Combined Endoscopic and Laparoscopic Surgery

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Abstract

Keywords

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- ▶ benign polyps

Benign colon polyps are best treated endoscopically. Colon polyps that are not amenable for endoscopic removals either because they are too large or situated in anatomically difficult locations can pose a clinical dilemma. Traditionally the most common recommendation for these patients has been to offer a colon resection. Although the laparoscopic approach has improved short-term outcomes, morbidities associated with bowel resection are still significant. We may be over treating majority of these patients because of the remote possibility that these polyps may be harboring a cancer. A combined approach using both laparoscopy and colonoscopy (combined endoscopic and laparoscopic surgery) has been described as an alternative to bowel resection in select patients with polyps that cannot be removed endoscopically. Polyp removal using this combined approach may be an effective alternative in select patients.

Large colon polyps and those on or behind a haustral fold can be very challenging to remove endoscopically. Although endoscopic mucosal resection and submucosal dissection have been performed for these polyps, this technique is not widely available and does not provide any solution for certain polyps.^{1,2} For this reason, the most common recommendation for these patients who cannot have their polyp removed through endoscopic means has traditionally been segmental colectomy. There are many studies that demonstrate that laparoscopic colectomy has quicker recovery rates, faster return of bowel function, and earlier return to normal activities in comparison with open colectomy. However, while the laparoscopic approach can minimize the morbidity associated with colectomy, only a minority of the colon resections performed in the United States are being performed laparoscopically.³ Furthermore, even if a minimally invasive approach is employed, it still entails a major abdominal operation with the potential for associated morbidities. In place of resection, combined endoscopic and laparoscopic surgery (CELS) has been described as an alternative in select patients.^{3–10}

The technique of laparoscopic-assisted polypectomy was first described in 1993 as a means to avoid the morbidities

associated with a major bowel resection.⁴ Larger retrospective studies have since been published indicating that the technique is safe and effective.^{3,6,7,10–12} The benefits of CELS include mobilization of the colon to make the polyp easier to resect endoscopically, the ability to directly observe the wall of the colon laparoscopically to ensure there is not a full-thickness defect, the capacity to repair an injury if there is one, and the option of converting directly to a laparoscopic resection if the polyp cannot be resected endoscopically or if there are findings suspicious for malignancy. Many different techniques and approaches have been described including laparoscopic-assisted colonoscopic resection, endoscopic-assisted laparoscopic wedge resection, and endoscopic-assisted laparoscopic resection.^{13–15} The largest study to date was performed by Franklin and Portillo, which included long-term follow-up of 160 patients with 209 polyps. At a median follow-up of 65 months (range, 6–196 months), there were no recurrences of completely resected polyps.¹⁶

Indications for CELS would include large benign colon polyps or polyps in a difficult anatomic location that are unable to be removed by endoscopic snare polypectomy. A polyp that has been incompletely removed via traditional endoscopic techniques may also be considered for CELS.

A preoperative colonoscopic biopsy should be benign, although polyps with high-grade dysplasia can be included. In addition, as there can be a discrepancy in pathology, it is important to have the slides reviewed by a pathologist at your own institution to make sure there is consensus. If the preoperative colonoscopy was done elsewhere, the report should be reviewed, as well as pictures of the polyp, to ensure that the polyp is acceptable for CELS. If the polyp is on the left side, it is often useful to evaluate the area in the office with a flexible sigmoidoscope to determine the exact location, polyp characteristics, and feasibility of CELS. If patients have other polyps, they should be able to be removed colonoscopically or with CELS technique. CELS should not be performed on patients with a known polyposis syndrome. In addition, patients with a history of multiple previous abdominal surgeries or those who have a polyp that is too close to the ileocecal valve may not be good candidates for this procedure.

Patients should undergo a preoperative workup as they would for any other abdominal procedure, including blood work, electrocardiogram, and chest X-ray if clinically indicated. Patients should receive a full mechanical bowel preparation the day before the procedure to aid in visualization of the polyp. When discussing the procedure, the patient should be informed that colonoscopic polypectomy will be attempted; however, if the polyp cannot be resected endoscopically or if there are findings suspicious for malignancy, then laparoscopic colectomy will need to be performed. In addition, patients should be made aware that even if CELS is successful in completely removing the polyp, it is possible that the final pathology may reveal a malignancy and that a bowel resection may be recommended at a later date.

