

## ORIGINAL ARTICLE

# Outcomes of surgical management of iatrogenic colonic perforation by colonoscopy and risk factors for worse outcome

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The work was done in National Cancer Institute.

## Summary

**Purpose:** To assess outcomes of surgical management for iatrogenic colonic perforations and risk factors of worse outcome.

**Methods:** We reviewed the medical records of patients with colonic perforations during colonoscopies 2007 – 2016 at the National Cancer Institute. We collected patient demographic data, colonoscopic reports, perforations treatment and outcome.

**Results:** Perforation rate was 0.14% (23 of 16 186). Twenty were managed surgically. The most common location of perforation was the sigmoid colon in 12 cases (60%). The most used surgical technique was simple suture (11 cases – 55%),

followed by resection with anastomosis (6 – 30%), and Hartman's procedure in 3 cases (15%). Postoperative morbidity and mortality rates were 45% and 15% - three patients died. No significant relationship between time to surgery ( $p=0.285$ ), American Society of Anaesthesiologists (ASA) score ( $p=0.642$ ) or patient age ( $p=0.964$ ) and postoperative complication were found.

**Conclusions:** Patients need to be informed of the complications of colonoscopy. We could not determine strong risk factors for worse outcomes.

**Key words:** colonic perforation, colonoscopy, iatrogenic injury, peritonitis

## Introduction

The widespread colorectal cancer screening programs and the expansion of the indications for therapeutic endoscopy resulted in an increased number of complications associated with colonoscopy [1]. The most common complications which can occur during the procedure are bleeding and perforation [2]. The risk of colonic perforation after diagnostic colonoscopy is estimated to be 0.03–0.9% and 0.15–2% for therapeutic colonoscopy [3–5]. Interventions performed during colonos-

copy, such as biopsy, polypectomy and endoscopic submucosal dissection may increase the rate of iatrogenic colonic perforation [6]. Although these complications are rare, they can lead to leakage of bowel content into the peritoneal cavity and eventually to sepsis, with significant morbidity (up to 40%) and mortality (up to 25%) [4,7,8]. The site of colon perforation must be closed immediately to prevent complications. Traditionally, surgery has been the standard treatment, but nowadays nonin-

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vasive methods such as endoscopic clip closure has become popular for closing the site of iatrogenic colon perforation [3].

The aim of this retrospective study was to assess the sequelae of colonic perforation in patients treated at the National Cancer Institute of Lithuania.

## Methods

This study was approved by the Institutional Review Board.

A retrospective review of the medical records of all patients, who underwent colonoscopies between January 2007 and December 2016 at the National Cancer Institute, was performed. Data including patient demographics, indications for colonoscopy, diagnostic and therapeutic interventions during the colonoscopy, mechanism of perforation, clinical presentations and physical find-

ings of perforation, time from procedure to diagnosis, diagnostic tool, definitive treatment, clinical outcomes and length of hospital stay, were collected by reviewing medical charts.

Colonoscopy was performed or supervised by senior endoscopists, either licensed gastroenterologists or licensed general surgeons. The diagnosis of perforation was made based on clinical presentation, physical examination and clinical evidence, such as a colonic wall defect found during the colonoscopy, or radiologic evidence, such as detection of free air on simple abdominal X-ray or computed tomography (CT) scan. The mechanism of perforation was classified as trauma-related or polypectomy-related. The clinical outcomes were evaluated on the basis of the length of antibiotics use, postoperative complications, and length of hospital stay.

The data were analysed by SPSS software, version 20.0 (SPSS, Chicago, IL). The chi-square test or Fisher's exact test were used to analyse the qualitative variables. P values < 0.05 were considered statistically significant.

