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Research Article

Use of New Short Bend ESD Colonoscope in Patients with Failed Colonoscopy: A Pilot Study

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Abstract

Background: Colonoscopy is a common procedure that allows for the detection of colon polyps and other gastrointestinal diseases. However, a failed colonoscopy can occur due to various factors such as diverticular disease, tortuosity, angulation, or fixation of bowel loops, and more. This study aims to evaluate the use of a new short-bend Endoscopic Submucosal Dissection (ESD) scope (PCF-H190T, Olympus America) in patients who failed their initial colonoscopy to assess for cecal intubation success.

Methods: Six patients with incomplete colonoscopy due to severe diverticular stenosis and sharp bends were referred for a repeat colonoscopy. These six patients underwent a repeat colonoscopy utilizing a new short-bend ESD colonoscope. Demographic data, indication for colonoscopy, reason for initial failure, and complications with colonoscopy were all analyzed.

Results: All six consecutive patients achieved successful cecal intubation using the new short bend ESD colonoscope without any major complications.

Conclusions: The use of short-bend ESD colonoscope allows for increased success with cecal intubation on subsequent attempts, especially in those patients who have failed an initial colonoscopy due to sharp bends or diverticular disease.

Keywords: Cecal intubation; Colon tortuosity; Endoscopic submucosal dissection colonoscope; Incomplete colonoscopy; Severe diverticulosis

Introduction

Colonoscopy is the most frequently performed endoscopic procedure in the US, valued for its high effectiveness in screening and surveillance of colorectal cancer, the third most common cancer worldwide. [1] In response to the growing body of evidence highlighting the rising incidence of colorectal cancer in younger populations, recent guidelines by the USPSTF have lowered the recommended age for initiating average-risk screening colonoscopy from 50 to 45 years old. This shift highlights the critical role of colonoscopy in early cancer detection and prevention. One of the primary advantages of a colonoscopy lies in its ability to provide direct visualization of the entire colon, enabling not only the detection of mucosal abnormalities and polyps but also the collection of tissue samples and the immediate removal of precancerous polyps during the same procedure. However, the effectiveness of colonoscopy is contingent upon the successful intubation of the cecum, which is not always achievable. Colonoscopies are considered incomplete when cecal intubation is not achieved, and this outcome limits both the diagnostic and therapeutic yield of the procedure.

Several factors contribute to incomplete colonoscopies. Patient-related factors can contribute to this, including inadequate bowel preparation, which is measured using the Boston Bowel Prep score. Additionally, it has been noted that patient discomfort, female sex, younger age, and low body mass index are attributable to incomplete colonoscopies. [2] Operator-related factors are dependent on the skill and experience of the endoscopist and assisting technician. [2] However, in regard to technical factors, achieving cecal intubation can be challenging in up to 10% of cases due to various anatomical obstacles, such as a fixed stenosis and sharp bends of the left colon caused by diverticular disease, long tortuous colons, bowel hernias, etc. [3] In many older patients, diverticular disease often leads to fibrosis, stenosis, and sharp angulations in the sigmoid or descending colon due to prior episodes of diverticulitis, making the successful passage of a colonoscope extremely difficult and hazardous.

Colonoscopy in general is a safe and effective procedure as mentioned above. However, just like any invasive procedure, it has the potential to cause some minor or even major complications. Some of the more common and minor complications include minimal bleeding, bloating, and abdominal pain/discomfort. Major complications on the other hand include perforation, severe bleeding and infection. Colonoscopic evaluation in patients with severe diverticular stenosis and colon tortuosity are associated with increased complications, especially perforations. Diverticular disease, characterized by small bulging pouches in the colon wall, lead to complications such as fibrosis, stenosis and colon tortuosity, further complicating colonoscopies. These complications increase the difficulty of achieving cecal intubation and result in challenging visualization. In fact, these patients are at higher risk for colonoscopy related complications. The incidence of colon perforations in diagnostic colonoscopies ranges from 0.016% to 0.2% but can be as high as 5% following other colonoscopy interventions. [4] However, the risk of perforation increases in patients with diverticular stenosis and colon tortuosity. To address these challenges, there are slimmer colonoscopes available to limit these disastrous complications.

