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Topical Review

Postoperative Management of Dogs With Gastric Dilatation and Volvulus

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The objective of the study was to review the veterinary literature for evidence-based and common clinical practice supporting the postoperative management of dogs with gastric dilatation and volvulus (GDV). GDV involves rapid accumulation of gas in the stomach, gastric volvulus, increased intragastric pressure, and decreased venous return. GDV is characterized by relative hypovolemic-distributive and cardiogenic shock, during which the whole body may be subjected to inadequate tissue perfusion and ischemia. Intensive postoperative management of the patients with GDV is essential for survival. Therapy in the postoperative period is focused on maintaining tissue perfusion along with intensive monitoring for prevention and early identification of ischemia-reperfusion injury (IRI) and consequent potential complications such as hypotension, cardiac arrhythmias, acute kidney injury (AKI), gastric ulceration, electrolyte imbalances, and pain. In addition, early identification of patients in need for re-exploration owing to gastric necrosis, abdominal sepsis, or splenic thrombosis is crucial. Therapy with intravenous lidocaine may play a central role in combating IRI and cardiac arrhythmias. The most serious complications of GDV are associated with IRI and consequent systemic inflammatory response syndrome and multiple organ dysfunction syndrome. Other reported complications include hypotension, AKI, disseminated intravascular coagulation, gastric ulceration, and cardiac arrhythmias. Despite appropriate medical and surgical treatment, the reported mortality rate in dogs with GDV is high (10%-28%). Dogs with GDV that are affected with gastric necrosis or develop AKI have higher mortality rates.

Introduction

Gastric dilatation and volvulus (GDV) is an acute, life-threatening syndrome, requiring immediate medical and surgical treatment, as well as intensive postoperative care.[1,2] The pathology involves rapid accumulation of gas in the stomach, gastric volvulus, increased intragastric pressure, and decreased venous return. GDV is characterized principally by relative hypovolemic-distributive and cardiogenic shock, during which the whole body may be subjected to inadequate tissue perfusion and ischemia.[3] The most serious complications of GDV are associated with ischemic-reperfusion injury (IRI) and consequent systemic inflammatory response syndrome and multiple organ dysfunction.[4-6] Complications from organ dysfunctions include hypotension, acute kidney injury (AKI), disseminated intravascular coagulation (DIC), gastric ulceration, and cardiac arrhythmias.[3,7] Despite appropriate medical and surgical treatment, the reported mortality rate in dogs with GDV is high (10%-28%).[4-6,8,9]

Prognostic Indicators

Gastric necrosis and high serum lactate concentrations have been identified as strong predictors of postoperative complications and mortality in numerous studies of dogs with GDV, indicating the important role of ischemic hypoperfusion in the progression of this disease.[4-6,8,10] Other reported risk factors for morbidity and mortality include time lag (>5 hours) from onset of clinical signs to admission, body temperature $<38^{\circ}C$ (<100.4 F) on admission, hypotension at any time during hospitalization, sepsis, peritonitis, and the need for splenectomy or partial gastrectomy or both during surgery.[4,8] In a retrospective study conducted at our hospital, dogs with GDV that developed AKI also had a significantly higher mortality rate.[8]

As blood lactate concentration on presentation and changes in lactate during hospitalization have repeatedly shown to accurately predict complications and outcome in GDV, dogs with a high presenting lactate level (>6 mmol/L) should be closely monitored, and serial lactate measurements are recommended in these patients.[6,9,10] Lactate concentrations that remain high postoperatively should raise suspicion for gastric necrosis.[9]

Goals of Postoperative Management

Intensive postoperative management of dogs with GDV is essential for patient survival. Pain management is imperative for all dogs following surgery. Additional therapy in the postoperative period is focused on maintaining tissue perfusion along with intensive monitoring for prevention and early identification of IRI and consequent potential complications associated with organ dysfunctions such as hypotension, cardiac arrhythmias, AKI, gastric ulceration, and electrolyte imbalances. In addition, early identification of dogs in need for re-exploration owing to gastric necrosis, sepsis, or splenic thrombosis is crucial.

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Serial abdominal focused assessment with sonography for trauma (aFAST)[11] is recommended in the postoperative period for detection and sampling of abdominal effusion. A mild to moderate volume of nonseptic abdominal effusion is considered normal; however, presence of bacteria, large numbers of degenerate neutrophils, and low fluid glucose concentrations (<50 mg/dL) should raise suspicions for gastric necrosis.[12,13] In some cases, the authors have identified that accumulation of nonseptic fluid associated with splenic thrombosis, which can be diagnosed by Doppler ultrasonography. If blood supply to the spleen is severely compromised, immediate splenectomy should be considered drugs commonly used for post-operative management of patients with GDV are listed in Table 1.

Postoperative Analgesia

Adequate postoperative analgesia is extremely important in dogs with GDV, and opioids such as morphine, buprenorphine, methadone, meperidine, hydromorphone, and fentanyl are all acceptable. Synergistic use of continuous infusions of lidocaine or ketamine or both provides good adjunctive analgesia and may allow for opioid dose reduction. Nonsteroidal anti-inflammatory drugs should be avoided to prevent any potential gastrointestinal and renal side effects.

