based on etiology, peritonitis is of two types: primary and secondary peritonitis. Primary peritonitis refers to a spontaneous inflammatory condition in the absence of underlying intra-abdominal pathology. Secondary peritonitis occurs more commonly and is the consequence of a preexisting aseptic or septic pathologic, intra-abdominal condition. Secondary septic peritonitis is the more common form in the dog and cat, most commonly resulting from leakage of gastrointestinal (GI) contents from a compromised GI tract [2]. GI tract may be compromised due to dehiscence of intestinal surgical wound, ulcerative lesions, ischemic intestinal injury, penetrating abdominal wound, intraluminal obstruction, etc. Veterinarians may suspect peritonitis based on physical examination findings, blood tests, and x-rays. To confirm peritonitis, they may extract and analyze a sample of abdominal fluid. Morbidity and mortality are always high in spite of the condition. Early diagnosis and appropriate intervention are, therefore, vital to the success of therapy. Stabilization of patient, removal of cause through surgical repair and postoperative care are essential for treatment of animal having peritonitis.

## Literature Review

### Anatomy and physiology of peritoneum

Peritoneum is a serious membrane comprises of single layer of squamous cells of mesothelial origin covered with numerous microvilli. The parietal peritoneum lines the inner walls of the abdominal cavity, and the visceral peritoneum covers the surface of all intra-abdominal organs. These peritoneal layers are highly permeable to low-molecular-weight solutes and water, allowing equilibration of concentration and osmotic gradients between the peritoneal cavity and intravascular space [3]. In the normal animal, there is small amount of the peritoneal fluid (<1 ml/kg body weight) that moistens the surfaces and reduces friction between. Fluid dispersed within peritoneal space is very dynamic (locally instilled contrast agent becomes completely distributed throughout the abdomen within 15 to 60 minutes) and is absorbed quickly also from the variety of routes especially *via* lymphatic vessel lying beneath the mesothelial basement membrane on the surface of the diaphragm [4].

### Etiology of peritonitis

Peritonitis is the inflammation of peritoneum which is serious and often fatal condition in dogs, with mortality ranging from 50% to 70% [1]. It may be localized or generalized (based on extent), septic or non-septic (based on infectious cause) and primary or secondary (based on etiology) [1,2].

**Primary peritonitis:** Primary peritonitis refers to spontaneous inflammation of the peritoneum without any pre-existing intra-abdominal pathology. Most cases of primary peritonitis are thought to occur *via* hematogenous spread or lymphopenias route or translocation of bacteria through an intact intestinal wall to the peritoneal cavity [3,5].

Example: feline infectious peritonitis (relatively common) pansteatitis (rare).

**Secondary peritonitis:** It is much more common than primary peritonitis and is generally associated with pre-existing abdominal pathology that might be aseptic or septic. Secondary septic peritonitis is the more common form in the dog and cat, most commonly

resulting from leakage of Gastrointestinal (GI) contents from a compromised GI tract [2].

Major causes of secondary septic peritonitis as described by [6] are as follows: Leakage of gastrointestinal contents

- Perforating foreign body
- Perforating ulcers
- Iatrogenic (e.g., dehiscence of intestinal surgical wound, perforation, feeding tube leakage)
- Gastric rupture in gastric dilatation-volvulus
- Ischemic intestinal injury
- Blunt abdominal trauma, penetrating abdominal wounds, bite wounds
- UrogenitalRuptured pyometraRuptured prostatic abscessRuptured urinary tract with urinary tract infection
- Pancreatitis and pancreatic abscess
- Liver abscess or hepatitis, ruptured infected gallbladder
- Splenic abscess or splenitis, splenic torsion
- Mesenteric lymph node abscess
- Umbilical abscess
- IatrogenicSurgical peritoneal contaminationPeritoneal dialysis

There are many possible causes of secondary septic peritonitis in animals as mentioned above; the most common are loss of integrity of the GI tract (53% to 75% of cases), foreign-body penetration, perforating ulcers, and surgical wound dehiscence [4,6]. Retro prospective study of cases suggests that GI perforation has been reported as early as 48 hours after the initiation of treatment with the use of anti-inflammatory drugs in dogs. The reported dehiscence rates following enterotomy range from 3% to 12% and dehiscence rate is even higher for intestinal anastomosis with 14% leakage in dogs. Dehiscence after intestinal surgery is reported to occur most commonly between 3 and 9 days after the surgery.