Technique

After the induction of general anesthesia, Venodyne boots, a nasogastric tube, and Foley catheter are placed. The patient is positioned in modified lithotomy, ensuring the legs are abducted and placed in padded yellow fin stirrups to facilitate the insertion and manipulation of the colonoscope during the operation. Both arms are tucked at the sides and the hands and wrists are padded. All equipment should be available to perform colonoscopic polypectomy as well as laparoscopic and open colectomy (though only opened as needed) (► **Table 1**). Subcutaneous heparin and intravenous antibiotics are given before incision.

Laparoscopic monitors will be placed depending on the location of the lesion. For right colon polyps, monitors are placed on the patient's right side and toward the head of the bed (► **Fig. 1**). For left colon lesions, the monitors are placed at the patient's left and toward the foot of the bed. For transverse colon or flexure lesions, the monitors are placed at the head of the bed as the endoscopist will stand between the patient's legs.

Endoscopic equipment may vary. Surgeons may prefer to use pediatric versus an adult colonoscope. In addition, we feel it is a prerequisite to have CO₂ colonoscopy available in the operating room. Simultaneous performance of laparoscopy and colonoscopy with room air can present technical chal-

lenges. Insufflation using room air can significantly obscure the laparoscopic view and compromise exposure. In institutions where CO₂ is not available for endoscopy, a technique of laparoscopically clamping the terminal ileum to minimize bowel distention during laparoscopy has been described, but we have found that colonic distention alone still is a major impediment to this method.^{3,4} Since 2003, our group has been performing colonoscopy with the use of CO₂ insufflation during laparoscopy. Because the bowel absorbs CO₂ gas approximately 150 times faster than room air, there is minimal unwanted dilation of the colon and excellent simultaneous endoscopic and laparoscopic visualization. We have previously demonstrated that intraoperative CO₂ colonoscopy is safe during laparoscopy and can be used to avoid excessive bowel dilation during CELS procedures.^{9,17} Therefore, if available, it is preferred to have CO₂ for insufflation during colonoscopy.

After the abdomen is prepped and draped in a sterile fashion, CO₂ colonoscopy is performed to locate the lesion (► **Fig. 2**). We feel it is important to perform colonoscopy first before port placement because intermittently the polyp, which may have previously been deemed unresectable by a referring gastroenterologist, may actually be amenable to traditional colonoscopic polypectomy alone. Dilute indigo carmine solution (50% dilution of indigo carmine with injectable saline solution) is then used to mark the location of the polyp and to raise it up. If the polyp seems amenable to endoscopic removal alone, then this may be attempted. During this portion of the procedure, it is important to try and recognize the signs of a potential malignancy. Many times, polyps that have been biopsied or previously had attempts at snaring may be scarred and difficult to lift with submucosal injection. These findings must be contrasted with findings of a possible cancerous polyp. These findings include central umbilication, ulceration, vascular pattern on narrow band imaging, and firmness. If these findings are present, options are to continue with CELS and perform an intraoperative frozen section or to proceed to formal colectomy. We do not feel that it is necessary to perform frozen section on all polyps resected, as this can add to the operative time and cost of the case. In our experience, the rate of cancer on polyps that were thought to be benign was only 2% (1/48). Therefore, frozen section should only be done on patients with suspicion of malignancy. In our experience, 12 patients underwent colectomy instead of CELS for suspected malignancy and only 4 (33%) of these patients actually had cancer.⁷ Although this is a low sensitivity, this may reflect our overly cautious attempts to avoid performing CELS for potential malignancy.

If the polyp cannot be removed through a purely endoscopic approach, then laparoscopy is performed. This combined method can be technically demanding and the surgeon must be proficient in both laparoscopic and endoscopic techniques. For the first several cases, it is useful to have an assistant who is proficient in both these techniques to be successful.

