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ORIGINAL RESEARCH & CONTRIBUTIONS

Perforation Following Colorectal Endoscopy: What Happens Beyond the Endoscopy Suite?

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Abstract

Background: The risk factors for perforation from colorectal endoscopy have been well studied, but little is known about clinical outcomes beyond the immediate event.

Objective: To evaluate short- and long-term outcomes of iatrogenic colorectal perforation following colorectal endoscopy.

Design: Retrospective review over 16 years at a single tertiary care institution.

Main Outcome Measures: Treatment interventions, morbidity and mortality rates, hospital length of stay, stoma closure rate, and long-term complications.

Results: Of 132,259 colorectal endoscopies, 26 patients (0.02%) had a perforation (54% males; mean age, 67 years). The rectosigmoid colon was the most common site of perforation (65%). Thirty-eight percent of the perforations were recognized at the time of procedure, 31% presented within 24 hours, and 31% presented beyond 24 hours. Operative repair was undertaken in 85% of the patients, and 15% were managed with inpatient hospital observation. Primary repair was performed in 68% (defunctioning stoma in 18%). Mean hospital length of stay was 10.1 days. The overall postoperative complications rate was 55%, and wound complications were noted in 45%. The 30-day mortality rate was 19%. No death was observed beyond the first month. American Society of Anesthesiologists physical status Classes 3 and 4 were associated with mortality ($p = 0.004$). Of 7 patients who received a stoma, only 2 patients (29%) had stoma reversal. Long-term complications included incisional hernia (10%) and small-bowel obstruction (5%).

Conclusions: Perforation following colorectal endoscopy was uncommon in this study but was associated with significant morbidity and mortality. An increased risk of death was noted with higher American Society of Anesthesiologists physical status class.

Introduction

Perforation is widely recognized as one of the most serious complications of endoscopy of the lower gastrointestinal tract.[1-10] Colonoscopy remains the gold standard for screening of colorectal cancer and is useful in the workup of many gastrointestinal conditions. The risk of perforation ranges from 0.027% to 0.088% for flexible sigmoidoscopy, from 0.016% to 0.2% for diagnostic colonoscopy, and up to 5% for therapeutic endoscopy.[1,11] As the volume of both diagnostic and therapeutic endoscopic procedures increases, the absolute number of perforations will undoubtedly increase even with a relatively constant perforation rate.[12]

The risk factors contributing to perforation are well established in the literature. They include patient-related factors such as advanced age, female sex, diverticular disease, previous abdominal surgery, and colonic stricture in addition to therapeutic procedures such as endoscopic resection and dilation.[1-4,11]

Treatment options for endoscopic perforation include conservative measures such as bowel rest with broad-spectrum antibiotic therapy and operative interventions such as primary surgical repair with or without diversion, segmental colectomy with primary anastomosis, or resection with a Hartmann pouch. Despite several published reports on the various available surgical and management options, little is known regarding the clinical outcomes of patients who sustain a perforation during or following colorectal endoscopy.[12-20] The aim of this study was to review the short- and long-term outcomes of such patients.

Methods

Patients

The study was approved by the institutional review board of Kaiser Permanente (KP) Southern California. A retrospective review was conducted of all patients who sustained a perforation during or following colorectal endoscopy over a nearly 16-year period from January 1995 to October 2011. All procedures were performed by a group of gastroenterologists and a colorectal surgeon at the KP Los Angeles Medical Center, a regional tertiary care institution in Southern California that serves a population of approximately 3.4 million patients. All elective patients prepared with polyethylene glycol-electrolyte solution the day before their procedure.

The cohort of patients with perforation was identified by reviewing the endoscopy suite database in addition to the morbidity and mortality registry of the Departments of Surgery and Gastroenterology. Individual patient data were abstracted using both the outpatient and inpatient records. Data analyzed included demographics, American Society of Anesthesiologists (ASA) physical status class, medical comorbidities, indication for the procedure, location of the perforation, the cause attributed to the perforation, and when the perforation was recognized.

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Outcome measures included type of treatment interventions, length of hospital stay, and short-term (within 30 days) and long-term postoperative morbidity and mortality rate.

Statistical Analysis

To analyze the significance of association between patients' related variables and mortality as well as between disease and treatment factors and mortality, 2-tailed p values were calculated using Fisher exact test. $P < 0.05$ was the criterion for statistical significance. All statistical analyses were performed using statistical analysis software (SPSS version 16.0, SPSS Inc, Chicago, IL).

