CE

An In-Depth Look:

ACUTE ABDOMEN

Acute Abdomen: Treatment*

Valissitie Heeren, DVM†
Lisa Edwards, DVM‡
Elisa M. Mazzaferro, MS, DVM, PhD, DACVECC
Wheat Ridge Animal Hospital, Wheat Ridge, Colorado

ABSTRACT:

Clinical signs of acute abdomen usually include abdominal distention, anorexia, lethargy, generalized gastrointestinal signs (e.g., vomiting, diarrhea), and various stages of shock. Once a diagnosis has been made, treatment generally consists of medical management (with or without delayed surgical management) or immediate surgical intervention. If the underlying cause is not treated, it could lead to death.

Acute abdominal pain (i.e., acute abdomen) is common in veterinary patients. Once a diagnosis has been made, medical, and sometimes surgical, intervention is necessary to treat a patient. This article reviews fluid therapy; the use of antimicrobials, analgesics, and inotropes; anesthetic protocols; and surgical therapy.

MEDICAL THERAPY

A variety of disease processes (e.g., hemorrhagic, infectious, and toxic gastroenteritis; severe liver failure; pancreatitis; prostatitis; pyelonephritis; ulceration of the gastrointestinal [GI] tract) can cause acute signs of abdominal pain and can usually be managed with medical therapy. If appropriate medical measures are taken and the clinical status of the patient does not improve, however, reevaluating the causative agent and animal's condition is necessary.

Fluid Therapy

The mainstay of medical therapy for patients with acute abdomen is treating the underlying cause once it is discovered. Regardless of the cause, however, several generalized treatment regimens apply to critically ill patients. Shock is the most important problem to address. Once hypovolemia and decreased tissue perfusion to abdominal viscera are present, compromise of the intestinal wall can lead to translocation of intra-

*A companion article on diagnosis appears on p. 350.

†Dr. Heeren is now affiliated with Seattle Veterinary Associates, Seattle, Washington.
‡Dr. Edwards is now affiliated with Animal Emergency and Referral Center, Lynwood, Washington.

Email comments/questions to **compendium@medimedia.com**, fax **800-556-3288**, or log on to **www.VetLearn.com**

Table 1. Antimicrobials for Use in Patients with Acute Abdomen

Drug	Dosage
Cefazolin sodium	22 mg/kg IV tid
Amoxicillin trihydrate–clavulanate potassium	12–25 mg/kg PO bid to tid
Ampicillin sodium	22 mg/kg IV tid–qid
Enrofloxacin	5.5–15 mg/kg IV sid–bid (in dogs)
Amikacin sulfate (use with caution in dehydrated patients)	30 mg/kg IV sid
Metronidazole	10 mg/kg PO or IV sid–tid
Clindamycin hydrochloride	11 mg/kg IV tid
Ticarcillin disodium–clavulanate potassium	40–110 mg/kg IM or IV qid
Cefoxitin sodium	30 mg/kg IV qid
Imipenem and cilastatin sodium	3–10 mg/kg IM or slow IV tid–qid
Cefotetan	22 mg/kg IV tid
Marbofloxacin	2.75–5.5 mg/kg PO sid
Ampicillin sodium–sulbactam sodium	30 mg/kg IV tid

Table 2. Analgesics for Use in Patients with Acute Abdomen

Drug	Dosage
Morphine	**Dogs:** 0.5–1 mg/kg SC or IM **Dogs and cats:** 0.05–0.1 mg/kg/hr CRI
Buprenorphine	**Dogs and Cats:** 0.005–0.02 mg/kg IM, IV, or SC q6–12h
Butorphanol	**Dogs and cats:** 0.1–0.2 mg/kg IV **Dogs:** 0.2–0.4 mg/kg SC
Hydromorphone	**Dogs and cats:** 0.05–0.2 mg/kg IM, IV, or SC
Fentanyl	**Dogs and cats:** 2 µg/kg IV bolus, then 1–5 µg/kg/hr CRI[8]

