

Mississippi State University
College of Veterinary Medicine
Clinicopathologic Conference

Gastric Dilatation-Volvulus; Management and Complications

Author: Jeimy Rivera Falcon

Advisor: Dr. Elizabeth Swanson

Date presented: July 22, 2016

Introduction

Gastric Dilatation Volvulus (GDV), is an acute and often fatal condition that affects mainly large and giant-breed dogs.¹⁻⁸ This condition is characterized by rotation (volvulus) of the stomach around its mesenteric or long axis and trapping of gas in the gastric lumen (dilatation of the stomach), leading to an increased intragastric pressure.¹⁻⁵ GDV leads to serious cardiovascular and systemic effects by decreasing venous return to the heart through direct abdominal compression.^{1,2} The result is a life-threatening situation of portal hypertension, systemic hypotension and shock.¹ In this state, the body is susceptible to inadequate tissue perfusion and ischemia.² Besides the cardiovascular problems, gastrointestinal, respiratory, coagulation and renal dysfunction commonly develop.^{2-4,6} Blood supply to the stomach is compromised in 2 ways: by compression and collapse of the gastric capillaries and vessels due to increased gas pressure and by stretching and tearing of the short gastric vessels during the volvulus. For this reason, gastric necrosis is a common consequence.^{3,4}

The exact etiology for GVD is still unclear after many years of research. However, many factors classified as inherited and environmental predisposing factors⁷ have been associated with an increased risk of developing GDV. Within these factors breed predisposition seems to be the strongest. Treatment of GDV requires aggressive emergency medical stabilization followed by decompression and surgery to reposition the stomach.^{3,5,8,9} At the time of surgery gastropexy to securely adhere the stomach to the body wall is highly recommended. The rate of recurrence if gastropexy is not performed may be as high as 80%.⁸ Surgery, even though life saving, can have severe complications. Therefore, intensive postoperative care is crucial for patient survival.²

Even with appropriate medical and surgical treatment, the latest studies of GDV report a mortality rate ranging from 10-33%.²⁻⁵

Pathogenesis

Although there have been a number of factors determined to be associated with the development of GDV, the etiology remains unclear.¹ Some have stated the pathogenesis of GDV to be a complex and multifactorial one^{3,6} composed of both genetic and environmental influences.^{6,7} It is known that large and giant breed dogs with deep chests are the most common dogs affected. Among the top breeds that consistently appear as the most at risk within studies are; German Shepherds, Great Danes, Standard Poodles, Weimaraners, Irish Setters and Saint Bernards,^{1,3,7} but many others have been reported. Along with the breeds, some studies have stated that the most significant finding is an increase in thoracic depth to width ratio.⁷ Other factors reported are older age, lean body condition, first degree relative with GDV, once a day large meal feeding and fearful or anxious dogs.^{1,3,5,7}

Pathophysiology

It is still unclear whether dilatation or volvulus occurs first in GDV cases because both scenarios have been documented.^{3,6} Regardless of the order of events, all reports agree on the life threatening sequela after the GDV is present. The increasing distention of the stomach compresses the low-pressure abdominal veins, including the caudal vena cava, portal vein and splenic veins, decreasing venous return to the heart. In an effort to compensate for the reduced stroke volume, the HR increases eventually causing inadequate cardiac output.^{3,6} Decreased coronary artery blood flow leads to myocardial ischemia which accounts for the commonly seen cardiac arrhythmias.⁵ This cardiovascular cascade has as an end result a decreased oxygen delivery to the tissues, compromising the respiratory, cardiovascular, gastrointestinal, nervous and renal systems.⁶ For this reason GDV has been stated as a condition that fulfills the criteria for the systemic inflammatory response syndrome (SIRS), having the potential to develop into multiple organ dysfunction syndrome (MODS).⁶

Hypoxemia due to compromised ventilation is also seen. The distended stomach displaces the diaphragm cranially, impeding normal respiration and forcing the animal to take shallow breaths.^{2,3,5}

