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# Gastric dilatation and volvulus. Part 2: Intra- and post-operative patient care

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**ABSTRACT:** This is the second of a two-part series of articles, the first part dealt with diagnosis and patient stabilisation. This article discusses intra- and post-operative care, including anaesthesia, the surgery itself and post-operative management.

## Introduction

Gastric dilatation (GD) involves the abnormal accumulation of fluid and/or air within the stomach. It may occur in isolation or be associated with volvulus of the stomach: this is referred to as gastric dilatation and volvulus (GDV) and it is an acute, life-threatening syndrome.

## Anaesthesia

Patients with GDV are often anaesthetised to protect the airway during orogastric intubation to decompress the stomach. Fluids should be given at the same time to support vascular volume.

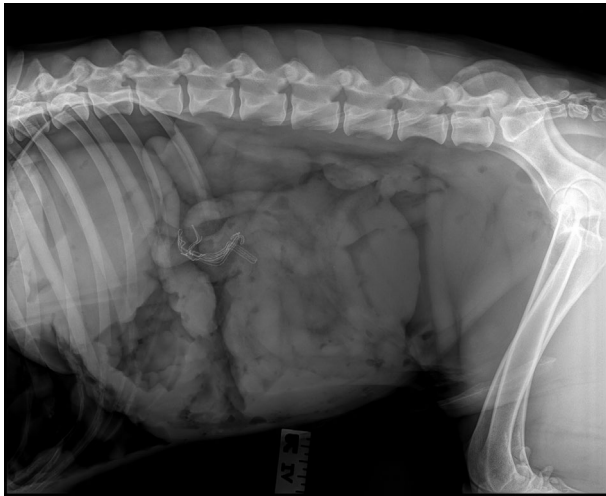
Opioids – for example, methadone or fentanyl – can be used alone or in combination with a benzodiazepine such as midazolam or diazepam for sedation and pre-anaesthetic medication. In compromised patients, lower drug doses can be used to good effect. If these drugs are administered intravenously, they should be given slowly and to effect, particularly with potent, rapid-acting opioids such as fentanyl. Acepromazine and alpha-2 agonists such as medetomidine/dexmedetomidine are generally avoided as sedatives and for pre-anaesthetic medications due to their potentially profound effects on both the cardiovascular and respiratory systems.

It is essential that patients with GDV are closely monitored in the peri-operative period and, if available, multi-parameter monitors are recommended. Multiparameter monitors are used to measure the following:

- Heart rate
- Pulse rate and quality
- Mucous membrane colour
- Blood pressure (direct/indirect)
- Electrocardiography (ECG) trace
- Oxygen saturation (SpO<sub>2</sub>)
- Core temperature
- End tidal carbon dioxide (useful to monitor ventilation in the anaesthetised patient)

Recording these physiological variables allows the patient's response to treatment to be assessed over time, as well as providing an accurate record of the anaesthetic period.

An ECG allows detection of cardiac arrhythmias such as those associated with myocardial ischaemia secondary to hypoperfusion. These arrhythmias are usually, but not always, present in the form of ventricular premature complexes (VPCs) or ventricular tachycardia. Ventricular premature contractions only require therapeutic intervention if they



▣ **Figure 1.** This lateral abdominal radiograph shows two retained surgical swabs that could not be accounted for at the end of surgery for GDV and gastropexy. Note also the presence of pneumothorax following inadvertent penetration of the pleural space during incisional gastropexy. Credit: © Elizabeth M. Welsh

affect cardiac output directly or if there is evidence of a malignant ventricular rhythm – for example, the R-on-T phenomenon, where VPCs are superimposed on the T-wave of the preceding beat, or if ventricular tachycardia is present.

Lidocaine is the preferred anti-arrhythmic and can be administered as an initial intravenous (IV) bolus dose prior to starting a constant rate infusion (CRI) of the drug – this is necessary because of its short duration of action. A recent study reported that early treatment of patients with GDV using an IV lidocaine bolus, followed by a CRI of lidocaine for 24 h, decreased the incidence of cardiac arrhythmias, acute kidney injury (AKI) and hospitalisation time significantly, in comparison to untreated historical control patients (Bruchim et al., 2012).

