Endoscopic Management of Polyps, Polypectomy, and Combined Endoscopic and Laparoscopic Surgery

5

Kelly A. Garrett and Sang W. Lee

Key Concepts

- Colonoscopic polypectomy is the treatment of choice for diagnosing and removing most colon polyps.
- Operator variability influences the quality of colonoscopy for both detection and resection.
- Multiple questions remain about best practice techniques for colonoscopic polypectomy.
- EMR of colorectal lesions is safe and effective but results in piecemeal resection that may prevent accurate histological diagnosis. Colonoscopy surveillance is required to assess for and manage local recurrence of neoplasia.
- ESD is able to resect superficial lesions en bloc regardless of tumor size, location, and fibrosis. These advantages come at a cost of an increased risk of perforation, bleeding, and a longer procedure time as compared with EMR.
- Combined endo-laparoscopic surgery is an adjunct to endoscopic polypectomy that may help to avoid colectomy.

K. A. Garrett
Department of General Surgery, Section of Colon and Rectal Surgery, Weill Cornell Medical College, New York Presbyterian Hospital, New York, NY, USA

Introduction

- Colon cancer is the third most common cause of cancer-related mortality in the United States.
- In 2015 there were estimated 93,090 new cases of colon cancer with almost 50,000 deaths due to colon cancer.
- There has been a steady decline in the colorectal cancer incidence since the mid-1980s which is partially attributed to the introduction of colorectal cancer screening.
- There has even been a more rapid decline in recent years (4% or greater per year from 2008 to 2011) which may be multifactorial but likely reflects the increased use of screening colonoscopy. Among adults aged 50–75 years, colonoscopy use increased from 19.1% in 2000 to 54.5% in 2013.
- Colonoscopic polypectomy is the treatment of choice for diagnosing and removing most colon polyps.
- Large polyps or polyps in an anatomically difficult location can be challenging to remove endoscopically. Traditionally the most common recommendation for these patients has been to undergo a colon resection.

S. W. Lee (✉)
University of Southern California, Los Angeles, CA, USA
e-mail: sangwl@med.usc.edu

Identification of Polyps

- Indicators of quality colonoscopy include cecal intubation, withdrawal time, and polyp detection rate.
- Low cecal intubation rates have been associated with higher rates of interval proximal colon cancers.
- Colonoscopy studies in screening patients in the United States have reported cecal intubation rates of 97% or higher.
- The US Multi-Society Task Force on Colorectal Cancer recommended a withdrawal time (defined as the time from cecal intubation to the time the colonoscope is withdrawn out of the anus) of at least 6 min as an indicator of quality colonoscopy.
- A correlation between longer withdrawal time and an increased rate in the detection of adenomas has been demonstrated.
- The American Society for Gastrointestinal Endoscopy (ASGE) and the American College of Gastroenterology (ACG) recommend a minimum target for overall adenoma detection rate (ADR) of at least 25% based on the observation that higher ADRs were associated with a reduced risk of both proximal and distal cancers.

Criteria for Polypectomy

- Polyps should be removed as any adenomatous tissue visualized should be assumed to carry some malignant potential.
- More than 95% of colorectal cancers arise from adenomatous polyps (adenoma to carcinoma sequence) in a process that may take many years.
- Polyps are characterized by their size and morphology (pedunculated or sessile).
- An advanced adenoma is one that is ≥1 cm in size or contains high-grade dysplasia or appreciable villous tissue.
- The prevalence of advanced adenomas is 6–9% for average-risk screening colonoscopy.
- The malignant potential of adenomas <0.5 cm is not as well studied.

- A retrospective study analyzed 7590 adenomatous polyps. Size was the strongest predictor of advanced pathologic features (high-grade dysplasia or invasive cancer). The percentages of adenomas with advanced pathologic features were 3.4%, 13.5%, and 38.5% for adenomas <0.5 cm, 0.5–1.0 cm, and >1 cm, respectively. Villous change, left-sided location, and age ≥ 60 were also associated with advanced pathologic features.
- If there are characteristics suspicious for malignancy (induration, mucosal irregularity, vascular pattern on narrow band imaging, ulceration or central umbilication, large size, failure to lift with submucosal injection), a polypectomy should not be performed.
- Large polyp size (without other concerning features) may be a reason to defer polypectomy due to higher risk of perforation during resection.
- A polypectomy should not be performed if the risks outweigh the benefits, for example, short life expectancy or significant comorbidites.