History/Presentation

Patients with GDV typically present with an acute onset of clinical signs. These can include restlessness, hypersalivation (ptyalism), non-productive retching, weakness or collapse, abdominal distention and pain, tachypnea and dyspnea.^{3,6}

On physical examination they may present in shock, depressed, with pale mucous membranes, prolonged capillary refill time, tachycardia, cardiac arrhythmias and weak pulses and with tachypnea.^{3,5,6} The abdomen may feel distended, firm and tympanic, but this is not always the case.^{3,5}

It is important to keep in mind that some patients walk in the hospital showing minimal or intermittent clinical signs. Some theories are that the stomach can partially rotate and then correct itself intermittently or that they can be early on the disease process and not compromised yet. These cases are still emergencies and should be treated as such.

Differential Diagnosis

Among the differential diagnosis for dogs that present with the above described clinical signs should be gastric dilation alone, with food bloat being the most common cause, splenic torsion, mesenteric volvulus and peritonitis.⁵

Diagnostic Approach/ Considerations

A single right lateral abdominal radiograph is the main diagnostic tool for GDV. The typical GDV radiographic sign (reverse C, boxing glove, Popeye sign, Smurf hat) is created by the

movement of the pylorus cranial and dorsal to the gastric fundus, making a fold in the stomach that accounts for the soft tissue opacity dividing these two gas filled structures.^{3,5}

Hemodynamic stabilization with appropriate fluid therapy and gastric decompression must be started previous to performing radiograph.⁵ Other diagnostics may include thoracic radiographs to check for aspiration pneumonia or any signs of metastasis and blood work.^{3,5}

A minimum database including a packed cell volume (PCV), total protein (TP), and lactate measurement should be performed as a first step,³ but if possible enough blood should be collected to run a CBC and Chemistry profile and assess patient's general health.

Plasma lactate has been studied as a prognostic indicator in dogs with GDV. The reason behind it is that lactate is produced when cellular oxygen supply is inadequate; to allow glycolysis and ATP production to continue.⁴ If lactate is produced at a rate higher than it is metabolized, hyperlactatemia develops and when tissue oxygen deficiency is the cause it's called a type A hyperlactatemia. Studies have been made to correlate type A hyperlactatemia with gastric necrosis. In an evaluation of four retrospective studies, plasma lactate concentration was higher in dogs with gastric necrosis⁴ but there was too much variation on the levels of plasma lactate to establish a cut off point. What was concluded was that with an initial plasma lactate of <4mmol/L survival may be more likely with less chance of complications and the opposite with an initial lactate >6mmol/L. Nevertheless, because of the great variation within studies, owners must be always advised that surgery is needed to identify gastric necrosis.⁴

Newer studies report that a more accurate prognostic indicator in dogs with GDV is the return of plasma lactate to normal range, or at least a significant decrease after appropriate fluid resuscitation and suggest serial plasma lactate measurements to assess resolution of hypoperfusion.¹³

Treatment/ Management

a. Medical management

The most crucial part of initial treatment is stabilizing the cardiovascular and respiratory systems. Aggressive fluid therapy, with the placement of two large bore catheters on the cephalic veins and isotonic crystalloids at shock rates (60-90ml/kg) should be the first step. Colloids or hypertonic saline may be added to aid with hypotension. Gastric decompression follows using an orogastric tube; if not possible, trocharization with a large gauge short needle or large-bore over the needle catheter is indicated. This last should be performed at the right dorso-lateral aspect of the abdomen where the loudest tympanic sound can be auscultated to try and prevent lacerating the spleen. Continuous electrocardiographic (ECG) monitoring is indicated since arrhythmias are common. Premature ventricular contractions (VPC's) are the most commonly seen arrhythmia and if sporadic don't need to be treated right away. However if VPCs are continuous or a persistent ventricular tachycardia >180 bpm is present along with decreased systolic or mean arterial pressure, treatment with lidocaine should be instituted.^{2,3} It is important to keep in mind that another type of arrhythmia called idioventricular tachycardia resembles ventricular tachycardia but has a rate of usually less than 130bpm, where proper ventricular filling can occur and no treatment needs to be instituted.¹⁵ Analgesia is warranted, with opioids as the main recommendation since NSAIDs are contraindicated due to the risk of gastric ulceration and renal injury. The patient must be continuously monitored to assess efficacy of treatment. Improvement on capillary refill time, mucous membrane color, pulse quality, stabilization of heart rate and return of mean or systolic pressure to within normal range are all good indicators of responsiveness to treatment and stabilization.^{2,3,5,10}