Patients should be pre-oxygenated prior to induction of anaesthesia using flow-by oxygen or a facemask for a period of 3–5 min, if they will tolerate it. Patients with GDV have reduced functional residual capacity and if they become apnoeic at the time of induction of anaesthesia, pre-oxygenation in this way can prolong the period of time before critical hypoxia develops.

Due to the severity of gastric distension, there is a high risk of peri-operative regurgitation, and suction equipment should be prepared and available at all times to minimise the risk of aspiration. Endotracheal tubes should be cuffed. Omeprazole can be used prior to induction to minimise the

risk of oesophagitis if regurgitation orogastro-oesophageal reflux occurs (Donnelly & Lewis, 2015). Omeprazole is a proton-pump inhibitor and acts to decrease gastric acid production.

Propofol and alfaxalone are suitable induction agents, although orotracheal intubation may be possible in compromised patients following slow IV injection of fentanyl and a benzodiazepine alone. Anaesthesia can be maintained using isoflurane or sevoflurane, delivered in oxygen via an appropriate breathing system. Nitrous oxide should be avoided due to its potential to diffuse into gas-occupied spaces, potentially exacerbating gastric distension (Dugdale 2010).

Non-steroidal anti-inflammatory drugs (NSAIDs) should be avoided due to their gastrointestinal side effects and their potential to decrease renal perfusion in hypovolaemic patients, leading to AKI.

## Surgery

The aims of surgery are:

1. Gastric decompression and derotation
2. Assessment of gastric and splenic viability and removal of compromised tissue
3. Completion of a gastropexy to prevent subsequent volvulus

Once positioned in dorsal recumbency, the patient is clipped from xyphoid to pubis and the site aseptically prepared for surgery. Intravenous broad-spectrum antibiotics such as amoxicillin–clavulanic acid should be administered IV prior to the first incision and repeated at 90-min intervals intra-operatively (Radlinsky & Fossum, 2013).

The risk of retained foreign objects such as swabs and instruments is increased during emergency procedures and where there is a change in surgical plan during the procedure – if, for example, the need for gastrotomy, gastrectomy or splenectomy arises. Consequently, it is essential that time is taken to perform and record a surgical swab count prior to starting surgery and again at the end of the procedure. It is also useful to record any swabs “packed” into the abdomen, to control haemorrhage or minimise contamination of the abdomen and to

document when they have been removed. The use of surgical swabs with radio-opaque markers is essential as, should the swab count be incomplete, the patient can then be radiographed to confirm if any swabs have been left in the abdomen (**Figure 1**).

## Surgical equipment for exploratory laparotomy in cases of GDV

Surgical equipment: sterile

- Standard surgical kit for abdominal procedures
- Additional haemostats, e.g. Kelly, Carmalt
- A traumatic bowel clamp, e.g. Doyen or Allen
- Self-retaining abdominal retractors, e.g. Balfour; Gosset
- Babcock forceps
- ± Re-usable suction tip, e.g. Poole
- Kidney dish or bowl

Surgical equipment: non-sterile

- Suction machine and canisters
- Orogastic tube
- Lubricant
- Bowl to collect gastric fluid

Sterile surgical consumables

- Waterproof drapes
- Scalpel blades: No. 10 or 15 depending on surgeon preference
- Large-gauge needle/catheter
- Surgical swabs with radio-opaque marker
- Laparotomy swabs with radio-opaque marker
- Bulb syringe
- Suture material ± skin staples
- Suction tubing (± disposable suction tip, e.g. Poole; Yankauer)
- Warm sterile saline lavage fluid
- Wound dressing materials

Additional surgical instruments and consumables

- Electrosurgical equipment, e.g. monopolar or bipolar electrocautery
- Vascular clips and applicators
- Surgical stapling equipment, e.g. thoracoabdominal staplers; gastrointestinal anastomosis or intestinal anastomosis staplers

### 1. Gastric decompression and derotation

A ventral midline incision is made from xyphoid to pubis to allow a full abdominal exploration. It is important to bear in mind that dilated or engorged viscera may be located just below the surgical incision and therefore the surgeon must take care not to cause inadvertently any visceral damage at this stage. The stomach is most commonly rotated in a clockwise direction and in this case the greater omentum will overlie the stomach.

