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DIFFUSE BACTERIAL PERITONITIS IN DOGS AND CATS: CONSIDERATIONS ABOUT SURGICAL MANAGEMENT
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Peritonitis is inflammation of the peritoneal cavity. It may be primary (e.g., hematogenous infection of the peritoneum as in feline infectious peritonitis) or secondary (i.e., resulting from chemical or septic contamination of the peritoneal cavity) and may be generalized (i.e., diffuse) or localized (i.e., only a small portion of the abdomen is involved). Chemical peritonitis is caused by the effect of irritating agents on the peritoneum (e.g., bile, urine, pancreatic secretions).

Diagnosis

Signalment. Any age, sex, or breed of dog or cat may develop peritonitis. It is particularly common in young animals that have perforating foreign bodies and in those that receive abdominal trauma (i.e., vehicular trauma and bite wounds).

History. The history is often nonspecific. The animal may not show signs of illness for several days after the traumatic episode. Mesenteric avulsions often do not cause clinical signs of peritonitis for 5 to 7 days after the injury. Animals with traumatic bile peritonitis may be asymptomatic for several weeks after the injury. Most animals are presented for lethargy, anorexia, vomiting, diarrhea, and/or abdominal pain.

Physical Examination Findings

Affected animals are usually painful on abdominal palpation. The pain may be localized but generalized pain is more common and the animal will often tense or “splint” the abdomen during palpation. Vomiting and diarrhea may be noted. Abdominal distension may be noted if sufficient fluid has accumulated. Pale mucous membranes, prolonged capillary refill times, and tachycardia may indicate that the animal is in shock. Dehydration and arrhythmias may also occur.

Radiography/Ultrasonography

The classic radiographic finding in animals with peritonitis is loss of abdominal detail with a focal or generalized “ground-glass” appearance. The intestinal tract may be dilated with air and/or fluid. Free air in the abdomen may be noted with rupture of a hollow organ or sometimes occurs with gas-producing anaerobes, without gut rupture. A more localized peritonitis may occur secondary to pancreatitis and cause the duodenum to appear fixed and elevated. Ultrasonography is useful to localize fluid accumulation and help determine etiology.

Laboratory Findings

The most common laboratory finding in animals with peritonitis is a marked leukocytosis. The predominant cell type is the neutrophil and a left shift is often apparent. Other abnormalities may include anemia, dehydration, and electrolyte and acid-base abnormalities. Following abdominocentesis, the amount of blood in the abdominal cavity can be estimated by observing the lavage sample. A red color reflects the presence of RBCs and a deep-red color usually indicates severe hemorrhage. If newsprint cannot be read through the plastic tubing, then hemorrhage is significant. If print can be seen through the tubing, only moderate or minimal hemorrhage is present. Surgical intervention is indicated when there is a substantial increase in the PCV of lavage samples taken within 5 to 20 minutes of each other, or if an animal in shock does not respond to aggressive fluid therapy.

SURGICAL TREATMENT
Abdominocentesis (see below) is the percutaneous removal of fluid from the abdominal cavity, usually for diagnostic purposes, although it may occasionally be therapeutic. Indications include shock without apparent cause, undiagnosed disease with signs involving the abdominal cavity, suspicion of postoperative GI dehiscence, blunt or penetrating abdominal injuries (i.e., gunshot wounds, dog bites, automobile accidents), and undiagnosed abdominal pain. A multifenestrated catheter should be used to enhance fluid collection. Physical and radiographic examinations should precede abdominocentesis to rule out instances where it may not be safe and to guide needle placement. Four-quadrant paracentesis may be performed if simple abdominocentesis is not successful in retrieving fluid. It is similar to simple abdominocentesis except that multiple abdominal sites are assessed by dividing the abdomen into four quadrants through the umbilicus and tapping each of these four areas. Diagnostic peritoneal lavage should be performed in animals with suspected peritonitis if the above methods are unsuccessful in obtaining fluid for analysis.

Exploratory surgery is indicated when the cause of peritonitis cannot be determined or when bowel rupture, intestinal obstruction (e.g., bowel incarceration, neoplasia), or mesenteric avulsion is suspected. Serosal patching and plication are techniques that decrease the incidence of intestinal leakage, dehiscence, or repeated intussusception. Animals requiring surgery and that have peritonitis secondary to intestinal trauma (disruption of mesenteric blood supply, bowel perforation, chronic intussusception, foreign body) are frequently hypoproteinemic. The role that protein levels play in healing intestinal incisions is not well understood. However, most surgeons are concerned that hypoproteinemic patients may not heal as quickly as patients with normal protein levels despite one study that showed similar complication rates among animals with normal protein levels and those that were hypoproteinemic and undergoing intestinal surgery. Most experimental evidence has shown that retardation of wound healing is not seen with moderate protein depletion but only with severe deficiencies (less than 1.5 to 2 g/dl).

Although the practice of lavaging the abdominal cavity of animals with peritonitis is controversial, lavage is generally indicated with diffuse peritonitis. Lavage should be done with care in animals with localized peritonitis to prevent causing diffuse dissemination of infection. When lavage is performed, as much of the fluid as possible should be removed because fluid inhibits the body’s ability to fight off infection, probably by inhibiting neutrophil function. Historically, many different agents have been added to lavage fluids, especially antiseptics and antibiotics. Povidone-iodine is the most widely added antiseptic; however, its use may be contraindicated in established peritonitis. Furthermore, no beneficial effect of this agent has been shown in repeated experimental and clinical trials in animals. Although a great many antibiotics have been added to lavage fluids over the years, there is no substantial evidence that their addition is of any benefit to patients who are being treated with appropriate systemic antibiotics. Warmed sterile physiologic saline is the most appropriate lavage fluid.

