Intracorporeal Suturing and Knot Tying Broadens the Clinical Applicability of Laparoscopy

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ABSTRACT

Objective: As surgeons become more experienced with basic laparoscopic procedures like cholecystectomy, they are able to expand this approach to less common operations. However, without laparoscopic suturing skills, like those obtained with Nissen fundoplication, many operations cannot be completed laparoscopically. We present a series of 10 patients with less common surgical illnesses who were successfully treated with minimal access techniques and intracorporeal suturing.

Methods: Over a 6-month period at 2 medical centers, 10 patients underwent operations with laparoscopic intracorporeal suturing and knot tying. Diagnoses included bowel obstruction due to gallstone ileus (n=1), perforated uterus from an intrauterine device (n=1), urinary bladder diverticulum (n=1), bleeding Meckel’s diverticulum (n=3), and perforated duodenal ulcer (n=4).

Results: Each patient was treated with standard surgical interventions performed entirely laparoscopically with intracorporeal suturing. No morbidity or mortality occurred in any patient due to the operation.

Conclusions: Although each of these operations has been previously reported, as a series, they point out the importance of mastering laparoscopic suturing. Although devices are commercially available to facilitate certain suturing scenarios, we encourage residents and fellows to sew manually. We believe that none of these operations could have been completed as effectively by using a suture device. The ability to suture laparoscopically markedly broadens the number of clinical scenarios in which minimal access techniques can be used.

INTRODUCTION

Laparoscopically placing a suture and tying a secure knot is one of the most difficult tasks to master in minimal access surgery. It is so difficult, in fact, that some surgeons have opted to either use a suturing device or perform the operation in open fashion. We have encouraged (mandated) that residents and fellows in our training programs learn the techniques of intracorporeal suturing as described by Szabo et al1 and Hanna et al.2 We believe this increases the number and scope of cases that they can complete laparoscopically. We present 5 examples drawn from our experience with 10 patients who underwent uncommon operations in which laparoscopic suturing was used successfully at our institutions.

METHODS

This is a retrospective case study. Representative cases from each type of surgery are presented, including bowel obstruction due to gallstone ileus (n=1), perforated uterus from an intrauterine device (n=1), urinary bladder diverticulum (n=1), bleeding Meckel’s diverticulum (n=3), and perforated duodenal ulcer (n=4).

CASE 1

A 26-year-old man had recurrent bouts of melena and hematochezia over a 3-month period. Although never hospitalized, he underwent numerous outpatient investigations that included a complete blood count (Hgb 8.0 mg/dL), colonoscopy (normal), small bowel follow through (normal), upper endoscopy (normal), barium swallow (normal), and Meckel’s scan (no diverticulum detected). When he had recurrence of his rectal bleeding, the Meckel’s scan was repeated, and it was positive for the presence of gastric mucosa in the right lower quadrant.

An exploratory laparoscopy was undertaken and a Meckel’s diverticulum was discovered. A small bowel resection was performed by firing a laparoscopic linear
Intracorporeal Suturing and Knot Tying Broadens the Clinical Applicability of Laparoscopy, Allen JW et al.

stapler across the small bowel approximately 5 cm proximal and 10 cm distal to the diverticulum. The small bowel mesentery was divided by using ultrasonic shears. The specimen was placed in a retrieval bag and a side-to-side stapled anastomosis was fashioned by making enterotomies in each limb with the ultrasonic shears, introducing the stapler, aligning the limbs, and firing. The common stoma that was formed was closed in 2 layers with an inner running 3-0 vicryl and an outer layer of 3-0 silk interrupted “Limbert” stitches. The specimen was removed through the slightly enlarged 10-mm camera port. The patient recovered uneventfully.

CASE 2
An 83-year-old woman was admitted to the medicine service with abdominal pain. She had had little previous medical care and no prior surgeries. Abdominal radiographs were suggestive of a small bowel obstruction. Computed tomography was obtained and a radio-opaque mass was detected in the right lower quadrant and a near complete bowel obstruction was seen. The patient was referred to the surgical service.

