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Optimal Methods for the Management of Iatrogenic Colonoscopic Perforation

Dae Kyu Shin[1], Sun Young Shin[1], Chi Young Park[1], Sun Mi Jin[1], Yang Hyun Cho[1], Won Hee Kim[1], Chang-Il Kwon[1], Kwang Hyun Ko[1], Ki Baik Hahm[1], Pil Won Park[1], Jong Woo Kim[2] and Sung Pyo Hong[1]

Departments of [1]Internal Medicine and [2]Surgery, CHA Bundang Medical Center, CHA University, Seongnam, Korea

Background/Aims: Colonoscopic perforations have been managed with exploratory laparotomy, and have resulted in some morbidity and mortality. Recently, laparoscopic surgery is commonly performed for this purpose. The aim of this study was to compare the outcomes of several management strategies for iatrogenic colonoscopic perforations.
Methods: We retrospectively reviewed the medical records of patients who had been treated for colonoscopic perforation between January 2004 and April 2013 at CHA Bundang Medical Center in Korea.
Results: A total of 41 patients with colonoscopic perforation were enrolled. Twenty patients underwent conservative management with a success rate of 90%. Surgical management was performed in 23 patients including two patients who were converted to surgical management after the failure of the initial conservative management. Among 14 patients who underwent surgery at 8 hours after the perforation, there was no considerable difference in adverse outcomes between the laparotomy group and the laparoscopic surgery group. The medical costs and claim rate were 1.45 and 1.87 times greater in the exploratory laparotomy group, respectively.
Conclusions: Conservative management of colonoscopic perforation could be an option for patients without overt symptoms of peritonitis or with a small defect size. If surgical management is required, laparoscopic surgery may be considered as the initial procedure even with a delayed diagnosis. **Clin Endosc 2016;49:282-288**

Key Words: Colonoscopy; Colonoscopic perforation; Laparoscopic surgery

INTRODUCTION

Colonoscopy is a safe and effective method for the screening of colorectal diseases. Although the incidence is low, colonoscopic perforation is a well-recognized and severe complication. With the growing numbers of colonoscopic procedures performed, the incidence of colonoscopic perforation has been increased.[1,2] Published series reported high mortality among patients with colonoscopic perforation.[3-6] Early exploratory laparotomy with primary closure or bowel resection has been the standard treatment of colonoscopic perforation; however, relatively high morbidity and mortality rates were reported.[7-10]

Recently, some reports have advocated either conservative management[11,12] or laparoscopic surgery.[13-16] However, the optimal management of colonoscopic perforation remains controversial. We therefore investigated the outcomes and effectiveness of each management strategy to suggest the optimal management for colonoscopic perforation.

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Correspondence: Sung Pyo Hong
Digestive Disease Center, Department of Internal Medicine, CHA Bundang Medical Center, CHA University, 59 Yatap-ro, Bundang-gu, Seongnam 13496, Korea
Tel: +82-31-780-5214, **Fax:** +82-31-780-5219, **E-mail:** sphong@cha.ac.kr

MATERIALS AND METHODS

Patients

We retrospectively reviewed the records of patients who had been treated for colonoscopic perforation between January 2004 and April 2013 at CHA Bundang Medical Center,

CHA University. The patients' demographic data, endoscopic procedure information, perforation location, perforation size, management, and outcomes of each management method were reviewed.

Methods

The diagnosis of colon perforation was assumed on the basis of clinical data and confirmed by using plain (chest or abdominal) radiography or computed tomography. The size of perforation was assumed from endoscopic records in the conservative management group and from surgical records in the surgical management group. The management was decided on the basis of the patients' clinical condition, by five endoscopists with 5, 12, 15, 18, and 22 years' experience in therapeutic endoscopy or six faculty surgeons on duty with 5, 10, 11, 15, 19, and 22 years' experience in surgery. For the patients without overt symptoms of peritonitis or a large defect, conservative management was applied. Otherwise, surgical management was performed.

Conservative management included absolute bowel rest, parenteral nutrition and broad-spectrum intravenous antibiotics. Endoscopic repair was attempted during the procedure in selected patients who had a small-sized perforation with immediate diagnosis. The types of surgical approach were decided by the surgeon according to his/her experience in laparoscopy, the elapsed time from perforation to operation, and the patient's clinical condition.

