Evaluation of laparoscopic-assisted placement of jejunostomy feeding tubes in dogs

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Objective—To evaluate feasibility of performing laparoscopic-assisted placement of a jejunostomy feeding tube (J-tube) and compare complications associated with placement, short-term feedings, and medium-term healing with surgically placed tubes in dogs.

Design—Prospective study.

Animals—15 healthy mixed-breed dogs.

Procedures—Dogs were randomly allocated to undergo open surgical or laparoscopic-assisted J-tube placement. Required nutrients were administered by a combination of enteric and oral feeding while monitoring for complications. Radiographic contrast studies documented tube direction and location, altered motility, or evidence of stricture.

Results—Jejunostomy tubes were successfully placed in the correct location and direction in all dogs. In the laparoscopic group, the ileum was initially selected in 2 dogs, 2 dogs developed moderate hemorrhage at a portal site, and 2 J-tubes kinked during placement but were successfully readjusted postoperatively. All dogs tolerated postoperative feedings. All dogs developed minor ostomy site inflammation, and 1 dog developed bile-induced dermatitis at the ostomy site. Despite mild, transient neutrophilia, no significant difference was noted in WBC counts between groups. No dog had altered gastric motility or evidence of stricture, although the jejunopexy site remained identifiable in several dogs at 30 days.

Conclusions and Clinical Relevance—Requirements for successful J-tube placement were met by use of a laparoscopic-assisted technique, and postoperative complications were mild and comparable to those seen with surgical placement. Laparoscopic-assisted J-tube placement compares favorably to surgical placement in healthy dogs and should be considered as an option for dogs requiring enterostomy feeding but not requiring a celiotomy for other reasons. (J Am Vet Med Assoc 2004;225:65–71)

Early use of enteral nutrition has been advocated in critically ill or injured patients because inadequate food intake during a period of high metabolic demand adversely affects several organ systems.1,3 Other benefits of earlier implementation of enteral feedings include improved preservation of nutritional status and intestinal motility, as well as superior immunologic function and tissue healing.1,5 Enterostomy feeding allows early enteric delivery in patients with gastrointestinal tract (proximal portion), hepatobiliary, and pancreatic disorders in which oral or gastric feeding is contraindicated.5,6 Jejunostomy feeding tube (J-tube) placement is typically performed via a celiotomy.4,8 More recently, laparoscopic, laparoscopic-assisted, and endoscopic-assisted J-tube placement techniques have been described in human and veterinary patients.8,9,11-12

Laparoscopic surgery has a low complication rate and results in rapid postoperative recovery, decreased adhesion formation, and improved patient convalescence, compared with open surgical procedures.2,3,4,14 These may be attributed to decreased surgical trauma, postoperative ileus, and pain.15-17 Laparoscopic-assisted J-tube placement offers a minimally invasive alternative to celiotomy for veterinary patients with underlying gastrointestinal, biliary, and pancreatic diseases.18 Although laparoscopic-assisted J-tube placement has been described in the veterinary literature, few reports12,19 objectively assess the ease and accuracy of laparoscopic-assisted J-tube placement and none compare clinical aspects such as short- and medium-term complications with those of tubes placed with an open surgical approach. The value of laparoscopic-assisted J-tube placement in veterinary medicine is therefore unknown.

The purpose of the study reported here was to compare laparoscopic-assisted and open surgical placement of J-tubes in clinically normal dogs. The main objective was to determine the ease of placement of J-tubes by use of a laparoscopic-assisted technique and, more specifically, to determine the feasibility of identifying the correct site for placement and the ability of directing the feeding tube aborally in the jejunum. Additional objectives involved the description of potential complications associated with laparoscopic-assisted J-tube placement, early postoperative feeding, and postoperative feeding up to 30 days following tube placement (intestinal stricture, pancreatitis, peritonitis, or premature tube removal), compared with open surgical placement.

Materials and Methods

Dogs—Fifteen mixed-breed adult dogs obtained from the Central Animal Facility weighing from 20 to 30 kg (44 to 66 lb) were used for this study (mean, 26 kg [57.2 lb] for each group). Dogs ranged in age from 0.7 to 3.5 years (mean, 2.2 years; median, 1.3 years). All dogs were sexually intact, and there were 5 females and 10 males. All dogs...
were determined to be free from preexisting gastrointestinal tract disease on the basis of results of physical examination, CBC, serum biochemical profile, fecal analyses, and contrast radiography of the gastrointestinal tract. The experimental protocol was approved by the Ontario Veterinary College Animal Care Committee, and dogs were cared for according to the Canadian Council for Animal Care and Use Guidelines.

