



# Laparoscopic-assisted colonoscopic polypectomy: a review

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**Abstract:** The majority of colon polyps encountered on endoscopy are resected via diathermy snare, which is the most commonly performed therapeutic intervention in colonoscopy. Endoscopic polypectomy can be unsafe when performed on larger polyps or polyps in difficult locations. Polypectomy of these lesions are a risk for perforation, difficulty obtaining clear margins, incomplete sampling due to piecemeal resection, recurrence and histologic misdiagnosis. Such lesions prompt either open or laparoscopic segmental colectomy with inherent risks of major colon resection such as anastomotic leaks and other postoperative complications. Laparoscopic-assisted colonoscopic polypectomy (LACP) is an established alternative to partial colectomy for resection of large, inaccessible, or sessile colon polyps. Laparoscopy facilitates polypectomy by enhancing endoscopic positioning via colonic mobilization and manipulation. This method provides a hybrid technique for resection of benign lesions that complements the strengths of laparoscopy and endoscopy for a minimally invasive surgical technique with good outcomes and low risk. This is a review of the literature regarding the indications, technique, benefits and drawbacks, and postoperative care, and complications of LACP.

**Keywords:** Laparoscopic-assisted colonoscopic polypectomy (LACP); colon polyps; minimally invasive surgery

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## Introduction

Colorectal adenomas are precursors of invasive adenocarcinoma and are defined as low- or high-grade intraepithelial neoplasia. Colonoscopy is the gold standard for adenoma detection. Endoscopy reveals polyp size and morphology such as flat, sessile, or pedunculated. Microscopic analysis differentiates tubular, villous, tubulovillous or serrated polyps. Lesion size, tumor morphology and histological findings correlate with the progression to high-grade intraepithelial neoplasia or invasive carcinoma (1). Removing adenomatous polyps prevents the transformation of adenoma to adenocarcinoma (2). Most colon polyps encountered on endoscopy are resected via diathermy snare, the most commonly performed therapeutic intervention in

colonoscopy. Endoscopic polypectomy may be deemed unsafe in the setting of larger polyps or in difficult locations due to the high risk of perforation, difficulty obtaining clear margins, or risk of piecemeal resection with incomplete sampling. There is also an increased risk of recurrence and for histologic misdiagnosis. When polypectomy via endoscope is not technically or safely feasible, these patients may be referred for colonic resection. Operative colonic resection exposes the patient to inherent risk of major colon resection.

Laparoscopic-assisted colonoscopic polypectomy (LACP) is a well-described alternative to partial colectomy for resection of difficult polyps (3,4) but formal colon resection remains the standard of care. LACP is a hybrid technique that utilizes the minimal invasive features of

endoscopy with the superior visualization and malleability of laparoscopy. There are many advantages of LACP. Laparoscopy provides the capability to mobilize the colon which improves access or positioning for colonoscopic resection. Laparoscopy also facilitates full inspection of colonic walls for perforation as well as the ability to repair them. LACP allow the conversion to a laparoscopic colon resection for lesions that are suspicious for malignancy or not amenable to endoscopic resection. This is a review of the literature regarding the indications, technique, benefits and drawbacks, and postoperative care, and complications of LACP.

### Indication

LACP is indicated for large, endoscopically inaccessible, or sessile polyps that are not amenable to colonoscopic resection via hot snare or endoscopic mucosal resection (EMR). Features of difficult polyp morphology include: sessile polyps >2 cm or pedunculated polyps >3 cm; polyps occupying >1/3 of the colonic luminal circumference, and polyps crossing 2 haustral folds. Features of difficult polyp location include: peri-diverticular polyps, polyps overlying or adjacent to the ileocecal valve or appendiceal orifice, rectal polyps close to the dentate line, and polyps wrapped around a fold (clamshell polyps) (5). Laparoscopic technique facilitates polypectomy by improving endoscopic positioning via colonic mobilization and manipulation. These difficult lesions traditionally warrant surgical referral and partial colectomy.

### Technique

Biopsies performed at initial preoperative colonoscopy should demonstrate benign pathology in order to proceed with LACP. Patients with high grade dysplastic polyps are not entirely excluded. Patients with a known malignant diagnosis should not undergo LACP. Discrepancy in pathology should prompt additional slide review by a pathologist to ensure consensus. If the initial preoperative colonoscopy was done at an outside institution, the full report should include pictures of the polyp for review to ensure that the polyp is acceptable for LACP (6) or the endoscopy can be repeated. A preoperative pathologic diagnosis of invasive adenocarcinoma is an absolute contraindication to LACP.