Polypectomy Techniques

- The principles of polypectomy are to remove all visible adenomatous tissue, but there are many different techniques that are used which create a wide variability in practice.
- Polypectomy is best performed with the polyp in the 5–7 o'clock position.
- Cold biopsy forceps is the simplest method of polypectomy and is frequently used for diminutive lesions (polyps <5 mm). The biopsy forceps is passed through the biopsy channel of the colonoscope, and the jaws are positioned over the polyp which is grasped, removed, and retrieved. More than one bite may be needed to remove all polypoid tissue. Minor bleeding may occur and there is an insignificant risk of perforation. Residual polyp tissue is present in 29–38% of specimens.
- Comparison of jumbo forceps (jaw volume 12.44 mm^3) to standard forceps (jaw volume 7.22 mm^3) showed a higher complete

histologic eradication with the jumbo forceps, but this did not reach statistical significance.

- Removing small polyps with the application of electrocautery to the forceps (hot biopsy forceps) during tissue removal fulgurates the base of the polyp while the specimen is protected in the jaws.
- Risks of this technique include architectural distortion from thermal energy and delayed bleeding or perforation in the right colon. The risk of persistent viable polyp is up to 17% of polypectomy. Some guidelines recommend avoidance of hot biopsy forceps for polyps >5 mm and those in the right colon.
- Snare polypectomy is a common technique. The device is passed through the working channel of the scope, and the snare is extended from a plastic sheath and passed around the base of the polyp. The snare is closed while simultaneously the sheath tip is advanced to the base of the polyp. The base is transected either with or without electrocautery.
- Cold snare produces a resection margin of 1–2 mm. Bleeding is typically not significant. Randomized trials have shown that bleeding is similar between cold and hot snare polypectomies in lesions up to 8 mm.
- Electrocautery with snare polypectomy is more common for larger polyps (>8 mm) and pedunculated polyps.
- The polyp should optimally be in the 5–7 o'clock position. For pedunculated polyps, consider repositioning the patient, so the base of the polyp is not in a dependent position to make post-polypectomy bleeding easier to control.
- Techniques to decrease bowel injury for hot snare are the following: (1) The polyp should be tented toward the center of the lumen to stretch the submucosa away from the muscularis propria and serosa. (2) The duration of energy delivery should be minimized to prevent injury to the wall of the colon.
- For pedunculated polyps, the snare should be closed at a third or halfway from the base of the polyp to ensure a sufficient stump to regrasp if there is immediate bleeding.

- There are many different snare devices available, but there are no trials to establish the advantage of one device over another.

