

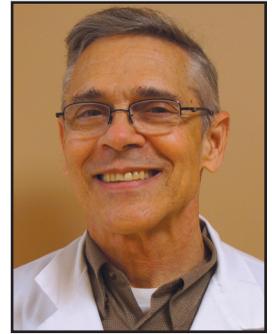
Single Balloon Enteroscope for Complete Colonic Examination in Patients with Failed Colonoscopy



Kimberly Kolkhorst



Eric Hill



Patrick Brady

Background & Aims

Colonoscopy is the current gold standard for colorectal cancer screening; however 5-10% of colonoscopies performed are incomplete. If the cecum cannot be intubated, a full diagnostic evaluation has not been achieved. Standard options to complete the evaluation include air contrast barium enema, CT colonography, or repeat colonoscopy. We studied the use of a single balloon enteroscope (SBE) to reach the cecum as an alternative method for complete colonic examination in patients failing conventional colonoscopy.

Methods

From October 2008 to June 2014 a total of 71 consecutive patients with previous incomplete colonoscopy were evaluated with colonoscopy using the SBE. After incomplete prior colonoscopy, the subjects underwent repeat colonoscopy using an Olympus SIF Q180 single balloon enteroscope. The primary endpoint was the rate of cecal intubation. Secondary endpoints included the total time of the examination, withdrawal time, complications, and findings.

Results

The mean age of patients was 63.5 years. 50 patients were female (70%). Indications for colonoscopy included surveillance for a personal history of colon polyps (n=21), average risk screening (n=19), family history of colorectal cancer (n=12), anemia (n=6), hematochezia (n=5), abnormal imaging (n=4), and other (n=4). Reasons for previous colonoscopy failure included tortuosity/looping (n=44), previous abdominal surgery/adhesions (n=20), diverticulosis/fixed, angulated sigmoid (n=5) and other (n=2). Colonoscopy to the cecum was successful in 70 of the 71 patients (98.6%). A total of 77 adenomas, 1 R-sided ischemic colitis and 2 carcinomas were found. All adenomas encountered were successfully removed. The mean total procedure time was 37 min (range 14-139 min) and mean withdrawal time was 16 min (range 4-122 min). Zero complications were encountered.

Conclusions

The SBE is longer, smaller in diameter, and more flexible than a standard colonoscope. The overtube adds stiffness but remains flexible enough to traverse colonic loops. This technique has the advantage of allowing direct endoscopic visualization of the colon with the potential for endoscopic therapies, as opposed to the alternative imaging modalities. Colonoscopy with the SBE is a useful technique in patients with a prior failed colonoscopy due to difficult anatomy or prior abdominal surgery.

Kimberly Kolkhorst, DO, Eric Hill, MD, Patrick Brady, MD, University of South Florida College of Medicine, Division of Digestive Diseases and Nutrition, Tampa, FL

INTRODUCTION

Colorectal cancer is the third most common cancer and the second leading cause of cancer death in the U.S. Colonoscopy is the gold standard for colorectal cancer screening and for removal of colorectal adenomatous polyps. Colonoscopic removal of adenomatous polyps reduces mortality from colorectal cancer by 53%.¹ Substantial improvements in colorectal cancer screening rates have occurred but screening rates still fall short of desirable levels. In fact, 5%-10% of colonoscopies performed are incomplete.² Multiple factors contribute to incomplete colonoscopy including: female sex, diverticular disease, low body mass index, prior abdominal or pelvic surgery, insufficient colon cleansing, long, redundant colon loops, fixed, angulated sigmoid colon and patient discomfort.³

Of all advanced neoplasms found in the colon, 33-50% are found in the proximal colon and 4.3% have been shown to be missed by incomplete colonoscopy.⁴ If the cecum is not intubated, a full diagnostic evaluation has not been achieved and malignant/pre-malignant lesions may go undetected. This is particularly important since right-sided neoplasms are often flat or depressed and harder to detect with imaging modalities.⁵ In addition, proximal neoplasms may develop through different molecular pathways than sporadic left sided lesions with more rapid progression to cancer.⁶ Standard options

for complete evaluation in the event of incomplete colonoscopy include air contrast barium enema, CT colonography, or repeat colonoscopy.^{7,8} We studied the use a single balloon enteroscope (SBE) to reach the cecum as an alternative method for a complete colonic exam in patients failing conventional colonoscopy. Prior studies using a double-balloon enteroscope or a push enteroscope have shown some success in completing the colonoscopy after a failed attempt with a standard colonoscope,^{9,10} however, only four studies have been reported using the single-balloon enteroscope for a difficult colonoscopy. These studies have been limited by small population size (range 14-30 patients) and lack of total procedure and withdrawal times.^{2,11,12,13}