Statistical analysis

Categorical variables were compared by using Fisher exact test or the chi-square test. Numerical variables were compared by using Student *t*-test or the Mann-Whitney test. Probability values ≤0.05 were considered statistically significant. All analyses were performed by using SPSS version 19.0.0 (IBM Co., Armonk, NY, USA).

RESULTS

During the study period, 48,088 colonoscopies were performed and a total of 28 colonoscopic perforations (0.06%) occurred. Colon perforation from diagnostic colonoscopy occurred in five (0.01%) of 40,232 cases and from therapeutic colonoscopy in 23 (0.29%) of 7,856 cases.

A total of 41 patients with colonoscopic perforation, including 13 patients referred from other clinics, were enrolled. There were 14 colonoscopic perforations from diagnostic colonoscopy and 27 from therapeutic colonoscopy. Sixteen cases occurred during polypectomy, four cases during mucosal resection and seven cases during submucosal dissection.

The mean size of the perforation was significantly larger in the diagnostic colonoscopy group than in the therapeutic colonoscopy group. Therefore, more surgical procedures were applied in the diagnostic colonoscopy group. The mean size of the perforation was also larger in the operation group than in the conservative management group; however, the difference was not significant because of some missing data in cases of unmeasurable micro-perforation. The perforation was diagnosed immediately during colonoscopy in only 23 cases (56%).

The most common site of perforation was the sigmoid colon (39%), followed by the rectum (17%). The sites of perforation were mostly in the left colon in the diagnostic colonoscopy group and variable in the therapeutic colonoscopy group. There was no significant difference in terms of management, outcomes and peritoneal contamination between the fasting group and the non-fasting group (Table 1).

Table 1. Outcomes according to the State of Fasting before Management

Variable	Fasting group (*n*=29)	Non-fasting group (*n* =12)	*p*-value
Peritoneal contamination (*n*=23)[a]	16	7	0.330
None	3 (18.8)	3 (42.9)	
Fluid	12 (75.0)	3 (42.9)	
Stercoraceous	1 (6.2)	1 (14.2)	
Management			0.344
Conservative	13 (44.8)	5 (41.7)	
Exploratory laparotomy	10 (34.5)	4 (33.3)	
Laparoscopic surgery	6 (20.7)	3 (25.0)	
Hospital stay, day	9.2±4.5	10.7±5.8	0.642
Adverse event[b] with 1st management, yes:no	0:27 (0)	2:10 (16.7)	0.024

Values are presented as number (%) or mean±SD.
[a]Confirmed by operation records; [b]Leakage and abscess formation.

Conservative management and endoscopic repair

Conservative management was applied in 20 patients without overt symptoms and signs of peritonitis, and was successful in 18 patients (90%) (Table 2). Surgical resection was needed in two patients because of evidence of aggravated peritonitis after the endoscopic repair; the perforation size in these two patients was 40 and 15 mm, respectively.

Endoscopic repair with clipping was attempted in nine patients and was successful in seven of them (78%). The patients who underwent successful endoscopic repair had perforation of ≤10 mm in size. Over-the-scope clipping was not applied in these patients. The remaining 11 patients recovered with only medications. One patient who had abscess formation at the transverse mesocolon after polypectomy was managed with aspiration and antibiotics treatment.

Surgical management

Surgical management was applied in 21 patients (51%) initially and in two patients who were converted to surgical management after the failure of the initial conservative management (Table 2). Among these 23 patients, 15 patients underwent exploratory laparotomy including one patient who was shifted from laparoscopic surgery because of a long circumferential perforation. Eight patients underwent laparoscopic surgery. The mean size of the perforation was significantly smaller in the laparoscopic surgery group than in the exploratory laparotomy group. Primary closure was done in 11 patients (73.3%), and segmental colectomy was performed in four patients (26.7%) in the laparotomy group. In the laparoscopy group, primary closure was performed in five patients (62.5%) and segmental colectomy in three patients (37.5%). Laparotomy was applied more commonly in female patients than in male patients. The laparoscopic surgery group was significantly superior to the laparotomy group in terms of hospital stay with non-inferior adverse outcomes. The medical costs and claim rate were 1.45 and 1.87 times greater in the exploratory laparotomy group than in the laparoscopic surgery group, respectively. One laparotomy patient needed a repeat laparotomy because of leakage from the anastomosis site. Laparoscopic approaches were performed only by a limited number of surgeons with ample experience in laparoscopy (Table 3).

