

Minimally invasive surgery for the management of iatrogenic colon perforation in the elderly

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Abstract

Aim: Colonoscopy is the most commonly used diagnostic tool for screening for colorectal cancer in asymptomatic individuals and for surveillance in patients with a history of colonic disease. The procedure has several drawbacks, including acute colon perforation. As elderly individuals with aging immune systems frequently respond inadequately to physiologic stress, this life-threatening complication requires meticulous management in this patient cohort. We aimed to evaluate a minimally invasive surgical approach to iatrogenic colon perforation (ICP) in this vulnerable age group.

Material and Methods: This is a retrospective study. We reviewed data from all patients ≥ 65 years of age diagnosed with iatrogenic colon perforation (ICP) between January 2012 and June 2019 at Gaziosmanpaşa University Hospital.

Results: Seventeen cases of ICP were identified (mean age was 76.5 years); 16 patients were treated surgically and one was managed conservatively. The most frequent site of perforation was the sigmoid colon (58.8%) and surgical management was primarily laparoscopic (93.7%). Twelve of the 16 patients who were managed with surgical intervention underwent laparoscopic primary repair and three patients underwent laparoscopic colectomy due to a primary diagnosis of colorectal malignancy. One patient with delayed diagnosis underwent laparotomy and proctosigmoidectomy (Hartmann procedure); this patient did not survive beyond the immediate post-operative period.

Conclusion: Our findings suggest that early recognition is critical for the successful treatment of ICP in the elderly. Most patients respond well to a minimally invasive laparoscopic approach. This approach can be considered for large perforations and is safe and effective when carried out by an experienced surgeon.

Keywords: Colonoscopy; geriatric; intestinal perforation; laparoscopy; minimally invasive surgery

INTRODUCTION

The most common indications for colonoscopy are screening of asymptomatic subjects and following patients with CRC or colon adenomas. The incidence of CRC increases dramatically by age; 90% of the diagnosed cases are detected after the fifth decade of life (1). The most frequent complication of colonoscopy is iatrogenic perforation. Colon perforation is defined as a discontinuity in the colon wall at any level between the cecum and the anus. This major complication poses a great risk for patients; recognition and treatment of colon perforation is a challenge for surgeons (2, 3). Colon perforation can be secondary to trauma, diseases (including diverticulitis, infections and cancer), iatrogenic or in rare cases, spontaneous.

A geriatric patient is defined as individual ≥ 65 years of age. Geriatric patients experience a variety of physiologic and systemic changes that are specifically associated with aging. These physiologic changes lead to diminished reserve and higher susceptibility to the negative consequences of physiological derangements. These factors contribute to the high mortality rate within the adult and elderly surgical population.

The rate of iatrogenic colon perforation (ICP) that can be directly related to endoscopic examination is in the range of 0.08%. This catastrophic condition can be fatal; the degree of severity depends mainly on patient age, general physical state, the time between the inciting event and its diagnosis, and the location, notably whether the perforation is on the mesenteric or anti-mesenteric side of the colon wall.

Received: 01.05.2020 **Accepted:** 28.09.2020 **Available online:** 21.10.2020

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At this point in time, our knowledge regarding the true incidence, risk factors, and management of ICP in the elderly is very limited; there are no large series that address this issue nor is there a specific management algorithm for this population. In this study, we highlight the etiology, recognition and treatment of ICP in elderly patients that were managed by our general surgical department from 2012 through 2019. Specifically, we focus on the use of minimally invasive laparoscopic surgery for this rare complication and we evaluate its effectiveness in our elderly patient population.

