Objectives:
- Improve the initial triage process and enhance early diagnosis
- Review pre-operative stabilization techniques of the GDV patient
- Review the surgical aspects associated with GDV cases, in particular partial gastrectomy and incisional gastropexy

Gastric dilatation and volvulus (GDV) is one of the more common surgical emergencies that are encountered in the larger breed dog. This condition occurs when both the stomach dilates with air, fluid, solid material (ingesta), or a combination thereof AND the stomach rotates 180 degrees to 360 degrees on its longitudinal axis. The exact order of events is generally unclear; however, it is believed that the dilation of the stomach increases the ability for it to mobilize. Also, we can certainly see dogs with underlying gastrointestinal disease and other causes have frequent bouts with gastric dilatation alone and these patients are believed to be more at risk for volvulus.

In addition to the stomach dilating and twisting on its axis, the vena cava and portal vein become compressed, which in turn reduces the venous return and cardiac output. This reduction in venous return and cardiac output can also cause myocardial ischemia. Other cardiac effects from the reduction of blood flow would include changes to the central venous pressure (CVP), stroke volume, and mean arterial pressures. These types of cardiac effects can cause obstructive shock with decreased tissue perfusion. Systemic effects associated with multiple organs can occur (decreased perfusion) and cause changes to the kidneys, heart, pancreas, and gastro-intestinal tract (in particular the stomach). Cardiac arrhythmias are also common in GDV cases and an electrocardiogram should be monitored – these can be life-threatening. With the above secondary effects caused by gastric dilatation and volvulus, other syndromes such as systemic inflammatory response syndrome (SIRS), multiple organ dysfunction syndrome (MODS), and disseminated intravascular coagulopathy (DIC) can also occur. Signs of these processes can be seen on presentation or develop following surgical intervention. The keen clinician should be aware of these conditions and actively searching for them.

The signalment of GDV patients tends to span the ages and most commonly occurring in larger breed, deep chested canine breeds. We also see a sex predilection for male dogs. The typical breeds thought of are the Great Dane, Mastiff, Labrador Retriever, and the Standard Poodle. In rare instances will we see small and medium sized dogs.

**Presenting Signs / Physical Examination**

Clinical history combined with signalment can drive us to a presumptive diagnosis prior to examination of the critical patient. The common history of most patients includes listlessness, abdominal dilation and enlargement, coupled with non-productive retching. The time frame can vary from peracute and the owner acting quickly to more time being lapsed. We do know that prognosis can be very dependent on lapsed time of symptoms. We can certainly see patients that are more critical than others, with the hemodynamic affects mentioned previously, all patients have the capacity to decompensate quickly.

There are some classic physical examination signs that will be encountered in most cases with GDV. In the patient that can ambulate (non-recumbent) abdominal distention is the hallmark feature. The patient usually will have a component of non-productive retching as well. In most cases, tachycardia will be noted, and the dog should have an electrocardiogram (ECG) performed and evaluated. Hypotension is also noted in the untreated patient and this is generally caused by a combination of hypovolemia with decreased perfusion (decreased caval return flow). Pulse deficits (discrepancy in heart rate and pulse rate) can also be noted.
Diagnostics

Upon triaging the suspected GDV patient, radiographs should be the primary modality of diagnosing. Both a right lateral and ventro-dorsal projection should be taken. The right lateral abdominal view will allow for better visualization of the pylorus in its altered position (on the left side) and the ventro-dorsal projection will allow for assessment of the anatomical positioning of the stomach. Abdominal ultrasound will have limited value in these cases – other than assessing for peritoneal effusion. Once a diagnosis of GDV is made, thoracic radiographs are recommended to assess for changes to the pulmonary parenchyma (aspiration pneumonia) due to the frequency of retching. Please note that many GDV cases have some degree of megaesophagus due to aerophagia – this does not worsen overall prognosis.

As already mentioned, other diagnostics that should be performed in addition to radiographs are ECG, blood pressure and complete blood work. There are some peer reviewed studies that have evaluated lactate as a prognostic indicator (>3 poor prognosis). A higher value has been implicated as an indicator of gastric necrosis and possible rupture. Also, on radiographs, a faint line (air) around the gastric silhouette has been correlated with gastric necrosis and could potentially hold a poorer prognosis. If fluid is present in the abdomen, acquisition of the fluid is recommended. In many cases of GDV a mild hemoperitoneum is seen due to the rupturing of the short gastric vessels – common. If the fluid is not hemorrhagic then in-house cytologic evaluation and/or comparison of blood glucose to fluid glucose and of blood lactate and fluid lactate can be performed and may guide the clinician to a diagnosis of gastric perforation.