b. Surgical correction

The goal of GDV surgery is to return the stomach to its correct anatomical position, assessment of gastric wall and splenic viability, partial gastrectomy and or splenectomy if necessary and perform a gastropexy to prevent recurrence.^{3,5,10}

After the stomach is placed back in normal anatomical position, it is extremely important to assess if there is any area that appears necrotic, in which case a partial gastrectomy must be performed. Determining tissue viability may be difficult but the indications are to assess color and texture of gastric wall. Necrotic tissue may vary in color from gray, green to black and upon palpation will feel thin walled. If an area seems suspicious, the suggestion is to make an incision to assess bleeding/ vascular patency.^{3,5,10,11}

A partial gastrectomy can be performed by manual dissection and suturing or by the use of a thoracoabdominal (TA) stapling device to close the incision.¹¹ Some recommend a second inverting suture line, regardless if staples or sutures are used for closure.³ Not many studies have been made to accurately compare stapled vs sutured gastrectomy. In a report comparing these two techniques on GI anastomoses surgery, it was stated that staples cause less trauma and fewer adhesions, produce less inflammatory response and are quicker. On the other hand, when placed under tension, staples are at greater risk of pulling through tissue and do not replace good surgical technique.¹²

c. Gastropexy

Gastropexy should be performed in all dogs that undergo surgical correction of GDV.⁸ The goal is to surgically attach the pyloric antral region of the stomach to the right body wall³ and by doing this induce the formation of adhesions that permanently attach the stomach to the body wall.^{3,5,8} There have been multiple techniques developed to perform a gastropexy. Among these the most common are incisional, tube, muscular flap, circumcostal and belt loop gastropexies.^{3,5,8} Of these, incisional gastropexy is the most common and less invasive⁸.

It consists in making a small (4-7cm) incision on the gastric wall, at the pyloric antrum region that only extends through the seromuscular layer and is aligned with the long axis of the stomach. This is followed by an incision of equal length on the peritoneum and right transversus abdominus muscle, parallel to the muscle fibers, and the two incisions are sutured together using a simple continuous pattern.⁸ A study conducted to evaluate the efficacy of incisional gastropexy on preventing recurrence of GDV reported that out 40 dogs that survived 2 years after having the procedure performed, none experienced GDV and 2 experienced GD alone.¹⁴ Prophylactic gastropexy on at risk breeds has gained popularity on recent years^{8,9} and with it the development of minimally invasive techniques to perform it, such as laparoscopically or endoscopically guided.⁸

Postoperative Management and Complications

In the post-operative period of GDV patients can develop a series of life-threatening complications. It is important to be aware of what these may be in order to monitor and promptly intervene if needed. These potential complications include but are not limited to cardiac arrhythmias, shock, gastric wall necrosis leading to septic peritonitis, disseminated intravascular coagulation, ischemic reperfusion injury, and aspiration pneumonia.^{2,10}

