ACHIEVING SUCCESS WITH GASTROINTESTINAL SURGICAL EMERGENCIES

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The animal with a true surgical gastrointestinal emergency requires a rapid but thorough physical examination and concurrent cardiovascular stabilization and correction of electrolyte and acid-base disturbances. Knowledge and experience with appropriate perioperative monitoring combined with a healthy suspicion for potential complications associated with gastrointestinal surgery is essential for a positive outcome. This lecture will discuss techniques used to help avoid common complications associated with gastrointestinal surgery.

When to Cut?

In patients with a high gastrointestinal obstruction (complete pyloric or proximal duodenal), gastric volvulus, gastrointestinal perforation, strangulation, torsion, or penetrating abdominal wounds, immediate surgical preparation, intervention, and cardiovascular stabilization are instituted simultaneously. If an obstruction is thought to be in the lower portion of the small intestine or if a partial obstruction is suspected, surgery can usually be delayed for a short period of time to correct fluid deficits, acid-base abnormalities, and any electrolyte derangements. Surgery should be performed within hours of diagnosis in all cases.

Preoperative Planning

Hypovolemia should be corrected prior to induction of anesthesia. Vascular access should be adequate for the concurrent delivery of blood products, anesthetic agents, crystalloid and/or colloid fluids, and for sampling arterial and venous blood. A minimum of two peripheral IV catheters should be placed and if the patient is in shock or septic, a central venous catheter (measurement of central venous pressure and rapid administration of fluids, blood products, and drugs) and arterial catheter (direct arterial pressure measurements) should be considered. A urinary catheter is useful for measurements of urinary output.

Rapid fluid administration may be necessary to restore and maintain cardiac output and adequate tissue perfusion during anesthesia and surgery. As a rule, 10 ml/kg/hour of an appropriate crystalloid should be administered during surgery (unless cardiac failure or renal failure is evident). Oncotic support or blood products may be indicated in critical cases. Some anesthetists will premedicate with atropine or glycopyrrolate to counter the potential vagal effects of gastrointestinal disease, distention, and surgery.

Easily Avoidable Complications

Complications of emergency gastrointestinal surgery can be fatal. They are easily avoidable if the surgeon has a thorough understanding of anatomy and physiology. The best way to deal with complications is to avoid them. Many potential complications can be prevented by adequately preparing your patient for surgery, following some basic principles for gastrointestinal surgery, recognizing the high-risk patient, and appreciating and understanding the consequences of gastrointestinal surgical complications.

1. **Restore electrolyte and fluid imbalances**

2. **Keep the patient warm**

3. **Appropriate use of antibiotics**

In most cases of abdominal surgery where a hollow organ is entered, prophylactic antibiotics are indicated. In the absence of septic peritonitis, a first-generation cephalosporin is commonly used for gastric and small intestinal surgery, administered as a slow intravenous bolus around induction. The dose is repeated every 2 hours until the end of surgery. If evidence of an infection is present, this broad-spectrum therapy should be continued into the post-operative period, until the results of culture and sensitivity provide an effective choice of antibiotic. A second-generation cephalosporin (such as cefoxitin) is preferred for the colon or rectal procedures. If good surgical principles are adhered to and no major spillage occurs intraoperatively, then there is no need for postoperative antibiotic use.

4. **Appropriate preparation of the patient**

A large clip and prep area is mandatory for gastrointestinal surgery. A complete abdominal exploratory should always be performed in these patients. The number one cause of surgical complications is "cutting corners". Most often, this is from making too small of an incision and not performing a full abdominal exploratory.

5. **Surgical technique/instrumentation/suture materials**

Always handle bowel gently. Excessive handling and drying of the intestines may result in a vagal response and postoperative ileus. The abdominal contents should be kept moistened with warm, sterile saline at all times, as they have a tendency to dry out under the intense heat of overhead surgical lights. Fingers are excellent for examining the intestines and occluding the bowel lumen. Correctly placed Doyen forceps can also be used to occlude lumen; however, they can also cause severe crushing injury if used inappropriately. Hemorrhage from vessels should be ligated with suture and not burned with electrosurgery. Minimal tension should be imposed on any suture line.