Slim colonoscopes are commonly used as a rescue in situations where standard colonoscopes fail to achieve cecal intubation, most commonly due to strictures or sharp bends that may have developed from the conditions mentioned above such as diverticular disease. A new colonoscope has become available (PCF-H190T, Olympus America) for performing Endoscopic Submucosal Dissection (ESD). ESD is a technique used to remove large or flat lesions. The slimmer design and increased ability to retroflex enhances maneuverability of the colonoscope making it ideal to perform ESD and to navigate sharp turns and access lesions in difficult to reach areas. This slim scope has a short bending radius, making interventions around the bends and behind the folds possible. We hypothesized that the use of this colonoscope would be effective in navigating sharp bends and fixed stenosis in patients with diverticular disease who had prior failed colonoscopy.

Methods

Six patients underwent repeat colonoscopy using a special short bend ESD colonoscope after a failed initial attempt due to severe diverticular disease with stenosis and sharp bends. The decision to pursue a repeat colonoscopy with a short-bend ESD scope was due to the fact that this scope negotiates sharp bends and stenosis better than standard pediatric colonoscope, and concerns for colonic injury including perforation and establishing a diagnosis. This case series was conducted at one institution by one endoscopist between September 2023 and March 2025. The patients underwent colonoscopy at different intervals between the time mentioned above. Three of these patients had failed colonoscopy at an outside facility as well, and were referred to the study endoscopist for a repeat colonoscopy. The endoscopist is an interventional gastroenterologist with over 20+ years of experience and over 70,000 procedures performed. Demographic and clinical data were collected, including patient's age, gender, BMI, indication for colonoscopy, reason for previous failed colonoscopy, success of cecal intubation, and major/minor complications (Table 1). Initial colonoscopy report was reviewed to determine if they would be an ideal candidate for repeat colonoscopy. The Olympus PCF- H190T

colonoscope was used after a failed initial attempt with a pediatric colonoscope in the same setting. CO2 insufflation was used during all 6 colonoscopies. The time for cecal intubation was recorded by using a computer clock available in the endoscopy suite. The primary objective was a successful cecal intubation while the secondary objective was the complication rate, including perforation and severe pain following the procedure. MAC anesthesia was used in all patients in the form of propofol.

Age	Gender	BMI	Indication for colonoscopy	Previous Failure	Successful Cecal Intubation	Major / Minor Complications
64	F	21	Surveillance	Severe diverticular stenosis and sharp bends	YES	NONE
77	M	18	Surveillance	Severe diverticular stenosis and sharp bends	YES	Moderate cramping pain, resolved
79	F	20	Abdominal pain/ diarrhea	Severe diverticular stenosis and sharp bends	YES	NONE
80	F	17	Surveillance	Severe diverticular stenosis and sharp bends	YES	NONE
83	M	28	Diarrhea & Weight loss	Severe diverticular stenosis and sharp bends	YES	NONE
84	F	22	Weight loss/ Cologuard +	Severe diverticular stenosis and sharp bends	YES	Moderate cramping pain, resolved

Table 1: Demographic data, indication for colonoscopy, reasons for previous colonoscopy failure, success of cecal intubation, and major/minor complications for each patient.

Results

The mean age of the patients involved in this study was 77.8 years (range, 64-84 years). There was an equal male to female ratio. All patients presented with failed initial colonoscopy and had severe diverticular stenosis and sharp bends during endoscopic evaluation. Colonoscopy was successful in all six patients using the new short bend ESD colonoscope (Table 1). Cecal intubation time ranged between 6 to 28 minutes. No perforation, tears or other major complications were encountered. Two patients had cramps and moderate pain after the procedure due to air trapping that resolved with time without requiring analgesics. There were no other complications noted. The six patients followed up with their respective gastroenterologist in an outpatient setting based on the results of the colonoscopy. The initial failed cecal intubation on colonoscopy highlights the anatomical constraints encountered during colonoscopy. On the other hand the outcome of the subsequent colonoscopy showcases the need for advanced tools, experienced endoscopists and techniques. The 100% cecal intubation rate seen in these 6 patients redemonstrates the success of using a short bend ESD colonoscope in this setting. This study provides further data regarding the benefits of using a short bend colonoscope in the setting of severe diverticular stenosis and other pathological etiologies that led to a failed cecal intubation.