A thorough preoperative discussion with the patient is crucial. There is a 15–35% risk that the resected polyp

is malignant which would require additional surgery for an oncologic resection. Continued follow-up endoscopic surveillance will be necessary (7). Laparoscopic repair of the bowel wall may be required for any endoscopic injury. A segmental bowel resection may be necessary if endoscopic polyp removal was not possible (7). LACP has a decreased risk of recurrence compared to primary endoscopic resection of equivalent sized lesions due to incomplete resection (6,7).

The patient should undergo a mechanical and antibiotic prep prior to the procedure (6,7). The patient should be placed in lithotomy position to facilitate endoscopy. A colonoscopy should be performed prior to port insertion. Some polyps initially considered unresectable may be amenable to resection by traditional colonoscopic polypectomy for various reasons (6,7). Preoperative colonoscopy will allow for lesion localization by Indigo carmine solution. Insufflation with CO<sub>2</sub> is preferred to minimize excess bowel distension and improve visualization during laparoscopy since CO<sub>2</sub> is absorbed by the bowel 150 times faster than room air (8).

Once the lesion has been localized, the abdomen is then prepped and draped to allow ideal laparoscopic port placement. Initially a supraumbilical port is placed and the abdomen is insufflated. Assistant ports are placed based on the location of the lesions. Mobilization of right sided lesions is facilitated by ports placed in the left upper and left lower quadrant, left sided lesions are more easily mobilized using right upper and right lower quadrant ports (6,7). Laparoscopic mobilization of the colon with division of lateral, omental, or retroperitoneal attachments allows for adequate visualization and external manipulation of the bowel wall. Once the bowel has been adequately mobilized, endoscopic polypectomy can be performed using snare polypectomy and saline lift techniques. A leak test involves insufflation of the colon with CO<sub>2</sub> with the colonoscope and immersion of the bowel segment under saline (9). A leak test is often performed prior to completion of the procedure to assess for injury or perforation at the biopsy sites and requires laparoscopic manipulation for visualization of the serosal surface of the colon wall (6,7). Use of laparoscopic bulldog clamp to occlude the terminal ileum also has been shown to help with ease of performing endoscopy. Proficiency with laparoscopic suturing is crucial for success with LACP, as over sewing the serosa may be necessary

The use of LACP is limited by the need for general anesthesia and availability of operating rooms. Additionally, LACP requires participation of two physicians in order to

perform endoscopy and laparoscopy simultaneously (9).

### Postoperative care and complications:

Patients are admitted to the hospital for observation. Postoperatively, most patients are placed on an Enhanced Recovery after Surgery pathway which includes minimizing narcotics, early mobility, and early advancement of diet (10). The patients must meet specific criteria prior to discharge including: tolerating a regular diet, pain controlled on oral medications, and return of bowel function (9-11). In these small studies, the median hospital length of stay was 2 days (9,11). Observation on a medical/surgical floor is important for early detection of complications.

Perforation is the most serious complication of polypectomy. Risk factors for perforation include large or sessile polyps, right sided location, longer electrocautery time, larger polyps, and right sided location. Large or sessile polyps are more difficult to resect and may lead to inadvertent full thickness biopsies (1,4,5). Perforation rates are higher in right-sided polyps due to the thin walled nature of the right colon. Hot biopsy is not recommended in the right colon due to the risk of delayed perforation (5). The preferred current for cautery is blended cut over coagulation (6). Other factors that contribute to risk of perforation include mechanical stress from the scope, barotrauma, and the depth of the polyp resection (1). Patients with perforation often present first with tachycardia, followed by abdominal pain progressing to peritonitis, fevers, inability to tolerate a diet, abdominal distension, and other signs of sepsis (1,2). Having telemetry monitoring may be useful for early detection of sinus tachycardia. Concurrent laparoscopy provides the ability to monitor the serosa for full thickness injuries and to perform immediate surgical repair as needed. If there is a high suspicion of malignancy, segmental resection can be performed at the same time (5,6,12).

Due to the small sample sizes, the complication rates in LACP is not consistent. Lee *et al.* (7) reported no complications in the LACP, whereas Wilhelm *et al.* (13) reported a complication rate of 4.2%. The majority of reported complications were minor, reported as: postoperative ileus, surgical site infection, urinary retention, seroma, atelectasis, wound hematoma, and bleeding per rectum requiring reoperation (6,7,11). Small amounts of hematochezia may be seen with polypectomy, but patients should be monitored for ongoing blood loss or symptomatic anemia. These complications may be seen with laparoscopic colectomy.