Suture material

A monofilament, absorbable suture material with a consistent, known rate of absorption and minimal reactivity is suitable for use in the small intestine. The smallest diameter suture material on the smallest diameter needle that is appropriate for the size of the patient is used. Polydioxanone and polyglyconate are most commonly used. Non-absorbable monofilament sutures such as polyamide (nylon) and polypropylene are also acceptable. Braided or multifilament suture materials are not good choices as they cause more trauma and tissue drag as they pass through the tissue and may harbor bacteria. Chromic gut is not indicated due to its unpredictable rate of absorption, especially in the presence of inflammation. Gut will also incite a significant inflammatory response. Usually, 4-0 or 5-0 suture material is used when suturing the bowel.

Suture patterns

Single layer, direct apposition of the bowel is preferred for rapid healing and not compromising bowel luminal diameter, rather than an inverting, everting, or double layer suture pattern. In small animals this is true for small and large bowel, but stomach wall is usually sutured in two layers. In small intestinal surgery, accurate apposition is difficult to obtain because of mucosal eversion. There are three recommended methods to limit mucosal eversion, often these techniques are combined:

1. Mucosal trimming
2. Using a modified Gambee interrupted pattern
3. Using a simple continuous suture pattern

"Packing off the Bowel"

The use of large laparotomy sponges is highly recommended. Small gauze squares can easily be left behind in abdomen. All sponges or gauze squares are counted before the abdomen is entered and before the abdomen is closed. Ideally, radiopaque sponges and gauze are used. The area of the bowel that will be opened is thoroughly packed off with sponges. These sponges act to protect the packed off abdomen from contamination in case of inadvertent leakage from a gastrotomy or enterotomy. Using a small amount of heated sterile saline on the sponges helps to keep the bowel warm and hydrated.

Assessment of Gut viability

A decision to resect stomach or bowel requires an accurate assessment of its viability. Subjective criteria for assessing gastrointestinal viability include color, arterial pulsations, peristalsis, and bleeding from a cut edge. Remember, these are subjective measurements. With gastrointestinal surgery "MORE IS BETTER". I would rather have taken a little more out than have to go back to surgery in two days because I didn't take enough. There are some more "objective" measures of gut viability, like; intravenous fluorescein dye injection, Doppler, and pulse oximetry. If you are not sure if it needs to be removed, replace all of the abdominal viscera back into the abdomen in its normal position, fill the abdomen with warm sterile saline and let everything sit for 5 minutes. If you are still unsure, then remove it! Depending on what section of small bowel is being removed, up to 75 - 80% of the small intestines can be resected before permanent short bowel syndrome is seen in dogs and cats. If the pylorus is left intact, a similar percentage of stomach can be removed without permanent adverse effects.

Abdominal lavage and suction

Anywhere from 200-600 mls/kg of warm, sterile saline followed by suctioning before closure is essential following GI surgery. Thorough abdominal lavage will reduce bacteria and debris and warm the patient. It is important to suction as much as the remaining fluid out of the abdomen as fluid prevents neutrophil migration and opsinization of any remaining bacteria. The addition of antibiotics or antiseptics to the final lavage solution has no proven benefit, and can be irritating to serosal surfaces and peritoneum.

6. Post-operative care

Continue to correct any fluid deficits or treat any anticipated post-operative fluid losses. If only the stomach was entered and no major spillage of gastric contents occurred, there is NO need for post-operative antibiotics. FEED THE GUT! The enterocytes need fuel to heal and a majority of this energy

comes in the form of glutamine from the diet. If the patient is vomiting or currently has a contraindication for oral feeding, or if you are suspicious that the patient will not be able to take anything orally, a feeding tube (gastrostomy or jejunostomy) should be placed during surgery.

7. The high-risk patient

Although complications of gastrointestinal surgery can occur in any patient, there are some patients at increased risk of dehiscence, or other complications. Patients with pre-existing peritonitis, hypoproteinemia, diseased bowel, uremia, or endocrinopathies, may not heal as well. These patients will require aggressive pre-operative care and planning as well as aggressive and critical post-operative care. Intestinal suture line augmentation is performed with serosal patching and omental wrapping.