Experimental protocol—Dogs were randomly assigned to receive either open surgical J-tube placement via celiotomy (group 1, 5 dogs) or laparoscopic-assisted J-tube placement (group 2, 10 dogs). As part of a second study not reported here, group 2 dogs were allocated randomly to 1 of 2 anesthetic protocols, general anesthesia (n = 5) or sedation and local and epidural anesthesia (5); for the purpose of this study, group 2 included all 10 dogs. At least 2 days before J-tube placement, food was withheld and the dogs were sedated with acepromazine maleate (0.03 to 0.08 mg/kg [0.014 to 0.036 mg/lb], IV) to perform survey abdominal radiographs and barium studies of the gastrointestinal tract.

Anesthetic protocol—Dogs receiving general anesthesia (group 1 and 5 dogs in group 2) were premedicated with hydromorphone (0.1 mg/kg [0.045 mg/lb], IM) and glycopyrolate (0.01 mg/kg [0.0045 mg/lb], IM). A cephalic catheter was placed, and fluids were administered IV at 10 mL/kg/h [4.5 ml/lb/h]. Anesthesia was induced with ketamine (7.5 mg/kg [3.4 mg/lb], IV) and diazepam (0.35 mg/kg [0.16 mg/lb], IV). Dogs were intubated, and anesthesia was maintained with isoflurane in oxygen. Intermittent positive pressure ventilation was performed to maintain the end tidal carbon dioxide pressure from 35 to 45 mm Hg. The surgical area was clipped and prepared aseptically for either a ventral midline surgical approach (group 1) or a left lateral laparoscopic approach (group 2).

The remaining 5 dogs in group 2 were premedicated with glycopyrolate (0.01 mg/kg, IM). Sedation was achieved with a bolus of fentanyl (5 µg/kg [2.3 µg/lb], IV) and midazolam (0.1 mg/kg, IV), followed by a constant rate infusion (CRI) of fentanyl (30 to 60 µg/kg/h [13.6 to 27.2 µg/lb/h], IV) and midazolam (0.2 mg/kg/h [0.09 mg/lb/h], IV) with the dose adjusted to the level of sedation that permitted the dogs to lie quietly with minimal manual restraint. Cotton balls were placed within the external ear canals to minimize external auditory stimulation. An oxygen mask delivering 100% oxygen was placed in the region of the dog’s muzzle. Preservative-free 2% lidocaine (4 mg/kg [1.8 mg/lb], maximum of 6 mL) was injected into a previously placed epidural catheter during a 5-minute period and was subsequently flushed with 1 mL of sterile saline (0.9% NaCl) solution. All dogs received 1 dose of cefoxitin (22 mg/kg [10 mg/lb], IV) at least 20 minutes prior to the first incision.

Surgical technique—Group 1 dogs were positioned in dorsal recumbency for a standard ventral midline approach with a 15-cm incision centered over the umbilicus. A loop of small intestine was exteriorized, and a section of the proximal portion of the jejunum approximately 10 cm caudal to the duodenocolic ligament was isolated. A stab incision was performed with a No. 11 blade, and a pediatric endoscopic biopsy forceps was used to obtain 2 or 3 partial thickness jejunal biopsy specimens. These specimens were placed in neutral-buffered 10% formalin for histopathologic examination. An 8-F pediatric feeding tube was placed through the jejunal stab incision, directed 10 cm aborally, and secured with a jejunal purse-string suture of 4-0 monofilament glycomer 63.

The tube exited the abdominal cavity through a stab incision created in the abdominal wall caudal to the umbilicus and approximately 2 cm to the left of midline. Jejunostomy was performed by placing 4 to 6 simple interrupted sutures of 3-0 monofilament glycomer 63 between the jejunum and the abdominal musculature. The area was wrapped with a section of omentum that was secured with a single suture of 3-0 monofilament glycomer 63. The J-tube was secured to the skin with a purse-string suture pattern and a finger-trap suture pattern of 2-0 polypropylene at the ostomy site. The tubes were flushed with sterile saline solution, and the abdominal incision was closed routinely. Group 2 dogs were positioned in right lateral recumbency. Four sites were marked with a sterile pen (central [midflank]; cranioventral [caudal to the last rib]; caudoventral [cranial to the pubis]; and dorsal [midflank, ventral to the epaxial muscles]). Each site received an injection of approximately 0.5 mL (10 mg) of 2% lidocaine. A Veress needle was inserted in the peritoneal cavity through a cutaneous stab incision at the level of the central site and tested for negative pressure by use of the hanging drop technique.