Methods

From October 2008 to June 2014 a total of 71 consecutive patients with a previous incomplete colonoscopy were prospectively evaluated using an Olympus SIF 180 SBE with overtube. Five different gastroenterologists trained in the use of the single balloon enteroscope system performed the procedures. The overtube was used in all cases. The endoscope was inserted to 50cm. It was then straightened by withdrawing the endoscope to reduce loops, followed by advancement of the overtube over the endoscope to stiffen it and prevent recurrent loop formation. This process was repeated until the cecum

Table 1. Indications for Conventional Colonoscopy

Indication For Colonoscopy	n (%)
Personal History of Colon Polyps	21 (30)
Average Risk Screening	19 (27)
Family History of Colon Cancer	12 (17)
Anemia	6 (8)
GI Bleeding	5 (7)
Abnormal Imaging	4 (6)
Other	4 (6)

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Figure 1. A. Large sessile lesion in the proximal transverse colon requiring lifting with submucosal saline injection, and piecemeal resection. B. Retroflexed view of the same lesion

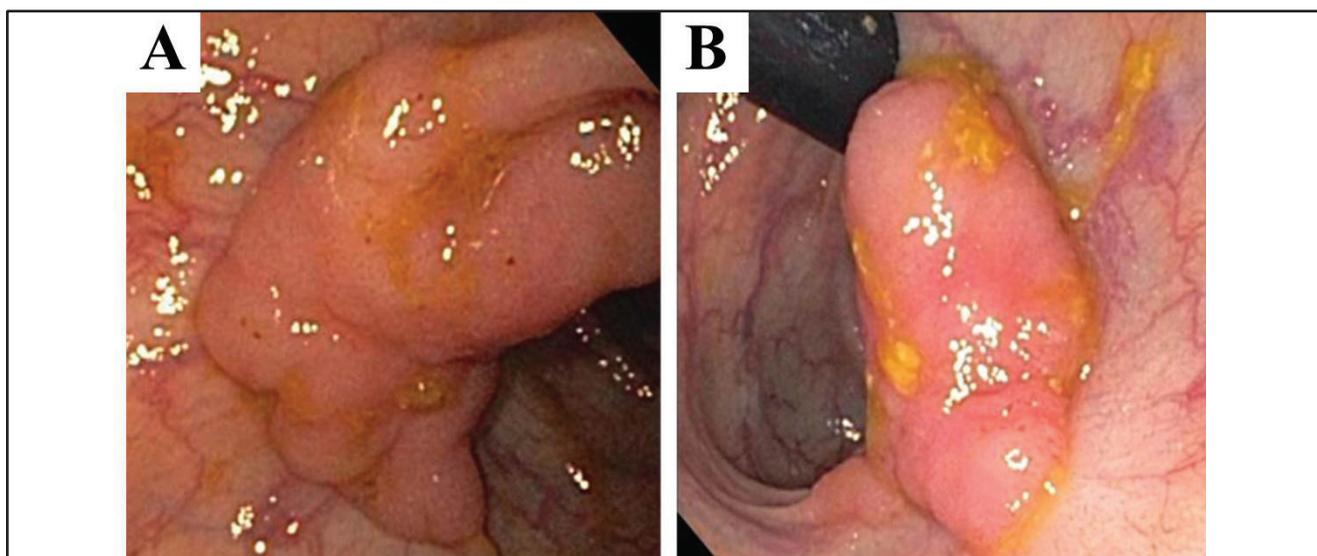


Table 2. Reasons for Previous Incomplete Colonoscopy

Reason for Previous Incomplete Colonoscopy	n (%)
Tortuosity/Looping	46 (65)
Previous Surgery/Adhesions	20 (28)
Diverticulosis/Fixed, Angulated Sigmoid	5 (7)

was reached. Balloon inflation was employed only if the position of the endoscope could not be maintained when reducing loops. Fluoroscopy was not used. Standard maneuvers including loop reduction, manual support, and patient position changes were employed.

Data for all 71 procedures was prospectively collected including: patient age, sex, indication for colonoscopy; reason for failure of the initial colonoscopy; cecal intubation rate; colonoscopic findings, total procedure time and withdrawal time. Patients with prior incomplete colonoscopy due to poor bowel prep or intolerance of the procedure were excluded from the study since these problems could be corrected without the need for special instruments. The study was approved by the University of South Florida and Tampa General Hospital Institutional Review Boards.

After an incomplete prior colonoscopy by the investigators (n=34), same day failure by the investigators (n=24), or referral due to incomplete colonoscopies by outside gastroenterologists (n=14), the subjects underwent a colonoscopy using the Olympus SIF Q180 single balloon enteroscope. Propofol, administered by an anesthesiologist or CRNA, was used for sedation in all patients. The primary endpoint was the rate of cecal intubation. Secondary endpoints recorded included the total time of the examination, complications, and findings.