luminal bacteria and can predispose patients to septicemia and/or endotoxemia. Decreased venous return and portal hypertension are additional concerns during shock.[1] Aggressive IV fluid therapy should be initiated via a large-bore catheter using a balanced electrolyte solution, including 0.9% saline, lactated Ringer's solution, or Normosol-R (Abbott Laboratories), at a rate of 90 ml/kg/hr in dogs and 30 to 40 ml/kg/hr in cats. In most cases involving shock, one-fourth of the calculated volume of fluid should be administered rapidly. Then the patient's perfusion parameters (including heart rate, capillary refill time, blood pressure, and urine output) should be reassessed. Fluid therapy can be titrated based on a patient's clinical response to therapy and cardiovascular status. If severe metabolic acidosis represented by a blood pH less than 7.1 continues despite adequate fluid resuscitation, administering sodium bicarbonate ($NaHCO_3$) can be beneficial.[2] The bicarbonate deficit can be calculated with the following formula:

$$\text{Bicarbonate deficit} = \text{Base deficit} \times 0.3 \times \text{kg}$$

In some cases, blood gas values cannot be measured but can only be estimated. This can be achieved by classifying suspected acidosis as mild, moderate, or severe. The base deficits would correlate at −5, −10, and −15, respectively.[3] One-fourth of the calculated $NaHCO_3$ replacement dose should be delivered IV over 20 minutes followed by a new blood gas measurement and assessment. Acidosis frequently improves following improved perfusion. If $NaHCO_3$ therapy is administered before fluid volume resuscitation, metabolic alkalosis may occur; therefore, this is not recommended as empiric therapy.

Drug Therapy

Once a patient's hypovolemic status has been addressed and proper fluid therapy initiated, medical therapy should continue by addressing the need for antimicrobial therapy. All therapeutic choices for infection should ideally be based on results of culture and susceptibility testing. However, empirical therapy is almost always warranted while laboratory results are pending. When available, a Gram's stain should be used to help obtain a diagnosis. Knowledge of resident microbes originating from the suspected source of infection is also very important in choosing the most appropriate course of antibiotic therapy. Some antibiotics used commonly in patients with acute abdomen are cited in Table 1. To provide broad-spectrum (aerobic and anaerobic) cover-

age, combination antibiotic therapy is often chosen. For example, administering ampicillin (22 mg/kg IV tid) along with enrofloxacin (2.5 to 10 mg/kg IV sid in dogs) is often the first line of defense in cases of acute abdomen with suspected sepsis.[4]

An extremely important aspect of medical management that should never be forgotten or delayed is the judicious use of analgesics. Even if eventual correction of the underlying problem is foreseen, that does not prevent an animal's immediate discomfort. If pain originates from a visceral organ, buprenorphine (0.005 to 0.02 mg/kg IV, IM, or SC, or half the dose given IV followed by the remainder of the dose given IM or SC q6h or as needed) is an excellent treatment choice. Other analgesic options are listed in Table 2. Morphine is effective at controlling visceral pain; however, side effects (e.g., nausea, emesis, urine retention, constipation, greater risk of respiratory depression) make this drug less desirable than buprenorphine. If morphine is the only analgesic available, administering antiemetics may be warranted.

Antiemetics are indicated not only to counteract potential side effects of opioids but also as general therapeutics for patients with acute abdomen (Table 3). The dopamine antagonist metoclopramide provides both antiemetic and antinausea effects in patients with a traumatized abdomen. Because this drug promotes GI motility, however, it is contraindicated in patients with suspected bowel obstruction.[4] Chlorpromazine is also relatively contraindicated because it blocks α-receptors, thereby producing hypotension.

Table 3. Antiemetics for Use in Patients with Acute Abdomen

Drug	Dosage
Dolasetron	**Dogs:** 0.3 mg/kg slow IV
Metoclopramide	**Dogs and Cats:** 1–2 mg/kg/day CRI *or* 0.1–0.5 mg/kg SC or PO tid
Ondansetron	**Dogs:** 0.1–1 mg/kg slow IV q12–24h **Cats:** 0.1–1 mg/kg slow IV q8–12h[8]

SURGICAL THERAPY

Some abdominal diseases originally suited for medical therapy may require surgical therapy because a patient's clinical status worsens or secondary complications develop. For example, a puppy with parvoviral enteritis may initially respond appropriately to medications and supportive care but may later develop intussusception that becomes a surgical problem. Clinical signs of complications that may require surgical intervention in patients with acute abdomen include persistent hypothermia or fever, hypoglycemia, protracted vomiting that is unresponsive to antiemetic therapy, severe abdominal pain that does not resolve, and consistent leukopenia.[2]