In a study of intestinal surgery, dehiscence occurred in 15.7% (19 of 121) of dogs. Enterotomy and anastomosis performed for traumatic injuries and foreign body obstruction had the highest incidence of dehiscence (31.7% and 27.7%, respectively). Studies suggest that leakage is induced following intestinal anastomosis or any other GI operations. Here are some risk factors for leakage following intestinal anastomosis in dogs and cats [7].

- **Sex:** Males more likely to develop leakage than females
- Malnutrition, pre-existing peritonitis, a foreign body causing obstruction, trauma, an intra-abdominal abscess, concurrent infection, malignancy, preoperative use of corticosteroids, increased age, preoperative bowel obstruction, preoperative weight loss of >4.5 kg (10 lb), chronic obstructive pulmonary disease, sepsis, hypertension, diabetes mellitus, and congestive heart failure
- Clinic pathology variables: High blood urea nitrogen concentration, hypoproteinaemia-mia, neutrophilia, and low serum albumin concentration (<3.0 g/dl)
- Operative variables: Long operative times, dirty or contaminated surgery, intraoperative or postoperative blood transfusions (>2 units of packed RBCs), emergency surgery, hypovolemia, hypotension, shock, use of intra-abdominal drains, colonic resection, resection of bowel beyond the peritoneal reflection

One study reveals that dogs with 2 or more of the following risk factors were predicted to be at high risk for developing anastomotic leakage: preoperative peritonitis, intestinal foreign body, and serum albumin concentration ≤ 2.5 g/dl. This study also reveals one fact that dogs are more likely to develop anastomotic leakage than that of cats [7]. There are some factors which are responsible for this type of result. One factor is number of cases of cats and dogs are incomparable i.e., 25 and 90 respectively. And none of the cats have preoperative peritonitis while 20 cases of dogs have preoperative peritonitis that might be the reason for higher incidence of leakage following anastomosis in dogs as compared to cats.

## Diagnosis of peritonitis

**Based on clinical findings and history:** Peritonitis constitutes an emergency. In spite of adequate care, fatalities associated with septic peritonitis may be as high as 40 per cent [7].

Presenting signs of peritonitis are as follows

- Depression, anorexia, pyrexia
- Ascites
- Abdominal pain (postural changes)
- Vomiting
- Tachycardia, tachypnoea, weak femoral pulse, capillary refill time >2 seconds

But these signs may be variable and misleading so appropriate history with correlated signs is essential for diagnosis of peritonitis. History like recent abdominal surgery or trauma can be helpful.

**Abdominocentesis or diagnostic peritoneal lavage:** Collection and analysis of peritoneal fluid is regarded as most accurate method of diagnosing peritonitis (95% or even more) [4] because peritoneal effusion and free abdominal fluid are the consistent feature of peritonitis due to vascular dilation, increased capillary permeability and the migration of inflammatory cells into the peritoneum.

Study shows that abdominocentesis requires larger volume of fluid (25 ml/kg) for true test results but diagnostic peritoneal lavage gives accurate result even if the peritoneal fluids are as little as 2 ml/kg.