First, a periumbilical incision is made and the fascia is entered sharply. A 5-mm port is placed and

Table 1 Equipment needed for CELS

Adult or pediatric colonoscope with monitor (CO ₂ insufflation if available)
Indigo carmine diluted 50% with injectable saline
Endoscopic injector needle
Endoscopic snare
Endoscopic Roth net (US Endoscopy, Mentor, OH)
Suction trap
Bovie cautery
Laparoscopic monitors
High-definition flexible tip laparoscope
Trocars: 5 mm × 4, 10 mm × 1, 12 mm × 1
Laparoscopic bowel graspers and scissors
Laparoscopic needle driver
Laparoscopic energy device (surgeon preference)
Microlaparoscopic (3 mm) instruments if available
Laparoscopic linear stapler with appropriate loads
Endo-Catch bag (Covidien, Norwalk, CT)
Wound protector
Polysorb or Vicryl sutures

Abbreviation: CELS, combined endoscopic and laparoscopic surgery.

pneumoperitoneum is established. A 5 mm, high-definition flexible tip laparoscope is preferred for better visualization. The abdomen is explored and the site that was previously marked is located. Depending on the location of the lesion, typically two 5-mm trocars may be placed. For right colon lesions, trocars can be placed in the left lower quadrant and suprapubically. For left colon lesions, trocars can be placed in the right lower quadrant, suprapubically. For transverse colon lesions, trocars can be placed on both sides in both the lower and upper quadrants. If available, microlaparoscopic (3 mm) instruments can be used. A 5- to 12-mm port may be needed

for a stapler if a colonoscopic-assisted laparoscopic wall excision is anticipated. Typically for CELS, a hand port is not necessary. However, if converting to a segmental or formal colectomy, then some may elect to place a gelport for hand-assisted laparoscopy.

For laparoscopic-assisted colonoscopic polypectomy, the lesion is located by the endoscopist and its position is confirmed by laparoscopic visualization with the use of transillumination and/or by endoscopic visualization during laparoscopic manipulation of the colon (→Fig. 3). This maneuver can also expose areas that were not previously visualized because of mucosal folds or segmental kinks of the colon. The location of the polyp in relation to the peritoneum is important. Polyps that are located on the retroperitoneal side or mesenteric side require lateral mobilization of the colon for adequate exposure. If the polyp is in a difficult location (i.e., at a flexure or near the mesenteric border of the colon) and this area cannot be manipulated, the colon will need to be mobilized. This is done as in any laparoscopic procedure. We prefer to use an energy device along the line of Toldt and carried in the native planes. Once the colon is mobilized adequately, the polyp can then be manipulated.

As stated previously, the polyp is lifted with dilute indigo carmine solution. This aids in visualizing the polyp in comparison to the normal surrounding mucosa and also aids in seeing the location of the polyp laparoscopically. It also provides a “buffer” zone to facilitate endoscopic resection without causing a full-thickness injury. If the polyp does not lift, we typically would err on the side of performing a colectomy even if it may be due to scarring from previous biopsy. Polypectomy is performed using an electrosurgical snare. This can be done using a single attempt or in a piecemeal fashion. For polyps that are either flat or situated in difficult location, laparoscopic manipulation of the polyp during snare polypectomy can facilitate delivery of the polyp into the snare (→Fig. 4).

During polypectomy, the serosal aspect of the colon should be monitored closely. If there is any subtle change to the area, this can be immediately recognized and then oversewn if

Fig. 1 Suggested trocar and monitor placement for CELS technique for excision of a right colon polyp.

Fig. 2 Endoscopic visualization of a right colon polyp.

Fig. 4 Laparoscopic manipulation of the polyp during a snare polypectomy with laparoscopic delivery of the polyp into the snare.

needed (► **Fig. 5**). Typically, seromuscular sutures are placed if a full-thickness thermal injury or perforation is noted. If there is some evidence of blanching or deterioration of muscle layers, the area can also be reinforced to avoid the evolution of partial-thickness to full-thickness injuries in the postoperative period. The ability to laparoscopically repair potential damage allows for a more aggressive polypectomy.

For polyps that are located in the cecum where the wall of the colon is the thinnest, one may elect for a laparoscopic sleeve excision of the polyp. Colonoscopy is used to locate the lesion and monitor adequate surgical margins. It should be noted if polyps are located very close to the ileocecal valve to avoid injury to this structure. This can be monitored with the colonoscope. Sleeve resection is performed using a laparoscopic linear stapler through a 12-mm port (► **Fig. 6**). Once the specimen is removed, it can be placed within an Endo-

Catch bag (Covidien, Norwalk, CT) and brought out through the 12-mm port site. The specimen can be opened in the operating room to make sure there is a clear margin. Oversewing of the staple line can be performed laparoscopically as needed.