Operative closure was performed within 8 hours from perforation in nine patients (35%) among the 23 surgically managed patients. Among them, six patients underwent laparotomy and three underwent laparoscopic surgery. Regardless

Table 2. Characteristics of Patients and Outcomes according to the Management

Characteristic	Operation (*n*=23)	Conservative care (*n*=18)	*p*-value
Age, yr	60.5±11.9	53.9±13.2	0.104
Sex, male:female	12:11	13:5	0.192
Aim of colonoscopy			0.037
Diagnostic	11	3	
Therapeutic	12	15	
Site of perforation			0.817
Ascending colon	6	4	
Transverse colon	1	2	
Descending colon	4	1	
Sigmoid colon	9	7	
Rectum	3	4	
Size of defect, mm	17.2±2.9	3.6±3.5	0.074
Awareness of perforation, yes:no	13:10 (56.7)	10:8 (55.6)	0.951
Fasting:non-fasting	16:7	13:5	0.853
Leukocytosis (>10,000 mm^3)	10	2	0.024
Hospital stay, day	12.6±4.4	5.8±2.1	<0.001
Adverse outcomes with 1st treatment			0.269
Operation after clipping	2	-	
Re-operation	1	0	
Abscess formation	0	1	

Values are presented as mean±SD or number (%).

Table 3. Characteristics of Patients and Operative_Outcomes according to the Surgical Methods

Characteristic	Laparotomy (*n*=15)	Laparoscopy (*n*=8)	*p*-value
Age, yr	58.7±11.4	64.3±11.9	0.294
Sex, male:female	5:10	7:1	0.013
Aim of colonoscopy, diagnostic:therapeutic	7:8	4:4	0.645
Size of defect, mm	22.0±22.2	8.6±5.2	0.036
History of abdominopelvic surgery, yes/no	3:12	0:8	0.175
Time from perforation to operation, hr	18.8±18.2	28.1±31.0	0.371
Leukocytosis (>10,000 mm^3), %	27.3	28.6	0.645
Early surgery, yes:no[a]	6:9	3:5	0.907
Abdominal contamination			0.189
None	10 (66.7)	5 (62.5)	
Fluid	4 (26.7)	2 (25.0)	
Stercoraceous	1 (6.7)	1 (12.5)	
Operation			0.317
Primary closure	11 (73.3)	5 (62.5)	
Wedge colectomy	3 (20.0)	3 (37.5)	
Colostomy	1 (6.7)	0	
Re-operation	1	0	0.455
Surgeon, active laparoscopist, yes:no	7:8	8:0	0.052
Hospital stay, day	14.7±3.5	8.6±2.9	<0.001
Medical cost (ratio)	1.45	1	0.119
Medical claim, yes:no[b]	7:8	1:7	0.176

Values are presented as mean±SD or number (%).
[a]Surgery which was started within 8 hours from perforation; [b]Medical claim, asking some compensation money.