Endoscopic Mucosal Resection

- Large polyps, those involving more than one third of the circumference of the colon or two haustral folds or those with a flat or depressed morphology, are more challenging to remove with the standard polypectomy technique.
- Endoscopic mucosal resection (EMR) is a technique of removal of these lesions and was originally described and popularized in Japan for the treatment of gastric and esophageal tumors. EMR tends to result in piecemeal excision of polyps which can cause difficulty with histologic diagnosis, staging, and evaluation of margins, and is associated with higher rates of complications (e.g., perforation) than standard colonoscopy.
- A solution is injected into the submucosa beneath the lesion to elevate the mucosal layer on a submucosal fluid cushion providing a safety zone for snare resection. Many different solutions have been used for injection. Once the lesion is raised, snare polypectomy is performed. For large lesions, piecemeal polypectomy is invariably required.
- The cap-assisted technique (EMRC) is another method used which involves a cap with a lip on the distal end. A snare is positioned around the lip of the cap, and then the target mucosa is suctioned into the cap. Once the tissue is aspirated, the snare is then closed around the tissue (Figs. 5.1 and 5.2).
- EMR is limited by the difficulty in determining which lesions are likely to be confined to the mucosa. In a prospective, multicenter cohort, risk factors for submucosal invasion were Paris classification 0-IIa+c morphology, nongranular surface morphology, and Kudo pit pattern type V (Tables 5.1 and 5.2). The presence of multiple risk factors magnified the risk of submucosal invasion. EMR was attempted on
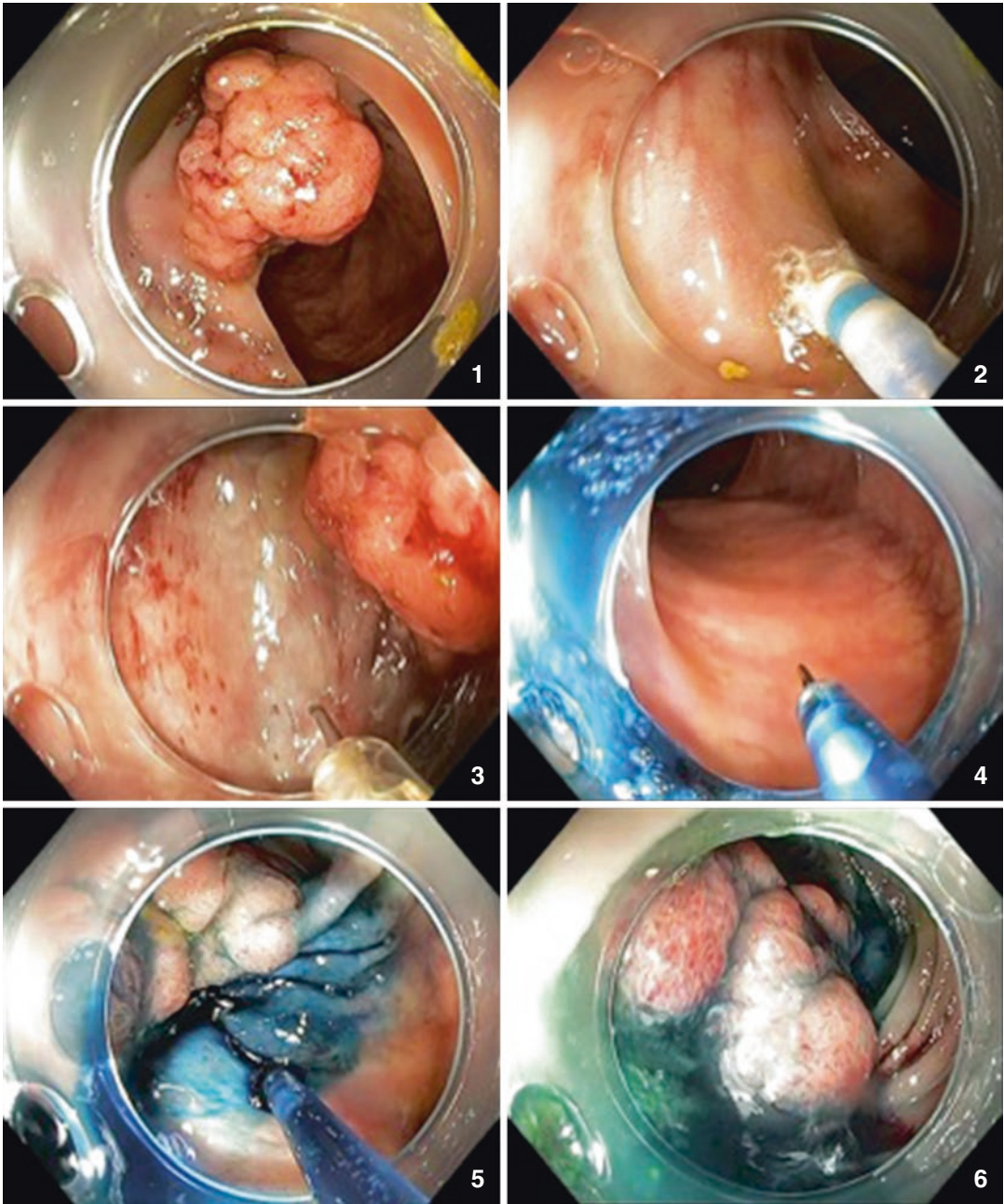
Fig. 5.1 Illustration of piecemeal endoscopic mucosal resection. (1–6) Mucosal lift by submucosal injection of Indigo carmine

464 patients and successful in 89% of patients, and risk factors for failure included a prior attempt at difficult position and ileo-cecal valve involvement.