The abdomen was insufflated with carbon dioxide to a pressure ranging from 11 to 15 mm Hg. The dorsal portal was created with a 3-mm reusable, trocar-cannula unit and used as a camera portal. The insufflation tubing was then transferred to the cranial canula, and the Veress needle was removed. A brief exploration of the abdominal cavity was performed. Instrument portals were then created at the cranioventral (3-mm canula) and caudoventral (10-mm canula with 5-mm reducer) location under direct laparoscopic visualization. A 5-mm Babcock endoscopic forceps was inserted in each of the instrument portals. The jaw of the caudal forceps was marked on 1 side with a piece of colored, sterile tape to indicate direction. A section of small intestine was grasped on the anti-mesenteric border and manipulated in a hand-over-hand technique until either the antimesenteric vessel of the ileum, the cecum, or the duodeno-colic ligament (when the jejunum could no longer be retracted toward the surgeon) was identified. If the ileum or the cecum was first identified, the intestine was then manipulated in the opposite direction until the duodeno-colic ligament was located. A site 10 to 15 cm caudal to the duodeno-colic ligament was selected with the caudal forceps. In some dogs, a 5-mm endoscopic clip applicator was inserted though the cranial instrument portal and a surgical staple was placed in the mesentery, close to the chosen ostomy site, to confirm the orientation of the intestine once it was exteriorized. The insufflation was discontinued, and the caudal canula (10 mm) was removed while extracting the selected portion of jejunum through the incision (Figure 1). A stay suture of 4-0 monofilament glycomer 63 was placed in the jejunum and directed 10 cm aborally, and secured with a jejunal purse-string suture of 4-0 monofilament glycomer 63. The tube exited the abdominal cavity through a stab incision created in the abdominal wall caudal to the umbilicus and approximately 2 cm to the left of midline. Jejunostomy was performed by placing 4 to 6 simple interrupted sutures of 3-0 monofilament glycomer 63.
placed in the jejunum to prevent inadvertent retraction into the abdomen after release of the forceps. A stab incision was created, biopsies were performed, and a feeding tube was inserted as described for group-1 dogs (Figure 2). The jejunum was apposed to the body wall within the canula incision by placing 4 to 6 simple interrupted sutures of 3-0 monofilament glycomer 63. The incised abdominal muscle was closed in a simple interrupted pattern of 3-0 monofilament glycomer 63, and the skin was apposed with a cruciate suture pattern with 3-0 polypropylene. The other portal sites were closed in a similar fashion. Feeding tubes were secured to the skin in an identical fashion to group-1 dogs.

All dogs received a caudal abdominal bandage to protect the feeding tubes. Dogs recovered from anesthesia and were treated with acepromazine (0.03 mg/kg, IV) as needed for dysphoria. The dogs were monitored throughout the study for pain by 2 investigators (SAH and SLS) by use of a 0 to 10 scoring system21 and by various animal attendants who were familiar with assessing signs of postoperative pain. Dogs received meloxicam20 (0.1 to 0.2 mg/kg, SC, q 24 h) if a cumulative pain score ≥ 3 was recorded and received hydromorphone (0.05 mg/kg [0.023 mg/lb], IM, as needed) if their pain score did not improve 20 to 60 minutes after meloxicam administration. Dogs with a cumulative pain score ≥ 4 received a combination of meloxicam and hydromorphone.

Histologic examination—Fixed biopsy specimens of the jejunum were embedded in paraffin and 6-mm sections were prepared, stained routinely, and examined by 2 investigators (RAF and SAH). Each specimen was evaluated to identify preexisting gastrointestinal tract disease that may have affected postoperative complication rates.