Gastrointestinal complications and management

- *Gastrointestinal healing:*

It is important to understand gastrointestinal healing to be able to recognize potential complications associated with surgery. A chapter on healing in the gastrointestinal (GI) tract in Surgical Clinics of North America, stated a comparison between wound healing in the GI tract vs cutaneous healing. It explains that the multilayer architecture of the GI tract works as an advantage because collagen synthesis, which is crucial to tissue healing, takes place in both fibroblasts and the smooth muscle cells. This differs from cutaneous healing where it is

solely dependent on fibroblasts. As a disadvantage, GI tract undergoes peristalsis, which exerts shearing forces on the suture line. Most importantly, tissue oxygenation on the GI tract is completely dependent on intact vascular supply and neocapillary formation. The skin on the other hand can rely on both circulatory transport of oxygen, as well as diffusion.¹² For this reason, it is so important to assess tissue viability and only oppose viable tissue together after resection of necrotic tissue. A crucial time of healing is the phase when there is an imbalance between collagen synthesis and degradation and usually occurs in the first 3 days of healing.¹² At this time patients must be closely monitored for any clinical signs that could indicate a perforation or dehiscence at the gastrectomy site, which if not treated immediately could turn into a life threatening peritonitis.

- *Dehiscence/perforation at the gastrectomy site*

Because it is anatomically not possible to inspect and visualize GI tract healing, close monitoring of patient's parameters of well-being have to be used to judge surgical success.¹² The patient must be monitored for sepsis by continuous physical examinations and follow up CBC and serum biochemistry to detect abnormalities.⁵ Serial assessment with abdominal ultrasonography has been recommended in the postoperative period to detect and sample any abdominal effusion. It is normal to see a minimal volume of non-septic effusion after surgery² but presence of intracellular bacteria and an increased number of degenerate neutrophils could be indicative of septic peritonitis.^{2,5} If septic peritonitis is confirmed, emergency surgery is indicated, along with broad spectrum antimicrobial treatment.^{5,10}

- *GI dysfunction*

After GDV surgery gastric ulceration, nausea, anorexia, vomiting and regurgitation and ileus are possible. For this reason medications targeted to treat and prevent these symptoms are routinely administered. Among these, antacid medication such as proton pump inhibitors or H2 blockers, sucralfate as a gastroprotectant and maropitant as an anti-emetic in the presence

of vomiting are commonly used. In the case of ileus metoclopramide as a continuous rate infusion is the most used pro-kinetic agent.²

Cardiovascular complications and management

It is indicated to continue fluid therapy with isotonic crystalloids after surgery and to monitor perfusion parameters (CRT, mucous membrane color, PCV, TP, urine output, blood pressure) to taper down rates and decrease the risk of post-ischemic reperfusion injuries.^{2,3}

Electrocardiac monitoring should continue for 24-48hrs after surgery, since post-operative arrhythmias, mostly ventricular, have been reported in 40-70% of dogs with GDV.² It is important to identify the source of the arrhythmia, to be able to treat it. Potential causes can be electrolyte imbalances and hypoxemia² and should be treated first because anti-arrhythmic treatment if needed will not be effective if the underlying cause is not addressed. Like mentioned before not all ventricular arrhythmias need to be treated immediately, most of them will resolve on themselves but close monitoring is crucial.

Coagulation complications and management

Multiple hemodynamic abnormalities occur in dogs with GDV and disseminated intravascular coagulation (DIC) is a concern. In the past DIC seemed to be a higher cause of death in dogs with GDV. However, the increase in use of fresh frozen plasma and aggressive postoperative management in recent years has reduced this incidence.²

Outcome

Prognosis with GDV is guarded. Despite proper and aggressive treatment GDV studies still present it with a mortality rate of 10-33%.²⁻⁵ However, it is important to note that this is a drastic improvement from the past where mortality rates were reported around 33-68%.¹⁴

This improvement in survival can be largely attributed to better and more aggressive pre and post surgical critical care.

