Seminars in Colon and Rectal Surgery 30 (2019) 100686

Contents lists available at ScienceDirect

Seminars in Colon and Rectal Surgery

journal homepage: www.elsevier.com/locate/yscrs

Management of colonoscopic perforation

Carey Wickham, MD, Kasim L. Mirza, MD, Sang W. Lee, MD*

Costello Chair of Colorectal Diseases, Professor and Chief of Colon and Rectal Surgery, Keck School of Medicine, University of Southern California, USA

ARTICLE INFO

Keywords:
Perforation
Colonoscopy
Endoscopy
Combined endoscopic and laparoscopic surgery
Laparoscopy

ABSTRACT

Colonoscopy is increasingly utilized for colorectal cancer screening, diagnosis of colorectal pathologies and therapeutic interventions for benign and malignant conditions. Perforation is a rare but morbid complication of colonoscopy. Management of colonoscopic perforation has evolved in parallel with advances in minimally invasive techniques to include nonoperative, endoscopic, and laparoscopic options. Endoscopic management has high success rates for select patients with small perforations diagnosed at the time of colonoscopy. Laparoscopic repair is associated with significantly decreased complications and hospital length of stay (LOS) compared to open repair. Smaller perforations diagnosed at the time of colonoscopy may be managed with endoscopic repair, while larger perforations or failed endoscopic repair should be managed with laparoscopy. Delayed presentation of colonoscopic perforation with fecal spillage or hemodynamic instability continue to warrant laparotomy.

Introduction

Colonoscopy is increasingly performed for colorectal cancer screening, as well as diagnosis and treatment of a variety of different colonic pathologies including benign polyps, inflammatory bowel disease, strictures, complications of diverticular disease and malignancy. Iatrogenic perforations resulting from colonoscopy occur most commonly in the sigmoid colon.[1-3] The incidence of iatrogenic perforation is very low for both diagnostic (0.01–0.8%) and therapeutic colonoscopy (0.02–3%).[5-10] Higher rates of iatrogenic colonoscopic perforation of 1.4% and 5.7% have been reported with use of the advanced endoscopic techniques, endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD), respectively.[11] Colonoscopic perforation can have serious consequences for patients with some studies reporting morbidity rates of up to 55%.[12] The management of iatrogenic colon perforation presents multiple options for optimizing patient safety and recovery. Traditionally, iatrogenic colon perforations have been managed by early laparotomy, primary repair or resection of the involved segment of bowel, and peritoneal lavage to address any spillage.[5] Initial management of iatrogenic perforations now frequently consists of endoscopic and laparoscopic methods, fueled largely by advancements in technology and surgeons' greater mastery of minimally invasive techniques. Depending on the endoscopic accessibility of the injury, the timing of the diagnosis of a perforation, and the subsequent clinical condition of the patient, there is evidence supporting primary management with minimally invasive approaches (Fig. 1).

Endoscopic management

Iatrogenic colon perforation identified at the time of colonoscopy is increasingly managed with endoscopic repair. Endoscopic metal clips (endoclips) are successfully used for endoluminal hemostasis or mucosal approximation after endoscopic polypectomy. Endoclips are the most frequently described endoscopic technique in management of iatrogenic colon perforation.[2,3,8,13,14] These metal clips are approximately 11 mm in diameter but do come in various sizes. Small anatomically accessible perforations detected at the time of endoscopy can be closed using endoclips, beginning at the lateral edges of the perforation with the final clips placed at the center of the perforation. Multiple studies have shown greater success at endoscopic repair using endoclips for smaller perforations (<1.5–2.0 cm).[2,3,8] Suction can also be used to facilitate successful approximation of the mucosa and submucosa prior to the application of clips, when managing larger perforations. Clinical success rates for endoscopic closure of colonoscopic perforations range from 81.7% –91% in the literature.[2,3,8] Endoscopic repair is associated with decreased hospital LOS and complications.[13,14] Inpatient observation is critical after attempted clip closure, to monitor patients for signs of clinical deterioration or peritonitis. One study reported a 13.6% rate of abscess formation after closure of perforations with endoclips.[8] Compared to endoclips, less information is available regarding the use of over-the-scope-clips (OTSCs), which can close defects up to 2 cm.[15] The major limitations for using OTSCs to close colonoscopic perforations are the inability to close larger defects and the difficulty in removing the OTSCs in cases of suboptimal closure of the perforation.[16]

