General Principles of Small Intestinal Surgery

**Fluid Therapy:** Small intestinal obstruction or ileus results in significant secretion of fluid into the intestinal lumen with resultant decrease in absorption of intraluminal fluid and electrolytes. This leads to decreased intravascular volume and dehydration. If left untreated, your patient may develop hypovolemic shock. Mechanical obstruction of the intestine can result in hypokalemia, hyponatremia, and hypochloremia. These losses can lead to metabolic acidosis. High intestinal obstruction causes excessive loss of gastric hydrochloride due to persistent vomiting and may result in metabolic alkalosis.

Treatment of hypovolemia consists of intravenous fluid infusion with balanced electrolyte solutions and correction of acid/base abnormalities. Crystalloid solutions are most commonly used to correct imbalances. Type and amount depends on the individual case. Additional potassium supplementation is generally necessary, however it should not exceed 0.5 mEq/kg/hr. Therefore, it should not be used when fluids are given as a large bolus. Colloid solutions can be given during the fluid resuscitation period. These solutions are particularly useful if colloid oncotic pressure is decreased or edema is present. Both crystalloids and colloids increase intestinal blood flow and systemic blood pressure, but colloids may have longer lasting effects.

Fluid therapy during surgery includes replacement of losses that have already occurred and those that occur during the surgical procedure. Surgical losses result from tissue damage during the surgical procedure and from evaporative losses, which are rather significant during open cavity procedures. Sequestration and third-space fluid accumulation also plays a role.

Each patient’s needs must be frequently reassessed after surgery. Electrolyte, acid/base status and hydration should be evaluated to accurately tailor each patient’s protocol.

**Assessment of Intestinal Viability:** Compromised bowel is difficult to evaluate. Complete obstruction of the small intestine can make the serosa dark red to black in color and the tissue may still remain viable. Once the obstruction is removed, the tissue may return to a more normal color. Criteria for establishing intestinal viability are the three P’s. These include color (pink), arterial pulsation (pulse) and the presence of peristaltic movement of the intestine (peristalsis). Peristalsis has been shown to be the most dependable indicator of intestinal viability.

Fluorescein dye has also been used to assess viability. It appears golden-green when exposed to ultraviolet light. After intravenous injection at a dose of 10-15 mg/kg a homogeneous golden-green pattern of fluorescence is seen in viable intestine. Nonviable intestine appear patchy with areas of non-fluorescence of greater than 3mm, which is indicative of loss of vascularity.

**Suture Material and Needle Selection:** The wide variety of materials available can make suture selection confusing. Multifilament suture material has been used successfully in intestinal surgery, however they have the disadvantage of increased tissue drag, and the possibility of potentiating infection in the face of contamination. The interstices between the filaments make it
difficult for leukocytes to migrate, resulting in areas for bacterial multiplication. Monofilament suture material should be chosen since they result in minimal tissue drag and are less susceptible to bacterial adhesion. Both absorbable and non-absorbable suture material have been used with similar results.

Needle selection can be as difficult a task as suture selection. The needle used in intestinal surgery should be swaged-on and small in diameter. Acceptable needles include taper point, taper-cut, and reverse cutting. Commonly used needles include RB-1, V-4, and SH.

Suture Patterns: The choice of suture material or staples is largely based on surgeon preference and is considered by many surgeons to be less important for successful intestinal closure than suture pattern. Approximating techniques are preferred over inverting or everting patterns. The simple interrupted pattern was the first appositional anastomosis technique to be commonly used in small animal surgery and is still widely accepted. Simple continuous patterns have been shown to achieve better continuity of the intestinal layers than simple interrupted patterns. The efficacy and complication rate of two techniques are similar.