Results

All patients with prior incomplete standard colonoscopy provided consent for colonoscopy with the SBE and were enrolled in the study. Of those patients, 50 (70%)

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were female and 21 (30%) male. The mean age was 63.5 years \pm 1.7 (range 29-84). Indications for colonoscopy (Table 1) included: surveillance for a personal history of colon polyps (n=21), average risk screening (n=19), family history of colorectal cancer (n=12), anemia (n=6), hematochezia (n=5), abnormal imaging (CT colonography or air contrast barium enema) (n=4), and other (including weight loss, colovesicular fistula, change in bowels and abdominal pain) (n=4). Reasons for prior incomplete colonoscopy (Table 2) included: tortuosity/looping (n=46), previous surgery/adhesions (n=20), and diverticulosis/fixed, angulated sigmoid (n=5).

Colonoscopy to the cecum was successful in 70 of the 71 patients (98.6% cecal intubation rate). Of the 71 procedures performed, 37 (52%) detected polyps, 2 (3%) detected colon cancer and 1 (1%) detected right-sided ischemic colitis (Table 3). A total of 111 polyps were found and all were successfully resected. This included a large sessile lesion in the proximal transverse colon requiring lifting with submucosal saline injection, and piecemeal resection (Figure 1). 77 (69%) polyps were found to be tubular adenomas that ranged in size from 5mm to >2.5cm. The number, size and distribution of these adenomas is given in Table 4. Of the 2 colon cancers detected, 1 patient was found to have an ascending colon carcinoma and 1 patient with a cecal carcinoma (Figure 2).

The mean total procedure time was 36.5 min

\pm 3.14 (range 11-139 min), with a mean withdrawal time of 14.7 minutes (range 6-122 min). Procedure time decreased as the operators gained more experience with the technique. The overtube was used in all cases, but the balloon on the overtube was inflated in only six cases. No complications were encountered. Due to the flexibility of the enteroscope, we were also able to perform retroflexion throughout the colon to view posterior aspects of folds and flexures (Figure 1b).

In the one patient in whom the SBE could not be advanced to the cecum, the ascending colon was reached. An additional 2 adenomas were found in the transverse colon on this examination that were not reached on the incomplete standard colonoscopy. A follow-up air contrast barium enema was performed on this patient, and due to colon tortuosity, the barium did not reach the cecum either.

Discussion

The single balloon enteroscope was initially designed for deep intubation of the small bowel. The SBE, however, has been shown to be useful not only for enteroscopy, but also for endoscopic retrograde cholangiopancreatography in cases of altered anatomy after small bowel surgery.¹⁴ Prior papers have cited the expanding use of the single balloon enteroscope for colonoscopy, but these studies are limited due to small patient size (range 14-30 patients) and lack of total procedure and withdrawal times.^{2,11,12,13} To our knowledge, the current series is the largest prospective

Figure 2. Two colon cancers found using SBE: A. Cecal adenocarcinoma B. Ascending colon carcinoma