After fluid resuscitation, the patient underwent exploratory laparoscopy. A large gallstone was detected in the ileum, approximately 15 cm from the cecum. The remainder of the small bowel was examined and no additional stone identified. The gallbladder was adherent to the duodenum. An enterotomy was made 10 cm proximal to the large gallstone, and the stone was “milked” backwards into the enterotomy and freely into the abdominal cavity. Minimal spillage of bowel contents occurred, and the stone was placed in a retrieval bag. The enterotomy was closed in 2 layers in the opposite direction of its creation, by using an inner layer of running 2-0 prolene and an outer layer of interrupted 3-0 silk sutures. She had no postoperative surgical complications.

CASE 3
A 23-year-old woman had lower abdominal and pelvic pain. A workup included a complete blood count, basic chemistry profiles, abdominal radiographs, and pelvic ultrasound. All results were normal. The admitting gynecologist performed exploratory laparoscopy. At exploration, an intrauterine device was found to have perforated the uterus and was adherent to the sigmoid colon. At this point, the laparoscopic surgery service was consulted.

The device was removed transabdominally through a port site. The perforation in the uterus was closed in 1 layer in interrupted fashion, with 2-0 vicryl sutures. The patient was discharged 3 days after the operation.

CASE 4
A 55-year-old man with recurrent urinary tract infections over a period of 7 years underwent cystoscopy and a cystogram. Both were abnormal with a large bladder diverticulum at the top portion of the bladder, well away from the ureters. A joint effort by the genitourinary and laparoscopic surgery teams for laparoscopic bladder diverticulectomy was undertaken.

A transperitoneal approach was used. Ultrasonic shears were used to excise the diverticulum. The defect in the bladder was closed in 2 layers with inner running 2-0 vicryl and outer interrupted 3-0 vicryl sutures. A Foley catheter was placed, and the patient was discharged with the catheter in place on postoperative day one. The catheter was removed 1 week later in the office.

CASE 5
A 23-year-old man presented to the emergency department with acute onset of severe abdominal pain. He had had no previous surgeries or medical care. He was markedly distended on physical examination, and abdominal radiographs were abnormal with free air under the diaphragm. His serum drug screen was positive for cocaine.

Exploratory laparoscopy was performed, and a perforated duodenal ulcer was present that appeared to have sealed. Injection of methylene blue down the nasogastric tube showed a small leak of blue dye from the ulcer base. A Graham patch was performed using the omentum. The patch was secured with 3 interrupted 2-0 prolene sutures. The patient was discharged to a drug rehabilitation unit 4 days postoperatively.

RESULTS
No serious complications occurred related to the surgery in any of the 10 patients. The patient who underwent enterolithotomy was diagnosed postoperatively with sick sinus syndrome and underwent pacemaker placement that lengthened her hospital stay to 11 days. The patients undergoing small bowel resection for Meckel’s diverticu-
lum had an average length of stay of 3.3 days. One patient with oversewing of a perforated duodenal ulcer that was diagnosed 2 days after his coronary artery bypass graft for atypical angina had a prolonged hospital course complicated by renal failure, but eventually was discharged home 62 days after his surgery. The remaining 3 patients had an average length of stay of 4.1 days.

DISCUSSION

Although each of these operations has been previously reported on an individual basis, as a group, they illustrate the impact of being able to sew through the laparoscope. With the advent of H2 blockers and proton pump inhibitors and the resultant near disappearance of peptic ulcer disease as a surgical illness, it is safe to say that each of these 10 patients had unusual surgical problems. In these cases, a conservative, readily accepted treatment was performed. However, each was done entirely laparoscopically using intracorporeal suturing.

A surgeon's operative skill is dependent on experience. It is for this reason that we recommend using intracorporeal manual suturing techniques when performing more common laparoscopic operations like Nissen fundoplication. By doing so, and sharpening manual suturing skills, less common operations may be completed laparoscopically.