Initial Stabilization

Just as important as early diagnosis of this disorder, the initial stabilization is crucial for a potentially successful outcome. Most of these patients will present in a form of shock (most likely hypovolemic) and may either be compensating or decompensating. When these cases present, it is important to provide cardiovascular support with fluid therapy. It is ideal to place one to two intravenous catheters and in the forelimbs if at all possible. Due to vena caval occlusion in the abdomen (from gastric dilation) hind limb catheters are not very effective. In patients with hypovolemic shock the author will generally start with bolus therapy of crystalloid fluids (10-20 ml/kg per bolus) that can be repeated. It is important to monitor both heart rate and peripheral blood pressure. Please remember that the dilation of the stomach causing compression of the vena cava can affect the blood pressure reading from the hind limbs, thus try to get the readings from the forelimbs.

It is important to monitor the patient’s clinical response and the corresponding heart rate and peripheral blood pressure when administering fluids. If crystalloids are not improving the status, then consider administering hypertonic saline or a colloid such as VetStarch.

The patient’s pain level must also be assessed and treated appropriately. When selecting an opioid one must take into consideration how affected the patient is due to the disease process. Opioids such as fentanyl and hydromorphone can be very beneficial. In order to provide relief to the patient and to assist in stabilization, the stomach should be trocarized (usually an 18 gauge over-the-needle catheter) or an orogastric tube placed to evacuate the stomach. The author prefers trocarization since this can generally be performed in the patient on presentation if needed without pain medication and/or sedation. Also, this can be repeated as necessary if the patient is unable to go to surgery immediately.

It is important that the clinician continually monitor the patient’s ECG during this time as well. In addition to being a quick visual reminder during stabilization, it is important to assess for changes to the cardiac rhythm that can be seen with splenic trauma and cardiac hypoxemia. In some patients depending on how critical they present, additional treatments may be needed such as vasopressor drugs (norepinephrine, etc.). In patients with suspect gastric perforation and necrosis, additional pre-surgical treatment may be needed. As mentioned above, some radiographic signs may be helpful in determining this, as well as lactate values.
Surgical Management

Once the patient is hemodynamically stabilized, surgery is recommended. It is imperative that the owners realize that while we have improved their hypovolemia and hemodynamically supported/stabilized them, they are still very much at risk of anesthetic and surgical complications – which can be life threatening. Our supportive care should be thought out carefully and administered swiftly. Patients that are not appropriately stabilized will have a higher than desired mortality rate. Anesthetic drugs should be selected with the patient in mind, using the current induction agents such as Propofol or alfaxalone paired with an appropriate pre-medication. In most cases midazolam is combined with an opioid. Maintenance of anesthesia is generally via gas inhalant or intravenous methods in very critical cases. The author prefers to use fentanyl constant rate infusions combined with low level gas inhalant when possible.

Preparation of the surgical patient is normal for all abdominal exploratory procedures and the patient is positioned in dorsal recumbency. A midline incision should be made from the xyphoid to the preputial/caudal abdomen region. The falciform fat is removed to improve exposure and the skin edges are covered with laparotomy sponges and a Balfour retractor placed. The first structure that the surgeon will notice is the omentum overlying the stomach (in GDV cases) where it is normal draped caudal to the stomach. This is a very common finding in both 180-degree and 360-degree rotations of the stomach. It is from here that the surgeon should begin to rotate the stomach back into the original position. The pylorus, in most cases, will be in the upper left quadrant and should be grabbed. The surgeon is best positioned on the patient’s right side, reaching across the patient’s abdomen to grab the pylorus. As the pylorus is brought to the surgeon with one hand, the surgeon should push the fundus/body of the stomach down (dorsally) and away from their (surgeon’s) body. This motion will generally achieve adequate rotation. Once the stomach is in the normal position an orogastric tube can be placed. An orogastric tube will usually NOT be able to be placed at this point until the stomach is in the correct position.

Once the stomach is positioned in its anatomical position and the orogastric tube placed (stomach contents – gas and fluid removed) the stomach should be evaluated for signs of erythema and necrosis. Redness and erythema are not indications for gastrectomy, however necrosis is. When in doubt, perform the rest of the abdominal exploratory and then reassess. It is important that ALL of the stomach be evaluated with particular attention placed on the cardia and the dorsal surface of the stomach. In cases of gastric necrosis, a partial gastrectomy will be needed. Assess for blood flow, color, and thickness of tissue to confirm necrosis.