Results

A total of 132,259 colorectal endoscopies (86,101 colonoscopies and 46,158 flexible sigmoidoscopies) were performed during the study period. Twenty-six patients (0.02%) with a perforation were identified. Only 1 of the 26 perforations was secondary to flexible sigmoidoscopy, and the remainder of the perforations were because of colonoscopies. Table 1 outlines the characteristics of the patients. There were 14 male patients (54%) and 12 female patients (46%). Mean age was 67 years (median, 70 years; range, 4 to 91 years). Of the patients, 46% were ASA Class 2 and 39% were ASA Class 3 or 4. The most common indications for the procedure were screening (42%) and bleeding (31%).

Table 2 summarizes the characteristics of the perforations. Most of the perforations (65%) involved the sigmoid and rectosigmoid areas. Various causes were attributed to the perforations, including tortuosity of the colon (27%), diverticulosis (23%), and polypectomy or biopsy (23%). The perforation was diagnosed at the time of the procedure in 38% of the patients, within 24 hours in 31% of the patients, and beyond 24 hours in the remaining 31%.

Table 3 highlights the management of the perforated patients. Most patients (85%) underwent operative intervention. Primary repair was performed in 68% of the operative cases. Seven patients (32%) received a stoma. Five patients (23%) were initially approached laparoscopically, and 2 patients were converted to an open procedure. The mean hospital length of stay was 10.1 days (median, 6 days; range, 1 to 60 days; Table 4). Nine patients (35%) required care in the intensive care unit during their hospitalization, with a mean stay in intensive care of 8.2 days (median, 5 days; range, 1 to 22 days). The rate of postoperative complications was 55%, and they were often wound related (45%). In all 22 patients who underwent an operation, the wounds were closed primarily at the time of the operation. The readmission rate was 14%.

The 30-day mortality was 19%. An ASA class of 3 or 4 and a history of heart disease were significantly associated with an increased risk of 30-day mortality ($p = 0.004$ and $p = 0.010$, respectively; Table 5). All deaths occurred in patients age 65 years or older ($p = 0.281$). None of the 4 patients managed nonoperatively died. Among the nonoperative group, 2 of these patients had their perforations discovered at the time of the endoscopy and the other 2 perforations were diagnosed beyond 24 hours. During a mean follow-up of 79 months (median, 63 months; range, 0 to 192 months), 4 of the 21 alive patients (19%) developed long-term complications, which included ventral hernia (10%), small-bowel obstruction (5%), and bleeding of the lower gastrointestinal tract (5%) (see Table 4). No mortality was observed beyond 30 days. Of the 7 patients who received a stoma at the time of operative intervention, only 2 patients (29%) had stoma reversal.

Table 1. Characteristics of 26 patients with perforation after colorectal endoscopy

Characteristic	No. (%)
Comorbidities[a]	
Hypertension	14 (54)
Heart disease	7 (27)
Diabetes	5 (19)
Renal disease	4 (15)
Lung disease	4 (15)
ASA class	
Class 1	4 (15)
Class 2	12 (46)
Class 3	8 (31)
Class 4	2 (8)
Indication for endoscopy	
Screening	11 (42)
Bleeding	8 (31)
Anemia	2 (8)
Stenting of large bowl obstruction	2 (8)
Other	3 (12)

[a] Some patients had more than 1 comorbidity.
ASA = American Society of Anesthesiologists.

Table 2. Characteristics of the 26 perforations

Characteristic	No. (%)
Location	
Sigmoid/rectosigmoid colon	17 (65)
Descending colon	4 (15)
Ascending colon	2 (8)
Rectum	1 (4)
Transverse colon	1 (4)
Cecum	1 (4)
Cause[a]	
Tortuosity	7 (27)
Diverticulosis	6 (23)
Polypectomy/biopsy	6 (23)
Stent deployment[b]	2 (8)
Retroflexion	1 (4)
Unknown	8 (31)
Recognition of perforation	
During the procedure	10 (38)
< 24 hours	8 (31)
≥ 24 hours	8 (31)

[a] Numbers do not total to 26 because some patients had more than 1 contributing cause.
[b] The cause of obstruction requiring stent placement for both cases was malignancy.