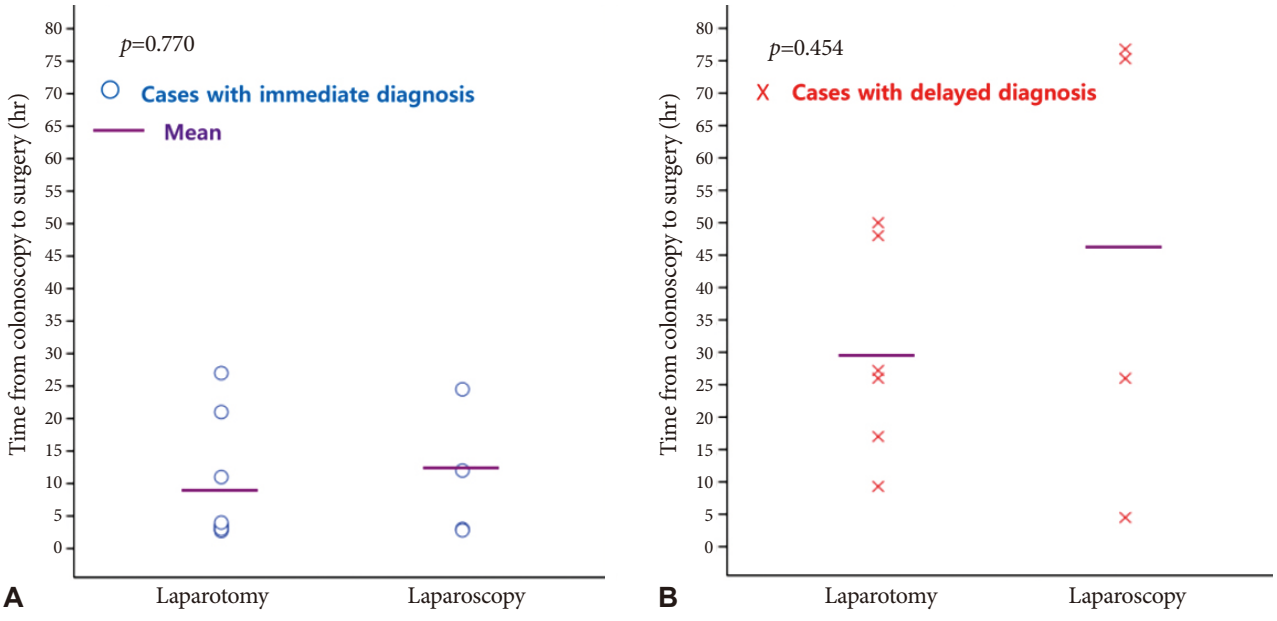

Fig. 1. Elapsed time from perforation to surgery according to the awareness of the perforation. (A) Elapsed time in patients with an immediate diagnosis of perforation. (B) Elapsed time in patients with a delayed diagnosis of perforation. There was no statistical difference in the elapsed time between laparotomy and laparoscopy.

Table 4. Outcomes of Surgical Managements Performed after 8 Hours from Perforation

Variable	Laparotomy (*n*=9)	Laparoscopy (*n*=5)	*p*-value
Hospital stay, day	14.7±4.2	8.8±3.1	0.018
Hospital cost (ratio)	1.36	1	0.332
Medical claim, yes:no[a)]	7:2	2:3	0.158
Re-operation	1	0	0.439

Values are presented as mean±SD.
[a)]Medical claim, asking some compensation money.

of whether the perforation was diagnosed immediately or not, the elapsed time from colonoscopy to surgery was not significantly different between laparotomy and laparoscopic surgery (Fig. 1).

Among 14 patients who underwent surgery after 8 hours from perforation, there was no significant difference in adverse outcomes between the laparotomy group and the laparoscopic surgery group (Table 4).

DISCUSSION

Unlike other colon perforation cases, perforation that occurred during colonoscopy could be managed conservatively because the bowel had been cleaned.[17,18] In our study, conservative management including endoscopic repair was available in 44% of patients with a 90% success rate. In case of colon perforation confirmed only with radiology, or a small perforation without overt peritonitis, conservative management could be a good choice with a high success rate.[19] However, as the failure of a conservative management can be catastrophic, the decision should be made carefully.

Endoscopic repair with clip closure can be applied in case of an immediate diagnosis of perforation during colonoscopy. It is effective in creating a leak-proof seal of the perforation and enables avoiding surgery. It is useful for the closure of small (10 mm) non-gaping perforations.[20] In cases of a large gaping perforation, over-the-scope clipping is available nowadays. In our study, endoscopic repair of colonoscopic perforation by means of clipping showed a success rate of 78 %. However, in cases with a perforation size of ≤10 mm, the success rate of endoscopic repair was as high as 100%. This result is consistent with previous reports.[1,20] To reduce pain or discomfort after endoscopic repair, CO_2 insufflation is recommended to accelerate intraperitoneal gas absorption.[21]

Recently, laparoscopic surgery has been increasingly used with good outcomes. Some reports have strongly suggested that laparoscopic surgery should be the initial treatment for early-diagnosed colonoscopic perforations.[14] However, when the time interval from perforation to surgery is delayed, exploratory laparotomy is generally preferred because of the possibility of peritoneal contamination and severe peritonitis. The risk factors of severe contamination or severe peritonitis are delayed surgery, large defects, and diet before the operation. According to our results, laparotomy was performed in cases with a larger defect, and laparoscopy in cases with a little longer elapsed time from perforation to surgery. As a result, the degree of peritoneal contamination was not different. One report showed that operative closure within 8 hours after the perforation achieved primary repair without diversion.[22] Therefore, the surgical managements were evaluated by dividing the surgeries to those performed before 8 hours and those performed thereafter. In our study, there was no significant difference in outcomes between the laparotomy and laparoscopic surgery groups even after 8 hours from perforation. These results demonstrated that a delayed time to the operation, which is closely related to having a clean wound on the perforation site, may not be the absolute indication for exploratory laparotomy. Hence, it is reasonable for surgeons to attempt the laparoscopic approach first for colonoscopic perforation in consideration of not only the recovery time and operation scar but also the cost and malpractice claim.