Discussion

Multiple factors contribute to a failed colonoscopy. These include inadequate bowel preparation, discomfort and tolerance, low body mass, female sex, and young age. In this study, we specifically focused on how anatomical factors could contribute to these failed colonoscopies. These factors are diverticulosis, luminal stenosis, tortuosity, adhesions due to prior surgeries, angulation or fixation of bowel loops, and ineffective sedation. [5] All six patients mentioned above had a failed colonoscopy due to severe diverticular stenosis and sharp bends in the left colon. A study by Brahmania et al regarding 90 patients who underwent incomplete colonoscopies showed that 30% of those who failed were due to a tortuous colon, while 6% of those who failed were due to diverticulosis, however, without specifying the severity. [6] This once again highlights the specific anatomical factors contributing to failed colonoscopies, which correlate with the findings in our study.

The slim colonoscope (PCF-H190T) made by Olympus America features a short bending section, which contributes to finding more disease through better retroflection in the lumen and access to lesions. [7] The outer diameter of the insertion tube for this slim scope measures out at 10.5 mm compared to an adult colonoscope, which measures at 12.8 mm. [7] The outer diameter of the distal end

of the slim scope measures 9.8 mm, while the outer diameter of the distal end of the adult colonoscope measures 13.2 mm. The major difference here, however, is that the slim scope has the ability to angulate up to 210° while the adult colonoscope can only angulate up to 180°. In addition, the slim colonoscope has a short turn radius bending section that allows an endoscopist to navigate more easily when challenged with difficult cases such as severe diverticular stenosis and tortuosity. This difference in diameter and angulation between the slim scope and adult scope allows for an increased success rate for cecal intubation. In addition, feedback from physicians who have used the Olympus slim colonoscope (PCF-H190T) have also commented that there is a possibility to detect more polyps when using this scope in retroflex for visualization of the proximal side of colon folds and around tight flexures. [7] This also raises the question of whether to use a slim colonoscope in routine screenings or diagnostic colonoscopies when provided with a known condition of severe diverticulosis to limit potential failures. There can also be speculation on whether this would decrease unnecessary additional colonoscopies, improve patient satisfaction, and reduce the use of resources.

There are additional slim colonoscopes on the market that cater to the pathological conditions mentioned above. One of these includes the Pentax EC-3490TLi colonoscope, which also has a short turn radius bending section that allows easier navigation around sharp turns and strictures seen in the colon. This scope also has the ability to angulate up to 210° to allow for retroflexion, similar to the Olympus scope mentioned above. The outer diameter, however, is slightly larger at 11.6 mm compared to the Olympus scope. Girotra et al mention that the use of a Pentax slim colonoscope with short turning radius facilitates successful colonoscopy to the cecum at a rate of 91.9% when completed on 34 patients. [8] A meta-analysis conducted by Bhogal et al. on 2819 patients found that the cecal intubation rate was far superior when using a slim colonoscope compared to an adult colonoscope. [9] Gawron et al looked at 100 patients with incomplete colonoscopies, in which 61.2% of the patients had a tortuous colon. [10] He highlighted that most patients were able to achieve cecal intubation with an adult colonoscope on their repeat colonoscopy following an initial failure. However, those with increased tortuosity required a pediatric scope 75% of the time [10]. This again highlights the importance of using a slim colonoscope in the setting of stenosis and tortuosity. There are also some studies supporting the time at which cecal intubation can be achieved when comparing a slim colonoscope to a standard adult colonoscope. A study looking at 105 patients conducted by Inoki et al. found that the PCF-PQ260L (PQL) scope by Olympus had a shorter cecal intubation time of 7 minutes compared to its standard adult scope which took 10 minutes. [11] In addition, the PQL scope was associated with decreased pain reported by patients (66% vs 20%) and decreased use of sedatives (48% vs 25%) [11].