**Radiography and ultrasonography:** Ultrasonography is more precise than radiography for peritonitis diagnosis. High quality plain radiographs presence with free abdominal gas, ileus or peritoneal effusion adds evidence for diagnosis of peritonitis. Contrast radiographs of GI tract are contraindicated for peritonitis. Diagnostic findings that suggest septic peritonitis and requires immediate stabilization and surgical correction summarized in Table 1 as explained by [4,5,6].

| Diagnostic tool | Diagnostic findings |
|---|---|
| Abdominal radiography | Pneumoperitoneum<br>Ileus<br>Peritoneal effusion<br>Loss of serosal detail with underlying etiology |
| Abdominal ultrasonography | Pneumoperitoneum<br>Underlying etiology |
| Abdominal effusion cytology | Toxic and/or degenerate neutrophils with foreign debris<br>Intracellular bacteria |
| Biochemical testing | Peripheral blood to abdomen fluid glucose difference >20 mg/dL<br>Abdominal fluid to blood difference in lactate value >2.0 mmol/L<br>A fluid lactate concentration >2.5 mmol/L in dogs |

**Table 1:** Summary of diagnostic tools and diagnostic finding for septic peritonitis.

## Management of peritonitis

Treatment must be started as soon as peritonitis is suspected because any delay in treatment may lead to fatal endings. With the proper treatment and management survival rate for septic peritonitis is low [4]. So for better results it requires intensive and 24 hours care. Management of septic peritonitis can be achieved through following procedures [8,9].

**Stabilization of patient:** Surgical correction of causal origin is the definitive treatment for septic peritonitis but before surgical repair stabilization of patient is the prime concern. Pre-surgical stabilization includes.

## Fluid resuscitation

There is massive loss of fluids, electrolytes, plasma proteins and blood into abdomen during peritonitis so requires early and aggressive fluid therapy. Crystalloids (Ringer's lactate or 0.9% sodium chloride) are considered as fluid of choice of resuscitation unless patient has any other underlying heart problems but colloids or whole blood may be needed. In human medicine rapid aggressive fluid therapy is associated with higher survival rate.

In general, for adequate resuscitation both crystalloids and colloids are necessary. At first crystalloids is first choice for replacement but crystalloid alone may lead to an increased capillary hydrostatic pressure and a decreased plasma oncotic pressure ultimately leading to extravasation of fluid into the peritoneal cavity. So, colloids either synthetic like dextran, hetastarch or natural like fresh whole blood, stored whole blood, packed RBC, plasma, albumin are used along with the crystalloids. Synthetic colloids provide adequate colloid osmotic pressure than natural colloids while natural colloids are rich in coagulation factors and albumin so these two are administered simultaneously in fluid therapy along with crystalloids.

Based on the initial assessment, a shock bolus of crystalloids in dogs (90 mL/kg) and cats (55 mL/kg) should be given over 10 to 15 minutes and the initial bolus of hetastarch in shock patients is 10 to 20 mL/kg given as quickly as possible. Further boluses may be needed based on patient's status. Constant Rate of Infusion (CRI) is given at a dose of 1 mL/kg/h if colloidal support is needed. Higher doses may be needed if colloid osmotic pressure is low. When crystalloids and colloids are simultaneously infused at CRI then the volume of crystalloid can be reduced to 40 to 60% [5,8].

Fluid resuscitation goals include maintaining the mean arterial blood pressure above 80 mm Hg and the heart rate between 80 and 120 bpm in dogs and 180 and 200 bpm in cats. Other parameters to maintain include central venous pressure (6 to 8 cm $H_2O$) and urine output (>1 mL/kg/h). When administering synthetic colloids, a COP of 17 mm Hg should be maintained while avoiding volume overload [5].

## Antibiotics therapy

Broad-spectrum, bactericidal, systemic antibiotics should be started as soon as the diagnosis of septic peritonitis is suspected and after culture and sensitivity tests antibiotics should be changed accordingly. The antibiotic chosen should cover a broad spectrum, as the bacteria in most cases are from Gastrointestinal (GI) leakage containing a combination of aerobic and anaerobic organisms. Suitable antibiotic combinations include penicillin or first-generation cephalosporin with a fluoroquinolone, such as enrofloxacin or a second-generation cephalosporin such as cefoxitin. Metronidazole may be included for additional anaerobic coverage. Based on previous results best combination of antibiotics was ampicillin combined with cefoxitin, enrofloxacin, or amikacin [3].