Postoperative procedures—All dogs were fed 50% of their nutritional requirements with a commercially available polymeric diet mixed 1:1 with bottled water during 8 to 10 hours as a CRI on the first postoperative day, followed by 4 days in which the full caloric requirement was administered as a CRI during the same time period. Nutritional requirements were calculated on the basis of ideal body weight to calculate basal energy requirements (70 X weight [kg]0.75) and multiplied by an illness factor of 1.5. Between feedings, the J-tubes were disconnected from the feeding lines and flushed with bottled water. On days 3 through 5, 340 kcal was provided as a single oral meal of a high-calorie canned food,1 and this amount of energy was subtracted from that provided via the J-tube. On days 6 through 10, the dogs were fed their entire caloric requirement as 3 orally administered meals consisting of a mixture of canned and dry low-residue diet.6 In all dogs, the tubes were periodically flushed from days 5 to 10 to ensure patency. After day 10 (J-tube removal), the dogs were fed dry maintenance food5 only.

Daily physical examinations, CBCs, and pain scoring were performed for the first 5 days to identify evidence of peritonitis or ostomy site complications. Serum activities of amylase and lipase were measured on days 1, 3, and 5 to monitor for potential pancreatitis. Daily physical examinations were performed on all dogs with close attention to ostomy site complications for the first 3 weeks, then twice weekly for the remainder of the study. A CBC was performed on days 11 and 12 to identify complications relating to ostomy site leakage after removal of the feeding tubes.

Group 2 dogs underwent a fluoroscopic contrast study performed under sedation (acepromazine maleate, 0.03 to 0.08 mg/kg, IV) the day after J-tube placement to determine the location of the ostomy site in the proximal portion of the jejunum. A small volume of an iodinated contrast material was first injected into the feeding tube until it reached the tip. This was followed by nasogastric administration of approximately 10 mL/kg [4.5 mL/lb] of barium sulfate mixed 1:1 with water. Digital films were produced after the barium reached the tip of the feeding tube (Figure 3). On day 10, a positive contrast fluoroscopic study was repeated by injecting 3 mL of contrast material into the feeding tube to identify any change in direction of the tube within the jejunum. The feeding tube and sutures were removed on day 10. At approximately day 30 after tube placement, a barium study of the proximal portion of the gastrointestinal tract was repeated to identify obvious alteration in gastrointestinal motility or stricture at the jejunostomy site.

Statistical analyses—By use of a commercially available software program,1 a Fisher exact test was performed to compare complication rates and a Wilcoxon-Mann-Whitney test was performed to identify differences in pain scores between the 2 groups. A summary statistics approach was used to calculate a mean and slope value for WBC and neutrophil concentrations for each dog. Overall mean values and slopes were compared by use of an ANOVA to identify significant differences.
Results

Jejunostomy feeding tubes were successfully placed in all dogs. The duration of the procedure was a mean of 39 minutes (median, 35 minutes; range, 30 to 60 minutes) for group 1 and a mean of 73.9 minutes (median, 74 minutes; range, 40 to 100 minutes) for group 2. In 2 group 2 dogs, the ileum was initially selected instead of the proximal portion of the jejunum. This was recognized after the selected intestinal segment was exteriorized through the cecal pouch. The incision was closed such that abdominal insufflation could be reestablished, and the intestine was manipulated in an oral direction under laparoscopic guidance with Babcock forceps until the proximal portion of the jejunum was identified. Procedural duration was considerably longer (by approx 30 minutes in 1 dog) when this occurred. Excluding the 2 dogs in which the ileum was initially exteriorized, mean duration for laparoscopic procedures was 72.3 minutes (range, 40 to 80 minutes). Two group 2 dogs had moderate hemorrhage from the paramedian muscular incision that was controlled with ligation or digital pressure. No other complications were encountered during tube placement.