- EMR is effective and practical with good outcomes (Table 5.3). When performed by experts, greater than 90% of referred polyps are removed endoscopically with
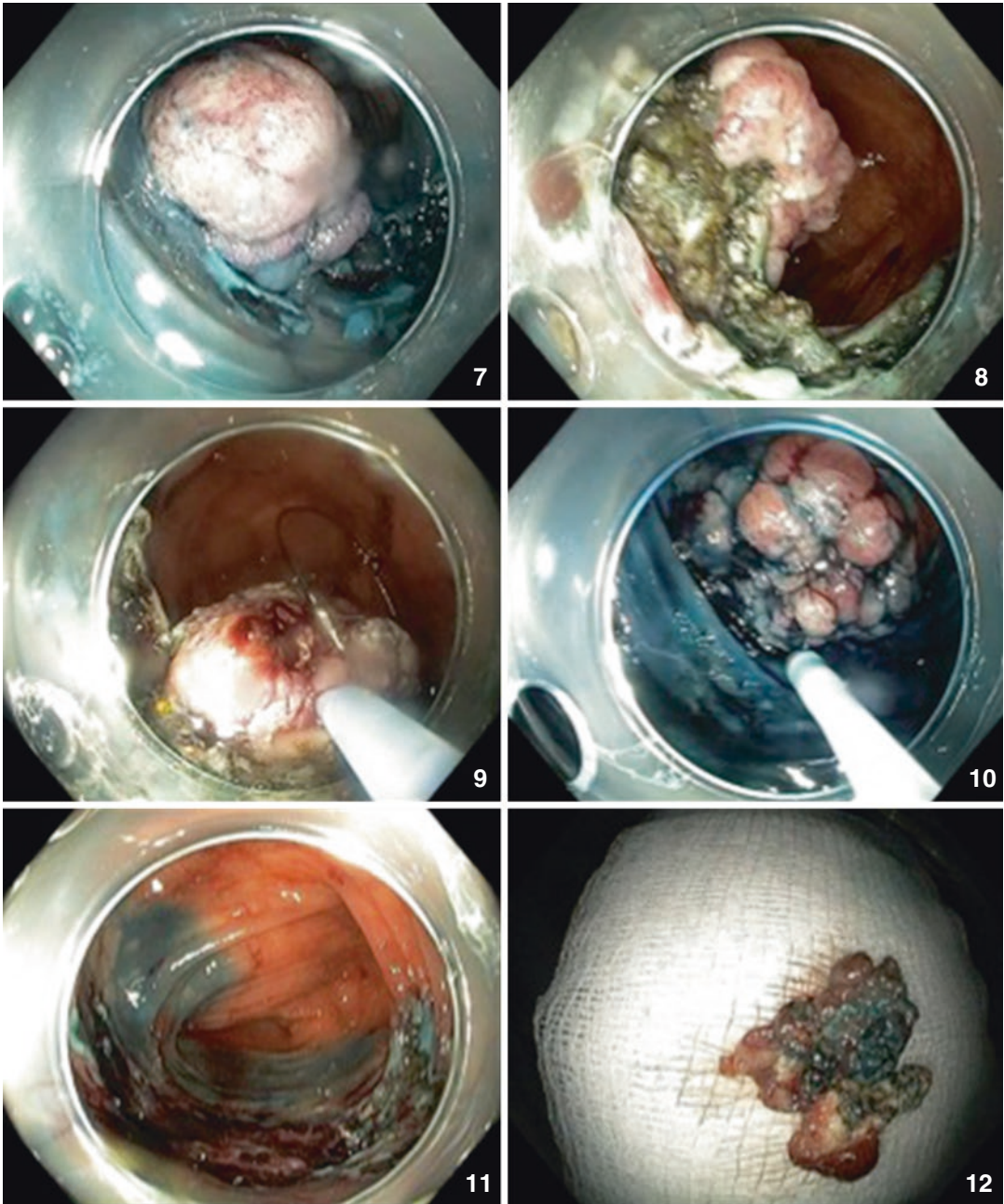
Fig. 5.2 Illustration of piecemeal endoscopic mucosal resection. (7–10) Piecemeal hot snare polypectomy. (11) Intact muscularis. (12) Removed specimen

approximately 44% of lesions are removed en bloc.