A partial gastrectomy can be performed in a quick fashion dependent on the available instruments. Visualization is key and multiple stay sutures/hemostats should be placed around the area of interest, in the healthy portion. Since the necrotic area will be removed, Allis tissue forceps or Carmalt forceps can be used to elevate the necrotic area. The quickest and easiest method to perform a gastrectomy would be to use a gastro-intestinal anastomosis (GIA) stapler. These stapling devices are readily available and are affordable. The cartridge is placed near the demarcation of healthy and necrotic region (in the healthy region) and deployed. The stapling device discharges four alternating lines of staples and cuts in the middle. In most cases, two to three cartridges are needed. This device also avoids any contamination as it not only seals the healthy side, but also the necrotic portion. Some surgeons may opt to place an inverting over sew (Lembert or Cushing’s suture pattern) with 3-0 polydioxanone suture, however this is not necessary.

Another method of performing a gastrectomy would be sharp dissection of the necrotic segment and closing the open stomach in two layers as one would close a gastrostomy. In many cases the author recommends that the diseased stomach be cut partly and carmalt forceps placed on the necrotic portion to decrease contamination. The cut portion is hand sewn and then more is cut and sewn until the disease portion is removed. The Carmalt can also be used to retract the stomach. This is a very effective technique and the author typically uses 3-0 polydioxanone suture.

The last technique for gastrectomy is the invaginating technique. This is where the necrotic portion of the stomach is inverted into the stomach and the healthy portion of the stomach is closed over
top, allowing the stomach to self-digest. While this has been described in older texts, the author does not recommend this method as it can cause gastro-intestinal complications and in some more recent research papers, this method can yield inconsistent results.

The rest of the abdomen should be assessed, in particular the spleen. It is not uncommon for the surgeon to encounter a mild to moderate hemoabdomen due to the tearing of the short gastric vessels. It is important to assess the blood flow to the spleen both from the tearing of the short gastric vessels and potential occlusion of splenic vessels and thrombosis to the splenic vasculature. If this is compromised, a splenectomy may be needed. The procedure for a splenectomy has been detailed in previous lecture notes.

The last part of the procedure for a GDV is the prophylactic gastropexy. This, without a doubt, needs to be performed to dramatically reduce the risk of this occurring in the future. The incisional gastropexy is the simplest technique and is very effective, rivaling the success of the other gastropexy techniques. The pyloric antrum region is attached to the adjacent body wall. The serosal layer of the stomach is incised creating an incision about 3-6cm in length (not full thickness – only through the seromuscular layer) and a corresponding incision is made through the innermost peritoneal muscle layer. The “fish-mouthed” incisions are apposed using polydioxanone sutures (2-0 to 0 size) in two separate, simple continuous suture lines. It is important to perform the cranial-most incision first and then the caudal-most incision. Another key point is to perform this just caudal (or inclusive of) to the 13th rib. Cranial to this may place the gastropexy into the diaphragm muscle in some deep chested dogs.

Post-operative Management and Prognosis

Post-operative care should be directed at the particular patient needs. Continued fluid support is generally needed, as these patients are typically still hypovolemic to some extent. Continuous ECG should be used for 24-48 hours to assess for cardiac arrhythmias which can develop (if not already present). The use of anti-emetic and gastro-protectant medications should also be considered. In patients where stomach necrosis and/or splenectomy are performed, additional critical care measures should be considered, as they have the potential for more severe complications. It has been shown in recent peer-reviewed literature that both splenectomy and gastrectomy are negative prognostic indicators for patients suffering from GDV. The accepted rate of survival following surgery is 80-85%, however this percentage decreases in cases that have gastric necrosis and severe splenic trauma/injury requiring a splenectomy.

In conclusion, gastric dilatation and volvulus is a condition that is very prevalent in our large and giant breed dogs. The patient affected by this disease process can have a myriad of signs varying in presentation. It is important to manage these patients aggressively and quickly as soon as the diagnosis is suspected and then confirmed. Surgical success is largely dependent on the patient’s pre-operative stabilization and all attempts should be made to lessen their anesthetic risks. Surgery is required in these patients and in many cases the amount of gastric and splenic complications is directly related to time in this condition. It is very important that the surgeon fully assesses the abdominal organs and a gastropexy performed. While many patients suffering with a GDV can have a good outcome, there is still a reasonable complication rate with a reasonably high mortality rate that owners must be made aware of when faced this this type on decision.

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