Fluoroscopic positive contrast studies performed on day 1 confirmed that all tubes were placed in the correct location and direction. A 180° kink located approximately 4 cm from the tip of the J-tube was noted in 2 group 2 dogs (Figure 4). In both dogs, a stylet was inserted in the lumen of the feeding tube to the level of the kink and the tube was repeatedly moved in and out under fluoroscopic guidance, resulting in successful correction of the kink. Two feeding tubes became obstructed from excessive tightening of the finger-trap suture; this was corrected by replacing the suture. Five dogs chewed the feeding line while wearing an Elizabethan collar, but did not damage their feeding tube or substantially delay feeding. One tube became blocked on day 3 and was successfully flushed with a carbonated beverage. One dog partially removed the J-tube (approx 8 cm) on day 5; the tube was reinserted and resutured without complication. One dog removed the tube completely on the day of scheduled removal without complications. Between days 6 and 10, all dogs developed minor ostomy site inflammation that resolved quickly after tube removal. Eleven of 15 dogs developed mild erythema, and 12 of 15 dogs developed mild discharge (sanguineous or mucopurulent) at the ostomy site. There was no significant difference in rate of complications between groups (P = 0.56 for erythema; P = 0.90 for discharge). Bile leakage from the ostomy site resulted in severe localized bile-induced dermatitis in 1 dog; this resolved with tube removal, administration of cephalixin (30 mg/kg [13.6 mg/lb], PO, q 12 h for 10 d) and local cleansing with a mild antiseptic solution. Excluding minor ostomy site inflammation, there were minor complications in 5 of 10 group 2 dogs and 0 of 5 group 1 dogs. The minor complications rate were not significantly (P = 0.10) different between groups. All ostomy sites healed completely within a few days after feeding tube removal. No complications were noted between days 10 (J-tube removal) and 30 postoperatively. No dog had a postoperative pain score > 4 during this study. In the postoperative period, group 1 dogs had mean ± SD pain score (3.8 ± 0.83) that was significantly (P = 0.049) greater than that of group 2 dogs (2.3 ± 1.25).

Histologic examination of endoscopically obtained biopsy specimens revealed similar numbers of plasma cells, eosinophils, and lymphocytes in the lamina propria and in the depth of the crypts between groups.

Serum activities of amylase and lipase were within reference ranges in all dogs at all time points. There were small but significant differences in the mean WBC concentration (group 1, 13.5 × 10^6 cells/L; group 2, 10.8 × 10^6 cells/L; reference range, 4.9 to 15.4 × 10^6 cells/L; P = 0.03) and mean neutrophil concentration (group 1, 9.1 × 10^6 cells/L; group 2, 7.3 × 10^6 cells/L; reference range, 2.9 to 10.6 × 10^6 cells/L; P = 0.04) between groups. Despite transient increases in leukocyte parameters, no dog developed clinical signs consistent with peritonitis during the study period.

All dogs tolerated jejunal feedings well, and none of the dogs developed signs of obstruction or colic with introduction of larger volumes of canned or dry food prior to tube removal. Twelve of 15 dogs developed transient diarrhea at some point during J-tube feeding. Of these, a single episode of cramping and diarrhea occurred in 3 dogs immediately after the jejunal feeding was inadvertently administered faster than desired and 1 dog developed a 24-hour episode of diarrhea associated with the onset of estrus. Seven dogs developed enteritis secondary to a nosocomial outbreak of Clostridium difficile infection. Clinical signs resolved within 24 to 48 hours after administration of metronidazole (15 mg/kg [6.8 mg/lb], PO, q 12 h for 5 d). There were no significant differences between groups with regards to the occurrence of diarrhea (P = 0.99).

Four dogs (including dogs from both groups) had 1 to 2 episodes of vomiting (bile or water), which resolved without treatment.

Figure 4—Right lateral abdominal radiographic view of the abdomen of a dog. Notice positive contrast material in the jejunostomy feeding tube, which reveals that the tube is kinked (arrowhead).
Group 1 dogs had mean weight loss of 0.04 kg (0.09 lb). Group 2 dogs had weight fluctuations that varied between losses of 0.9 kg (2 lb) and gains of 1 kg (2.2 lb; mean loss, 0.15 kg [0.33 lb]) during the study period.

Results of all preoperative abdominal radiography and barium studies were within reference limits. Gastric emptying was slightly delayed in all dogs that required a higher dose of acepromazine to allow nasogastric intubation. Dogs with increased gastrointestinal motility in the preoperative study had similar findings in the postoperative studies. Day-1 postoperative contrast studies revealed that tube placement was in a correct direction (aboral) in all dogs and in an adequate location in 13 of 15 dogs. In 2 group 2 dogs, the feeding tube appeared to enter the proximal portion of the jejunum approximately 5 to 10 cm aboral to the location in other dogs; this did not appear clinically important during the study. In 6 of 10 group 2 dogs, an identifiable jejunopexy site was noted via the 30-day barium series as a consistent, acutely angled turn in a section of small intestine that appeared in a similar location to the jejunopexy site, compared with day-1 findings. None of the barium series revealed an obvious stricture or evidence of decreased intestinal motility. In 1 group 2 dog, a mild but consistent narrowing of the jejunal lumen was noted at the jejunostomy site. The magnitude of luminal constriction was insufficient to classify the finding as a stricture, and these changes did not appear to affect intestinal motility or result in clinical evidence of obstruction.