**Table 1.** The information about colonoscopy and the type of surgery for colonic perforation by colonoscopy

Patient	Gender	Age (years)	Previous surgery	Indications for colonoscopy	Type of procedure	Perforation site	Treatment
Patient 1	♂	76	No	other	therapeutic	sigmoid colon	resection with colostomy
Patient 2	♂	69	No	follow-up	diagnostic	sigmoid colon	closure
Patient 3	♂	64	Yes	polypectomy	therapeutic	splenic flexure	closure
Patient 4	♂	71	No	polypectomy	therapeutic	sigmoid colon	closure
Patient 5	♂	64	Yes	polypectomy	therapeutic	descending colon	resection with primary anastomosis
Patient 6	♀	31	No	polypectomy	therapeutic	sigmoid colon	resection with primary anastomosis
Patient 7	♀	54	No	polypectomy	therapeutic	sigmoid colon	resection with primary anastomosis
Patient 8	♀	62	Yes	other	diagnostic	sigmoid colon	closure
Patient 9	♀	72	No	other	diagnostic	rectum	closure
Patient 10	♀	59	Yes	abdominal pain	diagnostic	sigmoid colon	closure
Patient 11	♀	85	No	rectal bleeding	diagnostic	ascending colon	resection with primary anastomosis
Patient 12	♀	72	No	follow-up	diagnostic	rectum	resection with primary anastomosis
Patient 13	♂	68	No	rectal bleeding	diagnostic	rectosigmoid junction	closure
Patient 14	♂	52	No	polypectomy	therapeutic	sigmoid colon	resection with colostomy
Patient 15	♀	68	Yes	other	diagnostic	sigmoid colon	closure
Patient 16	♂	59	Yes	other	diagnostic	rectosigmoid junction	closure
Patient 17	♀	76	No	polypectomy	therapeutic	sigmoid colon	unsuccessful endoscopic clipping + closure
Patient 18	♀	79	No	follow-up	diagnostic	rectosigmoid junction	resection with colostomy
Patient 19	♂	72	No	follow-up	diagnostic	sigmoid colon	unsuccessful endoscopic clipping + closure
Patient 20	♀	59	Yes	polypectomy	therapeutic	sigmoid colon	resection with primary anastomosis

♂: males, ♀: females

**Table 2.** Complications of patients with iatrogenic colonic perforation classified according to the Clavien-Dindo classification

Complication grade	Patients n (%)
No complication	11 (55)
I	1 (5)
II	3 (15)
III	2 (10)
IIIa	1 (5)
IIIb	1 (5)
IV	0 (0)
IVa	0 (0)
IVb	0 (0)
V	3 (15)

## Results

Between January 2007 and December 2016, 16 186 colonoscopies were performed at the National Cancer Institute. The overall perforation rate was 0.14% (23 of 16 186). Because the absolute numbers of diagnostic and therapeutic procedures were not known, the perforation rates for the type of procedure could not be calculated. Of the total 23 colonic perforations, 20 (86.9%) were managed operatively. Three patients underwent successful clipping. It is important to emphasize that endoscopists started using Ovesco (OTSC®; Ovesco Endoscopy GmbH, Tübingen, Germany) clipping for closure of colonic perforation from 2014.

In 8 cases (40%), perforation was noticed by the endoscopist through visualization of extra-intestinal tissue during the procedure, while other perforations were diagnosed shortly after the procedure because of symptoms and signs of perforation. In the delayed diagnosis cases, the patients presented with abdominal pain (100%) and abdominal distention (45%). Pneumoperitoneum was found on X-ray or abdominal CT scan in 7 patients (35%).

The information about colonoscopy and the type of surgery for colonic perforation by colonoscopy are summarised in Table 1. After colonic perforation diagnosis, 18 patients underwent immediate surgery, whereas 2 of the remaining patients initially underwent the Ovesco clipping, but a resection was performed 1 and 2 hrs later, respectively. Thirteen patients (65%) underwent surgery on the same day of the endoscopy, 5 (25%) on the second day and 2 (10%) more than two days after endoscopy. Ten of 11 (90.9%) perforations after diagnostic endoscopy were diagnosed and subjected to surgery same day. This means that 6 of 7 (85.7%) perforations with a delayed presentation followed a therapeutic procedure.

Of the 20 patients after surgery, 11 (55%) had no complications and the remaining 9 (45%) developed complications. In total there were 19 complications, which included cardiopulmonary arrest (2), postoperative fever (2), wound infection (3), hydrothorax (2), urinary retention (1), multiple organ failure (1), anastomosis leakage (1), wound dehiscence (1), acute bronchopneumonia (1), renal insufficiency (1), enterocutaneous fistula (1), abscess nested within the sigmoid mesocolon (1), sepsis (1) and hepatic insufficiency (1). Complications classified according to the Clavien-Dindo classification [9] are presented in Table 2. No significant relationship between time to surgery ( $p=0.285$ ), ASA score ( $p=0.642$ ) or patient age ( $p=0.964$ ) and postoperative complication were found. The 30-day hospital mortality rate was 15%. One death was because of multiple organ failure caused by acute bronchopneumonia and 2 patients with intra-abdominal sepsis died due cardiopulmonary insufficiency. For all the patients with perforation, the mean hospital stay was 15 days (range 6–24).

## Discussion

The involvement of anaesthesia services for colonoscopy sedation has increased from 11.0% of colonoscopies in 2001 to more than 50% in 2015 [10,11]. Although the use of anaesthesia can improve colonoscopy outcomes, it also leads to increased risk of colonic perforation. Wernli et al. determined that use of anaesthesia was associated with a 13% increase in the risk of any complication within 30 days and was associated specifically with an increased risk of colonic perforation. However, researchers observed increased risk for perforation only in polypectomy group patients [12]. This can be explained by the absence of patient feedback, as increased colonic-wall tension from colonoscopy pressure may not be identified by the endoscopist. Consistent with our results at our institution, the use of anaesthesia during colonoscopies was introduced in 2014 and it led to increased rate of colonic perforation. Of the colonic perforations 30.4% occurred between 2007 and 2013 inclusive and 69.6% developed from 2014 to 2016.