MATERIAL and METHODS

The study was designed as an evaluation of consecutive cases collected retrospectively in a single academic tertiary referral center. Ethical committee approval for this study was obtained from the Local Research Ethics Committee and registered under the number 19-KAEK-065. The patients were recruited after the review of the electronic database using ICD-10-CM Diagnosis Codes S36.5 and S36.6. The electronic database of endoscopy unit and the consultation requests from other hospital clinics to general surgery were searched using the terms "colon perforation, rectal perforation, caecal perforation, iatrogenic perforation." The operative notes were also searched to identify any cases went undetected in the initial screen using the aforementioned ICD-10 codes. The search was limited to time span between January 2012 and June 2019. Demographic and clinical data, including patient age (≥ 65), sex, circumstances under which the perforation took place, mechanism of perforation, description of the perforation (location, diameter, underlying bowel disease, status of the abdomen), clinical presentations and physical findings, time from procedure to diagnosis, diagnostic tools, treatment, clinical outcomes and length of hospital stay were retrieved from the electronic medical files and recorded. Colonoscopy was performed in our endoscopy unit by licensed endoscopists. As part of the post-procedure protocol, any question of perforation (abdominal pain not relieved after gas and stool passage, tenderness, distention) resulted in transfer to the emergency department for upright abdominal radiography and, if necessary, abdominal computerized tomography (CT) studies. The diagnosis of perforation was based on clinical presentation, physical examination and clinical evidence; the latter might include detection of a colon wall defect during the index event and/or detection of free air on abdominal radiography or CT studies. The patients were monitored throughout and resuscitated immediately after the procedure. Cases referred from other clinics were prepared for the surgery as per protocol. Clinical outcomes were evaluated on the basis of the postoperative complications and length of hospital stay.

Descriptive statistics were used to provide information on general characteristics of the study population.

Qualitative data are presented as total counts and percentages. Quantitative analyses were performed using SPSS Statistics 20 (IBM SPSS Statistics 20, SPSS Inc., IBM Co., Somers, NY).

RESULTS

We identified 17 cases of ICP in our patient screen; of these cases, 16 patients were treated surgically and one patient was managed conservatively. Eleven of the patients were female (64.7%) and 6 were male (35.3%). The mean age was 76.5 \pm 8.5 years with a range from 66 to 90 years. Demographic and clinical information are included in Table 1.

The median diameter of all perforations was 22.1 mm (range 5 – 50 mm). The diagnosis was made immediately or within 24 hours post-operatively in 88.2% of the cases; two cases (11.8%) were diagnosed after 24 hours, both at two days after the procedure. Nine patients did not require further radiological examination as the perforations were visualized directly. One case was diagnosed by abdominal radiography (5.9%) and CT scans were performed in an additional seven patients (41.2 %). Hospitalizations ranged from three and sixteen days with a mean of 6.6 \pm 3.7 days. The longest hospitalization was secondary to rectal perforation diagnosed two days after colonoscopy. This was treated with minimally invasive surgery; the patient developed an acute ileus which ultimately resolved with supportive measures. The 30-day mortality rate was calculated at 5.9%; one patient who was diagnosed after a two-day delay succumbed to multiple organ failure. Other complications included post-operative pneumonia (two patients) and cardiac arrhythmia (one patient) which reverted to sinus rhythm during follow-up.

The most frequent site of perforation was the sigmoid colon (ten patients, 58.8%) followed by the descending colon (3 patients), the rectum (3 patients) and the rectosigmoid junction (one patient). In one case in which colonoscopy was performed to diagnose sigmoid cancer and diverticulosis, the patient presented with diffuse subcutaneous emphysema which was the result of barometric injury resulting from perforation of a diverticulum. Of the 17 patients evaluated, 14 had history of previous abdominal and/or pelvic surgery.

In this study, the surgical management of ICP in the elderly was primarily laparoscopic (93.8%). While 12 patients (75%) were managed with laparoscopic primary repair, three patients required laparoscopic oncologic colectomy due to an existing colorectal malignancy. One patient underwent surgical proctosigmoidectomy (Hartmann procedure) through a midline incision.

