J Minim Invasive Surg Sci. 2017 November; 6(4):e57142. doi: 10.5812/minsurgery.57142.

Published online 2017 December 2. **Review Article**

Combined Endoscopic Laparoscopic Surgery (CELS): A Mini Review

Ali Solouki,[1] Alireza Khalaj,[2] and Abdolreza Pazouki[1,*]

[1]Minimally Invasive Surgery Research Center, Iran University of Medical Sciences, Tehran, Iran
[2]Tehran Obesity Treatment Center, Department of Surgery, Shahed University, Tehran, Iran

[*]*Corresponding author*: Abdolreza Pazouki, Minimally Invasive Surgery Research Center, Iran University of Medical Sciences, Tehran, Iran. E-mail: apazouki@yahoo.com

Received 2017 June 01; **Revised** 2017 June 28; **Accepted** 2017 July 26.

Abstract

Colon polyps are a relatively common problem which necessitates a colonoscopic polypectomy. It has its own limitations in surgery. Sessile or large polyps or those at unavailable section (ie: in mesenteric border of colon) are not suitable for a colonoscopic approach for excision. Furthermore, in colonoscopic resection, there is a frustrating risk of a colon wall perforation that not diagnosed intraoperatively. By the help of Combined Endoscopic Laparoscopic Surgery (CELS), a more aggressive polypectomy could be done while the colon wall monitored intraoperatively via laparoscopy and there is an appropriate possibility of colon wall repair if any perforation had occurred .This is a new method in diagnostic and curative surgical approaching to nonmalignant colon lesion that needs a coherent cooperation between laparoscopy and colonoscopy for performing a safe colonoscopic polypectomy.

Keywords: Endolaparoscopic Surgery, Colon Polyps, Hybrid Surgery, Mini Review

1. Introduction

Progression in all fields of surgery, especially in minimally invasive surgery (MIS), due to apparent benefits of MIS has been occurred significantly (1). Most of the colon polyps that are benign or have low malignancy potential are candidates for endoscopic (or colonoscopic) resection. However, there are some limitations in colonoscopic resection of such lesions. Large polyps in colon or those located in some specific positions (ie: haustral folds) are very difficult for endoscopic resection with clear margins. Moreover, there is a considerable potential for spreading the malignant cells if there is any of them (2, 3). This review is performed to study about the indications and employed techniques in colon hybrid surgeries.

2. Indication

Many large polyp resections are complicated by crucial bleedings which are very problematic in pure endoscopic control .In addition; there is always a concern of a transmural colonic damage that can expose the peritoneal cavity to be contaminated with colonic contents. In some cases, these damages are unnoticed that can result in disastrous complications. Although some more advanced techniques like endoscopic mucosal resection (EMR) or endoscopic submucosal dissection (ESD) are invented, these methods are not widely available and do not provide a satisfactory solution for some lesions (2, 3).

Regarding these issues, the commonest approach for these kind of lesions eventuate to a surgical segmental colectomy, providing exact location of the lesion is specified by colonoscopic means. This approach will be accompanied by a laparotomy which has its own problems. In addition to wound complications and pulmonary side effects, there is a lifetime risk for bowel obstruction due to intra-abdominal adhesion formation after any laparotomy. There are many studies that demonstrate laparoscopic colectomy in comparison to open colectomy results in quicker recovery and less pain in short postoperative period while oncological outcomes are the same (4).

However, laparoscopic colectomy is a technical demanding operation that most surgeons are not capable of performing it and it is the main reason that a small percentage of colon resections are being performed laparoscopically. In conclusion, combined endo-laparoscopic surgery (CELS) is developed for endoscopic colon polyps resection (5-11).

First cases of laparoscopy assisted colonoscopic polypectomy is reported in 1993 by David E. Beck and Richard E. Karulf and they concluded that Laparoscopic assisted polypectomy allows complete excision of moderate-sized sessile polyps in colon and could exclude some patients from a segmental colectomy (6). In approval of safety and efficacy of this technique, larger studies have been published by some other authors worldwide (8-11). Moreover, Winter et al. published a study in 2007 that

38 patients with colon polyps underwent a laparoscopy assisted and laparoscopy monitored colonoscopic resection and in five cases, histopathologic diagnosis showed a malignancy necessitating colonic surgery. They called it a rendezvous procedure and concluded that it's a safe, minimal-invasive diagnostic and therapeutic approach allowing the resection of benign sessile or colonoscopically inaccessible polyps and early stage colon cancer (12).

The advantages of CELS include ability to mobilize the colon to provide easier colonoscopic resection particularly in larger and flatter polyps, ability for monitoring and inspecting colon walls to ensure that there is no perforation, the ability to repair any full thickness defect if there is one, and the opportunity to immediate convert to a laparoscopic resectional operation if the lesion is not amenable to endoscopic resection or there is any suspicion of malignancy (13).

