

Case Analysis

# Experience in Iatrogenic Colonic Perforation Caused by Colonoscopy: A Review of 26,729 Colonoscopic Procedures

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## Key Words

Colonoscopy;

Perforation;

Colon

**Purpose.** The incidence of iatrogenic perforation caused by colonoscopic procedures is low. However, the rising number of procedures may pose problems. Our study aimed to clarify the perforation frequency in our hospital and to propose an appropriate treatment protocol for patients with perforation.

**Methods.** A retrospective study of patient records was performed for all patients with iatrogenic colonic perforation caused by colonoscopy between January 2001 and December 2007 in Tri-Service General Hospital, Taipei, Taiwan. The patients' demographic data, clinical characteristics, management and result were recorded. Fisher's exact and Wilcoxon rank-sum tests were used for statistical analysis.

**Results.** During these seven years, 26,729 colonoscopic procedures were performed and 10 iatrogenic colonic perforations occurred (0.037%). One patient recovered uneventfully with conservative treatment. Nine patients underwent a laparotomy. The postoperative course was uncomplicated in five cases and complicated in four. Eight perforations occurred in the sigmoid colon, one in the transverse colon and one in an unknown perforation site. In addition, the sepsis rate and mortality tended to be worse in cases with poor preparation of the colon, but these trends were not statistically significant. The hospital stay was prolonged significantly in patients with postoperative complications.

**Conclusions.** Iatrogenic colonic perforation during colonoscopy is a rare but serious complication. The sigmoid colon is the most common perforation site. Immediate operative management appears to be a good strategy for most patients.

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Colonoscopy is one of the standard diagnostic or therapeutic procedures for dealing with colonic lesions. As expertise and applicability for colonoscopy have widened, virtually all endoscopy centers have seen large increases in the number of examinations performed. Although endoscopy of the colon is

regarded as a relatively safe procedure, it entails significant morbidity and-rarely-mortality. The two main complications of colonoscopy are hemorrhage and perforation. Because of the associated hospitalization and surgery, perforation is the most serious and the most feared adverse outcome.<sup>1</sup> The reported incidence

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of colonic perforation during colonoscopic procedures is in the range of 0.2-2.0%. During diagnostic colonoscopy, the perforation incidence is 0.3-0.8% and during therapeutic colonoscopy, the incidence is 0.5-1.0%.<sup>2</sup> Although colonoscopy was formerly the domain of the surgeon, some procedures are now performed by internists and physician assistants. We reviewed our experience of colonic perforations caused by colonoscopy, focusing on morbidity, mortality and the principles of management.

## Patients and Methods

Medical records for 26,729 colonoscopic procedures at Tri-Service General Hospital Medical Center in Taipei, Taiwan, were reviewed for the seven years encompassing January 2001 to December 2007. There were 10 iatrogenic perforations during colonoscopy: four patients in the gastrointestinal department and six in the colorectal surgical department.

The demographic and clinical data recorded included gender, age, indication for colonoscopy, mode of anesthesia and the underlying disease. The underlying diseases included major abdominal surgery and major organ problems (cardiovascular system, lung, kidney, and liver). We also recorded the method of co-

lon preparation and type of procedure. Management and outcome parameters included time of diagnosis, type of operation, operative findings, complication, duration of hospital stay and results.

For statistical analysis, Fisher's exact test was used to compare the outcome and incidence of sepsis between good and poor preparation of the colon. The Wilcoxon rank-sum test was used to compare hospital stay with underlying diseases and postoperative complications.

## Results

Among the 26,729 colonoscopies, there were 10 perforations (0.037%). The patient characteristics are shown in Table 1. There were four men and six women with a mean age of 70.5 years (range 45-88). Indications for colonoscopy included changing bowel habits, abdominal pain, anal fistula, follow-up for previous polypectomy or carcinoma, bleeding and abnormal barium enema findings. Five patients had underlying disease conditions, which included major organs such as the liver, lung, kidney or cardiovascular system. Three patients had major abdominal operations: subtotal gastrectomy, right hemicolectomy and total abdominal hysterectomy. There had been good