Table 1. Demographic data, clinical presentation and management of 17 geriatric patients with iatrogenic colon perforation

ID #	Age	Sex	Location	Perforation Size (mm)	Diagnostic tool	Management / procedure	Morbidity / Mortality	Hospital Stay(day)	Identification Time	WBC
1	88	M	Sigmoid	25	CT	Lap. Primary suture	No	4	Same day	11.80
2	80	F	Sigmoid	25	Immediate	Lap. Primary repair+ileotransversostomy (right colon cancer)	Pneumonia	9	Same day	19.01
3	86	M	Sigmoid	35	CT	Lap. Primary suture	Cardiac arrythmia	13	Same day	8.80
4	66	F	Sigmoid	15	Immediate	Lap. Primary suture	No	3	Same day	9.92
5	84	M	Sigmoid	30	Immediate	Lap. Primary suture	No	6	Same day	14.84
6	67	F	Sigmoid	20	Immediate	Lap. Primary suture	No	3	Same day	13.80
7	74	F	Descending colon	30	Immediate	Lap. Primary suture	No	6	Same day	10.10
8	75	F	Sigmoid	25	CT	Hartmann procedure	EXITUS	4	two days later	3.03
9	68	F	Sigmoid	25	CT	Lap. Primary suture	No	4	Same day	8.27
10	89	F	Rectum	25	CT	Lap. Primary suture	No	5	Same day	6.60
11	90	M	Sigmoid	5	Abdominal plain x-ray	Left Colectomy	Pneumonia	10	Same day	4.64
12	67	F	Descending colon	5	Immediate	Lap. Anterior resection	No	7	Same day	6.71
13	68	M	Sigmoid	25	Immediate	Lap. Primary suture	No	4	Same day	6.30
14	72	F	Rectum	15	CT	Lap. Primary suture	Prolonged ileus	16	Two days later	12.40
15	67	F	Rectum	15	Immediate	Lap. Primary suture	No	4	Same day	19.86
16	84	M	Descending colon	5	CT	Lap. Primary suture	No	4	Same day	11.31
17	82	F	Rectosigmoid	50	Immediate	Conservative	No	10	Same day	-

Lap. : Laparoscopic, CT: Computed Tomography

DISCUSSION

Colonoscopy is an essential tool for screening, diagnosing, treating, and following various disorders of the colon and rectum. The widespread use of colonoscopy has led to an increase in the rate of ICP (4). ICP has been reported to occur at rates that range from 0.2% to 0.8% for diagnostic procedures and from 0.15% to 3% when used for therapeutic purposes (2,5-7). Over the eight-year study period, our unit performs a total of 11717 colonoscopies, or approximately 1464 colonoscopies per year. Given these numbers, our overall rate of ICP was 0.15%. Perforation most typically results from applied pressure and mechanical shearing force; barotrauma is the second most common cause of injury. ICP is most commonly identified in the sigmoid colon. In our study, we classified ICP as either early or delayed perforation; early perforations were those detected immediately or within the first 24 hours, and delayed perforations were those detected later on (after 24 hours). Of the 17 cases reviewed in our study, only two were diagnosed after 24 hours, both at two days post-operative. Upon diagnosis, evaluation and treatment were initiated immediately; this included consultation for appropriate preparation prior to surgery or conservative management. At our hospital, most cases of ICP were managed by laparoscopic surgery. All but one of the ICP cases in our cohort was treated with minimally invasive surgery. This procedure includes the introduction of three or four trocars, a thorough inspection of the abdomen and identification of the site of perforation. The decision to proceed with primary repair, diversion via a stoma, or treatment of the primary disease such as colon carcinoma depends mainly on the status of the abdominal cavity and hemodynamic status.

It is critical to recognize that ICP can be devastating for both the patient and the endoscopist. According to the American Society for Gastrointestinal Endoscopy (ASGE) and the European Society for Gastrointestinal Endoscopy (ESGE), the rate of ICP should be ≤ 1 per 500 and ≤ 1 per 1000 colonoscopies respectively. The overall perforation rate at our hospital where colonoscopies are performed on both healthy individuals and on patients with a variety of illnesses is comparable to the recommendations from these organizations. Advanced age is a risk factor for ICP; other risk factors are female sex (8, 12-14) and history of previous abdominal surgery (15).

