PRINCIPLES OF INTESTINAL SURGERY

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The best way to deal with complications is to avoid them. With gastrointestinal surgery, many potential post-operative crises can be avoided by adequately preparing your patient for surgery, adhering to basic intestinal surgery principles, and recognizing the high-risk patient beforehand.

1. Preparing your patient

When to operate? For lower or partial obstructions, surgery can usually be delayed for a few hours allowing time for fluid, acid-base and electrolyte corrections. Nevertheless, surgery should be performed within 12 hours of diagnosis. For complete gastric outflow obstruction, proximal intestinal obstruction, displacement, intestinal perforation, strangulation, or penetrating abdominal wounds, immediate surgical intervention is indicated and cardiovascular restorative therapy instituted simultaneously.

Fluid therapy Many patients requiring gastrointestinal surgery are dehydrated and often have acid-base and electrolyte disorders. Instigation of intravenous rehydration with a buffered saline solution is of paramount importance before surgery. Correction of acid-base and electrolyte imbalances are addressed if they are severe. The hypotension associated with anesthesia, as well as evaporation from the open abdomen and the anesthesia circuit will compound the fluid deficit, so aggressive fluid therapy is generally continued throughout surgery and into the post-operative period. 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 with colloids and/or blood products may be indicated in critical cases.

Fasting Fasting the patient before surgery is recommended - it will decrease the incidence of gastroesophageal reflux, decrease ingesta volume in the intestinal tract, and will also decrease bacterial numbers. A 12-hour fast is normal for adult patients, and a 6-hour fast for pediatric patients (measuring blood glucose before anesthesia). Of course, many intestinal surgery patients are vomiting and are effectively fasted upon presentation to the clinic.

Anesthesia and monitoring Most careful anesthetic protocols are suitable for small intestinal surgery. Some anesthetists will premedicate with atropine or glycopyrrolate to counter vagal effects of handling the bowel. If there is evidence of gas-filled loops of bowel, or free gas in the abdomen, then nitrous oxide should be avoided. Critical cases will require more intensive monitoring under anesthesia and into the post-operative period, such as urinary catheterization, triple lumen central line, and arterial line.

2. Intestinal surgery principles

Keeping patient warm Hypothermia is a huge concern with any open cavity surgery. Circulating water heating blankets should be routinely used, and other safe forms of warming (e.g., warm air huggers, warmed intravenous fluids) are warranted in smaller dogs and cats. It is desirable to keep core temperatures above 35 degrees Celsius.

Antibiotic prophylaxis / antibiotic therapy In most cases of abdominal surgery where a hollow organ is entered, prophylactic antibiotics are indicated. 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 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. In cases of gross contamination, an exit culture may be warranted.

Instrumentation Appropriate instrumentation greatly facilitates surgery of the gastrointestinal tract:
• Self-retaining abdominal retractors (such as Balfours, Gossets, or Nelsons) are essential.
• Hand-held retractors to expose deeper structures (e.g., malleable, Faraboeufs, Army-Navy).
• Doyen non-crushing intestinal forceps are useful for occluding the lumen of the bowel without compromising perfusion of the bowel wall.
• Suction connected to continuous regulated suction is also a great asset in surgery. A Poole suction tip is preferred when draining abdominal fluid, while Yankeur and Frasier tips will facilitate finer procedures.
• Metzenbaum scissors and Babcock forceps, should routinely be included in the surgery pack.
• Fine, multitoothed forceps such as Debakey or Cooley are the least traumatic for handling bowel edges - avoid large toothed forceps.
• Intestinal stapling equipment, automatic ligating staplers are quick, fun and secure. Moderately expensive.
• Ceiling-mounted, double-lighting system is invaluable. Fully mobile articulated arms are preferred, or track mounted.

**Assistance** Surgical assistance is a great asset and facilitates many gastrointestinal procedures. Having an assistant scrubbed-in will enable enhanced exposure due to accurate retraction, improved apposition of bowel ends, decreased contamination and shorter surgical times.

**Sponges** The use of large laparotomy sponges is highly recommended, rather than traditional small gauze squares. Moistening the sponges in sterile saline renders them less abrasive to the delicate tissues within the abdomen. If smaller sponges are used, they should have a radio-opaque stripe. Sponges should always be counted before opening the abdomen and the sponge count reconciled before closure of the abdomen.

