



# Hospital management of colonic perforations complicating ambulatory outpatient colonoscopy via over-the-scope clips or surgery: a case series

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## Abstract

**Background** Colonoscopy is the standard of care for the diagnosis and treatment of many colonic disorders. Over the past few years, endoscopic closure of colonoscopy-related perforation has become more common. Endoscopic closure of perforation secondary to colonoscopy has been undertaken in patients in the hospital setting and often during the same colonoscopic procedure in which the perforation itself occurred. The aim of our study was to analyze our experience with emergency endoscopic closure of colonoscopy-related perforation with over-the-scope clip (OTSC) technique.

**Methods** We report five cases of colonic perforation that occurred during colonoscopy in an outpatient facility remotely located from our hospital and then referred as an emergency to our institution for endoscopic closure.

**Results** Bowel preparation was reported to be adequate in all cases. Prior to attempting endoscopic closure of colonic perforation, all patients were in stable clinical condition, early broad-spectrum antibiotic coverage was initiated, and a surgical consult was obtained. All patients had sigmoidoscopy and were found to have sigmoid colon perforations. In three cases, the perforations were closed successfully using an OTSC clip device 14 mm type t. Two patients were found to have greater than 4-cm sigmoid perforations with irregular margins, incompatible with OTSC closure, and were referred for emergency surgery. All patients had an uneventful course following either OTSC closure or surgery.

**Conclusions** Based on the characteristics of the five cases and a review of the literature, we suggest a practical approach for undertaking closure of colonic perforations occurring during colonoscopy in the outpatient setting, focusing on clinical criteria to determine eligibility of patients for attempted endoscopic closure and outlining required therapeutic and monitoring steps needed to optimize outcomes.

**Keywords** Outpatients · Setting · Colonoscopy · Perforation · Closure

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## Introduction

Colonoscopy is a common and safe procedure for the diagnosis and treatment of colonic disorders. Rarely, perforation during colonoscopy may occur either in the hospital or ambulatory settings. The incidence of colonic perforations during diagnostic and therapeutic colonoscopy ranges between 0.07 and 0.1%. The risk increases to 0.2% after endoscopic mucosal resection and is as high as 5% after endoscopic submucosal dissection [1]. We report five cases of colonic perforations occurring in an outpatient facility who were subsequently referred emergently to our institution for an attempt of endoscopic closure with over-the-scope clip (OTSC) technique.

## Materials and methods

Between March 2015 and March 2018, five patients with outpatient colonic perforation that occurred during colonoscopy were included in our study. Written informed consent was obtained from all participants. All OTSC closure procedures were performed by one physician (HJ) with more than 25 years expertise in the field of advanced endoscopy. The procedures were performed under sedation using midazolam, ketamine and fentanyl, depending on the clinical situation. We used a therapeutic upper endoscope (Olympus Corp, Japan) equipped with water jet function. After evaluating the lesion, the endoscope was then withdrawn and the OTSC clip device 14 mm type t (Ovesco Endoscopy AG, Germany) was applied to the endoscope. The endoscope was then re-advanced to the perforation site. We positioned the OTSC cap such that the perforation was located inside the perimeter of the cap. Upon achieving a satisfactory position, we applied suction and securely placed the clip on the surrounding tissue of the perforation.

## Results

### Demographics and clinical presentations

Five patients who underwent outpatient colonoscopy were included in the study. The mean age of our cohort was 69.4 years and all patients were female. The indication of outpatient colonoscopy was for screening purposes in two patients, evaluation of constipation in one patient, evaluation of weight loss in one patient, and evaluation of positive fecal occult blood test in one patient. Following the outpatient procedures with perforations, all patients reported lower abdominal pain and abdominal distension, and one reported mild rectal bleeding. Upon arrival at our medical center,

on physical examination, all patients were afebrile, had abdominal tenderness, and their respiratory and hemodynamic status was stable (Table 1). The diagnosis of colonic perforation occurred in two patients upon colonoscopy withdrawal, on entry of the colonoscopy in two patients, and after resection of a large pedunculated polyp in one patient. All perforations were suspected and subsequently diagnosed after the patient was noted to have sudden onset abdominal pain and distention.