At our hospital, most of the perforations were located in the sigmoid colon (58.8%) with a diameter ranging between 5 and 50 mm and an average of 22.1 mm. The mechanism of injury in most of these cases was mechanical tear due to excess force or barotrauma; the latter is primarily associated with diverticular perforation. Diverticulosis is largely a condition associated with aging; the prevalence of diverticulosis has been estimated at 65% in patients at or older than 65 years (16). Despite the relatively large injuries (>20 mm) detected in our patient cohort, most were addressed with laparoscopic repair and primary suturing of the defect without fecal diversion.

All but one of the perforations was treated surgically; one patient with a large perforation (50 mm) at the level of rectosigmoid junction on the mesenteric side of the bowel was successfully treated with conservative measures. Thus, we hypothesize that the size of the lesion is not as critical to outcome as is the side of the bowel where the perforation resides; lesions on the mesenteric side may respond more readily to a conservative, non-surgical approach.

In this study, 12 patients (70.6%) with ICP were managed laparoscopically with primary repair; eleven of these patients were diagnosed within the first 24 hours. One patient with delayed diagnosis experienced a prolonged ileus and required a longer hospital stay than did the other patients, although no further interventions were required. By contrast, two patients (11.8%) with delayed diagnosis included one patient who developed generalized purulent peritonitis and fibrin formation despite no fecal contamination during laparoscopic intervention. A 15 mm defect was detected at the level of upper rectum, which responded to primary suturing and copious irrigation of the abdominal cavity with tepid physiological saline solution and drainage. The second patient was readmitted after discharge with a diagnosis of sepsis; this patient was stabilized and underwent proctosigmoidectomy (Hartmann procedure) but ultimately succumbed to multiple organ failure.

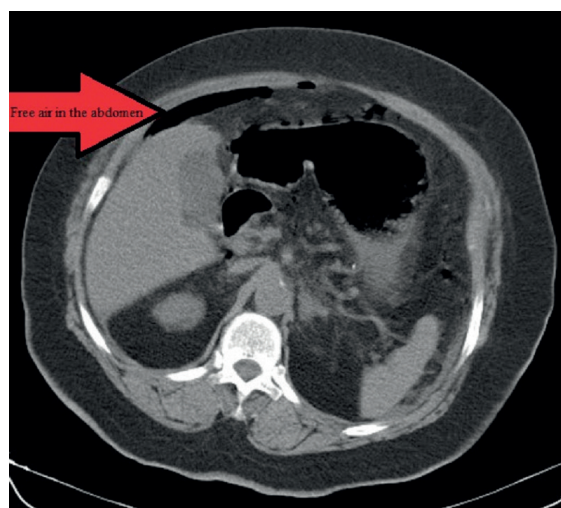


Figure 1. Free air in the abdominal cavity due to iatrogenic colon perforation

ICP can be identified immediately during the procedure or soon thereafter based on clinical and radiological findings. The most consistent symptom of colon perforation is pain and abdominal distention (17). A CT scan can be considered as part of the diagnostic workup in cases of high clinical suspicion and/or conventional radiographs that are insufficiently revealing (Figure 1). Once the diagnosis of colon perforation is established one needs to determine whether the ensuing medical issues are localized or generalized. This can be accomplished with serial clinical examinations, biochemical findings and

conventional radiography with confirmation as needed by CT scan. In our cohort of 17 patients, seven were diagnosed by means of abdominal CT scan (41.2%), one patient by means of conventional radiography (5.9%), and nine were diagnosed with endoscopy and direct visualization of the defect (52.9%).

Biochemical analyses may be helpful toward diagnosing ICP. Eight of the 17 patients in our cohort developed leukocytosis (47.1%), one patient was leukopenic and six presented with normal peripheral blood leucocyte counts. The two patients who experienced delayed diagnosis were among those with abnormal leucocyte counts; these results might be explained by anergy and delayed immune response, both features frequently observed in the geriatric population. Elderly patients who suffer significant injury frequently demonstrate impaired inflammatory and immunologic responses to stress. Moreover, stressful events such as ICP may lead to impaired metabolic responses, observations that have been attributed to a decrease in oxygen consumption that can lead to organ failure (18, 19). The decrease in oxygen consumption may relate to mitochondrial injury.