In addition, the immediate diagnosis of colonoscopic perforation is not easy. Colon perforations were diagnosed immediately in only 56% of cases. Surgical management was performed more frequently in cases of perforation from diagnostic colonoscopy, as in another report.[23] The reasons for this difference were a delayed awareness of the perforation and a larger defect size. The mechanism of perforation during polypectomy or submucosal dissection was based on a heat coagulation damage of the muscle layer; however, perforation from diagnostic colonoscopy occurred because of pushing or stretching in the angulated portion. Therefore, the sites of perforation from therapeutic colonoscopy were distributed in the whole colon but those from diagnostic colonoscopy were mostly located in the left colon. There was no significant difference in terms of peritoneal contamination at operation between the fasting group and the non-fasting group in our data.

Briefly, conservative management of colonoscopic perfora-

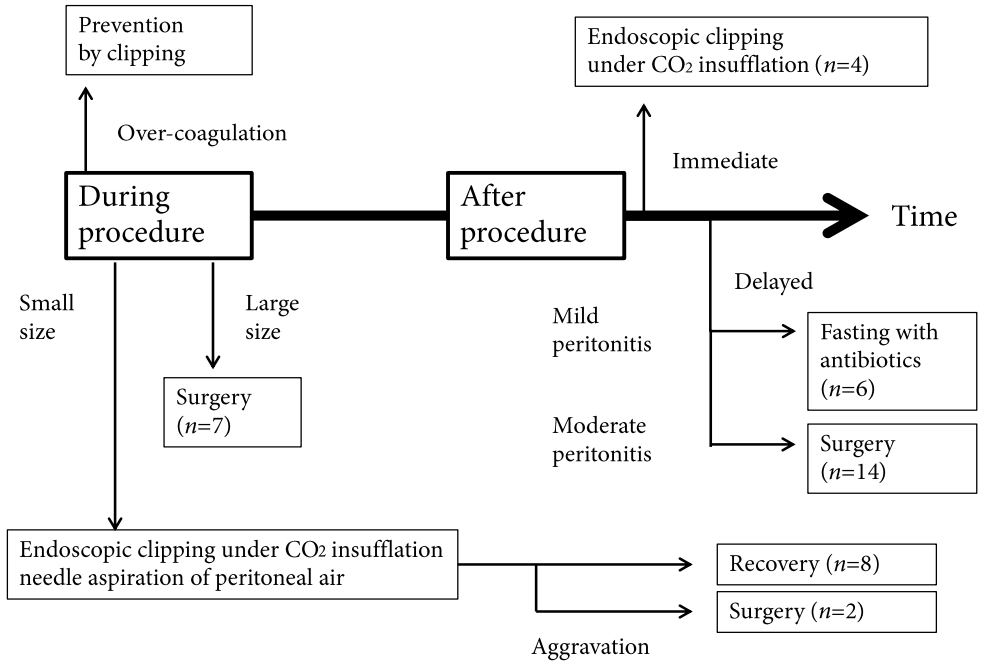

Fig. 2. Flow chart for the management of iatrogenic colonoscopic perforation. Colonoscopic perforations could be found during or after procedures. This figure shows processes and clinical outcomes of each management for colonoscopic perforations.

tion is effective for patients without overt symptoms of peritonitis, or a large defect. If surgical management is required, laparoscopic surgery should be considered as the initial surgical management even with a delayed diagnosis. The flow chart for the management of iatrogenic colonoscopic perforation is shown in Fig. 2.

The key message of our study is that colonoscopic perforation with a clean wound could be the indication of laparoscopic surgery even with a delayed diagnosis. Laparoscopic surgery can reduce the patients' physiological and emotional stress from laparotomy and help them return to normal life earlier. It may also reduce malpractice claims and medical costs as our results showed.

Conflicts of Interest

The authors have no financial conflicts of interest.

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