### Imaging, endoscopic findings, and treatment plan

All patients had an imaging study when perforation had been suspected after index colonoscopy. One patient had an abdominal X-ray that revealed subdiaphragmatic free air. Two patients had a chest X-ray that revealed a large amount of subdiaphragmatic and perihepatic free air and small amount of perihepatic free air, and two patients had computed tomography (CT) scan that revealed a large amount of intra-abdominal free air. All patients were diagnosed with sigmoid perforation at the index colonoscopy with two of the patients having sigmoid diverticular perforations. After transfer to our medical center, all patients had therapeutic flexible sigmoidoscopy for closure attempts by OTSC, and successful perforation closure was achieved in three out of five patients. Treatment details are shown in Table 2. A representative OTSC procedure of one patient is shown in Fig. 1.

### Outcomes, safety and adverse events

In three cases, we achieved complete closure of sigmoid perforations using OTSC as assessed by complete symptomatic resolution and disappearance of intra-abdominal free air as evaluated by imaging studies. In two cases (patients 4 and 5), the perforations were deemed ineligible for endoscopic closure upon assessment by the expert endoscopist

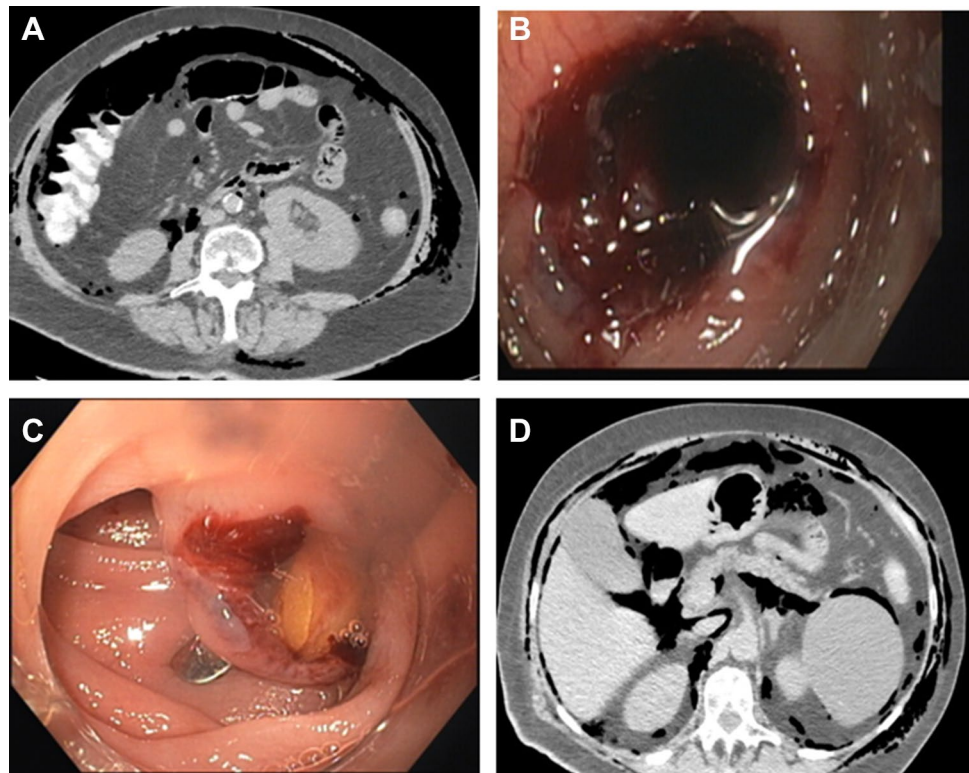
**Table 1** Patients' characteristics and clinical presentation