Intravenous administration has shown a trend towards improved survival rates compared with intramuscular or intraperitoneal routes [3]. Intraperitoneal administration of drugs is not recommended because some of the drugs may cause irritation to the peritoneum exacerbating the condition. Adequate level of antimicrobial activity is achieved in peritoneal fluid through systemic antibiotics [4].

Stabilization of patient can be done by various ways as given by [5] which is summarized in Table 2.

| Therapy used | Medicines/chemicals used |
|---|---|
| Fluid therapy | Crystalloids<br>Ringer's lactate<br>Normal saline<br>Colloids<br>Natural: Whole blood, packed RBC, Plasma, Albumin |

| | |
|---|---|
| | Synthetic: Dextran, hetastarch |
| Antibiotics therapy (empirical) | Gram-positive coverage<br>Ampicillin: 22 mg/kg IV q 8 h<br>Clindamycin: 10 mg/kg IV, PO q 12 h<br>Gram-negative coverage<br>Enrofloxacin: 10–15 mg/kg IV, PO (dogs) 5 mg/kg IV, PO (cats)<br>Cefotaxime: 25–50 mg/kg IV, IM, SC q 8 h<br>Anaerobic coverage<br>Metronidazole: 10 mg/kg IV, PO q 12 h |
| Pain management | Intravenous bolus<br>Buprenorphine: 0.005–0.02 mg/kg IV, IM, SC q 4–6 h<br>Constant-rate infusion<br>Fentanyl: 1–5 µg/kg/h<br>Lidocaine: 30–50 µg/kg/min<br>Ketamine: 0.1 mg/kg/h |
| Gastrointestinal protection | Antiemetics<br>Metoclopramide: 0.1–0.5 mg/kg PO, SC q 8 h or 1–2 mg/kg/d IV CRI<br>Dolasetron: 0.6–1 mg/kg/d IV, PO —<br>Chlorpromazine: 0.2–0.5 mg/kg IM, SC q 6–8 h<br>Antisecretory<br>Famotidine: 0.5–1 mg/kg IV, IM, PO, SC q 12–24 h<br>Omeprazole: 0.5–1 mg/kg PO q 24 h<br>Cytoprotective<br>Sucralfate: 0.5–1 g PO q 8 h (dogs) 0.25–0.5 g PO q 8–12 h (cats)<br>Misoprostol: 1–5 µg/kg PO q 6–8 h |

**Table 2:** Methods for stabilization of patient.

## Pain management

Analgesia is an important aspect of pre-surgical and post-surgical management. As pain delays the wound healing, it is also an important factor. In septic peritonitis, opioids are a first-line choice for the treatment of pain. Some opioids, such as morphine and hydromorphone, can induce GI ileus and vomiting and cause dose-dependent respiratory depression so buprenorphine is widely used as it has fewer GI effects. Common medications that are used in analgesic CRIs include fentanyl, lidocaine, and ketamine.

## Gastrointestinal protectants

Animal often experiences the vomiting in peritonitis so antiemetic such as dopamine antagonists, serotonin antagonists, and phenothiazines should be given. Choice should be made based on effect and side effects of available medicines. Metoclopramide, a dopamine antagonist, has some prokinetic activity and is contraindicated in cases of GI obstruction because increases in peristalsis may lead to further "bunching" of intestine. Phenothiazines have been associated with sedation and hypotension [5].

Drugs that reduce or neutralize gastric acid secretions can be given. Proton pump inhibitors are best suited for gastric ulcer.

In case of GI ulceration, cytoprotectant such as sucralfate and misoprostol are commonly used. Sucralfate binds with ulcers and coats the mucosa to prevent from acid damage.

## Oxygen supplementation

Adequate perfusion of tissue is necessary for surgical procedure. If patient have difficulty in breathing then they should be assisted with external oxygen supplement.