**Table 1. Perforations after Colonoscopy: Demographic and Clinical Characteristics**

Patient	Age	Gender	Indication for Colonoscopy	Anesthesia	Underlying disease/ Operative history	Colon preparation	Type of Procedure
1	80	M	Change of bowel habits	Local	COPD; Post status subtotal gastrectomy	Poor	Diagnostic
2	45	M	Change of bowel habits	Local	-	Good	Polypectomy
3	73	F	Low abdominal pain	Local	-	Good	Diagnostic
4	78	M	Anal fistula	Local	-	Good	Diagnostic
5	66	F	Follow-up for previous polypectomy	IVG	Colon cancer post status right hemicolectomy	Good	Polypectomy
6	76	F	Bleeding	Local	SCC of lung with multiple liver metastasis	Poor	Diagnostic
7	52	F	Follow-up for previous polypectomy	Local	-	Good	Polypectomy
8	77	M	Follow-up for colonic carcinoma	Local	COPD; HCVD	Good	Diagnostic
9	70	F	Abnormal barium enema	Local	HCVD; Post status LC & TAH	Good	Diagnostic
10	88	F	Bleeding	Local	Uremia; HCVD	Poor	Diagnostic

M = Male. F = Female. COPD = Chronic Obstructive Pulmonary Disease. HCVD = Hypertensive Cardiovascular Disease. LC = Laparoscopic cholecystectomy. TAH = Total Abdominal Hysterectomy. SCC = Squamous Cell Carcinoma.

colonic preparation in seven cases and poor preparation in three. Three perforations involved therapeutic colonoscopy and seven occurred during diagnostic colonoscopy. There were no significant differences in age, sex, underlying disease, type of major abdominal operation, or methods of colon preparation or anesthesia (data not shown).

Eight perforations occurred in the sigmoid colon, one in the transverse colon and one in an unknown site. Nine patients underwent a laparotomy: primary repair with diversion in one, primary repair with exteriorization in one, diversion in one, Hartmann's procedure in five, and resection with anastomosis and diversion in one. The patient with an unknown perforation site had a good preparation of the colon but signs of peritonitis were found 8 h after colonoscopy and an upright X-ray showed that air had accumulated in the subphrenic area. This patient was given conservative treatment and recovered uneventfully when dis-

charged.

Table 2 shows that the postoperative course was uncomplicated for five of the nine patients and complicated in four including two mortalities. For all patients with perforation, the mean hospital stay was 27.6 days (median 16.5; range 12-75). In addition, the sepsis rate and mortality tended to be worse in cases with poor preparation of the colon, but these trends were not statistically significant (Table 3). The hospi-

**Table 3. Fisher's exact test was used to compare the outcome and incidence of sepsis between good or poor preparation of the colon**

		Preparation of colon		P-value
		Poor	Good	
Outcome	Death	2	0	0.0667
	Recovery	1	7	
Sepsis	Yes	2	1	0.1833
	No	1	6	

**Table 2. Perforations after Colonoscopy: Management and Result**

Patient	Time of diagnosis	Management	Operative finding	Complication	Hospital days	Outcome
1	Immediate	Hartmann's procedure	Perforation hole of S-colon, Severe fecal peritonitis	Sepsis, Wound infection, Pneumonia, Renal failure	67	Death
2	2 day	Hartmann's procedure	Perforation hole of S-colon, Severe fecal peritonitis	-	14	Recovery
3	Immediate	Hartmann's procedure	Diverticulosis and perforation hole of S-colon, Severe fecal peritonitis	-	12	Recovery
4	4 day	Hartmann's procedure	Perforation hole and diverticulosis of S-colon, Severe fecal peritonitis	-	17	Recovery
5	1 day	Conservative treatment	Unknown perforation site; CXR: subphrenic free air	-	14	Recovery
6	Immediate	T-loop colostomy	Perforation hole of T-colon, Diverticulosis of whole colon, Carcinomatosis	Sepsis	22	Death
7	2 day	Primary repair with exteriorization	Perforation hole of S-colon, Severe fecal peritonitis	Sepsis, Wound infection	24	Recovery
8	1 day	Primary repair with loop ileostomy	Perforation hole of S-colon, Severe fecal peritonitis	-	16	Recovery
9	1 day	Resection with anastomosis and loop ileostomy	Perforation hole and serosa tear of S-colon, Diverticulosis of whole colon	-	15	Recovery
10	Immediate	Hartmann's procedure	Perforation hole of S-colon, Fecal impaction in whole colon	Aspiration pneumonia, Peptic ulcer	75	Recovery

S-colon = Sigmoid colon. T-colon = Transverse colon. Hartmann's procedure = Resection of the rectosigmoid colon with closure of the rectal stump and colostomy.

tal stay was prolonged significantly in patients with postoperative complications (Table 4).