Endoscopic suturing can also be used for repair of perforations during colonoscopy and has been described in the literature with

* Corresponding author.
E-mail address: sangwl@med.usc.edu (S.W. Lee).

https://doi.org/10.1016/j.scrs.2019.100686
1043-1489/

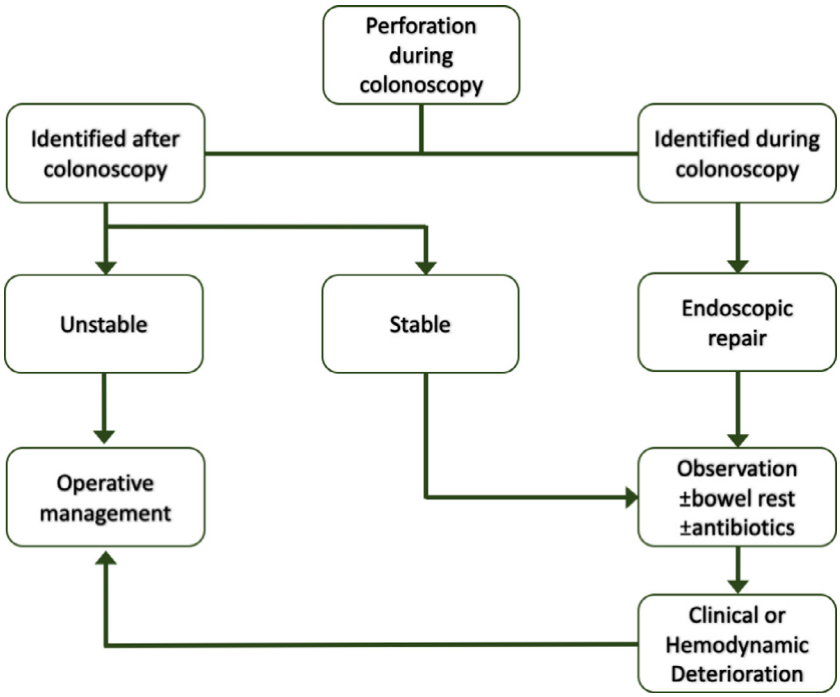

Fig. 1. Management algorithm for colonoscopic perforation.

success rates up to 100%.[16-17] The technique has been described in several small studies using an endoscopic suturing device to close perforations in full-thickness bites. Arguably, endoscopic clips may be quicker to apply, however, for the advanced practitioner experienced with endoscopic suturing, mean suturing time of 13.4 ± 9.1 min per patient has been reported.[17] This is comparable to the 5–15 min repair time reported in the literature for endoscopic clip repair.[3]

Nonoperative endoscopic management of colon perforation can be highly successful, however, a low threshold for surgical intervention must be maintained. As many as 10–18% of perforations closed with endoscopic clips may ultimately require surgery.[3,10] The signs and symptoms that should prompt early conversion to operative therapy within 24 h of perforation include large perforation, leukocytosis, fever, severe abdominal pain, and large volume peritoneal free air.[8] Endoscopic repair of iatrogenic colon perforation is a successful strategy for managing small perforations identified at the time of colonoscopy.

Conservative management

Nonoperative management for iatrogenic perforation in select patients has been described with successful outcomes.[4,7,18-21] There are a handful of studies reporting successful nonoperative management based on retrospective analyses. Patients selected for nonoperative management were characterized by delayed presentation with perforation diagnosed by radiography or CT scan, hemodynamic stability, and absence of peritonitis. None of these small studies report mortality after nonoperative management, however, a low threshold for conversion to surgical intervention should be maintained for clinical or hemodynamic deterioration. One study demonstrated 0% mortality but reported an 11% conversion rate to surgical management even in carefully selected patients.[7] Significantly higher complication rates and longer hospital LOS are reported in patients who undergo surgery after failure of conservative management compared with patients initially managed with surgery.[8] In carefully selected patients with delayed presentation of iatrogenic colon perforation, conservative nonoperative management with serial abdominal exams, bowel rest, and antibiotics may be attempted.