## Other medications

- Corticosteroids
- Use of corticosteroid is still controversial. Corticosteroid helps to reduce inflammatory response by modulating cytokines (IL-1 and TNF) or stimulating production of anti-inflammatory factors such as IL-10 and IL-1 receptor antagonist. However, a lack of efficacy in the treatment of sepsis and septic shock has been reported, and their routine use has fallen out of favour [5].
- Heparin
- Use of heparin shows the improved survival rate in experimental studies in dogs [3] that may be because of improved bacterial clearance from the abdomen or a reduction in disseminated intravascular coagulation.
- Insulin
- Greater survival rates were found in humans whose glucose level was maintained with insulin at ≤ 110 mg/dL [5]. So, insulin therapy can be used to maintain blood glucose level.
- Protein C

- Protein C can be decreased in sepsis in both human and dogs. Study in human shows that there was reduction in the risk of death which receive activated protein C. However, the incidence of bleeding was higher in the group that received activated protein C [5].

### Surgical repair

Surgical intervention is done once the patient is stabilized. The aim of surgery in diffuse peritonitis includes:

- Identification and correction of the underlying cause,
- Lavage of the peritoneal cavity,
- Consideration for postoperative drainage, and
- Provision of an access to ensure nutritional support (feeding tube) postoperatively.

Surgical approach involves the large ventral midline incision extending from xiphoid cartilage to the pubis. Identification of prime cause is identified and then correction or removal of that cause is performed. Necrotized or dead tissues are removed while resection and anastomosis are performed on healthy tissues with single interrupted appositional suture. The site of contamination is packed off from the remainder of the abdominal cavity using moistened laparotomy sponges, and samples are taken for aerobic and anaerobic bacterial culture. If a GI leakage is being treated, adjunctive procedures such as serosal patching or omental wrapping of the repaired site are recommended to reduce the incidence of postoperative intestinal leakage or dehiscence. Because enteral nutrition directly nourishes enterocytes and decreases bacterial translocation across the intestinal wall, feeding tube placement (gastrostomy or jejunostomy) should be considered during initial surgical exploration.

After surgical correction of the underlying cause, the abdominal cavity should be lavage thoroughly with warm isotonic saline solution at 200 mL/kg that has been shown to improve the outcome of patients with septic peritonitis. Purpose of the lavage is to remove foreign material, bacteria, and blood clots. After lavage, as much as fluid should be suctioned because any residual peritoneal fluid can serve as nidus for infection, impairs bacterial opsonization and clearance [2]. Use of antiseptic solution and antibiotics intraperitoneally is not advised because it may cause chemical peritonitis instead.

## Discussion

There is a controversy in veterinary literature for postoperative peritoneal drainage. Primary closure of the abdomen is acceptable without any drainage once the source of contamination has been isolated and controlled [2,9]. Peritoneal drainage has been advised by many authors for removal of foreign material, toxins, and bacteria. Types of peritoneal drainage include open peritoneal drainage, passive drainage, and active drainage. Multiluminal (sump) or column disk catheters are passive drains that can be used. Active drainage requires an external vacuum to create negative pressure within the peritoneal cavity. Active peritoneal drains, such as Jackson-Pratt, flat suction, or Hemovac drains, have a one-way valve to prevent fluid reflux and decrease the risk of iatrogenic contamination. Advantages of drains include removal of bacteria, toxins, foreign debris, and abdominal effusion; they also allow quantification of abdominal effusion. Disadvantages include the potential for drain occlusion, ascending nosocomial infection, hypoproteinemia, and electrolyte imbalances. Nosocomial infections have been documented to occur within 24 hours after drain placement, with an incidence as high as 90% [9]. Open peritoneal drainage is accomplished by delaying closure of the linea-alba and skin until several days after the initial surgery. The linea-alba is loosely apposed with a permanent, monofilament suture material (e.g., nylon, proline), leaving a gap of 2 to 4 cm between the wound edges. The wound surface is then covered with a thick layer of sterile absorbent bandage. Dressings need to be changed at least twice daily (more frequently if the bandage becomes completely wet with exudate), adopting sterile procedures when the abdomen is exposed. The abdominal wound should be examined thoroughly at each bandage change; any adhesions should be broken down and necrotic tissue in the wound debrided.