## Discussion

In our study, the overall incidence of perforation during seven years was 0.037%. The mortality rate was 20% resulting from colonic perforations and 0.007% resulting from all colonoscopic procedures. Our results were similar to frequencies found in the literature.<sup>2</sup> In our study, patients with colonic diverticulosis and fecal impaction might have been at greater risk of colonic perforation during colonoscopy. Considering the rapidly growing number of endoscopies, careful risk–benefit analysis is necessary, but has been infrequently published. Through the 1970s and even into 1990s, the incidence of perforations from diagnostic and therapeutic colonoscopy was ascertained by surveys. More recently, there have been a few small, prospective studies published. In 1996, Wayne *et al.* reviewed all of the published reports and found that five deaths occurred in 83,725 procedures for a mortality rate of 0.006% and that 165 perforations occurred in 99,359 patients for a rate of 0.17%.<sup>3</sup> In spite of the shortcomings of the previous reports, our results for perforation (0.037%) were strikingly lower. Most perforations in our study occurred in the sigmoid colon, as in other reports.<sup>1-4</sup> Although there is clearly some selection of patients before proceeding to colonoscopy, we studied each case to determine if age, medical problems or major operative history of the abdomen added significant risk. However, we were unable to find any clear correlation. The most important safety factor for avoiding colonoscopic perforation is accurate and rapid sen-

sory feedback from the patient to the endoscopist, which is retained in the alert patient and blunted by intravenous sedation. This risk factor must be considered whenever sedation is used. Another important safety factor for avoiding perforations is that experience can reduce endoscopic complication rates. However, the presence of an experienced endoscopist does not provide a guarantee against complications. The risk factors for perforation have been identified by Keeffe and Young.<sup>5</sup> These were sigmoid diverticulosis and the inability to distend the sigmoid colon. In our study, our operators were all well-experienced. Iatrogenic colonic perforation may be related to factor of well-experienced operator or not. However, we need more studies to prove.

The differences between colonoscopy for female and male patients have been recognized.<sup>6</sup> Thus, colonoscopy in women tends to be more difficult than in men. Saunders *et al.* argued that recurrent looping of the colonoscope is caused by greater total colonic length in women than men despite a usually smaller stature.<sup>6,8,9</sup> Our study had similar results with six women versus four men suffering perforations. This suggests that we should lower the threshold for aborting the process when we encounter difficulty advancing the colonoscope in female patients. However, for the management of perforations, the literature has indicated that colonic perforation after colonoscopy can be managed nonsurgically because adequate preparation of the bowel before colonoscopy minimizes the risk of fecal contamination of the peritoneal cavity.<sup>2</sup>

The decision about whether to perform surgery following a colonoscopic perforation depends on the condition of the patient.<sup>2</sup> With experience, it is now recognized that selected patients with small colonoscopic perforations can be conservatively managed by medical treatment alone, even when the patient has abdominal pain or pneumoperitoneum.<sup>2,10-13</sup> As various reports have emphasized, mortality increases as time elapses between injury and surgery.<sup>4,16-18</sup> Based on our study results, the following are indications for surgery: immediate awareness of perforation with intra-abdominal tissue or organ visible through the colonoscope; signs of peritonitis with poor preparation of colon and imaging studies confirming hollow