Patient no.	1	2	3	4	5
Age (years)	63	68	74	69	73
Gender	Female	Female	Female	Female	Female
Indication of colonoscopy	Screening	Constipation	Weight loss	+ve fecal occult blood	Screening
Colon preparation	Adequate	Adequate	Adequate	Adequate	Adequate
Presenting symptoms					
Abdominal pain	Yes	Yes	Yes	Yes	Yes
Distention	Yes	Yes	Yes	Yes	Yes
Rectal bleeding	Yes	No	No	No	No
Vital signs	Stable	Stable	Stable	Stable	Stable
Time to arrival to our hospital (h)	2	2	2	2	2

**Table 2** Detailed treatment plan, safety, adverse events and outcomes

Patient no.	1	2	3	4	5
Site of perforation	Sigmoid (diverticula)	Sigmoid	Sigmoid (diverticula)	Sigmoid	Sigmoid
Size of perforation (cm)	2	1.2	1	4	5
Distance of perforation from anal verge (cm)	18	30	22	20	25
Treatment	OTSC	OTSC	OTSC	Anterior resection	Hartmann resection + colostomy
Hours elapsed from perforation to closure	4	3	3.5	–	–
Hospitalization time days	6	7	6	12	10
Hospitalization course	Uneventful	Uneventful	Uneventful	Uneventful	Uneventful
Outcome	Complete closure	Complete closure	Complete closure	–	–
Adverse events	None	None	None	None	None
Follow-up (months)	6	1	1	–	–

**Fig. 1** **a** CT scan demonstrating free air in the abdomen. **b** One-centimeter sigmoid perforation. **c** Endoscopic view showing complete closure of sigmoid perforation. **d** Abdominal CT scan demonstrating no free intra-abdominal air



performing the procedure, and thus they were surgically treated. There were no adverse events related to the endoscopic closure, recovery was uneventful, and there was no mortality (Table 2). It is important to note that in all cases the sigmoidoscopy neither exacerbated the colonic perforation nor the patients' clinical condition.

## Discussion

Acute perforation of the colon is a rare but serious complication of endoscopy that may result when excessive mechanical forces are applied to the bowel wall by the endoscope or as a result of therapeutic interventions, such

as the application of electrocautery. As compared to perforations caused by electrocautery, perforations secondary to diagnostic colonoscopy are typically larger and traditionally have required surgical repair [2, 3]. In 1997, Yoshikane reported the first case of endoscopic closure of a small (4 mm) perforation that occurred after electrosurgical removal of a polyp [4]. Four years later, Mana was the first to report endoscopic closure of a perforation complicating diagnostic colonoscopy, utilizing three hemoclips [5]. Following the development of OTSC, there have been reports describing the utility of these clips in closing perforations resulting from diagnostic colonoscopy. Benedetto et al. described closure of an 8-mm perforation complicating a diagnostic colonoscopy [6]. Nevertheless, the management of iatrogenic colonic perforation continues to be controversial, and no clear criteria have been proposed for undertaking endoscopic closure before progressing to surgical management. Several series of endoscopic closures of colonic perforations were published, some using hemoclips and others using OTSCs. Both techniques had a high degree of success. Lee et al. reported successful closure of a 15-mm rectal perforation utilizing six hemoclips. These authors detailed the following conditions facilitating endoscopic repair: excellent bowel preparation, early detection, stable vital signs, and a cooperative patient [7]. Fujishiro et al. suggested four criteria for closing acute iatrogenic perforation endoscopically: perforation size less than 1 cm, the content of the gastrointestinal tract has to be as clean as possible, procedure must be conducted by an expert endoscopist, and there should be no deterioration of clinical symptoms or laboratory indices. With respect to perforations complicating diagnostic colonoscopy, authors have favored surgical treatment over endoscopic closure [8]. Various authors have emphasized that endoscopic closure must be performed at the time the perforation occurs, and not in a second endoscopic procedure, so as to avoid possible abdominal contamination [8]. Voermans et al. published a prospective series of 36 cases of endoscopic closure of acute perforations utilizing OTSCs, 13 of which were colonic, with an overall success rate of 89%, and the mean time from perforation to closure was 6 min [9]. In that series, one patient in whom a colonic perforation after polypectomy was endoscopically closed (and shown to be adequately closed on postprocedural contrast study) deteriorated 5 h later and had an immediate laparotomy that showed a detached clip and persistent perforation. Despite successful resection of the perforation site and construction of a colostomy, the patient died within 36 h, yielding a mortality rate of 3% in the series, an acceptable figure compared to 7% according to largest published series of surgical management of perforations [10, 11]. This case, however, exemplifies that endoscopic and radiographic results are not always predictive of long-term success.