The great advances made in the field of minimally invasive surgery have led to a shift from laparotomy with stoma diversion to management that focuses on laparoscopic repair or partial colectomy with primary anastomosis (20-22). In this study, all of the elderly ICP surgical patients in our cohort were managed with a laparoscopic approach. In contrast to what has been reported previously in the literature, the mechanism of perforation, the age of the patient, and the size of the tear were not critical factors in determining optimal management. The main factors that may contribute to this decision include the general status (i.e., comorbidities) and the time elapsed between perforation and diagnosis. Laparoscopic surgery may still be considered even in cases of delayed diagnosis. Minimally invasive surgery by means of laparoscopic suturing or resection and anastomosis is an effective treatment and is clearly safe in the elderly.

According to Wullstein et al.(7) and Yamamoto et al.(23), ICP secondary to mechanical injury typically requires more extensive repairs, including laparoscopic linear stapling. Interestingly, in our study, which features ICP secondary to mechanical injury and barotrauma with large defect size (mean = 22.1 mm), we document successful treatment with laparoscopic primary suturing. These findings indicate that the size of the defect and the mechanism of injury were not critical parameters for determining the surgical approach.

Laparoscopy has a clear postoperative advantage, reflected in overall patient satisfaction, less pain, reduced need for analgesics, and decreased hospitalization time. In our study, the mean hospital stay was 6.6 days. By contrast, ICP managed by laparotomy resulted in a mean hospital stay of 11.8 days (24).

Adequate bowel preparation is essential for a high quality examination of the colon; good preparation also contributes to a positive outcome in cases of perforation. As shown in our study, perforation in one patient with inadequate bowel preparation was associated with severe abdominal contamination and prolonged postoperative ileus.

Untreated ICP due to misdiagnosis carries a significant mortality rate. The most common cause of mortality secondary to delayed diagnosis is acute bacterial peritonitis and sepsis. One patient in our cohort was seen in the emergency department and was diagnosed with sepsis at 48 hours after colonoscopy; perforation was apparent on abdominal CT scan. After aggressive resuscitation, surgical exploration revealed generalized purulent peritonitis, due to a 25 mm perforation at the anti-mesenteric side of the sigmoid colon. A Hartman procedure was completed, although the patient deteriorated rapidly. This outcome is similar to cases described by Iqbal et al. who reported the demise of two patients with peritonitis who refused surgical intervention (25).

CONCLUSION

Our study is an original and novel evaluation of ICP exclusively in elderly patients. Among our results, we report that advanced age is not a restriction when considering laparoscopic surgery even under emergency conditions. The main limitations to our study relate to the retrospective observational design and inclusion of patient data from a single medical center with substantial experience with minimally invasive surgery.

Our data suggest that the minimally invasive surgery is an efficient strategy for managing ICP in the elderly population. Furthermore, simple suturing of the defect is a safe and feasible approach regardless of the age of the patient.

Competing interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical approval: Ethical committee approval for this study was obtained from the Local Research Ethics Committee and registered under the number 19-KAEK-065. (Tokat Gaziosmanpasa University)

REFERENCES

1. Howlader N. SEER Cancer Statistics Review, 1975-2008, National Cancer Institute, http://seer.cancer.gov/csr/1975_2008/, based on November 2010.
2. Rogers BH, Silvis SE, Nebel OT, et al. Complications of flexible fiberoptic colonoscopy and polypectomy. *Gastrointest Endosc* 1975;22:73-7.
3. Smith LE. Fiberoptic colonoscopy: complications of colonoscopy and polypectomy. *Dis Colon Rectum* 1976;19:407-12.
4. Paspatis GA, Dumonceau J-M, Barthet M, et al. Diagnosis and management of iatrogenic endoscopic perforations: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement. *Endoscopy*, 2014;46:693-711.