- Intraprocedural bleeding occurs in about 8% of patients, post-procedural bleeding in 0–1%, and perforation in 1–2%.

- Local recurrence after EMR is variable and reported in up to 27% of cases and can be managed endoscopically in 93% of cases.
- Risk factors for recurrence are lesion size >4 cm, use of argon plasma coagulation to

Table 5.1 Paris classification

Pedunculated	Ip
Subpedunculated	Isp
Sessile, higher than height of closed forceps (2.5 mm)	Is
Slightly elevated, below height of closed forceps (2.5 mm)	IIa
Completely flat lesion, does not protrude above mucosal surface	IIb
Slightly depressed, lower than mucosa but depth <1.2 mm	IIc
Excavated/ulcerated, deep ulcer below mucosa below 1.2 mm	III

Table 5.2 Kudo pit pattern

Pit pattern type	Characteristics
I	Round pits
II	Stellar or papillary pits
III S	Small tubular or round pits (smaller than type I pits)
III L	Large tubular or round pits (larger than type I pits)
IV	Branch-like or gyrus-like pits
V	Irregular or nonstructured pits (absence of pit pattern)

- ablate adenomatous tissue, intraprocedural bleeding, granular appearance, distal rectal location, lesion, and distal rectal lesions.
- Incomplete resection and resections with deep positive margins should be considered for surgery.

Endoscopic Submucosal Dissection

- The technique of endoscopic submucosal dissection (ESD) developed for en bloc resection for large and ulcerative lesions in the stomach has been widely accepted in Japan for the treatment of early gastric cancer.
- Compared with EMR, ESD has the advantage of permitting an en bloc and, therefore, histologically complete resection with fewer limitations on size, location, and fibrosis. These advantages come at the cost of an increased risk of perforation, bleeding, and a longer procedure time as compared with EMR.

- A major difference between surgical resection and endoscopic resection is the absence of lymph node dissection; therefore endoscopic resection should only be considered in lesions that have an insignificant risk of lymph node metastasis.
- This technique is indicated when an en bloc resection cannot be done with EMR or polyps with intramucosal to shallow submucosal invasion. Experience with ESD outside of Japan is still limited.
- The technique of ESD is similar to EMR in that it involves a single channel scope and submucosal injection. The border of the lesion may first be marked out by injecting dye or scoring the mucosa with electrocautery. A variety of solutions have been used for submucosal injection, but the most common are normal saline, glycerol, and hyaluronic acid.
- Once the lesion is lifted, specialized endoscopic knives help to dissect out the lesion (Fig. 5.3). There are a variety of electrocautery knives available, but the two traditional types are needle knives and insulated-tip knives. Management of bleeding is important for the procedure to be successful and is accomplished using either monopolar or bipolar coagulation forceps.
- ESD has a long learning curve.
- Compared with gastric lesions, ESD in the colon and rectum is more difficult due to anatomic features (thin wall, peristalsis, folds), and the position of the endoscope is less stable especially outside of the rectum.
- Successful en bloc resection may be as low as 60% in initial cases but increases up to 88–97% with experience. Similarly, R0 resection rate improves with experience and is reported as high as 96%.
- Bleeding occurs in 1.5–7.9% and perforation in up to 10.7% of cases (Table 5.4).
- Frequently, complications are successfully treated with endoscopic clipping.

Surveillance after ESD is case dependent but aims to detect residual disease or recurrent disease early.