Table 3. Management of 26 patients with colorectal perforation

Type of repair	No. (%)
Operative repair	22 (85)
Primary repair, no diversion	11 (50)
Primary repair, proximal diversion	4 (18)
Resection, primary anastomosis	4 (18)
Resection, Hartmann pouch	3 (14)
Nonoperative repair	4 (15)
Bowel rest, broad-spectrum antibiotics	4 (100)
Endoscopic clipping[a]	1 (25)

[a] Performed during the index endoscopy after immediate recognition of perforation.

Table 4. Outcome of 26 patients with perforation

Outcome	No. (%)
Postoperative complications	12/22 (55)[a]
Wound-related	10 (45)
Surgical-site infection	8 (36)
Seroma or dehiscence	2 (9)
Postoperative ileus	5 (23)
Cerebrovascular accident	2 (9)
Myocardial infarction/congestive heart failure	2 (9)
Respiratory failure	1 (5)
Coagulopathy/bleeding	1 (5)
Readmission rate	3/22 (14)
30-day mortality	5/26 (19)[b]
Long-term complications	4/21 (19)
Incisional ventral hernia	2 (10)
Small-bowel obstruction	1 (5)
Anastomotic bleeding	1 (5)

[a] Some patients had more than 1 complication.
[b] No mortality was noted beyond 30 days.

Discussion

The incidence of perforation was very low, and most cases involved the sigmoid and rectosigmoid areas of the colon. All perforations were diagnosed by history and physical examination findings in conjunction with radiographic evidence of free air or by direct endoscopic visualization during the index endoscopic procedure. Most patients presented with the perforation after leaving the endoscopy suite, and they were commonly managed surgically at the discretion of the treating surgeon. A primary repair was feasible in most patients. Those who were treated nonoperatively did not require an eventual operation, although one required a percutaneous drain for an abscess. The time to recognition of the perforation did not affect mortality, nor did it singlehandedly dictate the management of the patient. The morbidity and mortality following perforation were significant, and a higher ASA class was associated with an increased risk of death within 30 days of the event. All patients who died were elderly (65 years or older) and succumbed to either a cardiopulmonary or cerebrovascular event. Wound-related complications were common postoperatively.

There were several limitations to this study. Despite a large volume of endoscopic procedures during the 16-year period, the number of patients who sustained a perforation was relatively small. This small sample size might have affected the findings. Furthermore, the study was retrospective in nature, and a diverse group of surgeons contributed to the management of the patients. No standard algorithm had been established to guide the decision making of when to manage nonoperatively vs operatively and what type of operation to perform. Indeed, the management of each patient was left to the discretion of the individual surgeon. Furthermore, the setting of this study was a tertiary care institution with a large population of elderly patients with substantial cardiopulmonary disease, which might have skewed the morbidity and mortality findings.

Despite the acknowledged shortcomings, this study provided valuable data on the entire spectrum of care and described the outcomes of patients beyond the endoscopy suite. Most of the existing literature on endoscopic perforation describes the incidence, mechanism, and location of the perforation[1-7,9,11] or focuses on the various treatment options, including new evolving techniques such as endoscopic clipping or laparoscopic repair.[10,13-18,20] There is a paucity of data on the outcome of patients who sustain a perforation during colorectal endoscopy and on factors that have an impact on morbidity and mortality.[8,12,19] Some of the findings of the current study confirmed the observations of prior studies. We documented a 0.02% perforation rate, which is within the previously reported range of 0.005% and 1.2% in most studies.[1,11] Therapeutic endoscopy has been associated with a higher incidence of perforation, ranging from 0.06% to 5%.[1,2,4,6,9,11] The most common site of perforation in the present study was the rectosigmoid and sigmoid colon, which is consistent with other published studies.[1-3,6,12,20] The relative mobility, angulation, and tortuosity of this portion of the large bowel, disease processes such as diverticulosis, and older age have been implicated as contributing factors to the development of perforation.[1,2]

Therapeutic endoscopy has been associated with a higher incidence of perforation … Most patients presented with the perforation after leaving the endoscopy suite …

Most patients in our study underwent operative intervention, and nonoperative management was selectively used in a few patients. Surgical management has been advocated for most patients with colorectal perforation, and more recently the laparoscopic approach has been introduced as an alternative to the open approach to minimize the postoperative morbidity.[12,14-16] In our study, the number of patients who were approached laparoscopically was small and none died, but we cannot draw any conclusion because of the limited number. However, two recent studies have reported shorter hospitalization and fewer complications in patients treated laparoscopically compared with patients managed with an open approach.[15,16] We suspect that laparoscopy will play an increasing role in the management of this condition in the future.