5. Shahmir M, Schuman BM. Complications of fiberoptic endoscopy. *Gastrointest Endosc* 1980;26:86-91.
6. Mühlendorfer SM, Kekos G, Hahn EG, et al. Complications of therapeutic gastrointestinal endoscopy. *Endoscopy* 1992;24:276-83.
7. Wullstein C, Köppen M-O, Gross E. Laparoscopic treatment of colonic perforations related to colonoscopy. *Surg Endosc* 1999;13:484-7.
8. Samalavicius NE, Kazanavicius D, Lunevicius R, et al. Incidence, risk, management, and outcomes of iatrogenic full-thickness large bowel injury associated with 56,882 colonoscopies in 14 Lithuanian hospitals. *Surg Endosc* 2013;27:1628-35.
9. Lohsiriwat V, Sujarittanakarn S, Akaraviputh T, et al. What are the risk factors of colonoscopic perforation? *BMC Gastroenterol* 2009;9:71.
10. Arora G, Mannalithara A, Singh G, et al. Risk of perforation from a colonoscopy in adults: a large population-based study. *Gastrointest Endosc* 2009;69:654-64.
11. Day LW, Kwon A, Inadomi JM, et al. Adverse events in older patients undergoing colonoscopy: a systematic review and meta-analysis. *Gastrointest Endosc* 2011;74:885-96.
12. Lohsiriwat V. Colonoscopic perforation: incidence, risk factors, management and outcome. *World J Gastroenterol* 2010;16:425.
13. Hamdani U, Naeem R, Haider F, et al. Risk factors for colonoscopic perforation: a population-based study of 80118 cases. *World J Gastroenterol* 2013;19:3596.
14. Anderson ML, Pasha TM, Leighton JA. Endoscopic perforation of the colon: lessons from a 10-year study. *Am J Gastroenterol* 2000;95:3418-22.
15. Martínez MG. Perforation after colonoscopy-our 16-year experience. *Rev Espan Enferm Digest* 2007;99:588.
16. Comparato G, Pilotto A, Franzè A, et al. Diverticular disease in the elderly. *Digest Dis* 2007;25:151-9.
17. Farley DR, Bannon MP, Zietlow SP, et al. Management of colonoscopic perforations. *Mayo Clin Proc* 1997;72:729-33.
18. Frankenfield D, Cooney RN, Smith JS, et al. Age-related differences in the metabolic response to injury. *J Trauma* 2000;48:49.
19. Moore FA, Haenel JB, Moore EE, et al. Incommensurate oxygen consumption in response to maximal oxygen availability predicts postinjury multiple organ failure. *J Trauma* 1992;33:58-65; discussion 65-7.
20. Mattei P, Alonso M, Justinich C. Laparoscopic repair of colon perforation after colonoscopy in children: report of 2 cases and review of the literature. *J Pediatr Surg* 2005;40:1651-3.
21. Hansen AJ, Tessier DJ, Anderson ML, et al. Laparoscopic repair of colonoscopic perforations: indications and guidelines. *J Gastrointest Surg* 2007;11:655-9.
22. Araujo SE, Seid VE, Caravatto PP, et al. Incidence and management of colonoscopic colon perforations: 10 years' experience. *Hepato-gastroenterol* 2009;56:1633-6.
23. Yamamoto A, Ibusuki K, Koga K, et al. Laparoscopic repair of colonic perforation associated with colonoscopy: use of passing sutures and endoscopic linear stapler. *Surg Laparosc Endosc Percutan Tech* 2001;11:19-21.
24. Cobb WS, Heniford BT, Sigmon LB, et al. Colonoscopic perforations: Incidence, management, and outcomes/discussion. *The Am Surg* 2004;70:750.
25. Iqbal CW, Chun YS, Farley DR. Colonoscopic perforations: a retrospective review. *J Gastrointest Surg* 2005;9:1229-36.