Summary

GDV is a life-threatening emergency that affects mainly large and giant breed dogs and causes detrimental cardiovascular and systemic effects. After decades of studies the exact etiology remains unclear, but several genetic and environmental factors have been reported to predispose dogs to this condition. Immediate medical treatment should be instituted to stabilize the patient, followed by surgical intervention. Because necrosis of the stomach wall due to loss of blood supply is common, partial gastrectomy may be required. Gastropexy must follow repositioning of the stomach on the correct anatomical position, to prevent recurrence. Although GDV is considered a surgical emergency, and prompt surgical intervention is needed to save the pet's life, there are many peri and postoperative risks that must be discussed with owners. Despite proper treatment GDV studies still present it with a mortality rate of 10-33%.²⁻⁵ Prophylactic gastropexy seems to be gaining popularity and can be recommended to owners of at risk breeds at the time of spay/neuter.

References

1. Gazzola, Krista M. and Laura L. Nelson. "The Relationship Between Gastrointestinal Motility and Gastric Dilatation-Volvulus in Dogs". *Topics in Companion Animal Medicine*. Vol 29 (2014): 64-66
2. Bruchim, Yaron and Efrat Kelmer. "Postoperative Management of Dogs With Gastric Dilatation and Volvulus". *Topics in Companion Animal Medicine*. Vol 29 (2014): 81-85
3. Sharp, Claire R. "Chapter 123 Gastric Dilatation-Volvulus." *Small Animal Critical Care Medicine*. 2nd ed. St. Louis: Elsevier, 2014. 649-53. *Science Direct*. 2015. Web.
4. Mooney, Erin, Cameron Raw and Dez Hughes. "Plasma Lactate Concentration as a Prognostic Biomarker in Dogs With Gastric Dilatation and Volvulus". *Topics in Companion Animal Medicine*. Vol 29 (2014): 71-76
5. Soiderer, Emily. "Chapter 32 Gastric Dilatation-Volvulus." *Handbook of Small Animal Practice*. 5th ed. St. Louis, MO: Saunders Elsevier, 2008. 350-56.
6. Sharp, Claire R. and Elizabeth A. Rozanski. "Cardiovascular and Systemic effects of Gastric Dilatation and Volvulus in Dogs". *Topics in Companion Animal Medicine*. Vol 29 (2014): 67-70
7. Bell, Jerold S. "Inherited and Predisposing Factors in the Development of Gastric Dilatation Volvulus in Dogs". *Topics in Companion Animal Medicine*. Vol 29 (2014): 60-63
8. Allen, Phillip and April Paul. "Gastropexy for Prevention of Gastric Dilatation-Volvulus in Dogs: History and Techniques". *Topics in Companion Animal Medicine*. Vol 29 (2014): 77-80
9. Ward, Michael P., Gary J. Patronek and Lawrence T. Glickman. "Benefits of prophylactic gastropexy for dogs at risk of gastric dilatation-volvulus". *Preventive Veterinary Medicine* Vol 60 (2003): 319-329
10. Sullivan M. and D. A . Yool. "Gastric Disease in the Dog and Cat". *The Veterinary Journal* Vol 156 (1998): 91-106
11. Fossum, Theresa W. and Cheryl S. Hedlund. "Gastric and Intestinal Surgery". *THE VETERINARY CLINICS Small Animal Practice* Vol 33 (2003): 1117-1145
12. Thornton, Frank J. and Adrian Barbul. "Healing in the Gastrointestinal Tract". *Surgical Clinics of North America*. Vol 77. Number 3(1997): 549-573.
13. Zacher, Laurie A., John Berg, Scott P. Shaw and Raymond K. Kudej. "Association between outcome and changes in plasma lactate concentration during presurgical treatment in dogs with gastric dilatation-volvulus". *Journal of American Veterinary Medical Association* Vol 236. Number 8 (2010): 892-897
14. Przywara, John F., Steven B. Abel, John T. Peacock and Susan Shott. "Occurrence and recurrence of gastric dilatation with or without volvulus after incisional gastropexy". *The Canadian Veterinary Journal* Vol 55. Number 10 (2014): 981-984
15. Macintire, Douglass K. "Chapter 10: Cardiac Emergencies" *Manual of Small Animal Emergency and Critical Care Medicine* 2nd edition (2012): p220