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PREOPERATIVE DECISIONS IN THE GDV DOG

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The gastric dilation and volvolus (GDV) syndrome is one of the classical indications for emergency surgical intervention. Rapid identification and initial stabilization are major components of successful treatment.

GDV is a disease that predominately affects large and giant breed dogs. The following is an incomplete list of possible epidemiological aspects that could influence GDV:

1. GDV increases with age
2. Purebred dogs are more likely affected
3. Giant breeds are more likely than large breeds
4. Narrow and deep chest increases GDV risk
5. Single meal feeding increases risk
6. Dry dog food containing soy bean meal might increase risk
7. Exercise after eating increases risk
8. “Stressed, fearful” dogs more likely than “calm” dogs
9. Inflammatory bowel disease increases risk of GDV
10. Abnormal esophageal function increases risk of GDV
11. Long hepato-gastric ligaments could increase risk of GDV
12. Aerophagia increases risk of GDV

Most of the predisposing factors are controversially discussed in the literature. The true relevance of these parameters are controversially discussed. It is however a fact that most of the epidemiological information is not helpful for identification of GDV expect maybe the breed predisposition. The fact that barrel-chested dogs have an increased risk is important because these dogs can have a dilation of the stomach within the rib cage without obvious externally visible abdominal distension.

Pathoanatomy

The stomach can be divided into cardia, fundus, body and pyloric region. The stomach is vascularized from the lesser curvature through the gastric artery and from the greater curvature through the left and right gastroepiploic artery. The short gastric arteries arising from the splenic artery supply the greater curvature in the region of the fundus.

More than 90% of all gastric volvuli are rotated in a clockwise direction when viewed from the surgeon’s perspective with the dog laying on its back. The pylorus normally located in the right cranial quadrant will move ventrally together with the antrum and depending on the degree of rotation (90-270 degrees) will most often be located left to the midline in the region of the cardia. With subsequent dilation of the fundus, the ventral leaf of the omentum will become the first visible intraabdominal structure on the ventral midline approach in GDV patients with the classical clockwise volvolus of the stomach. The spleen normally located on the left side will usually be displaced to the right ventral side.

Relevant Pathophysiology

GDV results in gastric ischemia with possible loss of gastric tone or possible gastric rupture: Gastric vascular supply is severely inhibited with increased dilation and volvolus. Ischemia and formation of thrombi start in the fundus region and can progress over the whole stomach. Acute rupture is possible however late ruptures (2-5 days after surgery) are more common. Functional innervation of the gastric wall can be inhibited with increased distension of the stomach. Continued gastric atony might result even after decompression of the stomach.
GDV can result in general ischemia and hypotension: The GDV syndrome includes not only problems in the gastrointestinal tract but also several other potentially lethal complications. With increased gastric dilation, venous return from the caudal vena cava is reduced. Although several compensatory mechanism like venous blood shunting through the azygos and intervertebral veins are induced, the net effect will still be a reduction in cardiac output with decreased coronary blood flow and decreased systemic arterial pressure. Circular hypotension will lead to generalized ischemia, and reduced coronary blood flow will lead to myocardial ischemia and resultant dysrhythmias.

GDV can lead to hypoxemia: Diaphragmatic movement is severely restricted with increased distension of the stomach. This leads to hypoventilation due to reduced tidal volume. Dogs will initially correct the situation with an increased respiratory rate. With time, this compensatory mechanism will not be effective enough and severe hypoxemia will aggravate tissue ischemia.

GDV can lead to endotoxemia: With reduced splanchnic blood flow, the reticulo-endothelial system is not able to clear gram-negative bacteria from the ischemic gastric mucosa, leading to increased levels of endotoxins. Proteolytic pancreatic enzymes are released.

GDV can lead to abdominal bleeding: Tension of the short gastric vessels increase with increased dilation and rotation of the stomach to the point of arterial and venous disruption. Potentially fatal bleeding can occur via this pathway.