It is advisable to try to decompress the stomach fully before attempting to reposition it. In some cases it may be possible to pass an orogastric tube and if not, a large-bore needle (14–16 G), attached to appropriate sterile suction tubing, can be used.

As previously mentioned, the stomach most commonly rotates in a clockwise direction. It follows that the pylorus will be located on the left-hand side of the body rather than in its usual position on the right. Therefore, to reposition the stomach, it must be rotated counter-clockwise. Standing on the right side of the dog, the surgeon grasps the pylorus with the right hand, placing the left hand on the body of the stomach. The body of the stomach is then pushed down towards the surgical table while the pylorus is simultaneously elevated towards the incision site. With gentle manipulation, the stomach should return to its correct anatomical location. This can be confirmed by palpating the intra-abdominal oesophagus to ensure the stomach is now completely derotated and lying in the correct position.

Once the torsion is corrected, the surgeon can empty the gastric lumen of its contents. This is preferably achieved by passing an orogastric tube into the stomach, if this has not already been done. Warm saline is then introduced by means of a funnel and the stomach thoroughly lavaged until it is empty. In some circumstances, a gastrotomy is performed and in this case it is essential to limit the risk of spillage of gastric contents into the abdomen. The use of at least two stay sutures or Babcock forceps to elevate the stomach wall prior to making the gastrotomy incision is useful in this regard. Nevertheless, it is still important to protect the rest of the abdomen by placing moist laparotomy swabs around the stomach to catch any spills. Contaminated swabs are discarded once the gastrotomy incision has been closed.

### 2. Assessment of gastric and splenic viability and removal of compromised tissue

The surgeon can now carry out an assessment of splenic and gastric viability. During GDV the blood vessels supplying the spleen and gastric wall may become avulsed or thrombosed. Therefore, each organ should be assessed carefully to check its viability. Any evidence of gastric necrosis prompts partial gastrectomy or invagination of the affected tissue. In some patients, the location or extent of the necrosis may mean that euthanasia must be recommended.

Splenectomy is indicated in cases where there is splenic torsion or if there are signs of splenic necrosis and/or splenic infarction. Partial or complete splenectomy and/or partial gastrectomy are deemed poor prognostic indicators, with splenectomy noted to bear the greatest influence on post-operative mortality rate (Mackenzie, Barnhart, Kennedy, DeHoff, & Schertel, 2010). Interestingly, it has been proposed that partial gastrectomy is associated with an increased incidence of post-operative complications rather than being directly associated with an increased risk of death (Beck et al., 2006).

### 3. Completion of a gastropexy to prevent subsequent volvulus

A recent paper concluded that the rate of recurrence of GDV without gastropexy can be as high as 80%, whereas, following gastropexy, recurrence is less than 5% (Allen, 2014). Consequently, a gastropexy is indicated in every case of GDV to create a permanent adhesion between the stomach (pyloric antrum) and body wall. Furthermore, prophylactic gastropexy should be recommended in patients that have suffered an episode (or episodes) of gastric dilatation alone, particularly for predisposed breeds.

There are several gastropexy techniques described; however, the incisional gastropexy (IG) is the most commonly documented. An IG can be performed rapidly with fewer technical challenges and fewer post-operative complications in comparison to other techniques (Benitez, Schmiedt, Radlinsky, & Cornell, 2013). It involves making a 4–7 cm incision in the seromuscular layer of the stomach at the level of the pyloric antrum, parallel to the long axis of the stomach, taking care not to enter the lumen. A similar incision is made through the peritoneum and fascia of the *transversus abdominus* muscle on the right ventrolateral abdominal wall, parallel to the direction of the muscle fibre.

The incisions are sutured together using a monofilament absorbable or non-absorbable suture material. Some surgeons find this procedure easier with the aid of an assistant.

At the end of the procedure, the abdomen is lavaged, if required, using warm sterile saline and the fluid suctioned from the surgical site, a swab count is performed (see above) and the abdomen closed routinely. The surgical wound should be covered using a non-adherent dressing such as Primapore™ to protect it from soiling and to minimise patient interference while the patient remains hospitalised, or until such time as the wound has sealed.