Intensive clinical observation for 24 h and immediate surgical intervention in case of deterioration are of utmost importance. A large international retrospective series by Yamile et al. summarized 188 cases of gastrointestinal defects treated endoscopically with OTSCs, with a total of 48 perforations, 8 being colonic, and a median size of 7 mm. Primary OTSC placement was performed in 43 cases, while in 5 patients it was used as rescue therapy following failed previous closure attempt within 7 days (4 patients) and 30 days (1 patient). Overall long-term clinical success was achieved in 90% of patients. Though not reaching statistical significance, there was a trend toward a better outcome with immediate closure as compared to rescue therapy (91.4% vs. 80% success rates, respectively) [1]. The European Society of Gastrointestinal Endoscopy (ESGE) published guidelines on the management of iatrogenic endoscopic perforation of the colon. The ESGE recommends the application of through the scope or OTSC clipping within 4 h of iatrogenic colonic perforation given that the bowel is clean and depending on the type and size of perforation and the endoscopic expertise available at that center [12]. Moreover, the 2011 American Society of Gastrointestinal Endoscopy (ASGE) guidelines state that in cases of endoscope induced perforation, surgical consultation should be obtained in all cases. The guidelines also state that nonsurgical management may be appropriate in selected individuals depending on the degree of bowel cleaning and size of the perforation [13].

To the best of our knowledge, three of the five cases we report here are the first reported cases of endoscopic closure of an iatrogenic perforation occurring in an ambulatory care center after which the patient was transferred to a tertiary health care center with a request for endoscopic closure. In addition, as the perforation was induced by the endoscope, the defects were larger than many of those treated in the reported literature. With the increasing number of colonoscopies being performed in ambulatory care centers and with increasing experience being attained with closure devices, the scenario we describe in this report is likely to become more common. Therefore, we suggest the following approach for undertaking closure of perforations occurring in the outpatient setting. The attempted closure should occur no later than approximately 4 h after the perforation has occurred and broad-spectrum antibiotics should be administered before undertaking attempted closure. The bowel preparation should have been adequate at the time of the initial colonoscopy. The patient should have stable vital signs and should be cooperative with no evidence of generalized peritonitis. A CT scan should be performed immediately following the endoscopic closure with 750 ml of water-soluble contrast per rectum with no leakage of contrast. Careful inpatient monitoring should ensue until the patient has demonstrated sustained stability.

## Conclusions

Perforations occurring during colonoscopy in an outpatient setting remote from a hospital may be able to be closed endoscopically in a second and separate endoscopic procedure if the appropriate conditions are present. Obviously, clinical judgement plays a major role in the application of the criteria suggested and the final decision to undertake endoscopic or surgical closure.

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## Compliance with ethical standards