Management of Cardiovascular Dysfunction

Intravenous (IV) fluid therapy is continued postoperatively; however, it should be tapered down based on perfusion parameters in patients with noncomplicated GDV. Isotonic crystalloids are the mainstay of IV fluid therapy for dogs with GDV. Given the relatively small contribution of hypovolemia to shock in dogs with GDV, and based on our clinical experience, we have taken a conservative fluid approach in dogs with GDV. We have found that in most GDV cases, initial restoration of perfusion and reversal of shock can be achieved by gastric decompression and moderate fluid therapy rates, that is, 20-30 mL/kg of lactated Ringer solution as a bolus to minimize the risk of post–ischemic-reperfusion injuries, followed by 5 mL/kg/h for the next 24 hours. Obviously, monitoring of perfusion parameters such as heart rate, capillary refill time, lactate, blood pressure (especially diastolic as it reflects volume status more accurately), packed cell volume and total solids (PCV/TS), serum creatinine, and urine output is warranted to identify cases in which a more aggressive fluid approach is indicated.

Point-of-care blood tests are usually performed at least every 12-24 hours to monitor PCV/TS, lactate, creatinine, acid-base status, and electrolyte concentrations. IV fluids can be supplemented with potassium as needed.

The use of synthetic colloids in critically ill human patients has been called into question owing to a higher incidence of AKI and increased mortality associated with their use.[14-19] In some European countries, their use in human medicine has been banned and as such they are no longer available. Additionally, a black box warning has been instituted by the Food and Drug Administration in the United States cautioning against their use in critically ill people. Until clear data regarding the safety and efficacy of synthetic colloids is published in the veterinary literature, it is our opinion that these fluids should be used cautiously, and when necessary and financially feasible, the use of natural colloids should be considered. Severely hypoalbuminemic dogs (albumin level <1.5 g/dL) with hypovolemic shock will likely benefit from canine or human albumin solutions; however, if human albumin is to be used, owners should be made aware of potential serious adverse effects.[20-22] Modest data are available regarding the safety and efficacy of canine albumin; however, its use increased albumin concentrations in a small group of septic dogs with no apparent significant adverse effects or change in outcome.[23]

Postoperative cardiac arrhythmias, generally of ventricular origin, have been reported in 40%-70% of dogs with GDV, and their development has been associated with a worse prognosis in some studies.[24,25] As such, electrocardiogram monitoring of cardiac arrhythmias is important in the first 24-48 hours such that treatment can be instituted when indicated. Although some of the potential causes of cardiac arrhythmias in dogs with GDV are not able to be prevented (such as myocardial ischemia), it is important to rule out potentially modifiable causes of cardiac arrhythmias such as hypoxemia and electrolyte abnormalities. The potential for hypoxemia owing to aspiration pneumonia or the development of acute respiratory distress syndrome should be evaluated by pulse oximetry, arterial blood-gas analysis, and thoracic radiographs if clinical signs supporting respiratory failure are present (e.g., dyspnea, tachypnea, and cyanosis). Electrolyte and venous blood-gas analysis should be performed to evaluate potassium and magnesium disturbances and acid-base status. Treatment with lidocaine (2 mg/kg slow IV bolus followed by a constant rate infusion of 50 μg/kg/min) or procainamide (2-4 mg/kg slow IV bolus followed by 10-40 μg/kg/min) is indicated if sustained ventricular tachycardia (heart-rate >180) is present in the face of compromised perfusion despite appropriate fluid resuscitation. In addition, if “R on T phenomena” or multiform ventricular premature complexes are present, lidocaine should be administered.[2,26,27]

Management of Respiratory Dysfunction

Respiratory rate and effort should be monitored closely in the postoperative period in dogs with GDV. Dogs with evidence of aspiration pneumonia on preoperative thoracic radiographs should receive appropriate IV antimicrobial therapy and be monitored particularly closely in the postoperative period. Pulse oximetry or arterial blood-gas analysis or both are warranted in dogs with signs of respiratory difficulty to assess the severity of their impairment and guide therapy. Oxygen therapy may be indicated in dogs with hypoxemia and can be provided in a variety of ways. Nasal oxygen insufflation is perhaps the most practical way of providing oxygen supplementation to large and giant breed dogs, although oxygen cages can also be used when available. Dogs with severe hypoxemia, hypercapnia, or impending respiratory fatigue may require mechanical ventilation.

Management of Gastrointestinal Dysfunction

Given the propensity for gastric ulceration, nausea, anorexia, vomiting, and regurgitation in dogs following surgery for GDV, pharmacotherapy often involves drugs targeting the gastrointestinal system.

Antacid medications are administered routinely in the postoperative period and may include either a H_2 receptor antagonist or a proton pump inhibitor or both. Sucralfate may be administered as a gastroprotectant. In dogs with evidence of postoperative ileus (identified by diagnostic imaging) or regurgitation, prokinetics are also indicated. Metoclopramide, as a continuous rate infusion, is generally the first-line prokinetic agent used in dogs with GDV, but erythromycin or ranitidine or both can also be used. The use of antiemetics in dogs with postoperative vomiting is recommended. Maropitant is the only antiemetic specifically labeled for use in dogs, although serotonin receptor antagonists