Discussion

Results of the study reported here confirm that laparoscopic-assisted J-tube placement is safe and the number and severity of complications are comparable to those associated with surgical placement. Jejunostomy tube placement was successful in all dogs, and no dog required conversion of the laparoscopic procedure to an open surgical approach because of intraoperative complications. In humans, conversion from laparoscopy to an open surgical approach has been reported in 8.0% to 12.5% of cases and appears to be associated with specific procedures and the presence of preexisting adhesions.16,22

Laparoscopic-assisted J-tube placement has been described in dogs positioned in dorsal recumbency.12,20 Because of a concurrent anesthetic study involving J-tube placement under sedation and local and epidural analgesia, all laparoscopic-assisted procedures in this study were performed in right lateral recumbency. The lateral positioning may have resulted in a slightly smaller area for triangulation of the instruments, but it precluded obstruction of the surgical field by the falci-form ligament.

The time required to insert trocar-canalula units and induce adequate pneumoperitoneum was comparable to the time required to perform the celiotomy incision; however, laparoscopic incisions required less time for closure. Laparoscopic intestinal manipulation was more technically demanding and time-consuming than hand manipulation, but became substantially easier and faster as the surgeon became more experienced. Initial exteriorization of the ileum instead of the proximal portion of the jejunum in 2 group 2 dogs was related to inexperience and inadequate viewing of the ileal anti-mesenteric vessel because of poor instrumentation (light source) in the early stages of the study. A modification of the technique described in this study could be used to insert enterostomy feeding tubes in the duodenum rather than into the proximal portion of the jejunum. This modification would facilitate identification of the proximal portion of the small intestine and decrease the need for extensive intestinal manipulation, likely requiring only 2 laparoscopic portals rather than 3 and shortening the duration of the procedure. Duodenal insertion would also facilitate the aboral orientation of the tube in the small intestine.

Jejunopexy was more easily performed with a laparoscopic-assisted approach, compared with the open surgical approach. In group 2 dogs, jejunopexy was performed through the caudal portal incision, which allowed direct apposition of the jejunum to the abdominal musculature from outside the abdominal cavity. Initial exteriorization of the jejunum through the portal site was performed in this study to allow intestinal manipulation and biopsy, but is not required for tube placement. Direct apposition of the intestinal loop to the peritoneal surface (with tacking sutures) without prior exteriorization can be performed prior to feeding tube insertion.

All laparoscopic-assisted J-tubes were placed in the correct direction and location. Modifications of the procedure were developed to facilitate identifying the aboral direction of the intestine and included an arrow-shaped sterile marking tape placed on the jaw of the caudal forceps to indicate direction after exteriorization from the abdominal cavity. In the last 3 laparoscopic-assisted procedures, a surgical staple was also applied near the proposed jejunostomy site to provide further orientation. The staple also enabled identification of the jejunopexy site on radiographic studies. It is unknown whether aboral orientation of the tube during placement is necessary because normal intestinal peristalsis may reorient tubes placed in an orad direction. However, orally directed tubes may cause duodenogastric reflux and potentially worsen clinical outcome in patients with pancreatitis. Clinical patients may also have poor peristaltic movement, limiting the potential reversal in direction.

All complications that occurred during this study were mild and non-life-threatening. Reports of intraoperative complications specific to laparoscopy include organ damage during trocar-canalula unit placement, gas embolism, inappropriate placement of canulae for adequate viewing and organ manipulation, omental insufflation, subcutaneous emphysema, and anesthetic complications17,21 and were not identified in this study. Two group 2 dogs had moderate hemorrhage from the abdominal musculature at the level of the caudal portal site; this was promptly controlled with ligation and digital pressure. Thiopental administration was avoided to prevent splenomegaly, and the urinary bladder was emptied after anesthetic induction, which decreased the risk of inadvertent puncture of abdominal organs. Major postoperative complications,
such as premature J-tube dislodgement resulting in peritonitis, gastrointestinal tract obstruction, and fistula formation, have been reported in 7.1% to 25% of human patients, and higher morbidity rates have been associated with a preexisting disease process.\(^6,9,11,24\) Minor complications were not identified in this study and may reflect the lack of preexisting disease in these research dogs.