There are additional advantages to using slim colonoscopes vs adult colonoscopes regardless if there was failed cecal intubation or not. One of the major factors in colonoscopy tolerability is pain from the size of the scope. [12] The idea is that due to having a smaller diameter, they induce less stretching of the mesentery, which would result in a less painful procedure. According to Garborg et al., 200 patients who underwent a colonoscopy with a slim scope did not experience severe pain, and 70% of them were pain-free compared to the adult colonoscope group, in which only 23% of the patients reported to be completely pain-free. [13] In regards to safety, slim colonoscopes are also known to require less sedation compared to when the adult colonoscope is used. [14] Most colonoscopy procedures use propofol as the preferred sedative prior to beginning the procedure. While the rate of adverse effects is relatively low, they can still be a safety concern. Some of these adverse effects include respiratory depression, hypotension, myoclonus, and EKG changes. [15] Horiuchi et al. looked at over 2101 patients who received propofol before colonoscopy. Only 0.2% of these patients required supplemental oxygenation. [16] However, patients who have multiple comorbidities have an increased rate of adverse effects, including respiratory depression. Using a slim colonoscope in this scenario would be beneficial for those wanting to limit sedation use during the procedure.

In this case, all six patients had severe diverticular stenosis that led to a failed cecal intubation, which begs the question about what is the etiology of such a severe presentation. Diverticulosis, which is a sac-like protrusion seen along the gastrointestinal tract, affects about 5-45% of people in the Western world. The prevalence of this condition increases with age, as high as 60% in those above 60 years old. [17] As seen in our case, the youngest patient who underwent a colonoscopy was 64. Some of the complications of diverticulosis include pain, inflammation, infection, intestinal obstruction, and bleeding. While most patients are asymptomatic, 10-15% may experience an episode of acute diverticulitis, and an additional 15% may even encounter more serious complications such as fistula, abscess, and perforation. [18] In order to reduce the incidence of diverticulosis, clinicians must properly educate their patients on the management of this condition. This includes advising them to follow a balanced diet with fruits, veggies, and whole grains. Additionally, it is crucial to educate patients to implement foods with high fiber, sufficient water intake throughout the day, exercise, and avoid smoking. [19] Taking an approach to preventing diverticular disease may reduce the number of patients who fail cecal intubation due to severe diverticulosis.

While the outcomes in this study were excellent following initial colonoscopy, several key areas warrant investigation. The need for prospective, comparative studies on slim colonoscopes is warranted to create a standard on the use of this equipment for similar cases in the future. Randomized controlled trials would

also be beneficial to provide clearer guidance on the type of colonoscope to implement in the setting of difficult procedures. Furthermore, new innovative measures to increase the angulation and retroflexion of standard scopes could limit the incidence of roadblocks seen during colonoscopies. AI-assisted colonoscopies, particularly ultra-slim versions, are in development to not only enhance polyp detection but to improve colonoscopy procedures outcomes. Also, while CT scans are the preferred imaging method to check for diverticulosis, there can be an argument made to enhance research development in newer imaging modalities that can pick up severe diverticulosis. By doing so, this would give clinicians more data to determine whether a patient would be an ideal candidate for endoscopic evaluation and what tool to use for successful cecal intubation. The Toshiba Aquilion One and GE Revolution Apex are examples of advanced CT scans that provide faster and more detailed diagnosis [20].

Our study focuses on the ability to achieve a 100% success rate during endoscopic evaluation. While the prior colonoscopies failed to achieve cecal intubation, there are multiple factors regarding the success of the subsequent colonoscopy that were conducted. Technical factors are a major component of succeeding in cecal intubation, especially in the patients seen in this study. It is important to highlight the importance of honing these advanced endoscopic skills and implementing a method to decrease cecal intubation failure. A solution to assist in the mitigation of this issue begins with implementing continued learning. An example of this is creating lectures for trainees and other providers that could teach them how to properly navigate when faced with a difficult colonoscopy. In addition, having sessions that allow hands-on training, whether through a simulation lab or joining local workshops, will hopefully bring awareness to these challenging scenarios and ultimately reduce the number of failed cecal intubations seen in practice.

If the cecal intubation rate is greater with a slim colonoscope versus an adult colonoscope, as mentioned above, there is a possibility that it could become the standard of care moving forward for both screening and diagnostic colonoscopies. While there is plenty of optimism in the use of these slim colonoscopes in practice, there needs to be a larger standardized approach to help alleviate these complications seen on initial colonoscopies.

Conclusion

In this study, we described the first use of a new slim short-bend colonoscope designed for ESD in patients with tortuous left colon due to diverticular disease with sharp bends and luminal stenosis leading to failed prior colonoscopies. We hope to highlight the use of this new slim scope and utility in achieving a higher success rate for cecal intubation for future cases.

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