In a pretty large study published by Franklin et al., a total of 209 polyps in 160 patients from 1990 to 2008 resected and in a 65 month median follow up recurrence occurred. They named the procedure laparoscopically monitored colonoscopic polypectomy (LMCP). During this procedure, diagnosed malignant lesions can be treated laparoscopically during the same operation without the need for a second procedure, with good long-term oncologic outcome (13).

Different techniques are described including laparoscopic assisted colonoscopic resection and endoscopic-assisted laparoscopic (wedge) resection (14, 15).

Current indications for CELS include large benign colon polyps or polyps in a difficult anatomic site unaccessible for resection by colonoscopic snare polypectomy. Same polyps incompletely removed by traditional endoscopic polypectomy techniques are another indication. It is essential to have a benign pathologic report of the lesions, although polyps with high grade dysplasia can be operated. If there is other polyp in colon, it must be resectable by colonoscopy or CELS methods. Contraindications include patients with a polyposis syndrome, multiple previous abdominal surgeries causing sever adhesions and polyps that are near the ileocecal valve (5-7).

3. Preoperative Workup

After a detailed medical and surgical history and examination, the colonoscopy and pathology reports that are done previously should be reviewed. If the pathology blocks are available, they should be reviewed too. In left colon polyps, a flexible recto-sigmoidoscopy can be considered to examine and evaluate that part of colon. Other preoperative workups are the same as any other abdominal surgery like blood tests, CXR and ECG. In order to visualize the lesions properly, a full mechanical bowel preparation should be applied one a day before the operation.

Patients should be aware that a colonoscopic resection will be tried but if the lesion cannot be resected endoscopically or if there is any suspicious of malignancy, a laparoscopic colectomy will be performed. It is possible that the procedure converted to an open colectomy if it's been considered prohibitive by the surgeon. Patients have to be informed that although CELS is capable of complete removing polyps, if further pathologic studies reveal an invasive malignancy, they will need a surgical colonic resection at a later time (5-9, 12, 13).

4. Procedure

After insertion of NG-tube and a Foley catheter, in modified dorsal lithotomy position, both arms are tucked at the sides. All equipment for performing a colonoscopic resection and laparoscopic (or possibly open) colectomy should be ready. IV antibiotics and anti-thrombotic medications are injected prior to skin incision (5, 6, 11-13). Necessary equipment for CELS is listed in the following Box 1.

Box 1. Equipment Needed for CELS

Equipment Needed for CELS
Adult or pediatric colonoscope with monitor + CO_2 insufflation
Endoscopic injector needle
Endoscopic snare
Diluted Indigo carmine with saline
Suction trap
Cautery
Laparoscope with monitor
Trocars: 5 mm × 4, 10 mm × 1, and 12 mm × 1
Laparoscopic bowel graspers and scissors
Laparoscopic energy device (ie. ligasure, harmonic scalpel)
Laparoscopic linear stapler (with appropriate loads)
Endo catch bag and wound protector
Polysorb or vicryl sutures

Endoscopic equipment's vary. Surgeons may prefer to use pediatric versus an adult colonoscope (16).

5. Monitor Position

For left colon polyps, the monitors are placed at the patient's left side and toward the feet. For right colon lesions, monitors are placed on the patient's right side and toward

the head. In transverse colon or flexure lesions, the monitors are placed at the head of the bed and surgeon may stand between the patient's legs (as will the endoscopist).

6. Colonoscopy Considerations

It is necessary to have CO_2 colonoscopy available. Simultaneous laparoscopy and colonoscopy with room air can be technically challenging. Insufflation with room air will obscure the laparoscopic view and compromise exposure. Laparoscopic terminal ileum clamping to minimize small bowel distention during laparoscopy has been described, but still colonic distention alone, still is a major problem in this method. Because the bowel absorbs CO_2 gas approximately 150 times faster than room air, there is little unwanted dilation of the colon and satisfactory endoscopic and laparoscopic visualization (17). A CO_2 colonoscopy is performed for lesion localization and the lesion is marked with diluted Indigo carmin solution under and around the polyp. It is a good practice to perform colonoscopy before port insertion because some polyp, marked unresectable by a gastroenterologist, may be possible to be resected by a traditional colonoscopic polypectomy effort alone (16).

7. Port Placement

After inserting the primary 10mm trocar in periumbilical region for camera, two other 5 mm trocars are placed according to the polyp location identified in colonoscopy. RLQ port plus a suprapubic port are preferred for left colon polyps and vice versa for right colon polyps. For transvers colon lesions, both 5 mm trocars are placed in RLQ and LLQ region. If a colon resection is planned, a 12 mm trocar is placed for introducing a stapler. If a hand assisted procedure is anticipated, a Gelport can be used, otherwise it's not necessary (16).