**Conflict of interest** The authors declare no conflict of interest regarding this manuscript.

**Ethical approval** The study was approved by the local institutional ethic committee.

**Informed consent** Written informed consent was obtained from all participants.

## References

- Haito-Chavez Y, Law JK, Kratt T, Arezzo A, Verra M, Morino M, Sharaiha RZ, Poley JW, Kahaleh M, Thompson CC, Ryan MB, Choksi N, Elmunzer BJ, Gosain S, Goldberg EM, Modayil RJ, Stavropoulos SN, Schembre DB, DiMaio CJ, Chandrasekhara V, Hasan MK, Varadarajulu S, Hawes R, Gomez V, Woodward TA, Rubel-Cohen S, Fluxa F, Vleggaar FP, Akshintala VS, Raju GS, Khashab MA (2014) International multicenter experience with an over-the-scope clipping device for endoscopic management of GI defects (with video). *Gastrointest Endosc* 80(4):610–622. <https://doi.org/10.1016/j.gie.2014.03.049>
- Orsoni P, Berdah S, Verrier C, Caamano A, Sastre B, Boutboul R, Grimaud JC, Picaud R (1997) Colonic perforation due to colonoscopy: a retrospective study of 48 cases. *Endoscopy* 29(3):160–164. <https://doi.org/10.1055/s-2007-1004156>
- Taku K, Sano Y, Fu KI, Saito Y (2006) Iatrogenic perforation at therapeutic colonoscopy: should the endoscopist attempt closure using endoclips or transfer immediately to surgery? *Endoscopy* 38(4):428. <https://doi.org/10.1055/s-2006-925248>
- Yoshikane H, Hidano H, Sakakibara A, Ayakawa T, Mori S, Kawashima H, Goto H, Niwa Y (1997) Endoscopic repair by clipping of iatrogenic colonic perforation. *Gastrointest Endosc* 46(5):464–466
- Mana F, De Vogelaere K, Urban D (2001) Iatrogenic perforation of the colon during diagnostic colonoscopy: endoscopic treatment with clips. *Gastrointest Endosc* 54(2):258–259
- Mangiavillano B, Arena M, Masci E (2014) Treatment of a sigmoid perforation with an over-the-scope clip during diagnostic colonoscopy. *Clin Gastroenterol Hepatol* 12(6):xxi–xxii. <https://doi.org/10.1016/j.cgh.2013.11.019>
- Lee SH, Cheong YS (2012) Successful endoscopic repair of an iatrogenic colonic perforation during diagnostic colonoscopy. *J Am Board Fam Med* 25(3):383–389. <https://doi.org/10.3122/jabfm.2012.03.110070>
- Mangiavillano B, Viaggi P, Masci E (2010) Endoscopic closure of acute iatrogenic perforations during diagnostic and therapeutic endoscopy in the gastrointestinal tract using metallic clips: a literature review. *J Dig Dis* 11(1):12–18. <https://doi.org/10.1111/j.1751-2980.2009.00414.x>
- Voermans RP, Le Moine O, von Renteln D, Ponchon T, Giovannini M, Bruno M, Weusten B, Seewald S, Costamagna G, Deprez P, Fockens P, Group CS (2012) Efficacy of endoscopic closure of acute perforations of the gastrointestinal tract. *Clin Gastroenterol Hepatol* 10(6):603–608. <https://doi.org/10.1016/j.cgh.2012.02.005>
- Iqbal CW, Cullinane DC, Schiller HJ, Sawyer MD, Zietlow SP, Farley DR (2008) Surgical management and outcomes of 165 colonoscopic perforations from a single institution. *Arch Surg* 143(7):701–706. <https://doi.org/10.1001/archsurg.143.7.701> (**discussion 706–707**)
- Luning TH, Keemers-Gels ME, Barendregt WB, Tan AC, Rosman C (2007) Colonoscopic perforations: a review of 30,366 patients. *Surg Endosc* 21(6):994–997. <https://doi.org/10.1007/s00464-007-9251-7>
- Paspatis GA, Dumonceau JM, Barthet M, Meisner S, Repici A, Saunders BP, Vezakis A, Gonzalez JM, Turino SY, Tsiamoulos ZP, Fockens P, Hassan C (2014) Diagnosis and management of iatrogenic endoscopic perforations: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement. *Endoscopy* 46(8):693–711. <https://doi.org/10.1055/s-0034-1377531>
- Committee ASoP, Fisher DA, Maple JT, Ben-Menachem T, Cash BD, Decker GA, Early DS, Evans JA, Fanelli RD, Fukami N, Hwang JH, Jain R, Jue TL, Khan KM, Malpas PM, Sharaf RN, Shergill AK, Dominitz JA (2011) Complications of colonoscopy. *Gastrointest Endosc* 74(4):745–752. <https://doi.org/10.1016/j.gie.2011.07.025>

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