Laparoscopic management

Conventional laparoscopy is effective for the management of iatrogenic colon perforations resulting from colonoscopy. Indications for laparoscopic intervention for iatrogenic perforations include large perforations identified during colonoscopy, perforations not anatomically amenable to endoscopic repair, delayed diagnosis in a

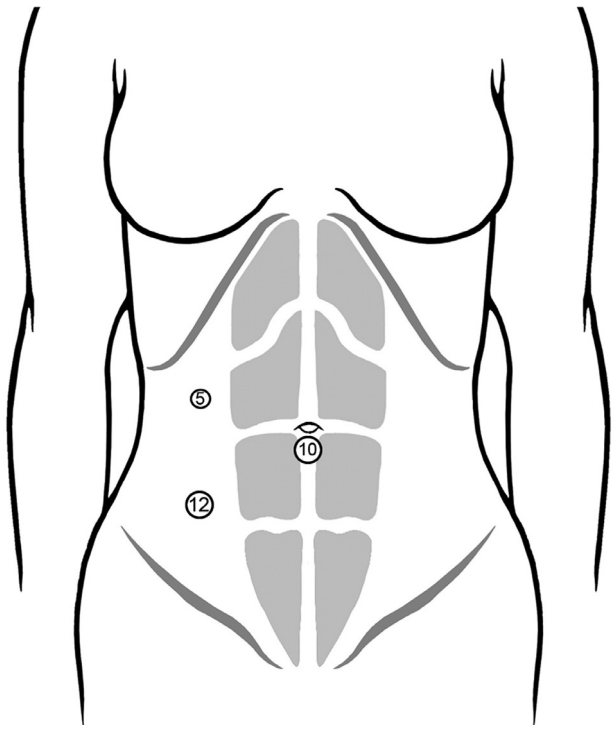

Fig. 2. Port placement for laparoscopic repair of iatrogenic perforation.

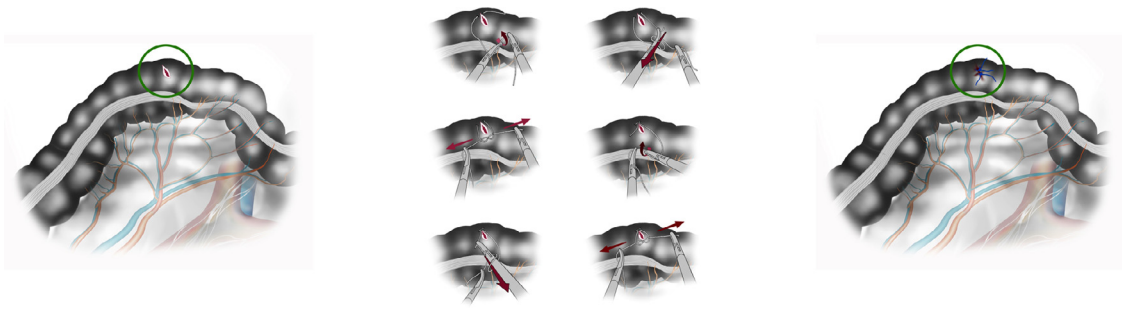

Fig. 3. Laparoscopic suture repair.

hemodynamically stable patient, or clinical deterioration of patients initially managed endoscopically. After identification of colonoscopic perforation and transfer of the patient to the operating room, localization of the defect can be performed under direct visualization by colonoscopic and laparoscopic rendezvous.[22] With suspected injury, an air leak test can easily be performed for confirmation of location and presence of a full-thickness defect.[23] Port placement will be determined by the location of the injury, most commonly targeting the left lower abdomen (Fig. 2). Perforation can be repaired using various techniques under endoscopic surveillance, including primary laparoscopic suture repair (Fig. 3), over-sewing of the serosa after endoscopic clip repair, and laparoscopic stapled wedge resection.[23-25] Segmental resection can be performed when the defect is not amenable to laparoscopic repair. Primary laparoscopic suture repair following endoscopic localization has been reported with up to 100% success rates in the literature.[22] Multiple studies demonstrate significantly lower rates of complications with laparoscopic repair compared to open repair as well as significantly decreased hospital LOS.[22,26-28] The mortality and re-intervention rates remain equivalent regardless of whether laparoscopy or laparotomy is performed.[10,27] These trends were also observed in patients who failed initial endoscopic management and required surgical repair, with shorter hospital LOS observed in the patients managed laparoscopically.[8] While it is preferable to attempt laparoscopic repair because of the decreased incidence of complications and the shorter postoperative hospitalization, open operative management is required in cases of hemodynamic instability and concern for significant fecal contamination.