**Surgical technique** Always handle bowel gently. Excessive handling and drying of the intestines can cause a vagal response and postoperative ileus; the serosa also becomes irritated and inflamed. Keep the abdominal contents moistened with warm, sterile saline at all times, as they have a tendency to dry out under the operating room lights. Hands are excellent for examining the intestines and occluding the bowel lumen. Correctly placed Doyen forceps can also be used to occlude lumen, if used carefully, watching where the tips of the forceps are. Electrocautery should not be used on the bowel wall – haemorrhage from transected or incised bowel will soon clot with gentle pressure from moistened gauze. Likewise, bleeding from vasa recti or arcuate vessels should be attenuated with fine ligatures of 5-0 monofilament suture, not electrocautery. When suturing bowel, use a simple interrupted or continuous suture pattern, quite snug. The tension on the suture line in an intestinal anastomosis should be minimal.

**Assessment of intestinal viability** A decision to resect bowel requires an accurate assessment of its viability. The standard subjective criteria for viable intestine are, colour, arterial pulsations, peristalsis and bleeding from a cut edge. The bowel should be moistened and warm when assessing these characteristics. These are not all completely accurate, but it is advisable to err in favor of resecting too much, rather than leaving non-viable bowel behind. Other tests of perfusion used clinically include intravenous fluorescein dye injection, Doppler ultrasonic flow probes and pulse oximetry. If viability is questionable, resection is the prudent choice. Around 75 - 80% of the small intestines can be resected before permanent short bowel syndrome is seen.

**“Packing off”** Following initial exploration of the abdomen, the affected area of bowel should be isolated and packed off from the remaining abdominal contents. Four (or more) large laparotomy sponges moistened with warmed sterile saline are placed around the affected area. These sponges act to protect the packed off abdomen from contamination in case of inadvertent leakage from an enterotomy or enterectomy site; they will also keep abdominal contents moistened and decrease heat loss. By using a double top layer of exclusion draping, the top sponge can be whisked away if spillage occurs, minimising further contamination.

**Stay sutures** Stay sutures are loops of suture material passed through the bowel wall, and held with forceps. They are atraumatic and can be used to provide traction and reposition the bowel as needed. Stay sutures are removed by snipping one end of the suture close to the bowel, so that drag through the tissues is minimized.

**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. Polydioxanone and
Polyglyconate are most commonly used. Non-absorbable monofilament sutures such as nylon, polypropylene and polybutester are also suitable choices. Braided sutures are not recommended – they harbour bacteria from the intestinal lumen and they also cause more trauma as they pass through the tissue. 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. A fine suture material is always indicated, usually 4-0 or 5-0, and occasionally 3-0 in size.

**Suture patterns** Single layer, direct apposition of the bowel is preferred for rapid healing, rather than an inverting, everting or two-layered suture pattern. This is true for small and large bowel, but stomach wall is usually sutured in two layers – a simple continuous full thickness layer, followed by an inverting layer in the serosa and muscularis. Gastrointestinal sutures need to be tied snugly. Accurate apposition is difficult to obtain, due to the tendency for the redundant mucosa to bulge outward from the lumen. Mucosal eversion can be minimized by trimming the mucosa before suturing, modifying the bite to a modified Gambee bite, and also using a simple continuous pattern.

**Abdominal lavage and suction** Copious quantities of warm, sterile saline followed by suctioning before closure is essential following GI surgery. Thorough abdominal lavage will reduce contaminating bacteria and debris, removes residual blood, warms the abdomen, moistens all organs and enables a final check of the cavity. Obviously, water-impermeable barrier draping should be consistently used as part of the draping protocol. The addition of antibiotics or antiseptics to the final lavage solution has no proven benefit, and can be irritating to serosal surfaces.

**Checklists** It has been well documented in human surgery that complications are decreased by adherence to checklists. Checklists should be mandatory in large, busy hospital settings, and are even useful in smaller clinics. Checklists will ensure that the correct patient is in the Operating Room, the procedure is appropriate to that patient, informed consent has been granted by the owner, and costs have been discussed. They will also confirm that antibiotics have been given when indicated, what tissues are submitted for histopathology and other laboratory testing. The checklist should be read out before the procedure and following the procedure.

**3. Recognizing the high-risk patient**

Although complications of gastrointestinal surgery can occur in any patient, there are some patients at increased risk. Patients with pre-existing peritonitis, hypoproteinemiam, uraemia, hyperadrenocorticism, immunosuppressed state, advanced liver disease, negative nitrogen balance, coagulopathies, septic, etc, may not heal as quickly or effectively, and carry a greater risk of dehiscence. These patients should be aggressively prepared for surgery and may require intensive post-operative care. Intestinal suture lines should be augmented with a serosal overlay or an omental wrap, thus bringing in blood supply, a source of macrophages and mesothelial cells to the sutured area. High-risk patients should be considered for feeding tube placement before leaving the abdomen. The abdominal wall closure needs to be secure and long lasting in these cases. An interrupted or continuous, carefully spaced linea closure with a monofilament (slowly absorbable or nonabsorbable) suture should be placed. Subcutaneous and skin layer should follow.