GDV can lead to multiple organ failure: Different organ systems can start to produce local cytotoxic substances with continued ischemia. Reperfusion injury after initiation of treatment can aggravate the situation. Systemic inflammation is initiated leading to cell dysfunction, and cell death with organ dysfunction is the consequence.

GDV can lead to peritonitis: Ischemia, endotoxemia and abdominal bleeding can lead to bacterial contamination and bacterial growth within the peritoneal cavity. Especially patients undergoing gastroscopy or having gastric perforation are at higher risk for localized or generalized peritonitis.

GDV can lead to disseminated intravascular coagulation: Ischemia and reperfusion injuries leading to intravascular damage can lead to DIC. Early recognition and treatment are likely responsible for better short term outcomes.

Clinical signs are all related to the relevant pathophysiology. Acute non productive retching together with continued abdominal distension are the classical presenting complaints. Hypersalivation, restlessness or depression are also seen. Dogs present with various degrees of circulatory shock. Poor peripheral pulses, tachycardia, dyspnea and prolonged capillary refill time are seen. The preoperative treatment is directed towards counteracting the systemic consequences of GDV. It includes mainly the control of the cardiovascular system, the anticipation of complications and appropriate prophylactic action.

Resuscitation

Obtaining pre-fluid blood samples for PCV/TS, electrolytes, venous gas, azostick and dextrostick, platelet count, activated clotting time, and saving samples for coagulation profile, serum chemistries, complete blood count and urinalysis

Prefluid values provide a baseline from which subsequent values are compared to and monitored. In addition, any significant abnormalities are addressed prior to surgical intervention.

Any clinical evidence of coagulation abnormalities in addition to laboratory abnormalities requires appropriate treatment prior to surgery; frozen plasma if DIC or coagulation factor defect is suspected. DIC might be defined as development of coagulopathy and thrombocytopenia with elevation in fibrin degradation products, or elevation in D-dimer levels or both, with clinical suspicion of the syndrome by the attending veterinarian.

Immediate and rapid fluid resuscitation

Fluid resuscitation is performed in stages to end-point parameters of improved perfusion, normal heart rate and normal blood pressure. Isotonic replacement crystalloids (such as Plasmalyte-A, Normosol-R, Ringers Lactate) are always administered with incremental doses of 10-15ml/kg. Synthetic colloids (Hetastarch, Voluven) are administered at incremental doses of 5-10 ml/kg (up to 20 ml/kg). These solutions promote colloid osmotic pressure during fluid resuscitation. If crystalloids are used alone, the
bolus doses are increased to 20-30 ml/kg. The use of colloids during resuscitation has been shown to decrease the risk of hypotensive events during the GDV treatment.

The rapidly deteriorating hypovolemic patient without significant hemorrhage can benefit from the infusion of hypertonic saline (4 ml/kg 7% solution) with synthetic colloids in an effort to augment exogenous fluid infusion with interstitial fluid redistribution. Large volume resuscitation with any fluid product can induce a dilutional coagulopathy and plasma transfusions can be helpful to prevent hemorrhagic tendencies.

**Blood pressure and ECG**

Hypotension is usually present in the critical GDV patient. Hypotension should be corrected as quickly as possible with fluid resuscitation. Usually significant hemorrhage is not a problem but in the rare case of additional splenic rupture or massive disruption of the short gastric vessels clinically important hemorrhage might be present. In this case, hypovolemic resuscitation may be warranted until exploration. This entails careful endpoint resuscitation techniques using crystalloids and colloids to a MAP of approximately 80 mmHg (systolic around 100 mmHg). The goal is to initiate some reperfusion without disturbing any clots that have formed until hemostasis is achieved surgically. A constant rate infusion (CRI) of hetastarch can be administered after resuscitation of the hypotensive animal at a rate of 1 ml/kg/hr to help maintain blood pressure until cardiovascularly stable.

Normal to increased blood pressures are assessed with respect to intravascular volume status. Adequate or increased blood pressure may result of a compensatory response to hypovolemia, and aggressive fluid resuscitation is still indicated.