Localized peritonitis may be managed without drainage or with local drainage techniques. With severe generalized septic peritonitis, effective drainage cannot be achieved with drains, which function as foreign bodies and are rapidly sealed off within 24 hours by omentum and fibrin. Open abdominal drainage seems to be superior to abdominal closure for the postoperative management of severe cases of generalized peritonitis [3]. Despite the proven effectiveness of open peritoneal drainage, the nursing care involved is demanding and time-consuming and should not be undertaken lightly. But with successful removal of cause, thorough lavage and post-operative care, better results have been found in case of septic peritonitis in dog [9].

## Metabolic Support

**Nutrition:** Animal often face anorexia; heavy loss of plasma proteins so proper nutritional management is necessary for quicker recovery. Patient may not be able to eat soon after surgery but nutrient should be given *via* parenteral routes or through nasogastric or stomach tube. Alternatively, placement of a gastrostomy or jejunostomy tube at the time of exploratory surgery helps in feeding of animal. Enteral feeding is essential for proper functioning for intestinal mucosa so soft liquid diet is preferred soon after surgery then semisolid diet for few days to weeks. A concentrated, balanced diet, with high digestibility and high energy density, should be chosen to provide nutritional support.

**Physiotherapy:** Constant lateral dependency in depressed animals can complicate recovery because of the effects of pulmonary edema and aspiration pneumonia. Encouraging the animal to stand and walk three to four times a day, combined with coupage of the chest to stimulate coughing, facilitates ventilation and helps clear dependent bronchial secretions.

## Conclusion

This study suggests that septic peritonitis is major complication following any of the intestinal surgery and is usually life-threatening condition. Early prompt diagnosis and rationale treatment procedure are vital for the survival of the patient. Patient stabilization is the foremost work for management of peritonitis that includes fluid resuscitation, antibiotic therapy (empirical), pain management, etc. Removal of primary cause through surgical intervention is the ideal treatment of peritonitis. Closure of wound is controversial topic; thorough intraoperative lavage and appropriate postoperative management gave better results in some study while drainage through open surgical wound was prescribed by other group of researchers so choice should be made based on condition of patient, available resources, management practice of that clinic or hospital.

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## Conflict of Interest

The Author has no conflict of interest

## Author Contribution

Conceptualization of the study: S.P; literature review: S.P, writing the original paper: S.P, M.G., Review and editing: S.P, M.G, Supervision: M.K.S

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## References

1. Volk SW (2009) Peritonitis: Small Animal Critical Care Medicine. 579-583.
2. Swann H, Hughes D (2000) Diagnosis and management of peritonitis. Vet Clinic 30:603-615.
3. Bray J (1996) Diagnosis and management of peritonitis. In Practi ce 18:403-413.
4. Casas JP (1996) Septic peritonitis. Curr Ther Res Clin Exp 57:45-51.
5. Ragetly GR, Bennett RA, Ragetly CA (2011) Septic peritonitis: etiology, Pathophysiology and diagnosis. Compend Contin Educ Vet 33:E1-E6.
6. Ralphs SC, Jessen CR, Lipowitz AJ (2003) Risk factors for leakage following intestinal anastomosis in dogs and cats. J Am Vet Med Assoc 223:73-77.
7. Laforcade AM de (2010) Management of Septic Peritonitis in Dogs and Cats. 2019, In: World Small Animal Veterinary Association World Congress Proceedings. North Grafton, USA.
8. Ragetly GR, Bennett RA, Ragetly CA (2011) Septic peritonitis: treatment and prognosis. Compend Contin Educ Vet 33: E1-E5.
9. Lanz OI, Ellison GW, Bellah JR, Weichman G, VanGilder J (2001) Surgical treatment of septic peritonitis without abdominal drainage in 28 dogs. J Am Anim Hosp Assoc 37:87-92.