Some cases that are not immediate surgical emergencies must be managed with temporary medical therapy until surgery is feasible. For example, if an animal presents with uroabdomen; elevated serum potassium, blood urea nitrogen, and creatinine levels; and metabolic acidosis, surgery is warranted once the patient's metabolic status has been stabilized. To correct metabolic abnormalities before inducing anesthesia, appropriate therapy for uroabdomen includes diuresis and abdominocentesis or peritoneal lavage to remove peritoneal urine. Metabolically stable patients with intestinal foreign bodies may initially be treated with medical management and by closely assessing changes in clinical status. Frequent observation to evaluate abdominal pain and/or pyrexia is mandatory as well as repeated abdominal radiography or ultrasonography to monitor the progression of the foreign material aborally through the GI tract.

Animals with clinical signs of acute abdomen can generally be categorized as follows[5]:

- Patients that can be managed medically
- Patients that require immediate surgery
- Patients that may benefit from medical therapy and stabilization before undergoing surgery

Whether to perform surgery on a patient with acute abdomen is a critical decision, but the distinction between the need for surgical and nonsurgical therapy is not always clear. Properly using diagnostic tools often helps identify a specific disease process. If a definitive diagnosis cannot be made, however, exploratory laparotomy may be indicated.

Stabilizing patients in shock is ideal; with certain surgical emergencies, however, there is little time for aggressive shock therapy. An abbreviated list of surgical emergencies includes gastric dilatation–volvulus (GDV), penetrating abdominal wounds, mesenteric torsion, pyometra, GI obstruction (including foreign body and intussusception), ruptured abdominal masses, and intractable abdominal hemorrhage.[6] Indications for surgical intervention include septic peritonitis, pneumoperitoneum, clinical signs of decompensatory shock that is unresponsive to aggressive medical therapy, and worsening hemoabdomen.

Anesthesia

Because of the inherently complex and unstable nature of patients with acute abdomen, it is important to pay particular attention to the anesthetic protocol. In general, drugs that should be avoided include acepromazine, ketamine, propofol, thiobarbiturates, and α_2-agonists such as xylazine and medetomidine. Administering the α-receptor antagonist acepromazine can result in vasodilation and secondary hypotension.[7] In debilitated patients, ketamine can often have direct cardiodepressant effects, resulting in poor contractility, decreased cardiac output, and hypotension.[7] Using propofol can result in hypotension secondary to vasodilation, decreased cardiac output, and respiratory depression.[7] Administering thiobarbiturates also causes dose-dependent myocardial and respiratory depression.[8] α_2-Receptor agonists should be avoided because they result in reduced cardiac output. Medetomidine causes vasoconstriction and secondarily decreases perfusion to vital organs, even at minute doses.[7]

Every effort should be made to correct fluid, acid–base, electrolyte, and cardiovascular abnormalities before inducing anesthesia.[5] A balanced anesthetic protocol is recommended. The overall objective should be to reduce the required dose of any one drug and thus the potential for its side effects. Preoxygenation by mask before induction is recommended to reduce hypoxia secondary to respiratory depression.[6] In a balanced anesthetic protocol, opioids are often used in combination with other

Treating various forms of shock is important and includes using IV fluids and, sometimes, inotropic therapy.

drugs. For example, using an opioid and a benzodiazepine (e.g., diazepam) is a good choice for induction. Using etomidate in combination with a benzodiazepine should also be considered because of minimal cardiovascular effects.[7]

Anesthesia should be maintained by using inhalant agents such as isoflurane or sevoflurane. These inhalant anesthetics are preferred over halothane because they produce less cardiovascular depression and provide a more rapid titration or change in anesthetic depth.[7] The addition of fentanyl (0.007 to 0.01 mg/kg/min) by intraoperative constant-rate infusion (CRI) can decrease the total dose of gas anesthetic required. Because of the potential for hypoventilation during fentanyl infusion, however, carefully monitoring ventilation, including the end-tidal carbon dioxide concentration, is recommended because mechanical or hand ventilation may become necessary. IV fluids should be administered during anesthetic induction and throughout surgery. Additional fluid losses such as hemorrhage evaporation from open body cavities can occur during surgery. Intraoperative fluid rates should be 5 to 10 ml/kg/hr in stable patients, with IV crystalloid or colloid boluses as needed to support blood pressure and perfusion in critically ill patients. Special consideration should be given to severely hypotensive patients. Administering dobutamine (2 to 10 µg/kg/min CRI) can improve cardiac contractility.[9] Other drugs that can be used to augment blood pressure in hypotensive patients include dopamine (5 to 10 µg/kg/min CRI), norepinephrine (0.05 to 0.4 µg/kg/min CRI), epinephrine (0.05 to 0.4 µg/kg/min CRI), and ephedrine (0.1 to 0.25 mg/kg IV).[9]