Any auscultable or ECG arrhythmia should be treated with oxygen therapy. Any acid-base and electrolyte (potassium, calcium) abnormalities should be corrected. A study has shown that magnesium depletion is not pathophysiologically important in dogs with GDV and does not play a role in cardiac arrhythmias. When improvement of arrhythmias and especially perfusion does not occur, antiarrhythmics are administered. The most common arrhythmia treated is a ventricular tachycardia, and lidocaine is administered IV up to 4mg/kg slow bolus. Lidocaine is commonly used in the anaesthetic GDV protocol (see other GDV lecture)

If the blood pressure is not responsive to fluid resuscitation, dobutamine infusion (5-10 mcg/kg/min) may be required and underlying causes of nonresponsive shock investigated. Dopamine infusion (5-15 mcg/kg/min) may also be necessary. Clinical experience has shown that animals in need of catecholamins to maintain blood pressure have decreased survival rates compared to animals that do not need catecholamins.

**Lidocaine treatment**

Lidocaine is used in our institution for various effects in a GDV patient. Lidocaine is an effective pain relieving substance, it is a viable option for treatment of ischemic arrhythmia’s and it is potentially helpful in the prevention of reperfusion injuries. (See anaesthetic protocol in other GDV lecture notes)

**Temporary relief of distension and pain relief**

Complete gastric emptying prior to surgery is not advised. Immediate surgical intervention after resuscitation is generally preferred so that the gastric wall can be palpated and visualized while the orogastric tube is placed. Percutaneous trocharization of the stomach during initial resuscitation provides immediate release of some gas and fluid when appropriately placed, and provide immediate pain relief. The lateral abdominal wall is percuted and the area sounding most tympanic/resonant is trocharized. Risks associated with trocharization include puncture of the spleen, which can be malpositioned during GDV. This method of relief does not work with food-bloat.

Orogastric intubation can be attempted. There is a risk of gastric rupture with a severely necrotic stomach. Tube passage is not always possible, and passage does not equal derotation. Smaller tubes can pass through the twisted cardia and still allow temporary relive of distension. An immediate indication for surgical decompression is present if orogastric intubation is not possible. An indication for abdominal radiographs is present if orogastric intubation is possible. The reason to take the x-rays is to differentiate an acute dilatation (non surgical)from a gastric volvolus (surgical).

GDV is a presumably very painful experience. Administration of injectable opioids generally provides some relief and acts as a premedication in anticipation of surgery. Oxymorphone (0.1 mg/kg) or hydromorphone (0.1-0.4 mg/kg) can be administered intravenously, or morphine (0.5-1 mg/kg) can be
administered intramuscularly or by slow intravenous injection to avoid hypotension or arrhythmias. The partial agonists/antagonists such as butorphanol and buprenorphine may not provide adequate analgesia for this type of surgical intervention.

Lateral abdominal and thoracic radiographs
Radiographs are not to be taken until fluids and temporary decompression has been initiated, unless euthanasia is an option over surgery. Radiographs should not delay surgical preparation. Abdominal x-rays are not performed routinely in our institution. A right lateral abdominal radiograph will show if a volvulus is present and will indicate surgical treatment.

It is essential to understand the pathomechanism of gastric rotation to identify the pylorus on the x-ray. Usually a dog with GDV will have a gas filled pylorus located dorsally. In contrast to a normal dog that has a fluid filled pylorus located ventrally. A soft tissue fold that seems to compartmentalize the gas filled stomach is classically seen an described as double bubble phenomenon. Duodenal loops between the liver and the gastric fundus, splenic enlargement and malpositioning are also commonly seen. Free abdominal gas or gas within the gastric wall indicate severe gastric compromise and probable gastric rupture.

Injection of broad-spectrum antibiotic
Preoperative broad-spectrum antibiotics such as a first generation cephalosporin or ampicillin (10 mg/kg IV) should be administered as the patient is being prepared for surgery. Once the abdominal exploratory has been performed, addition of antibiotics selecting anaerobes or gram-negative organisms may be added.