Open management

Open repair with laparotomy is reserved for larger perforations that fail minimally invasive management, delayed recognition of injury with hemodynamic instability, or concern for significant fecal contamination. Optimal open management strategy depends on the delay from perforation to operation, the tissue quality of the involved segment of colon, the location of the perforation, and perioperative clinical status. Strategies include primary repair, bowel resection with or without primary anastomosis, and fecal diversion.[1,7,14] A retrospective review of 35 colonoscopic perforations, all treated with laparotomy, demonstrated that primary repair was most commonly performed (56%), followed by resection with anastomosis (25%), and resection without anastomosis (19%). A complicated postoperative course followed in 14 patients (40%) with 3 (8.6%) mortalities.[1] In a more recent retrospective study comparing laparoscopic and open management of colonoscopic perforation, open operations were performed for 32% of colonoscopic perforations, of which Hartmann's operation was the most common, and there were no mortalities.[27] As surgical endoscopists gain more skill and familiarity with colon-preserving minimally invasive endoscopic and laparoscopic techniques, laparotomy will increasingly be reserved for delayed presentation of perforation in hemodynamically unstable patients.

Conclusion

Perforation is a rare complication of colonoscopy, but it carries a significant morbidity risk. Management should be based on when the perforation is diagnosed, the size of the perforation, the hemodynamic and clinical condition of the patient, and the comfort of the endoscopist with minimally invasive endoscopic and laparoscopic techniques. Endoscopic repair with conservative nonoperative management may be attempted for small perforations identified at the time of colonoscopy. Laparoscopic repair is appropriate for larger perforations diagnosed at the time of colonoscopy, for perforations diagnosed after colonoscopy without significant fecal spillage or hemodynamic instability, or for clinical deterioration after endoscopic repair. Patients with delayed diagnosis of perforation with significant fecal spillage and hemodynamic instability merit open surgical management.