Analgesia

Proper pre- and postoperative analgesia are of paramount importance. It can sometimes be difficult to accurately identify pain in patients. Particular attention should be given to potential indicators of discomfort or pain such as heart rate, respiratory rate, and posture. The absence of vocalization should not be used to rule out the presence of pain.[7] Common modes of analgesia include local nerve blocks and systemic opioids. Administering NSAIDs can also be considered with caution.[7] Injectable carprofen is available, but because of the potential to exacerbate GI ulceration and renal perfusion in hypotensive patients, its use in dogs with acute abdomen or other conditions that may cause hypotension is not recommended. Although using α_2-receptor agonists provides potent analgesia, the adverse effects mentioned previously contraindicate their use in hypotensive patients with acute abdomen.[7]

Effective analgesic protocols should be tailored to

each patient's needs and underlying conditions. For example, if an opioid is used, the drug of choice should be delivered via CRI to allow close dose titration and avoid peak and trough concentrations.[7] Because of the benefits of CRI, fentanyl, hydromorphone, and oxymorphone are frequently chosen to provide postoperative analgesia in critically ill patients. Using epidural analgesia can also be a valuable adjunctive therapy because of the ability to deliver the drug close to its proposed site of action.[7,10] Administering preservative-free morphine (0.1 mg/kg) can provide pain relief for up to 24 hours.[7] For chronic conditions, an epidural catheter can also be placed until deemed unnecessary.

Anesthesia can be challenging in patients with acute abdomen. Negative inotropes or potent vasodilators should be avoided.

The Surgical Procedure

The surgical approach to acute abdomen should be systematic and thorough. The ventral midline incision should be generous to allow visualization of all abdominal structures. The incision should extend from the xiphoid process caudally to the level of the pubis.[6,9] The falciform ligament should be excised to improve visualization.[7] A sample of any fluid, when present, should be collected and set aside for culture and cytologic and biochemical analyses. Warm peritoneal lavage with an isotonic solution can be valuable when there is evidence of GI contamination or peritonitis. It can also help to warm the patient once the exploratory procedure has been completed.[11] Warm lavage fluid can also help prevent or treat perioperative hypothermia.

The abdomen should be completely explored in each surgical case regardless of the disease process. One approach begins with exploring the cranial abdomen by assessing the diaphragm and liver, including each lobe, the gallbladder, the bile ducts, and the major vessels.[11] Next, the stomach and omentum should be inspected, followed by the spleen and intestines.[11] The spleen and intestines should be exteriorized to facilitate visualization and palpation. Next, the midabdominal structures, including the kidneys, adrenal glands, ovaries, and proximal ureters, should be assessed.[11] The mesentery and mesenteric lymph nodes should be carefully examined. Finally, the caudal abdominal structures, including the colon, bladder, distal ureters, urethra, prostate, uterine body, and regional lymph nodes, should be carefully examined.[11]

During laparotomy, appropriate tissue samples should always be collected. If the cause of abdominal pain cannot be determined grossly during exploratory laparotomy, a sample of bile should be collected and biopsies should be obtained from the liver, GI tract, kidneys, pancreas, and associated lymph nodes.[1] Conditions that are commonly encountered and repaired during acute abdominal surgery include intraabdominal masses, urinary tract rupture, GDV, GI or penetrating foreign bodies, splenic mass abnormalities and torsion, and hepatobiliary problems. This list is by no means inclusive, and discussing the specific surgical repair of each condition is beyond the scope of this article.

SUMMARY

Stabilizing a patient with signs of acute abdomen often begins before obtaining a diagnosis. Stabilization includes administering IV fluids, analgesics, and, when appropriate, antibiotics. Once a patient has been stabilized and a diagnosis made, appropriate definitive therapy can be initiated. Definitive treatment can be medical or surgical, depending on the primary cause of acute abdomen.