8. Lesion Identification and Colon Mobilization

Position of polyp is confirmed with manipulating and trans illuminating the colon by laparoscopy while looking at the lesion in colonoscopy .This is particularly helpful in defining lesions in some difficult locations like polyps on retroperitoneal or mesenteric side or those obscured by a haustral fold. A lateral mobilization is helpful in these situations. For lesions at flexures, colon mobilization with some energy device is performed (5, 6, 9-13).

9. Lesion Excision

An electrosurgical snare is used for polypectomy, after adequate colon mobilization, polyp manipulation and marking it with Indigo carmin solution. It is important to notice that laparoscopic manipulation of the polyp will help it's delivery into the snare circle especially for flatter lesions. Colon wall is inspected for any full thickness injury and repair any possible perforation at the same time. Typically it is done with a seromuscular suture and if there is evidence suggesting muscular layer damage, this repair should be reinforced. In this situation, opportunity will make us capable of performing a more aggressive polypectomy without fear of a missed colon perforation (9-13).

For lesions located in cecum region, as the colon wall is very thin so it is recommended that a laparoscopic sleeve resection is a safer approach. It is very important for polyps near the ileocecal valve resection procedure to avoid injury to this structure. It is performed by a linear stapler. After polyp excision, a leak test with colonoscopic CO_2 insufflation should be done while floating the colon in saline (10).

It is very important to recognize any malignancy signs while doing a colonoscopy. In some instances, polyps are tried for biopsy or snaring previously, and some scar and fibrosis is present in or around the lesion. This will make it difficult to lift up the lesion. Such phenomenon is being seen in malignant lesions too and these two should be differentiated from each other. There are various signs suggest a potential malignant polyp like central umbilication, firm consistency of the lesion and ulceration. If these clues are present, one options is to continue CELS and a frozen section .The operation can be converted to a formal colectomy alternatively (9, 11-13, 16, 17).

10. Postoperative Care

Most studies on colon hybrid surgery report 1 - 2 days length of stay in hospital but it is in a range of 4 - 8 days in some studies. Any patient with a colon wall excision or suture repair should be monitored in hospital until the bowel movements return like other laparoscopic operations. VTE prophylaxis and early ambulation are mandatory in all patients. Post-surgical oral diet is advanced and the patient will be visited 2 weeks after surgery for pathology results and looking for possible complications (5, 6, 8, 9, 12, 13).

11. Complications

In a large study in 2013 performed by Hamadani et al. risk of colon perforation was about 1% in all colonoscopic

studies (18). With the aid of a laparoscopic endoscopic hybrid approach, any full thickness colon wall injury due to thermal injuries, barotrauma or endoscope itself will be diagnosed properly and repaired if needed. The rate of serosal suture repair is reported about 10% by Franklin et al (13). Risk of laparoscopic complications are probably similar to other laparoscopic abdominal procedure and potentially even less than them,if no mobilization of the colon is required. Franklin reported a 9 % postoperative complication rate, with all complications being minor and mostly consisting of ileus, atelectasis, and seroma (13).

12. Conclusion

- Combined endo-laparoscopic surgery (CELS) is indicated for benign colon polyps that are not amenable to endoscopic removal.

- With CO_2 colonoscopy, exact location of the polyp identified and marked with diluted Indigo carmin solution.

- The colon wall near the polyp is manipulated laparoscopically to facilitate snare polypectomy.

- Colon wall repair should be examined by leak test.

- Laparoscopic wall excision may be necessary in some locations like near ileocecal valve.

- The procedure will be converted to a laparoscopic colectomy if findings are indicative of a malignancy. Also in post-operative period, in spite of a successful CELS operation, if the final pathology reveals a cancerous polyp, colectomy should be performed.