References

1. Luning TH, Keemers-Gels ME, Barendregt WB, et al. Colonoscopic perforations: a review of 30,366 patients. *Surg Endosc*. 2007;21:994–997.
2. Kim JS, Kim BW, Kim JI, et al. Endoscopic clip closure versus surgery for the treatment of iatrogenic colon perforations developed during diagnostic colonoscopy: a review of 115,285 patients. *Surg Endosc*. 2013;27:501–504.
3. Hassan MA, Thomsen CØ, Vilmann P. Endoscopic treatment of colorectal perforations–a systematic review. *Dan Med J*. 2016;63(4) pii: A5220.
4. Cobb WS, Heniford BT, Sigmon LB, et al. Colonoscopic perforations: incidence, management, and outcomes. *Am Surg*. 2004;70(9):750–757.
5. Iqbal CW, Chun YS, Farley DR. Colonoscopic perforations: a retrospective review. *J Gastrointest Surg*. 2005;9:1229–1235.
6. Panteris V, Haringsma J, Kuipers E, et al. Colonoscopy perforation rate, mechanisms and outcome: from diagnostic to therapeutic colonoscopy. *Endoscopy*. 2009;41:941–951.
7. Lin CI, Wang JH, King TM, et al. Incidence and management of iatrogenic colonoscopic perforations. *J Soc Colon Rectal Surgeon (Taiwan)* 2010;53–57.
8. Cho SB, Lee WS, Joo YE, et al. Therapeutic options for iatrogenic colon perforation: feasibility of endoscopic clip closure and predictors of the need for early surgery. *Surg Endosc*. 2012;26:473–479.
9. Shi X, Shan Y, Yu E, et al. Lower rate of colonoscopic perforation: 110,785 patients of colonoscopy performed by colorectal surgeons in a large teaching hospital in china. *Surg Endosc*. 2014;28:2309–2316.
10. Martínez-Pérez A, de'Angelis N, Brunetti F, et al. Laparoscopic vs. open surgery for the treatment of iatrogenic colonoscopic perforations: a systematic review and metaanalysis. *World J Emerg Surg*. 2017;12:8.
11. Fujiya M, Tanaka K, Dokoshi T, et al. Efficacy and adverse events of EMR and endoscopic submucosal dissection for the treatment of colon neoplasms: a meta-analysis of studies comparing EMR and endoscopic submucosal dissection. *Gastrointest Endosc*. 2015;81:583–595.
12. Tam MS, Abbas MA. Perforation following colorectal endoscopy: what happens beyond the endoscopy suite? *Perm J*. 2013;17(2):17–21.
13. Magdeburg R, Collet P, Post S, et al. Endoclipping of iatrogenic colonic perforation to avoid surgery. *Surg Endosc*. 2008;22(6):1500–1504.
14. An SB, Shin DW, Kim JY, et al. Decision-making in the management of colonoscopic perforation: a multicentre retrospective study. *Surg Endosc*. 2016;30(7):2914–2921.
15. Singhal S, Changela K, Papafragkakis H, et al. Over the scope clip: technique and expanding clinical applications. *J Clin Gastroenterol*. 2013;47:749–756.
16. Kukreja K, Chennubhotla S, Bhandari B, et al. Closing the Gaps: endoscopic suturing for large submucosal and full-thickness defects. *Clin Endosc*. 2018;51(4):352–356.
17. Kantsevoy SV, Bitner M, Hajiyeva G, et al. Endoscopic management of colonic perforations: clips versus suturing closure (with videos). *Gastrointest Endosc*. 2016;84(3):487–493.

18. Christie JP, Marrazzo III J. "Mini-perforation" of the colon —not all postpolypectomy perforations require laparotomy. *Dis Colon Rectum*. 1991;34:132–135.
19. Jentschura D, Raute M, Winter J, et al. Complications in endoscopy of the lower gastrointestinal tract. *Therapy prognosis. Surg Endosc*. 1994;8:672–676.
20. Lo AY, Beaton HL. Selective management of colonoscopic perforations. *J Am Coll Surg*. 1994;179:333–337.
21. Ker TS, Wasserberg N, Beart Jr RW. Colonoscopic perforation and bleeding of the colon can be treated safely without surgery. *Am Surg*. 2004;70(10):922–924.
22. Bleier JI, Moon V, Feingold D, et al. Initial repair of iatrogenic colon perforation using laparoscopic methods. *Surg Endosc*. 2008;22:646–649.
23. Senadhi V, Sharma A, Fleischer S, et al. Combined colonoscopy and laparoscopy to close a colonic perforation. *Endoscopy*. 2010;42(Suppl 2):E213–E214.
24. Gorgun E, Benlice C, Abbas MA, et al. Experience in colon sparing surgery in north America: advanced endoscopic approaches for complex colorectal lesions. *Surg Endosc*. 2018;32(7):3114–3121.
25. Whelan RL. Laparoscopic-facilitated colonic endoscopic mucosal resection and endoscopic submucosal resection of adenomas: techniques to avoid segmental colectomy. *J Gastrointest Surg*. 2011;15(8):1309–1312.
26. Zhang YQ, Lu W, Yao LQ, et al. Laparoscopic direct suture of perforation after diagnostic colonoscopy. *Int J Colorectal Dis*. 2013;28:1505–1509.
27. Kim J, Lee GJ, Baek JH, et al. Comparison of the surgical outcomes of laparoscopic versus open surgery for colon perforation during colonoscopy. *Ann Surg Treat Res*. 2014;87(3):139–143.
28. Zhong W, Qiu C, Liu C, et al. Efficacy of laparoscopic primary repair in the treatment of colonic perforation after Colonoscopy: a review of 40,127 patients. *Surg Laparosc Endosc Percutan Tech*. 2016;26(6):e105–e108.