A leak test using CO₂ insufflation with the colonoscope and immersion of the bowel segment under saline (using gravity to make the correct area dependent) should be performed. For polyp retrieval, an endoscopic Roth net (US Endoscopy, Mentor, OH) can be used if the polyp is resected en bloc. For polyps that are resected piecemeal, a trap can be added to the suction device and the polyp can be suctioned through the scope.

For patients who undergo standard snare polypectomy and there are no concerns intraoperatively, these patients may have a very short hospital stay and may even go home the same day of the procedure. Most groups report length of stay between 1 and 2 days, although other large studies report a mean length of stay of 4 to 8 days.^{9,12,16} Patients who have a partial- or full-thickness injury or undergo colonoscopic-assisted laparoscopic wall excision should be monitored in the hospital for observation and to await return of bowel function. These patients should be admitted to the hospital and treated like any patient who has had a laparoscopic abdominal procedure. Diet is advanced as tolerated, and once patients have return of bowel function, they are discharged. Patients will usually follow up within 2 weeks after discharge for review of the final pathology and to confirm if additional treatment is needed.

Aggressive follow-up colonoscopy should be performed on these patients. Typically we would do a repeat surveillance colonoscopy at 3 months. In the long-term follow-up of our CELS patients, five patients (10%) had recurrent polyps. Four of these patients underwent colonoscopic polypectomy and one patient underwent laparoscopic segmental colectomy. All of these patients had benign pathologies.⁷

Fig. 3 Endoscopic visualization of a colon polyp with simultaneous laparoscopic manipulation of the colon wall.

Fig. 5 Suture reinforcement of the colon in an area of partial-thickness injury.

Outcomes

Several published studies have similarly addressed this combined technique, considering it a safe and effective method to

Fig. 6 Sleeve resection of a polyp in the cecum using a laparoscopic linear stapler.

avoid colectomy and remove difficult polyps in many cases. For patients who undergo a successful CELS procedure, postoperative morbidity is low as reported in the literature. Franklin and Portillo reported a 9% postoperative complication rate, with all complications being minor and mostly consisting of ileus, atelectasis, and seroma.¹⁶ Our group reported an overall rate of 4.2%, with postoperative complications including urinary retention and wound hematoma.⁷

Intraoperative morbidity can be related to the endoscopic portion of the procedure or to laparoscopic port placement and mobilization. The most significant endoscopic complication would be perforation. In a large retrospective study, the risk of colonoscopic perforation for all comers was less than 1%.¹⁸ As stated previously, the benefit of the laparoscopic and endoscopic combined approach is that any full-thickness injury to the colon from electrocautery, barotrauma, or scope trauma can be immediately recognized and repaired. Franklin and Portillo reported a 10% rate of serosal suture placement.¹⁶ Our group reported a higher rate of 43%. However, in all of these patients, there was no evidence of a full-thickness injury, but rather concern that the wall appeared to have a partial-thickness compromise that could easily be repaired at the time.⁹ The other benefit of doing a concomitant colonoscopy is that a leak test can be performed to assess the site of injury and repair. The risk of laparoscopic complications should be similar to any other laparoscopic abdominal procedure and potentially even less if no mobilization of the colon is required. There is risk of abdominal wall and intra-abdominal injury with port placement, bowel injury related to grasper trauma, or the use of an energy device and injury to

surrounding viscera such as the bowel, ureter, or the gonadal or iliac vessels.

Regarding long-term follow-up, the longest follow-up for these patients is a median of 65 months, which is reported by both our group and Franklin's group.^{7,16} Overall, the long-term outcome of patients undergoing CELS is excellent. For patients with benign polyps who are successfully resected with a CELS technique, there are variable recurrence rates in the literature. Our group reports a recurrence in five patients (10%). Four of these patients underwent a repeat colonoscopic polypectomy and one patient had a subsequent laparoscopic segmental colectomy and all patients had benign pathologies.⁷ Franklin and Portillo report no recurrences over a median follow-up of 65 months, but three patients were reoperated on for polyps in different locations.¹⁶

There is concern that patients who are diagnosed with a cancer on final pathology are at potential risks associated with a potential perforated cancer. However, although follow-up is limited, in patients who have had evidence of cancer on final pathology and have then gone on to have formal resection, there are no reports of tumor recurrence.¹⁶

Conclusion

CELS appears to be safe and effective for the treatment of benign colon polyps and may help avoid laparoscopic colectomy in most cases.

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