Gastric Dilatation with Gastric Volvulus

Let's assume appropriate cardiovascular stabilization and preoperative gastric decompression has occurred and now its time to surgically address the problem.

Surgical Approach

An incision is made to accommodate complete abdominal exploration and manipulation of any potential abnormal finding. The skin incision begins at the xiphoid and continues caudally to the brim of the pubic bone. If the patient is a male dog, the skin incision is curved just cranial to the prepuce on the side adjacent to the surgeon and is continued as a paramedian skin incision to the brim of the pubis. The preputial vessels will often require double ligation and transaction.

A complete and thorough abdominal exploratory is performed in all patients. In some cases, intra-operative gastric decompression will be required in order to perform a complete exploratory laparotomy.

Intra-operative gastric decompression (orogastric tube or gastrocentesis)

The surgeon should palpate the esophageal hiatus and guide the tube into the stomach as the non-sterile assistant passes the tube via the oral cavity. Once the tube is in the stomach the surgeon should make sure the tube doesn't get pushed in too far and puncture the gastric wall. After the gas and fluid have been removed from the stomach, I will often lavage the stomach a few times with lukewarm or body temperature water via the orogastric tube. If the GDV occurred secondary to a food bloat, this method of decompression is often unsuccessful and a gastrotomy may need to be performed.

If the orogastric tube cannot be passed into the stomach, intra-operative gastrocentesis is performed with a large bore catheter. Sterile suction tubing can be connected to the catheter for rapid evacuation.

Derotation

Gastric decompression via orogastric tube or gastrocentesis is not always necessary prior to derotation. In the typical case, derotation is accomplished by reaching to the left side of the abdomen to grasp the misplaced pylorus (now in the left dorsal quadrant of the abdomen) and pull it ventrally to the right

while pushing on the fundus to move it dorsally and eventually to the left. If derotation is accomplished before decompression, it is advised to decompress via orogastric tube as described above.

Partial Gastrectomy

Visual inspection and surgical judgement remain the mainstay for determining if gastric wall necrosis has occurred secondary to GDV. The decision to resect a portion of stomach is based on gastric color, serosal integrity, and palpation of the underlying tissues. The invagination technique is not recommended as a definitive treatment as full thickness ulceration and septic peritonitis have been reported as a long-term complication. If the patient is unstable and needs to be closed and awakened from anesthesia quickly, the necrotic area of stomach can be invaginated temporarily. A second and definitive surgery is scheduled when the patient is more stable for partial gastric resection. Mortality can be expected if necrotic stomach is not resected. The suture technique for gastric resection will require monofilament suture. The stapling technique will require a GIA or TA 55 or 90 (blue 3.5 mm cartridge or a green 4.8 mm cartridge. Multiple cartridges may be required. The GIA will lay down four staggered rows of staples and cut between them. The TA will lay down two staggered rows of staples but will not cut automatically.

The physical appearance of the mucosa often influences the surgeon to remove more stomach than necessary. Don't be surprised if the entire mucosal surface is dark purple or black. This is not a reason to euthanize a dog on the table as the mucosa will slough and rapidly be replaced. After the tissue to be removed is defined, the supplying vessels to this section are double ligated and transected. Alternately, hemostatic clips or an LDS may be used. The section of stomach is excised using a sharp blade. The remaining cut surfaces should bleed normally. If there is unsatisfactory bleeding, further resection should be done.

Suture closure is similar to routine gastrotomy closure. For the first layer, the mucosa and submucosa are approximated using absorbable monofilament suture in a simple continuous pattern. The second layer is closed using a continuous Cushing/Lembert pattern. When using the staple closure technique, I recommend an oversew of the staple line with a continuous Cushing or Lembert pattern.

Now we need to prevent this from happening in the future. Although I routinely use an incisional gastropexy (personal preference) for prevention of recurrence and as a prophylactic technique, I will perform a tube gastropexy in most partial gastric resection GDV patients. The justifications for this are multiple:

1. Allows for post-operative gastric decompression (prevent regurgitation, aspiration pneumonia, and keep tension off of suture line)
2. Provides a mechanism for enteral nutrition in the critical patient. Feeding via the gastric tube or via a J through G tube (a smaller tube is placed through the G tube and into the stomach, across the pylorus, and into the proximal jejunum). This is useful in cases where the stomach and duodenum need to be bypassed for immediate nutrition.
3. Provides an enteral route for medications that otherwise cannot be given intravenously in the patient that will not tolerate transoral administration.

