Risk of colon perforation during colonoscopy at Baylor University Medical Center

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Colonoscopy is an important procedure in preventing colon cancer. The risk of colonic perforation during colonoscopy at the Baylor University Medical Center (BUMC) Gastrointestinal Laboratory was chosen as a surrogate marker for the safety of colonoscopy. A recent 2-year experience at BUMC was examined and compared with reports in the medical literature. The results are presented here along with a discussion of problems inherent with different health care systems and their ability to accurately track complications. It was concluded that colonoscopy at BUMC is as safe as that reported by comparable health care systems. The risk of perforation at BUMC was 0.57 per 1000 procedures or 1 in 1750 colonoscopies. Continued efforts to make colonoscopy safer are needed.

Colonoscopy plays an important role in the diagnosis and management of colonic diseases and in the prevention of colon cancer (1–3). However, complications associated with this procedure can be quite serious (4). The frequency of complications is dependent on the skill of physicians doing the procedure, on safeguards that are in place within the laboratory where the procedure is carried out, and whether colonoscopy is done for screening or for diagnostic or therapeutic indications. Major complications include adverse sedation or anesthetic events including aspiration pneumonia, post-polypectomy bleeding, diverticulitis, intraperitoneal hemorrhage, and colonic perforation (5–7).

Assessing the complication rate of colonoscopy is relatively easily done in countries where medical care is sponsored by the government, because complete and lifetime medical records are available on almost all patients. In some integrated health care systems, such as Kaiser-Permanente in the United States, complications from colonoscopy can also be accurately determined (8). The latter are referred to in this report as “closed” systems. However, assessing the safety of colonoscopy in private health care systems such as Baylor is much more difficult because patients may receive medical care in other hospitals with different medical records. For example, there are 27 gastroenterologists and 8 colorectal surgeons who do colonoscopies in the Baylor University Medical Center (BUMC) Gastrointestinal Laboratory. Some of these physicians practice in several hospitals and may perform colonoscopies in independent outpatient facilities

within the community. Systems such as this are referred to as “open” systems in this report.

Although colonoscopy has been done at BUMC for over 40 years, there has never been a comprehensive assessment of complications. To partially rectify this deficiency, it was decided to use perforation rate as a surrogate measure of colonoscopy safety in general. Perforation was chosen because it always demands hospitalization and often requires surgery, and records of admission and surgery would be available for study. Moreover, most patients experiencing colonic perforation would be expected to return to BUMC for hospital care.

METHODS

Upon approval of the institutional review board, we reviewed the BUMC electronic health records from January 1, 2011, through December 31, 2012, and identified all patients discharged with a diagnosis of colonic perforation. We then identified those who had undergone colonoscopy at BUMC within the month prior to admission for colonic perforation. These numbers were then compared with the number of colonoscopy procedures performed in the Baylor Gastrointestinal Laboratory for any purpose. A literature search was then conducted to determine the rates of colonic perforation during colonoscopy at other “open” and “closed” health care institutions.

RESULTS

Perforation rate

A total of 10,534 colonoscopies were performed at BUMC from January 1, 2011, through December 31, 2012. Of this number, 3137 (30%) were for screening of healthy persons for colon polyps and colon cancer. During this time frame, 107 patients were discharged from BUMC with a diagnosis of colonic perforation from all causes. As shown in *Table 1*, five patients had undergone colonoscopy at BUMC within 1 month prior to admission, and one had undergone flexible sigmoidoscopy. By

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Table 1. Cases of colonic perforation at Baylor University Medical Center at Dallas, 2011–2012

Patient	Age	Sex	Procedure	Indication	Findings	Intervention	Perforation site	Time to diagnosis	Treatment	Outcome
1	53	M	Flexible sigmoidoscopy	Hematochezia, radiation proctitis	Radiation proctitis	ERB ablation	? Splenic flexure on CT	5 days	No surgery	Multiorgan failure and died
2	79	F	Colonoscopy	Diarrhea, abdominal pain, <i>C. difficile</i> +	Ischemic colitis, perforation	None	Descending colon	Immediate	Colon resection	Perforated duodenal ulcer, died
3	68	F	Colonoscopy	Colonic stricture	Ischemic colitis	Biopsy	Multiple perforations	22 days	Colectomy, ileostomy	Died
4	18	M	Colonoscopy	Ulcerative colitis	Severe colitis	Rectal biopsies	Sigmoid	Immediate	Colectomy, ileostomy	Recovered
5	44	M	Colonoscopy	Chronic diarrhea	Ischemic colitis	Biopsies	Multiple sites	1 day	Colectomy, ileostomy	Recovered
6	42	F	Colonoscopy	Sigmoid stricture, radiation colitis	Sigmoid stricture	Dilation, stent placed	Sigmoid	2 days	Diverting colectomy	Recovered

definition, these were assumed to represent colonic perforation due to colonoscopy. The calculated incidence of colonic perforation due to colonoscopy at BUMC during this 2-year period was 0.57 per 1000 procedures, or 1 per 1750 procedures. Two additional patients were admitted to BUMC with colonic perforation after colonoscopy done elsewhere. They were not included in the calculations.