Several recent studies have reported on nonoperative management.[10,17-20] Depending on the time of recognition of

the perforation, endoscopic clipping, bowel rest, and broad-spectrum antibiotics are a viable alternative in a select group of patients. In our study, 15% of the patients were successfully treated nonoperatively, with no morbidity or mortality. Small perforations that are recognized at time of the procedure can be managed with endoscopic clip closure.[17-20] Jovanovic and colleagues[18] attempted endoscopic clip closure in 6 of 12 perforations over a 6.5-year period.[18] A successful outcome was noted in patients with a defect less than 10 mm, and the only observed failure was in a patient with a 20-mm defect. Patients who undergo endoscopic closure need close observation. Cho and colleagues[19] closed 29 perforations with endoscopic clipping. Seven patients required additional surgical intervention, and in 3 patients an intra-abdominal abscess developed. Patients who present with delayed localized perforation can be candidates for conservative management with bowel rest and antimicrobial therapy.[1,2,10,13]

In our study, 32% of the patients who underwent surgical intervention had fecal diversion. This is similar to the Mayo Clinic study, which reported a stoma formation rate of 38%.[12] Most stomas in our study were never closed because of either patient's death or major medical comorbidities that precluded any additional elective surgery. A significant rate of morbidity and mortality was noted in our study. The Mayo Clinic study reported a postoperative complication rate of 36% and 7% mortality rate. Teoh and colleagues[8] reviewed 37,971 colonoscopies over an 8-year period and reported 43 perforations with an overall morbidity and mortality rate of 48.7% and 5.6%, respectively. Their study found that an ASA Class 3 or higher and antiplatelet therapy were independent predictors of mortality. We documented a similar finding in patients with ASA Class 3 or higher.

Table 5. Predictors of mortality in 26 patients with colorectal perforation

Variable	Category	Number of patients	Mortality	p value[a]
Age	< 65 years	8	0	0.281
	≥ 65 years	18	5	
Sex	Male	14	4	0.330
	Female	12	1	
Comorbidities	Hypertension	14	4	0.330
	None	12	1	
	Heart disease	7	4	**0.010**
	None	19	1	
	Diabetes	5	3	0.236
	None	21	2	
ASA class	Class 1 or 2	16	0	**0.004**
	Class 3 or 4	10	5	
Intervention	Operative	22	5	0.555
	Nonoperative	4	0	
Type of operation	Primary repair	15	2	0.274
	Resection	7	3	
Cause of perforation	Biopsy/stent	8	1	1.00
	Nontherapeutic	18	4	
Recognition of perforation	Procedure	10	1	0.640
	< 24 hours	8	2	
	≥ 24 hours	8	2	

[a] Boldface values indicate statistically significant.
ASA = American Society of Anesthesiologists

Conclusions

The risk of perforation during or following colorectal endoscopy was low in this study. However, the morbidity and mortality associated with such events were significant. A higher ASA class was associated with an increased risk of mortality. Although most cases in this study underwent surgical intervention, endoscopic and medical management may play an increasing future role in the management of patients with colorectal perforation. Although we anticipate that such interventions may lead to less morbidity and mortality, further research is needed to delineate a standard algorithm of care and to identify patients who are suitable for nonoperative management. ❖

Disclosure statement

This manuscript was presented at the American Society of Colon and Rectal Surgeons 2012 Annual Scientific Meeting in San Antonio, Texas, June 2-6, 2012. The author(s) have no conflicts of interest to disclose.

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The Belly and The Members

The members of the Body rebelled against the Belly, and said, "Why should we be perpetually engaged in administering to your wants, while you do nothing but take your rest, and enjoy yourself in luxury and self-indulgence?" The members carried out their resolve, and refused their assistance to the Belly. The whole Body quickly became debilitated, and the hands, feet, mouth, and eyes, when too late, repented of their folly.

— *Fables*, Aesop, c 620 – 564 BC, fabulist and story teller