Table 5.3 Endoscopic mucosal resection

Author	Year	Polyps	Polyp size, cm	Macroscopic classification	Operating time, min	En bloc resection, %	LOS, day	Leakage/ fistula, %	Postoperative bleeding %	Cancer %	Depth	Recurrence %
Gomez	2014	131	3.3	NA	NA	27	NA	3	2.3	7.6	Unknown	17
Maguire	2014	269	2.8	NA	NA	0	NA	1.3	3	16	Tis, 6.3%; T1, 9.3%	24
Knabe	2013	252	>2.0	Paris	NA	12	NA	1.6	1.6	3.2	Unknown	22
Buchner	2012	315	2.3	Paris	NA	54	<1	0.4	7.2	4.4	Unknown	27
Conio	2004	139	2.0	NA	NA	0	NA	0	0	12.2	Tis, 6; T1, 3; T2, 1	21.9
Stergiou	2002	68	>3.0	Sessile/ pedunculated	NA	38	NA	0	4	10	Unknown	29

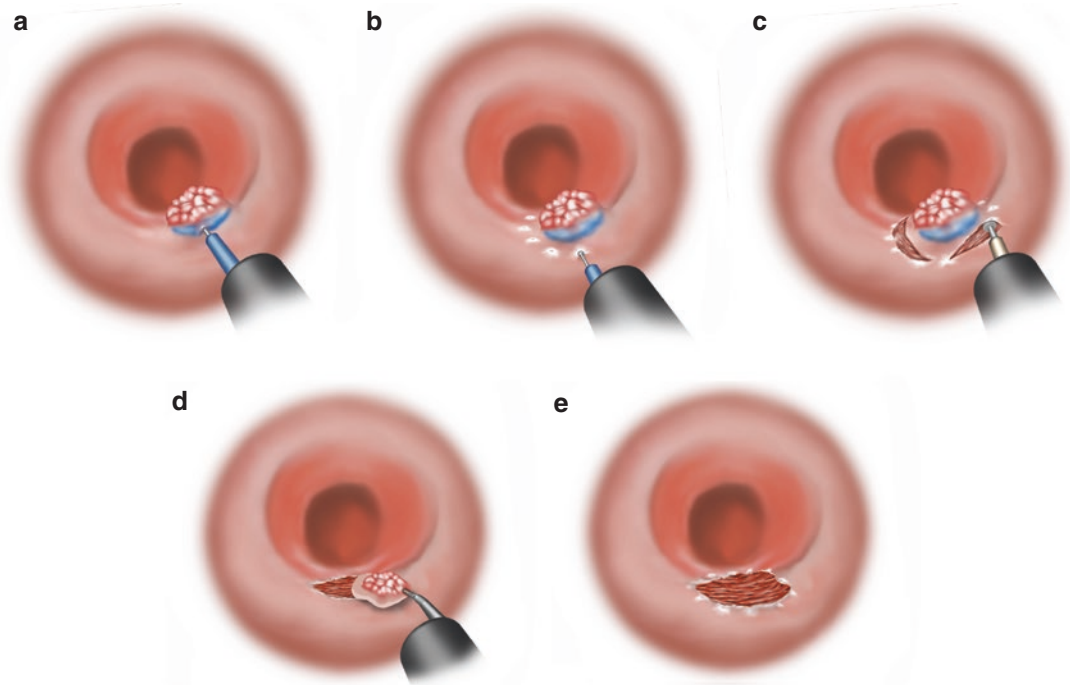*LOS* length of stay, *Tis* carcinoma in situ, *NA* not available

Fig. 5.3 Steps of endoscopic submucosal dissection. (**a**) Submucosal injection. (**b**) Marking of the resection margin. (**c**) Submucosal dissection using a needle knife. (**d**) Extraction of specimen. (**e**) Intact muscularis

Combined Endo-Laparoscopic Surgery (CELS)

- As previously discussed, large polyps or polyps within or behind a haustral fold can be very challenging to remove endoscopically. Although EMR and ESD are performed for these polyps, these techniques are not widely available and require a high level of technical skill. Traditionally, the most common recommendation for these patients has been segmental colectomy – an oncologic resection. Although the laparoscopic approach can minimize the morbidity associated with colectomy, only a minority of the colon resections performed in the United States are being done laparoscopically. Furthermore, even if a minimally invasive approach is used, it still entails a major abdominal operation with associated morbidities. Combined endo-laparoscopic surgery (CELS) has been described as an alternative to bowel resection in select patients.