Surgical Procedures

Intestinal Resection and Anastomosis: Intestinal resection and anastomosis is indicated when bowel is devitalized. Disparity in luminal diameter can make end-to-end anastomosis difficult. The small segment can be enlarged by making the cut on a 45-60° angle with the antimesenteric border shorter than the mesenteric border. Alternately, a small incision can be made in the antimesenteric border to “fish mouth” the smaller segment. Placing sutures 180° apart from each other at the mesenteric and antimesenteric borders starts the anastomosis. These sutures are tied leaving a 3- to 4-cm end for a stay suture to which a mosquito forceps is attached. The strand with the needle is used to complete the anastomosis. Tension is placed on the stay sutures to help appose intestinal ends and the continuous suture pattern is advanced from one border toward the other. If mucosal eversion develops, the mucosa is manually replaced into the lumen, or, if excessive, trimmed back, and full-thickness bites are placed 3 to 4 mm from the cut edge. The needle is advanced around the perimeter of the intestine with bites approximately 3 mm apart, and square knot is tied to the tagged end of the knot at the opposite border. Using the stay sutures, the intestine is rolled over to expose the opposite, unsutured side, and the remaining suture is used in a continuous pattern to complete the anastomosis. Take care to adequately appose the mesenteric border, because fat within the mesentery can make accurate suture placement difficult.

Enterotomy: Enterotomies are used for numerous purposes, including removal of foreign bodies, intestinal biopsies, and access to the Sphincter of Odi. A longitudinal incision is made on the antimesenteric border aboral to the foreign body. Enterotomies can be closed successfully using simple interrupted or simple continuous suture patterns. Inverting patterns should be avoided since they decrease luminal diameter and the inverted tissue tends to slough.

Serosal Patch: A serosal patch is indicated when an intestinal repair needs reinforcement or when conventional suture closure must be done in an area of marginally viable tissue. Serosal patching has been used successfully to close intestinal perforations, dehiscences and to buttress other questionable areas. A loop of healthy jejunum is chosen based on ease of ability to reach
the area of interest without tension or kinking of the intestine. The antimesenteric border of the jejunum is placed over the affected tissue and sutured in place with simple interrupted or simple continuous sutures. As with all intestinal surgical procedures, the submucosa must be included in each suture pass.

State of the Art Techniques

Gastrojejunostomy Tube Placement: Gastrojejunostomy tubes are used to treat animals with severe pancreatitis. Studies have shown that the further down the intestinal tract that nutrition is deposited, the less the pancreatic enzyme stimulation. Jejunostomy alimentation has the advantage over total parenteral nutrition (TPN) by maintaining gut mucosal thickness, villous height, and gut barrier integrity. Additionally, gastrojejunostomy tube feeding has been shown to reduce the length of hospital stay compared to TPN feeding.

Complications for surgically placed jejunostomy tubes include leaking anastomotic seals, bowel obstruction from adhesions at the enterotomy site, abscess formation, bowel infarction and necrosis, body wall and enteric mural edema, erythema, cellulitis, hemorrhage, and fistula formation. Complications associated with jejunostomy tubes include clogging, tube dislodgement and migration, and bowel obstruction.

Gastrojejunostomy tube placement helps to decrease the complications associated with surgically placed jejunostomy tubes by making the attachment to the body through the stomach. A routine gastrostomy tube (20fr – dogs; 16fr – cats) is placed in the body of the stomach. An additional gastrotomy is made in the pylorus. The jejunostomy tube (10fr – dogs; 8fr – cats) is passed through the gastrostomy tube and exits through a created or existing opening in the distal tip of the tube. The tip of the jejunostomy tube is grasped through the pylorotomy and fed into the duodenum, then into the jejunum. The gastrotomy is closed in a routine fashion. Enteral feeding is initiated 24 hours after tube placement.

Laparoscopic-Assisted Techniques: Laparoscopy provides a minimally invasive means of accomplishing a number of diagnostic and surgical procedures currently used in small animals. Laparoscopic-assisted techniques have been used for colopexy, cystopexy, placement of enterostomy feeding tubes, placement of gastrostomy feeding tubes, gastropexy, cystoscopic removal of calculi, gastroscopic removal of gastric foreign bodies and many other procedures. The advantages of the minimally invasive techniques include diagnostic accuracy and rapid patient recovery.

Most laparoscopic-assisted surgeries require two small incisions. One is used for placement of the laparoscope and the other for a laparoscopic Babcock forceps. The desired organ is grasped with the Babcock and exteriorized through a lengthened trocar site. The enteric or gastric procedure is performed outside of the body. Once the procedure is completed, the organ is then returned to the abdomen.