### Discussion

LACP is a safe alternative to traditional colon resections and an underutilized method of polypectomy for difficult benign colon polyps. The technique was first described in 1993 by Beck and colleagues as an alternative to colectomy (3). A few small studies have reviewed the efficacy of LACP (3,4,10,11). Endoscopic polypectomy is dependent on the technical skill and experience of the endoscopist. Referral of patients with difficult polyps to specialty centers can increase the success rate of colonoscopic resection. Due to the higher risk of perforation in the thin-walled right colon or bleeding from broad-base lesions, many endoscopists are likely to be less aggressive with large, sessile polyps in the cecum or right colon. Laparoscopy alone is not sufficient to localize small polyps or provide intraluminal verification of complete excision. Tattooing the polyp with indigo carmine may aid localization but this technique is not always accurate or reliable (2). Excessive tattooing can make visualization and identification difficult. The conversion rate from LACP to colon resection has been reported to be anywhere from 3–26% due to suspicious lesions and technical difficulties (7,12).

A wide range in complication rates has been reported in the literature for attempted LACP, likely due to small patient samples. Lee *et al.* (7) reported no complications, whereas Wilhelm *et al.* (13) reported a complication rate of 4.2%. The majority of reported complications were minor. In a study comparing colectomy for benign and malignant polyps, the overall complication rate for standard colectomy performed for treatment of benign complex polyps was 46% (1). Difficult polyps were defined as sessile and pedunculate polyps that larger than 2 cm. Size greater than 3 cm is a major risk factor for bleeding or perforation during polypectomy and are considered the most challenging (14,15). The reported median polyp size in LACP series has been 2–4 cm (7,12). The risk of cancer in a polyp larger than 2 cm has been reported to be as high as 35% to 50% (16). LACP literature reports only 10–15% of large colonic polyps harbor cancer (17-20). There is a wide range in the reported rate of malignancy identified on final pathology for polyps considered to be benign preoperatively, ranging from 1.6% by Lee *et al.* (7) to 11% by Wilhelm *et al.* (13). This highlights the importance of proper patient selection, including a full colorectal cancer risk factor assessment, is crucial to performing LACP successfully as the underlying malignancy risk is elevated in complex/difficult polyps (Table 1).

**Table 1** Comparison of previous LACP studies

Study	Number of cases	Number of polyps	Length of stay (days)	Conversion to colectomy	Complications	Polyp size (cm)
Franklin <i>et al.</i>	110	149	1.14	17%	1 (umbilical port seroma)	0.2–6
Lee <i>et al.</i>	5	N/A	1	None	None	1–4
Wood <i>et al.</i>	13	16	2	19%	None	2–5
Lascarides <i>et al.</i>	17	N/A	2.63	12%	2 (1 a fib and urinary retention, 1 readmission)	1–5

LACP, laparoscopic-assisted colonoscopic polypectomy.

Currently, there is only one randomized control trial (11) that compares laparoscopic right hemicolectomy to LACP. Lascarides *et al.* report both techniques have similar complication rates, but LOS was shorter after LACP; however, only right sided polyps were included in the study. Although well designed, this was a small study with 17 patients in each treatment arm (11). Another limitation is that it was performed at a single institution. Most of the studies describing or investigating this technique are case studies or case series that demonstrate excellent outcomes (3,4,7,9). Large, prospective, randomized control trials will be necessary to determine superiority of this technique over traditional colon resection in difficult colon polyps.

Concern for recurrence after routine colonoscopic polypectomy of difficult polyps has led to more aggressive approaches such as LACP or EMR. Reported recurrence rates for polyps of any size removed by colonoscopy alone have been reported to be as high as 33–40% (21,22). In particular, Binmoeller *et al.* (17) reported a recurrence rate of 16% for endoscopic removal of polyps larger than 3 cm. Studies have reported a recurrence rate as low as 3.3% for polyps removed by LACP (12).

LACP provides a complimentary hybrid technique that combines the strengths of laparoscopy and endoscopy for a minimally invasive surgical technique with good outcomes that lowers the rate of resection of likely benign lesions. If malignancy is suspected, an oncologic segmental resection should be performed. As with traditional colonoscopic polypectomy, a partial colectomy should be performed if final pathology reveals malignancy. This technique is underutilized; however, large, multicenter, prospective randomized control trials will be needed to demonstrate superiority or at least non inferiority when compared to the standard of care.

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## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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