References

1. Kermansaravi M, Pazouki M, Darabi S, Eghbali F. New techniques and challenges in minimally invasive surgeries; highlights of 12th international congress of minimally invasive surgeries and techniques (MISTIC 2016-Tehran). *J Minimal Invasive Surg Sci*. 2017;**6**(1). doi: 10.5812/minsurgery.45032.
2. Fujishiro M, Goto O, Kakushima N, Kodashima S, Muraki Y, Omata M. Endoscopic submucosal dissection of stomach neoplasms after unsuccessful endoscopic resection. *Dig Liver Dis*. 2007;**39**(6):566–71. doi: 10.1016/j.dld.2007.01.026. [PubMed: 17382610].
3. Zhou PH, Yao LQ, Qin XY. Endoscopic submucosal dissection for colorectal epithelial neoplasm. *Surg Endosc*. 2009;**23**(7):1546–51. doi: 10.1007/s00464-009-0395-5. [PubMed: 19263116].
4. Guller U, Jain N, Hervey S, Purves H, Pietrobon R. Laparoscopic vs open colectomy: outcomes comparison based on large nationwide databases. *Arch Surg*. 2003;**138**(11):1179–86. doi: 10.1001/archsurg.138.11.1179. [PubMed: 14609864].
5. Franklin MJ, Diaz E, Abrego D, Parra-Davila E, Glass JL. Laparoscopic-assisted colonoscopic polypectomy: the Texas Endosurgery Institute experience. *Dis Colon Rectum*. 2000;**43**(9):1246–9. [PubMed: 11005491].
6. Beck DE, Karulf RE. Laparoscopic-assisted full-thickness endoscopic polypectomy. *Dis Colon Rectum*. 1993;**36**(7):693–5. [PubMed: 8348855].
7. Ommer A, Limmer J, Mollenberg H, Peitgen K, Albrecht KH, Walz MK. [Laparoscopic-assisted colonoscopic polypectomy–indications and results]. *Zentralbl Chir*. 2003;**128**(3):195–8. doi: 10.1055/s-2003-38531. [PubMed: 12695924].
8. Lee SW, Garrett KA, Shin JH, Trencheva K, Sonoda T, Milsom JW. Dynamic article: long-term outcomes of patients undergoing combined endolaparoscopic surgery for benign colon polyps. *Dis Colon Rectum*. 2013;**56**(7):869–73. doi: 10.1097/DCR.0b013e3182821e58. [PubMed: 23739193].
9. Lee MK, Chen F, Esrailian E, Russell MM, Sack J, Lin AY, et al. Combined endoscopic and laparoscopic surgery may be an alternative to bowel resection for the management of colon polyps not removable by standard colonoscopy. *Surg Endosc*. 2013;**27**(6):2082–6. doi: 10.1007/s00464-012-2714-5. [PubMed: 23306590].
10. Yan J, Trencheva K, Lee SW, Sonoda T, Shukla P, Milsom JW. Treatment for right colon polyps not removable using standard colonoscopy: combined laparoscopic-colonoscopic approach. *Dis Colon Rectum*. 2011;**54**(6):753–8. doi: 10.1007/DCR.0b013e3182108289. [PubMed: 21552062].
11. Wilhelm D, von Delius S, Weber L, Meining A, Schneider A, Friess H, et al. Combined laparoscopic-endoscopic resections of colorectal polyps: 10-year experience and follow-up. *Surg Endosc*. 2009;**23**(4):688–93. doi: 10.1007/s00464-008-0282-5. [PubMed: 19169747].
12. Winter H, Lang RA, Spelsberg FW, Jauch KW, Huttl TP. Laparoscopic colonoscopic rendezvous procedures for the treatment of polyps and early stage carcinomas of the colon. *Int J Colorectal Dis*. 2007;**22**(11):1377–81. doi: 10.1007/s00384-007-0345-4. [PubMed: 17646999].
13. Franklin MJ, Leyva-Alvizo A, Abrego-Medina D, Glass JL, Trevino J, Arellano PP, et al. Laparoscopically monitored colonoscopic polypectomy: an established form of endoluminal therapy for colorectal polyps. *Surg Endosc*. 2007;**21**(9):1650–3. doi: 10.1007/s00464-007-9237-5. [PubMed: 17318689].
14. Feussner H, Wilhelm D, Dotzel V, Papagoras D, Frimberger E. Combined endoluminal and endocavitary approaches to colonic lesions. *Surg Technol Int*. 2003;**11**:97–101. [PubMed: 12931289].
15. Le Picard P, Vacher B, Pouliquen X. [Laparoscopy-assisted colonic polypectomy or how to be helped by laparoscopy to prevent colectomy in benign colonic polyps considered to be unresectable by colonoscopy]. *Ann Chir*. 1997;**51**(9):986–9. [PubMed: 10868040].
16. Garrett KA, Lee SW. Combined Endoscopic and Laparoscopic Surgery. *Clin Colon Rectal Surg*. 2015;**28**(3):140–5. doi: 10.1055/s-0035-1555005. [PubMed: 26491405].
17. Nakajima K, Lee SW, Sonoda T, Milsom JW. Intraoperative carbon dioxide colonoscopy: a safe insuffl ation alternative for locating colonic lesions during laparoscopic surgery. *Surg Endosc*. 2005;**19**(3):321–5.
18. Hamdani U, Naeem R, Haider F, Bansal P, Komar M, Diehl DL, et al. Risk factors for colonoscopic perforation: a population-based study of 80118 cases. *World J Gastroenterol*. 2013;**19**(23):3596–601. doi: 10.3748/wjg.v19.i23.3596. [PubMed: 23801860].