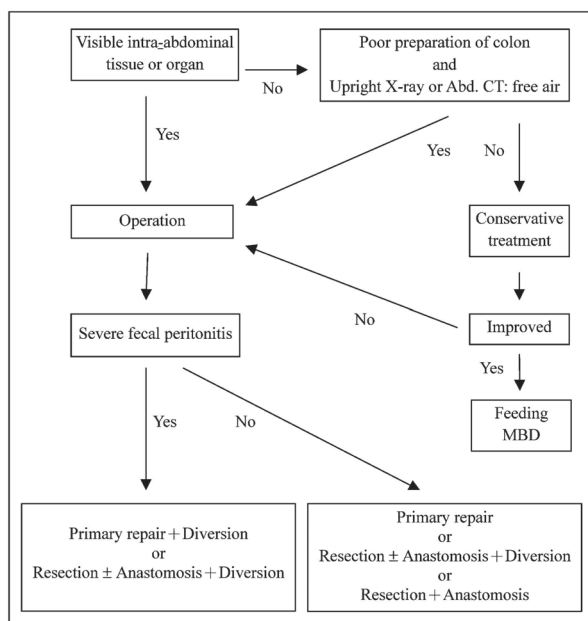
**Table 4. The Wilcoxon rank-sum test was used to compare hospital stay with underlying diseases and postoperative complications**

		Patient numbers	Hospital stay: median day (Inter Quartile Range)	P-value
Underlying Diseases	Yes	5	22(51)	0.1349
	No	5	14(3)	
Postoperative Complications	Yes	4	45.5(48)	0.0095
	No	6	14.5(2)	

organ perforation; deterioration of the patient's condition during nonsurgical treatment. In older individuals, peritoneal signs of a problem might be absent even if there is obvious peritonitis. In addition, these patients usually have associated disease and delaying surgery might be detrimental. In our ten perforation cases, we followed the well-established principles of repair of the colonic perforations<sup>17,18</sup> and have proposed a suggested management algorithm for colonoscopic perforation according to our experience (Fig. 1).

## Conclusion

Iatrogenic colonic perforation during colonoscopy is a rare but serious complication. The sigmoid colon is the most common perforation site. With the awareness of colonic perforations that can arise during the colonoscopic procedures, many complications may be avoided. Immediate operative management appears to be a good strategy for most patients.



**Fig. 1.** Suggested management algorithm for colonoscopic perforation. Diversion = colostomy or ileostomy. Hartmann's procedure = Resection + Diversion. MBD = maybe discharge. Abd. CT = Abdominal computed tomography. ± = with or without.

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## 病例分析

# 大腸鏡造成穿孔之經驗：回顧 26,729 個病人

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**目的** 大腸鏡檢查導致醫源性結腸穿孔的機率雖然極低，但隨著大腸鏡檢查的普及率提高仍可能會造成相關問題的發生，我們的研究宗旨就是在分析本院的穿孔發生率，並根據本院的經驗提出穿孔病人適當的處理原則。

**方法** 針對 2001 年 1 月至 2007 年 12 月間，因進行大腸鏡檢查而引發醫源性結腸穿孔的所有病人，進行病歷紀錄的回溯性研究，以紀錄病人的基本資料、接受大腸鏡檢查的原因、病人的潛在疾病、大腸鏡檢查資料、重大腹部手術病史、結腸穿孔診斷時間、手術後之發現、治療方法、併發症與結果。

**結果** 在此 7 年期間，三軍總醫院總共進行過 26,729 次大腸鏡檢查，因為此項檢查而引發醫源性結腸穿孔的病人共有 10 位 (0.037%)。其中一個病例接受保守治療 (conservative treatment) 後復原，另外 9 位病人則是接受剖腹手術治療，其中有 5 個病例在手術後未發生併發症，但有 4 個病例發生了併發症，包括有 2 人死亡。在上述 10 個穿孔病例中，有 8 個病例 (80%) 是發生於乙狀結腸，1 個病例發生於橫結腸，1 個病例穿孔部位不明。此外，在我們的研究中顯示，相較於結腸準備充足的病人，結腸準備不足者的敗血症發生率與死亡率有增加趨勢，但統計學上差異並不顯著，而發生術後併發症者的住院時間則顯著較長 ( $p < 0.05$ )。

**結論** 大腸鏡檢查時發生醫源性結腸穿孔為罕見但嚴重的併發症，最常發生穿孔的部位為乙狀結腸，若是發生醫源性結腸穿孔立即接受手術治療是大部分病人的最佳治療策略。

**關鍵詞** 大腸鏡、穿孔、大腸。