Mortality is markedly reduced in patients with GD where a prophylactic gastropexy has been previously performed (Rawlings, Mahaffey, Bement, & Canalis, 2002) and this procedure may be offered as a routine preventative procedure in predisposed breeds (Bell, 2014). It may be performed either as an open, laparoscopic or laparoscopic-assisted procedure (**Figures 2a and 2b**) and carried out in conjunction with neutering in bitches.

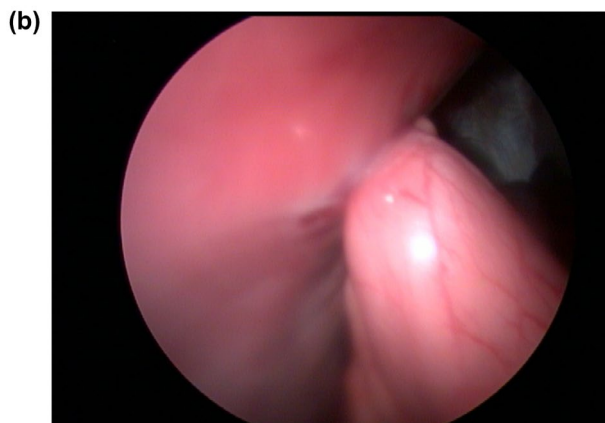
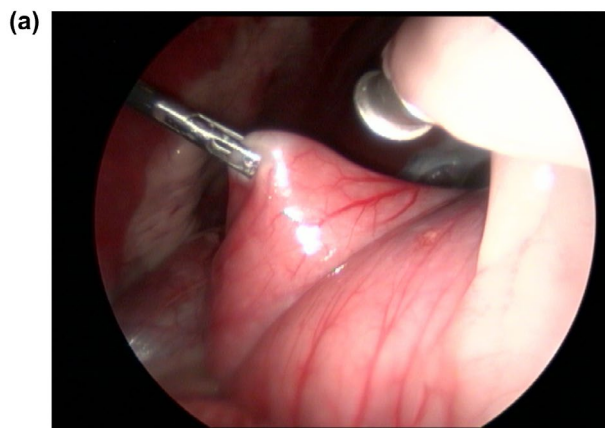
## Post-operative management

Management of patients following GDV in the post-operative period is heavily focused on maintaining cardiac output and subsequently, tissue perfusion.

### Ischemia-reperfusion injury

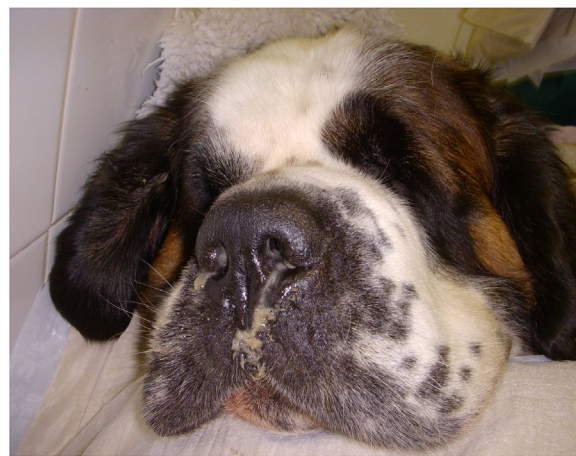
The patient should be closely monitored for evidence of ischaemia-reperfusion injury (IRI). This is defined as the production of damaging reactive oxygen molecules following restoration of blood flow to previously oxygen-deprived ischaemic tissues. These harmful molecules can lead to cell injury and potentially cell death (Bruchim & Kelmer, 2014). Reperfusion injury may ultimately result in end-organ damage and multi-organ dysfunction syndrome. Clinical signs of IRI include (McMichael & Moore, 2004):

- Refractory hypotension,
- Cardiac arrhythmias,
- AKI, gastric ulceration,
- Disseminated intravascular coagulation,
- Electrolyte imbalances
- Excessive abdominal pain



▣ **Figures 2a and 2b.** During laparoscopic-assisted gastropexy, the pyloric antrum is grasped (a) and secured to the right body wall (b)

Credit: © Elizabeth M. Welsh.