Abdominal closure is routine. Close the subcutaneous tissue with a continuous intradermal/subcuticular pattern. Suture the skin using the interrupted pattern of your choice or skin staples.

Achieving Success Through Prevention:

Gastropexy techniques should be used to complete a permanent adhesion between the stomach and the body wall. Indications include the prevention of GDV, hiatal hernia recurrence, and to achieve a secure seal for a gastric feeding tube. In order to achieve a permanent adhesion, the incised muscle of the body wall must be in contact with the incised muscle of the stomach. An intact serosa sutured to the body wall will not form a permanent adhesion.

1. Incorporating gastropexy: This is performed by incorporating the ventral body and pyloric antrum in the linea closure. This procedure is fast and prevents GDV but is not recommended. If the abdomen is opened in the future, it is likely that the stomach will perforate as it becomes permanently adhered to the dorsal aspect of the linea.
2. Tube gastropexy (tube gastrostomy): This is a great technique for preventing GDV, allowing for gastric decompression post-operatively, and provides an easy and well-tolerated mechanism for enteral feeding assist regimens. I choose this method of gastropexy in patients that require gastric resection or in patients with concurrent esophageal disease or dysfunction. Tubes can be removed within 10 days or maintained for months to years. Pezzer tubes (mushroom tip) work great for tube gastrostomy. The balloon on Foley catheters will not hold their seal long term as gastric acid will erode through the balloon.
3. Circumcostal gastropexy: This is likely the most secure technique but is the most challenging to perform. A seromuscular flap is created on the stomach at the pyloric antrum with the base of the flap at the lesser curvature. The twelfth rib is carefully dissected over 5-6 cm centered at the costochondral junction. Care is taken not to damage or penetrate the fibers of the diaphragm at this level causing a pneumothorax. The free edge of the gastric flap is advanced around the dissected circumference of the rib and sutured back down to the original flap bed on the stomach.
4. Incisional gastropexy: Probably the most commonly performed gastropexy. A seromuscular incision is made in the pyloric antrum parallel with the long axis of the stomach and situated half way between the greater and lesser curvature. A second incision is made in the lateral abdominal wall, through the peritoneum and the fascia of the transverse abdominus muscle. The incision can be made parallel or perpendicular to the twelfth or thirteenth rib. The author has seen two cases of gastric dilatation torsion (GDT) where the stomach twisted along the axis of the pexy site. Both of these cases had short (in length) incisional gastropexies with the abdominal wall incision perpendicular to the ribs. The cranial margin is sutured first from dorsal to ventral and then the caudal margin of the incision is sutured from dorsal to ventral.
5. Belt loop gastropexy: Technically simple and forms good permanent adhesions. A single pedicle flap is created in the stomach as described for circumcostal gastropexy. Two transverse incisions are made in the ventral and lateral abdominal wall and musculature. These incisions should be about 2.5 cm apart and 4-5 cm long. A tunnel is created under the bipedicle flap made in the abdominal wall and the single pedicle flap of the stomach is passed through the tunnel and then sutured back its site of origin on the stomach. Some surgeons place extra sutures between the body wall and the stomach to relieve initial tension on the suture line of the pexy site.
6. Gastrocolopexy: The greater curvature is sutured to the transverse colon. This technique is associated with a high recurrence rate of GDV and is not recommended for the prevention of GDV.

7. Laparoscopic and laparoscopic-assisted gastropexy: Both techniques involve a modification of the incisional gastropexy and involve the development of permanent adhesions between the stomach and the body wall.
8. Grid approach incisional gastropexy: Another modified incisional gastropexy that is performed in left lateral recumbencey. This is a prophylactic technique and not one that is used to explore the abdomen or derotate the stomach in dogs with GDV.
9. Flexible endoscopic assisted grid approach: A recently described technique that combines flexible gastroscopy with a grid approach. Again, this is a prophylactic technique but does provide a permanent adhesion between the body wall and the stomach.

References available from the author