Literature review

In *Table 2*, the average perforation rate for six “open” system reports involving 187,810 patients was 0.59 per 1000 colonoscopies (9–22). *Table 3* summarizes 10 studies with 603,132 patients in “closed” systems with an average perforation rate of 0.74 per 1000 procedures. *Figure 1* summarizes the average colonoscopic perforation rates in both “open” and “closed” systems. The Baylor rate of 0.57 per 1000 procedures is included; it is comparable to the 0.59 per 1000 rate in “open” systems and less than the 0.74 per 1000 rate in “closed” systems.

Clinical features of Baylor perforations

No perforations occurred in the 3137 patients who underwent screening colonoscopy. All of the six perforations occurred in the 7347 patients examined for diagnostic or therapeutic reasons. Moreover, all of the six perforations occurred in patients who were found to have colonic disease. The diagnosis of colonic perforation was made immediately in two patients and as long as 22 days after colonoscopy in one. Three patients died and

Table 2. Perforations during colonoscopy in six “open” systems

Study	Year	Ref	Location	Number of colonoscopies	Perforations	Perforation rate per 1000
Geenen et al	1975	9	Wisconsin	1,106	9	9
Farley et al	1997	10	Rochester, MN	57,028	43	0.7
Zubarik et al	1998	11	Georgetown, DC	1,196	0	0
Anderson et al	2000	12	Scottsdale, AZ	10,486	20	1.9
Imperiale et al	2000	13	Indiana	1,994	1	0.5
Korman et al	2002	14	USA, 45 ASCs	116,000	37	0.3
Total				187,810	110	0.59

ASC indicates endoscopic ambulatory surgical centers.

Table 3. Perforations during colonoscopy in “closed” systems

Study	Year	Ref	Location	Number of colonoscopies	Perforations	Perforation rate per 1000
Basson et al	1998	15	Connecticut VA	5,163	3	0.6
Eckardt et al	1999	16	German	2,550	2	0.8
Sieg et al	2001	17	German	82,416	13	0.16
Nelson et al	2002	18	VA	3,198	0	0
Gatto et al	2003	19	Medicare	39,286	77	2
Viiala et al	2003	20	Australia	23,508	23	1
Levin et al	2006	8	Kaiser-Permanente	16,318	15	0.91
Rabeneck et al	2008	21	Canada	97,091	54	0.7
Arora et al	2009	22	California Medicaid	277,434	228	0.82
Warren et al	2013	6	Medicare	53,220	33	0.6
Total				603,132	448	0.74

VA indicates Veterans Affairs.

Figure 1. Colonic perforations per 1000 procedures.

three recovered. One patient had severe ulcerative colitis, three had ischemic colitis, and two had radiation colitis. Four patients underwent immediate colectomy, and one underwent a diverting colostomy. One patient developed multiorgan failure and was determined not to be an operative candidate. One patient developed a perforated duodenal ulcer postcolectomy and died. One patient with ischemic colitis died after colectomy. Two patients had a sigmoid stricture, due to ischemia in one and to radiation in the other. The latter patient had a sigmoid stent placed. Three patients were men and three were women. The age ranged from 18 to 79 years. Those who died were 53, 68, and 79 years of age. One endoscopist had two perforations. He was one of the highest-volume endoscopists on our staff.

DISCUSSION

The Baylor perforation rate of 0.57 per 1000 procedure is comparable to that reported in other "open" systems, which averaged 0.59 per 1000, and less than the rate of 0.74 per 1000 in "closed" systems. The higher rate in closed systems is likely due to more complete retrieval of complications.

How can the risk of colonic perforation at colonoscopy be reduced? It is important to be aware of risk factors that increase the likelihood of perforation, which include female sex, increasing age, obstruction, polypectomy, inflammatory bowel disease, stricture dilation, thermal cautery, and comorbidities (23, 24). Sedation, especially with propofol, should be kept as light as possible so that patients experiencing pain or discomfort can be identified and corrective maneuvers instituted. Patients with inflammatory bowel disease, including ulcerative colitis, Crohn's colitis, ischemic colitis, and radiation colitis, should be approached with special care (25).

Dilation of colonic strictures must be done cautiously. Barotrauma can result in colonic perforation and can be avoided by frequent monitoring of abdominal distention and minimal air or CO₂ insufflation during the procedure. Special care must be employed during resection of sessile or flat colon lesions with thermal cautery. The saline lift technique is indicated in resecting these lesions. Hot biopsy forceps are thought to be associated with an increased risk of perforation and should not be used (23).

Avoiding screening colonoscopy in persons over age 80 with a previous normal exam and no risk factors should be

considered. Low-volume colonoscopists have an increased rate of complications and may need to be monitored. Endoscopists who have difficulty reaching the cecum may require monitoring (26). Regularly scheduled morbidity and mortality conferences where all serious complications are reviewed should help identify safety concerns and promote best practices (25).

This study indicates that colonoscopy as performed at BUMC is as safe as that reported in the literature from comparable institutions. However, we should continuously strive to reduce complications insofar as possible. The measures cited above should hopefully reduce the risks of this important procedure. Periodic monitoring of the colonoscopic perforation rate at BUMC, as done in this study, should reveal how effective our efforts are. The safety and welfare of our patients should be our primary goals.

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