REFERENCES

1. Franks JN, Howe LM: Evaluating and managing the acute abdomen. *Vet Med* 95:56–69, 2000.
2. Mann FA: Acute abdomen: Evaluation and emergency treatment, in Bonagura JD (ed): *Kirk's Current Veterinary Therapy XIII.* Philadelphia, WB Saunders, 2002, pp 160–164.
3. Macintire DK: The acute abdomen: Differential diagnosis and management. *Semin Vet Med Surg (Small Anim)* 3:302–310, 1998.
4. Mazzaferro EM: Triage and approach to the acute abdomen. *Clin Tech Small Anim Pract* 18:1–6, 2003.
5. Walters PC: Approach to the acute abdomen. *Clin Tech Small Anim Pract* 15: 63–69, 2000.
6. Dye T: The acute abdomen: A surgeon's approach to diagnosis and treatment. *Clin Tech Small Anim Pract* 18:53–65, 2003.
7. Hofmeister EH: Anesthesia for the acute abdomen patient. *Clin Tech Small Anim Pract* 18:45–52, 2003.
8. Parkowski SL: Anesthesia for the emergency small animal patient. *Vet Clin North Am Small Anim Pract* 30:555–579, 2000.
9. Mazzaferro EM, Wagner AE: Hypotension during anesthesia in dogs and

cats: Recognition, causes, and treatment. *Compend Contin Educ Pract Vet* 23: 728–737, 2001.

10. Hansen BD: Epidural catheter analgesia in dogs and cats: Technique and review of 182 cases (1991–1999). *J Vet Emerg Crit Care* 11:95–103, 2001.
11. Boothe HS: Exploratory laparotomy in small animals. *Compend Contin Educ Pract Vet* 12:1057–1066, 1990.

ARTICLE #3 CE TEST

This article qualifies for 1.5 contact hours of continuing education credit from the Auburn University College of Veterinary Medicine. Subscribers who wish to apply this credit to fulfill state relicensure requirements should consult their respective state authorities regarding the applicability of this program. To participate, fill out the test form inserted at the end of this issue. To take the CE test online, log on to ***www.VetLearn.com****.*

1. When anesthetizing a critically ill patient with acute abdomen, it is generally recommended to avoid all of the following drugs except
a. ketamine.
b. benzodiazepines.
c. propofol.
d. thiobarbiturates.
e. acepromazine.

2. Surgery is not indicated to
a. retrieve hemorrhage using abdominocentesis.
b. treat septic peritonitis.
c. treat shock that is unresponsive to medical therapy.
d. treat pneumoperitoneum secondary to trauma.
e. treat GDV.

3. Which condition should be considered an immediate surgical emergency?
a. pneumoperitoneum
b. lower intestinal obstruction/foreign body
c. pancreatitis
d. open pyometra
e. acute intraabdominal hemorrhage secondary to blunt trauma

4. _____ should be administered as the first form of therapy in patients with severe metabolic acidosis.
a. $NaHCO_3$
b. 0.45% NaCl
c. Fluid therapy to improve perfusion
d. Potassium citrate
e. Magnesium sulfate

5. To provide both aerobic and anaerobic coverage in patients with suspected sepsis, administering _____ is most appropriate.
a. enrofloxacin with gentamicin
b. metronidazole
c. doxycycline and ampicillin
d. ampicillin with enrofloxacin
e. chloramphenicol

6. In animals with clinical signs of acute abdominal pain and vomiting, an appropriate antiemetic to administer would be
a. metoclopramide.
b. dolasetron.
c. chlorpromazine.
d. butorphanol.
e. dimenhydrinate.

7. Administering _____ via CRI may decrease intraoperative inhalant anesthetic doses but cause hypoventilation.
a. morphine
b. buprenorphine
c. propofol
d. fentanyl
e. diazepam

8. Administering _____ via CRI can improve cardiac contractility.
a. fentanyl
b. dobutamine
c. phenylephrine
d. nitroprusside
e. ketamine

9. Using NSAIDs is relatively contraindicated in patients with acute abdomen because of increased
a. cost.
b. risk of gastric ulceration.
c. risk of decreased renal perfusion.
d. risk of delayed wound healing.
e. b and c

10. Which volume of IV fluids should be administered to dogs in shock?
a. 24 ml/lb/day
b. 10 to 15 ml/kg/hr
c. 44 ml/kg/hr
d. 60 ml/kg/hr
e. 90 ml/kg/hr