- Laparoscopic-assisted polypectomy was first described in 1993, and larger retrospective studies have since been published.
- There are several ways in which laparoscopic assistance during colonoscopic polypectomy can be helpful: (1) the underlying colon can be invaginated to assist in snaring of a flat polyp, (2) laparoscopic mobilization of flexures and angulated colon can provide better access and exposure, and (3) full-thickness injury to the colon can be detected and repaired laparoscopically.
- Simultaneous performance of laparoscopy and colonoscopy can often present a technical challenge, but the use of carbon dioxide (CO_2) for insufflation during colonoscopy has been shown to be safe and can remedy this issue since CO_2 gas is absorbed approximately 150 times faster than room air.
- Several published studies have similarly addressed this combined technique, considering it a safe and effective method to avoid colectomy and remove difficult polyps in many cases (Table 5.5). One of the largest

Table 5.4 Endoscopic submucosal dissection

Author	Year	Polyps	Polyp size, cm	Macroscopic classification	Operating time, min	En bloc resection	LOS, day	Perforation, %	Postoperative bleeding %	R0 resection rate, %	Cancer %	Depth	Recurrence %
Saito	2014	900	3.7	Paris	60	91	NA	2.7	1.7	87	74	Unknown	NA
Toyonaga	2014	468	3	NA	60	99	NA	1.5	1.5	NA	66	Tis: 49%; T1: 17%; T2: 0.4%	NA
Lee	2013	874	2.7	Sessile/pedunculated	54	97	3.5	5.3	0.5	91.2	43	Tis: 28%; T1: 15%; T2: 0.2%	0.4
Yoshida	2013	530	3.1	Protruding/superficial	93	91	NA	4.1	2.3	NA	54	Tis: 41%; T1: 12%	NA
Nakamura	2014	300	3.0	LST/non-LST	90	91.7	5	1.7	5	91	99	M-SM-s: 92%; SM-d: 7%	NA

LOS length of stay, *NA* not available, *Tis* carcinoma in situ, *M-SM-s* mucosal or shallow submucosal invasion <1000 mcm from the muscularis mucosae, *SM-d* >1000 mcm of submucosal invasion

Table 5.5 Combined endo-laparoscopic surgery

Author	Year	Patients	Polyps	Polyp size, cm	Frozen section	Operating time, min	Intraoperative complications, %	Postoperative complications, %	Mortality, %	LOS (days)	Tis, %	Submucosal cancer, %	Successful endoscopic resection, %	Conversion to open surgery, %	Prognosis, m = months
Goh	2014	30	30	1.4	–	105 (75–125)	0	13.3	0	2.0	HGD 26.7	6.7	73	0	No recurrence at 20 m
SW Lee	2013	75	75	3 (1–7)	If needed	145 (50–249)	0	9.2	0	1	HGD 9.3	6.7	74	3	10% recurrence at 65 m
Wood	2011	13	16	3 (2–5)	All	NA	0	15	0	2	7.7		77	0	NA
Grunhagen	2011	11	12	2 (0.6–4.5)	–	45 (15–80)	0	18.1	0	1	9	0	82	0	No recurrences at 11 m
Cruz	2011	25	25	2.4 (1–4)	–	92.7 (60–145)	0	8	0	1.5	8	4	76	0	NA
Agrawal	2010	19	19	0.6–6	All	35.3–37	0	5.6	0	0–14	5.3		58	NA	No recurrences at 3 m
Wilhelm	2009	146	154	NA	–	100 (40–272)	1	25	0.7	8	11		73	5	Local recurrence of adenoma 0.9% at 35 m
Franklin	2009	176	251	3.7 (2–6)	All	96.5	0	10	0	1.1	10.2		91	0	No recurrences at 65 m

NA not available, *HGD* high-grade dysplasia, *Tis* carcinoma in situ, *LOS* length of stay

studies to date was reported by Franklin and Portillo describing the technique of laparoscopic-monitored colonoscopic polypectomy in 176 patients with excision of 251 polyps. The procedure was performed successfully in all but four patients (97.8%). This study was an update of two previous publications from their group in 2000 and 2007. In their practice, all specimens were sent for frozen section, and ultimately, 18 (10.2%) patients required colectomy for cancer.

- Overall, technical success rates for CELS are consistently reported between 74% and 97%. Postoperative complications are typically minor and less than 5%. Recurrence rates are low, reported in 10–15%, and can typically be approached endoscopically or with CELS.