A perforated duodenal ulcer appears to be a surgical problem ideally suited for laparoscopic management. Typically, patients will have severe abdominal pain or free air on radiography. Laparoscopy offers the opportunity for rapid diagnosis without additional costly diagnostic studies, minimal exposure trauma for an operation that consists of placing 3 or 4 sutures, a shortened hospital stay, and a better profile of resource utilization. Interestingly, the laparoscopic patch repair has not been shown to decrease acute stress responses on a mediator level when compared with that in open surgery. In patients who have illicit drug-induced ulcers, as in the patient we describe, the laparoscopic approach has been shown to be beneficial. Prospective, randomized studies are needed to clarify the role of laparoscopy in perforated duodenal ulcer.

Gallstone ileus is a very uncommon disorder that is usually seen in elderly, debilitated patients. It is in this patient group that decreasing operative trauma should be maximally beneficial. Only 1 previous report has detailed the laparoscopic approach of treating gallstone ileus. Soto describes a laparoscopic-assisted enterolithotomy as well as a second case in which the gallstone was advanced into the colon to be passed later per rectum. Using intracorporeal suturing, this operation can be completed entirely through the laparoscope. In addition, a concurrent cholecystectomy, which continues to be controversial, can be performed without conversion to an open operation.

The management of symptomatic Meckel's diverticuli in adults is dependent on the nature of the symptoms. When abdominal pain is the presenting complaint, simple excision (diverticulectomy) will generally suffice. However, with gastrointestinal bleeding, the diagnosis is often illusive and the treatment different. In this scenario (as in the case we presented), laparoscopy can help make the diagnosis and offer immediate treatment. Generally, the bleeding point is not within the diverticulum, but instead in the "normal" ileum. It is the small bowel mucosa that has been irritated by the hydrochloric acid produced by the functioning gastric cells within the Meckel's diverticulum. With this in mind, an enterectomy (with removal of the hemorrhagic small bowel) and enterenterostomy is performed. Using manual suturing, this is readily accomplished laparoscopically.

A number of commercially produced devices are available to assist the surgeon in laparoscopic suturing. Although these devices likely help to decrease the operative time on an individual basis, we believe that their use, especially in training programs, should be abandoned. These devices do not rely on the universally sound and safe laparoscopic principles of optical correctness and 2-handed technique as described by Rosser et al. They also add to the total cost of any operation. Arguments that the suturing devices decrease cost by shortening operating time on a case-by-case basis are shortsighted. They rely on the unproven premise that shortening an operation by 15 minutes will translate into lower labor costs for a hospital. This will hold true only if the saving of 15 minutes will allow employees to avoid overtime or "clock-out" and go home early. In reality, it will likely represent a "paid break" for the employees and an additional fixed cost of the device for the hospital.

In addition to cost profile, manual suturing also has additional advantages over the use of a device. Virtually any size, brand, or type of suture material may be used when
Intracorporeal Suturing and Knot Tying Broadens the Clinical Applicability of Laparoscopy, Allen JW et al.

sewing manually. Needle size and type can also be readily varied. When using a device, usually only 1 or 2 types of sutures are available to choose from. This preset suture material is typically designed for 1 specific application, such as laparoscopic fundoplication, and is less applicable in other clinical situations. Finally, the reliance on a device to suture fosters a need for that device to always be available. A break in the hospital’s supply chain can render that device unavailable, and without the device, the operation cannot be completed laparoscopically.

The surgical literature is replete with examples of manual laparoscopic suturing being used to treat less common surgical illnesses.9-12 We add these 10 cases to that list. We encourage surgeons learning laparoscopy to use manual sewing techniques in all cases. The more common operations when suturing is used, such as Nissen fundoplication, may seem ideally suited for a suturing device. However, by using those cases to hone intracorporeal suturing skills, less common operations, such as those described here, may be performed without reliance on costly, less well-suited suturing devices.

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