Open abdominal drainage (OAD) is a useful technique for managing animals with peritonitis. Reported advantages include improvement in the patient’s metabolic condition secondary to improved drainage, reduced abdominal adhesion and abscess formation, and access for repeated inspection and exploration of the abdomen. With this technique the abdomen is left open and sterile wraps are placed around the wound. The frequency of the wrap changes is dependent upon the amount of fluid being drained and the amount of external soiling. Complications of open abdominal drainage include persistent fluid loss, hypoalbuninemia, weight loss, adhesions of abdominal viscera to the bandage, and contamination of the peritoneal cavity with cutaneous organisms.

**Anesthesia**

Animals with peritonitis are often endotoxic and/or hypotensive. Small amounts of endotoxins are normally absorbed from the intestine and transported via the portal system to the liver, where they are removed and destroyed by hepatocytes. Hypotension in dogs is associated with intense portal vasoconstriction. This vasoconstriction causes breakdown of the intestinal mucosal barrier,
allowing increased endotoxin to be absorbed from the intestines. If hepatic function is impaired (common in septic animals), small doses of endotoxin that would normally be nonharmful may be lethal. Thus hypotension should be corrected before and prevented during and after surgery in animals with peritonitis. Animals with total protein less than 4.0 g/dl or albumin less than 1.5 g/dl may benefit from perioperative colloid administration. Colloids may be given preoperatively, intraoperatively, and/or postoperatively for a total dose of 20 ml/kg/day. If colloids are given during surgery (7 to 10 ml/kg), acute intraoperative hypotension should be treated with crystalloids.

**Techniques**

**Abdominocentesis**

*Insert an 18 or 20-gauge, 1-1/2 inch plastic over-the-needle catheter (with added side holes) into the abdominal cavity at the most dependent part of the abdomen. Do not attach a syringe, instead allow the fluid to drip from the needle and collect it in a sterile tube. If sufficient fluid is obtained, place the fluid in a clot tube, and EDTA tube, submit samples for aerobic and anaerobic culture, and make 4 to 6 smears for analysis. If fluid is not obtained, apply gentle suction using a 3cc syringe.*

It is difficult to puncture bowel by this method since mobile loops of bowel move away from the tip of the needle as it strikes them. Perforations created by a needle this size usually heal without complications. The major disadvantage of needle paracentesis is that it is insensitive to the presence of small volumes of intraperitoneal fluid and hence a negative result can be meaningless. At least 5 or 6 ml of fluid/kg body weight must be present in the abdominal cavity of dogs to obtain positive results in a majority of cases using this technique.

**Diagnostic Peritoneal Lavage**

*Make a 2-cm skin incision just caudal to the umbilicus and ligate any bleeders to avoid false positive results. Spread loose subcutaneous tissues and make a small incision in the linea alba. Hold the edges of the incision with forceps while the peritoneal lavage catheter (without the trocar) is inserted into the abdominal cavity. Direct the catheter caudally into the pelvis. With the catheter in place, apply gentle suction. If blood or fluid cannot be aspirated, connect the catheter to a bottle of warm sterile saline and infuse 22 ml/kg of fluid into the abdominal cavity. When the calculated volume of fluid has been delivered, roll the patient gently from side to side, place the bottle on the floor, vent it, and collect the fluid by gravity drainage. Do not attempt to remove all the fluid.*

![Fig. 1 Diagnostic peritoneal lavage](image)
**Exploratory Laparotomy**

Perform a ventral midline incision from the xiphoid to the pubis. Obtain a sample of fluid for culture and analysis. Explore and inspect the entire abdomen. Find the source of infection and correct it. Break down adhesions that may hinder drainage. Lavage the abdomen with copious amounts of warm sterile saline if the infection is generalized. Remove as much necrotic debris and fluid as possible. Close the abdomen routinely or perform open abdominal drainage.

**Open Abdominal Drainage**

After completing the abdominal procedure, leave a portion of the abdominal incision (usually the most dependent portion) open to drain. Close the cranial and caudal aspects of the incision with monofilament suture using a continuous suture pattern. Place a sterile laparotomy pad over the opening, then place a sterile wrap over the laparotomy pad. Change the wrap at least twice daily initially with the animal standing (sedation is seldom necessary). Break down adhesions to the incision that may interfere with drainage. Abdominal lavage may be attempted, but is seldom necessary. Place a diaper over the wrap to decrease contamination from urine. Assess the fluid daily for bacterial numbers and cell morphology. When bacterial numbers have decreased and normal neutrophil morphology is present (non-degenerative), close the incision (generally in 3 to 5 days). If the opening is small it may be left to heal by second intention.

**PROGNOSIS**

The prognosis for animals with generalized peritonitis is guarded; however, with proper and aggressive therapy, many survive. Some authors have suggested that the mortality rate approaches 50%. The mortality rates reported in animals with generalized peritonitis treated with open abdominal drainage have varied from 20% to 48%.