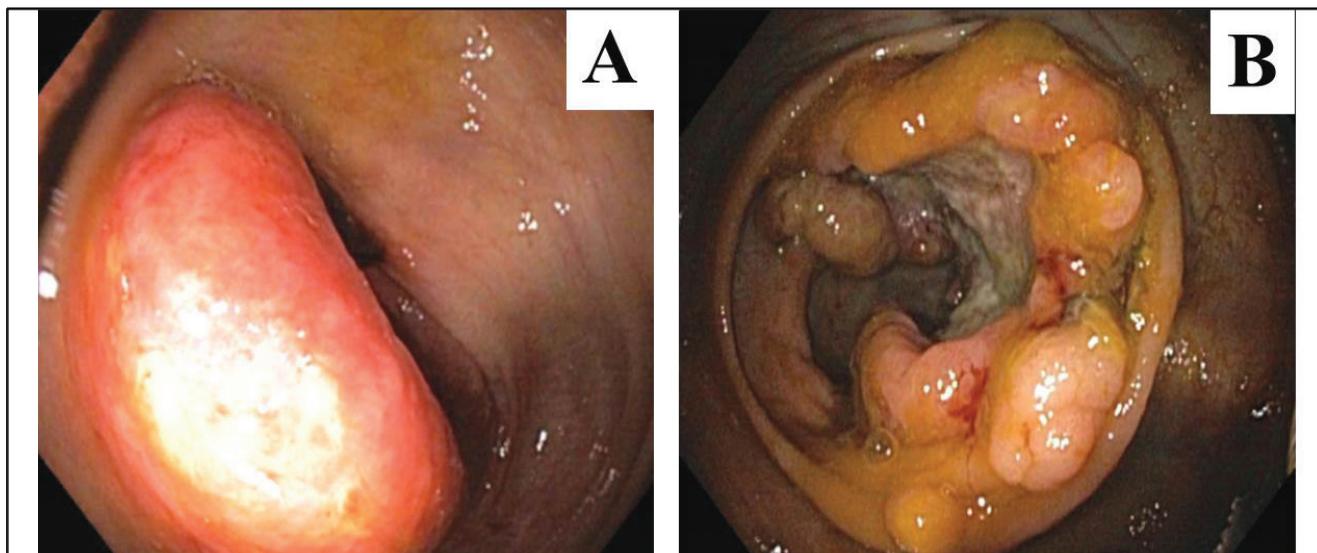


Table 3. Findings Using Single Balloon Enteroscope for Previous, Incomplete Colonoscopy

SBE Colonoscopic Findings	n (%)
Normal (includes diverticulosis + hemorrhoids)	31 (44)
Polyps	37 (52)
Cancer	2 (3)
R-Sided Ischemic Colitis	1 (1)

study reporting the results of colonoscopy using a single balloon enteroscope after a prior incomplete colonoscopy using a conventional colonoscope. In our study, 98.6% of the SBE procedures were successfully completed after previous incomplete colonoscopy using a standard colonoscope. Our success rate compares favorably with the results of prior studies, with reported cecal intubation rates ranging from 93 to 100%.^{2,11,12,13} Zero complications occurred. For our study, fluoroscopy was not needed, balloon insufflation was used only if the position of the endoscope could not be maintained when reducing loops and standard manipulation maneuvers were infrequently required. Loop reduction was, however, necessary to facilitate advancement of the instrument but easily accomplished in most instances without balloon assistance.

The single balloon enteroscope is useful in achieving complete colonoscopy and therapeutic techniques in patients with a failed prior exam due to tortuosity, adhesions and fixed, angulated sigmoid colons. The SBE is longer, smaller in diameter, and more flexible than a standard colonoscope. The overtube adds stiffness but remains flexible enough to traverse colonic loops. Colonoscopy using the SBE has the advantage of allowing direct endoscopic visualization of the colon with the potential for endoscopic therapies, as opposed to the alternative imaging techniques which would require subsequent endoscopy for evaluation of positive findings. An additional advantage of the instrument is the ability to easily retroflex in virtually all areas of the colon to facilitate looking behind folds, and assessing the cecum, and hepatic flexures.

Use of this technique resulted in longer total

procedure times (mean 36.5 min) and longer withdrawal times (mean 14.7 min) versus standard colonoscopy with mean total time of 15.84 min and mean withdrawal time of 8.77 min.¹⁵ Longer procedure times using the SBE were likely due to use of the overtube, difficult patient anatomy and longer time spent suctioning due to the longer, smaller diameter suction channel. Other limitations to use of the SBE include: requirement of active participation of an assistant to control the longer endoscope, air may escape via the overtube, colon preparation needs to be excellent due to limited suctioning capabilities and the flexible endoscope retroflexes easily. Despite these limitations, full visualization of the colon was achieved in all patients, two colon cancers were detected and all polyps encountered were completely removed.

One limitation to our study is that 69% of the procedures were performed by a single operator. However, four other endoscopists participated in the study and their success rates were 100%. Also, seventeen patients (24%) had prior incomplete colonoscopies by an operator other than the one performing colonoscopy with the SBE. It is possible that some of those procedures could have been completed with a conventional colonoscope by the second endoscopist.

The importance of a complete examination of the colon was illustrated due to the fact that two adenocarcinomas of the right colon, one right-sided ischemic colitis and multiple adenomas, not previously identified on prior standard colonoscopy, were detected using the SBE technique. Colonoscopy using the single balloon enteroscope is a successful technique in patients with difficult anatomy or multiple prior abdominal

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Table 4. Number, Size and Distribution of Adenomas, n=77*

Adenoma Size	n (%)	Location	n (%)
>20 mm	3 (4)	Cecum	26 (34)
10-20 mm	19 (25)	Ascending Colon	23 (30)
6-9 mm	17 (22)	Hepatic Fixture	9 (12)
<6 mm	38 (49)	Transverse Colon	14 (18)
		Left Colon	5 (6)

* Two carcinomas >2 cm were found in cecum and ascending colon.

surgeries. Taking these factors into consideration, SBE may be the preferred instrument for initial colonoscopy in patients predicted to have a difficult colon to negotiate, and is certainly a good option for evaluation of patients with a prior incomplete colonoscopy. It can also be utilized for therapy of right sided lesions seen on imaging in patients with a prior incomplete standard colonoscopy. Prospective studies using SBE as the initial tool for colonoscopy in patients with features predicting a high rate of incomplete colonoscopy are warranted. ■

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