Minor complications reported in human and veterinary literature\(^8,9,11,16,23,24\) include J-tube obstruction, localized dermatitis, and development of gastrointestinal tract disturbances. Reported minor complications unique to veterinary patients include chewing or pawing at the tube or site of insertion, which results in inadvertent tube removal or inflammation of the ostomy site.\(^7,18\) Complication rates have been reported in as many as 34% of veterinary cases, but did not include inflammation of the ostomy site.\(^7,18\) In our study, minor complications including early tube removal, kinking of the tube during placement, and J-tube blockage were seen in 5 of 15 dogs, similar to previous reports, and did not prevent J-tube feedings. Including inflammation of the ostomy site, diarrhea, and chewed feeding lines, minor complications affected 10 of 15 dogs. Although this rate of minor complications is higher than previous reports, there may have been increased incidence of feeding lines being chewed and tubes being removed, compared with rates recorded in clinical cases, because the dogs used in this study were untrained, healthy, young, and only periodically supervised. These complications may therefore be expected less frequently in clinically ill dogs observed in an intensive care unit. In addition, flushing the feeding tubes intraoperatively would likely have resulted in early identification of the 2 tubes that kinked during insertion, allowing immediate correction. Although 12 of 15 dogs in this study developed mild transient diarrhea, this is not unexpected in dogs fed a liquid diet. These numbers are also confounded by the concurrent infectious diarrhea outbreak that occurred in our hospital during this study. There was no treatment effect associated with development of diarrhea, and the diarrhea was mild and transient in all instances. No complications were identified in the period after J-tube removal.

Moderate-term complications such as substantially altered intestinal motility or intestinal obstruction were not identified in this study on the basis of contrast radiologic studies performed 30 days after J-tube placement. Although jejunopyexy sites remained radiographically identifiable in some group 2 dogs because of the apposition of the jejunum within the abdominal wall musculature, this did not appear clinically relevant. Other radiographic contrast techniques such as administration of barium-impregnated polyspheres may have been a more accurate test of intestinal motility, but were cost prohibitive in this study.

The small but significant increase in pain scores in group 1, compared with group 2, is consistent with previous reports. However, limitation of pain assessment in this study included potential bias from the investigators toward dogs treated via open surgery and bias to administer analgesics to vocalizing dogs. Careful patient assessment in an intensive care unit by trained individuals blinded to the treatment groups would have been ideal, but was not possible in this study. The analgesic requirements for both groups were low in frequency and did not extend beyond 2 days postoperatively.

All dogs were fed 50% of their nutritional requirements diluted with bottled water on the first postoperative day to acclimatize the intestine to the change in diet. They were fed during an 8- to 10-hour period to facilitate monitoring and tolerated the feeding schedule well. Because the polymeric diet used in this study partially settles within 15 minutes, the drip rate had to be adjusted after the thicker material had passed through the feeding line to prevent an inadvertent increase in feeding rate; this may have led to the development of diarrhea in 3 of 15 dogs. This problem could be eliminated with the use of motorized fluid pumps, but these were not available for use in this study.

Laparoscopic placement of J-tubes is a feasible alternative to open surgical placement for providing early enteral feeding. The procedure can be performed in healthy dogs with relative safety and allows direct viewing of the abdominal contents as well as the jejunostomy site for optimal placement. Minor complications are common, but not clinically important, and can be minimized with careful attention to tube management. Laparoscopic-assisted J-tube placement compares favorably to open surgical placement of J-tubes in healthy dogs and should be considered as an option for dogs that require enterostomy feeding but do not require a celiotomy for other reasons. In instances in which J-tubes are inserted in critically ill dogs, smaller laparoscopic incisions, decreased postoperative pain, and lower analgesic requirements may result in shorter recovery times and decreased cost to owners, compared with surgical placement. Further data are required to determine whether laparoscopic-assisted J-tube placement is the procedure of choice for providing enteral nutrition in critically ill dogs.

**References**


Correction: Animal Behavior Case of the Month

In the “Animal Behavior Case of the Month” published May 15, 2004 (2004;224:1594–1596), the dosage give for alprazolam in the second paragraph on page 1596 is incorrect. The correct dosage is 0.25 mg, PO, q 12 h.