▣ **Figure 3.** This patient suffered from regurgitation of gastric contents on recovery from anaesthesia; although the dog did not aspirate the fluid, it resulted in nasal reflux of the regurgitated fluid and rhinitis

Credit: © Elizabeth M. Welsh.

**Pain**

It is important to consider pain management when monitoring patients following GDV. Opioids such as methadone may be used to provide analgesia following surgery. However, opioids can contribute to gastric stasis (GS) and ileus, both of which will prolong recovery after surgery.

**Abdominal girth**

Measurement of the abdominal girth should be performed immediately post-operatively. This measurement can be repeated periodically to allow for early detection and management of recurrent post-operative gastric dilatation.

To reduce these effects, opioids may be combined in a CRI with lidocaine, either in isolation or in combination with ketamine. It is important to avoid NSAIDs due to their negative effects on both the gastrointestinal tract and the kidneys. In dogs, intravenous paracetamol may be used as an adjunctive analgesic.

**Fluid therapy**

Intravenous fluid therapy should be titrated based on serial assessment of perfusion and the cardiovascular status of the patient (Davis et al., 2013). Peripheral limb oedema is a late sign of over-perfusion and should be brought to the attention of the attending veterinary surgeon as soon as it is noted. Fluids may be supplemented with potassium if required and should be continued until the animal is eating, drinking and passing urine.

Hypotension at any time during GDV management is closely correlated with increased mortality (Beck et al., 2006).

**Blood analysis**

Assessment of packed cell volume and total solids (PCV/TS), blood gas analysis, electrolytes, creatinine and urine output should be performed every 12–24 h, based on the clinical assessment of the patient. Plasma lactate levels are a useful measurement of response to treatment, with an absolute decrease in plasma lactate greater than 40% correlated with increased survival in patients with GDV (Mooney, Raw, & Hughes, 2014).

**Vomiting and regurgitation**

Patients are at high risk of post-operative vomiting and regurgitation. This can lead to aspiration pneumonia, which can increase morbidity and mortality during recovery (Figure 3).

Suction should be prepared and available at all times while the patient is in recovery. Post-operative GS and ileus can cause nausea, resulting in anorexia or hyporexia and, of course, can also cause vomiting and regurgitation. In patients where GS and/or ileus is suspected, it is important to rule out other factors that may be contributing to the problem. These can include:

- Electrolyte abnormalities
- Acid–base disturbances
- Hypothermia
- Narcotisation

The use of anti-emetics and pro-kinetics, for example maropitant, metoclopramide and ranitidine, may help to control the severity of the problem. In some patients, an indwelling nasogastric tube to suction excess gastric fluid from the stomach may need to be used. While an early return to enteral nutrition helps to reduce the risk of GS and ileus, this may not be possible initially, although in those patients with a nasogastric tube, micro-enteral nutrition may be started (Corbee & Kerkhoven, 2014).

**Abdominal ultrasound**

Ultrasound can be used to allow the early detection of free abdominal fluid. If effusion is present, ultrasound-guided abdominocentesis can be used to obtain fluid for fluid analysis and cytology. The presence of intracellular bacteria and high numbers of degenerate neutrophils should raise the suspicion of gastric necrosis and subsequent sepsis. Elevated lactate in the abdominal fluid is also an important early indicator of gastric necrosis (Zacher, Berg, Shaw, & Kudej, 2010).

**Patient comfort**

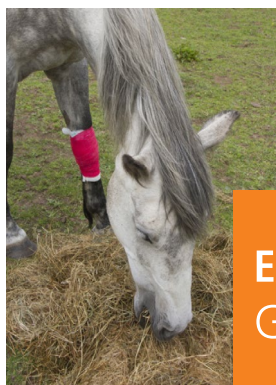
Every effort should be made to reduce stress and improve comfort while the patient is convalescing. Soft mattresses combined with thick, absorbent bedding can be used for this purpose and should be checked regularly and changed as required. It is advisable to turn recumbent patients regularly to reduce the risk of decubital pressure sores and increase their overall level of comfort.

## Conclusion

Gastric dilatation and volvulus is an acute, life-threatening condition. Early diagnosis and effective patient stabilisation combined with appropriate surgical intervention and post-operative care are essential to achieving a successful outcome for these critical patients.

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