Most studies highlight the importance of early operative intervention for patients with suspected iatrogenic colonic perforation [13-15]. The type of procedure used will depend on the size of perforation, time to diagnosis, type of injury, degree of faecal contamination, presence of associated colon pathology, patient status, concomitant disease and the surgeon's experience [16,17]. Primary repair of the colon is recommended for patients with perforations that encompass <50% of bowel circum-

ference, without significant faecal contamination and with no serious comorbidities. Resection with primary anastomosis should be attempted if the perforation site is large or concomitant pathology is present [17]. Resection and ileostomy or colostomy are used in patients with extensive faecal contamination, operative delay and multiple comorbidities [18]. The resultant inflammatory changes associated with stercoral peritonitis clearly limit the operative options, precluding a single-stage procedure and resulting in faecal diversion in 38% of the patients [7].

Perforations during diagnostic colonoscopy usually occur in the sigmoid or rectosigmoid junction due to the difficulty of traversing this convoluted segment of bowel due its anatomical characteristics of frequent redundancy or narrowing from diverticular disease or adhesions after previous pelvic operations [19]. Mechanical injuries tend to be generally large (>2 cm), more severe, causing greater contamination of the peritoneal cavity and more frequently lead to a faecal diversion [7]. Conversely, perforations due to therapeutic procedures tend to occur in the thinner walled area of the proximal colon. These perforations tend to be small and causing minimal faecal contamination. An experimental study on polypectomy in pigs found that the use of tungsten instead of steel snares was significantly associated with a lower depth of tissue injury, suggesting a potential effect on reducing the risk of perforation [20]. The improvement of laparoscopic techniques boosts the practice of laparoscopic repair for colonic perforations more widely [21]. Zhang et al. reported that laparoscopic primary perforation repair is a safe and feasible repair method [22]. Compared to laparotomy, patients who underwent laparoscopic repair had fewer perioperative complications [23]. These studies suggest laparoscopy as the initial approach for repairing iatrogenic colorectal perforation. A recent meta-analysis showed that the laparoscopic approach was associated with significantly fewer postoperative complications compared to open surgery (18.2% vs. 53.5%  $p < 0.0001$ ) and shorter hospital stay (mean difference - 5.35 days  $p < 0.00001$ ). No differences between the two surgical approaches were observed for postoperative mortality, need of re-intervention and operative time [1].

In our study 80% of perforations were diagnosed during the procedure or in the first 24 hrs. According to the literature this rate is 65.1–78% [17]. All of these patients were admitted to our hospital already with peritonitis, which increases

the need for surgery and probably incurs a worse prognosis. One of the reasons for delayed diagnosis of perforation may be related to the growing rate of therapeutic colonoscopies, because these perforations are usually smaller, therefore it is more difficult to detect them [17]. Moreover, the patients could initially have gone to primary care units before being referred to the tertiary hospital, postponing its diagnosis and approach.

In our study the postoperative morbidity and mortality rates were 45% and 15% respectively. Large series of colonoscopy-induced perforations managed surgically reported a morbidity rate of 35% [4,7]. The mortality rate in our study is fairly comparable to other reports which is up to 25% [7,8]. Infection of the surgical site is the most common complication, while cardiopulmonary complications and multiple organ failure are the leading causes of death [7,24]. Iqbal et al. noted that patients presenting after 24 hrs have morbidity nearly twice as high as patients who present within 24 hrs [7]. In our study we had the same results, but we didn't find statistical significant relationship between time to surgery and postoperative complications. Several other factors are also known to influence outcome, namely, advanced age of patients, severe comorbidities, a large perforation site, poor bowel preparation, corticosteroid use, and anticoagulant or antiplatelet therapy [7,8,25].

Our study has few limitations. The most important limitations are the small size of cohort and its retrospective nature. Because of the small sample size there is no possibility to assess more risk factors that could affect the morbidity and mortality.

## Conclusions

If surgery and its associated morbidity can be avoided in cases of colonic perforation, the negative impact of a colonoscopy-associated complication can be considerably reduced. Patients need to be informed of the complications of colonoscopy, and clinicians must be cautioned about the potential problems for patients with a high-anaesthetic risk when performing the procedure. Yet, we could not determine strong risk factors for worse outcomes.

## Conflict of interests

The authors declare no conflict of interests.



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