Spiral enteroscopy: a novel method of enteroscopy by using the Endo-Ease Discovery SB overtube and a pediatric colonoscope

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Background: Pathologic diagnosis and therapeutic interventions on the small bowel have been difficult and challenging for gastroenterologists. In the last few years, significant advances have been made in this direction. New diagnostic and therapeutic modalities for visualizing the small bowel have been introduced. Furthermore, increased indications for small-bowel imaging and therapeutics have been recognized. However, the currently available methods have limitations, and development of newer, rapid, minimally invasive, safe, and readily available techniques is needed.

Objective: Our purpose was to evaluate the safety and efficacy of a novel method of spiral enteroscopy using a specialized overtube (Endo-Ease Discovery SB) with a pediatric colonoscope (PCF-140L).

Design: Case series.

Setting: Two international tertiary referral centers.

Patients: Twenty-seven adult patients with obscure GI bleeding were enrolled in this study.

Intervention: Spiral enteroscopy with the Endo-Ease Discovery SB overtube and a pediatric colonoscope.

Main Outcome Measurements: Depth of insertion, time of procedure, and complications.

Results: Average depth of insertion was 176 cm (range 80-340 cm) from ligament of Treitz, and average time of procedure was 36.5 minutes (range 90-65 minutes). Eleven patients had minor complications, which included minimal mucosal trauma and sore throat.

Limitations: Small number of patients with a case series study design.

Conclusions: Preliminary data suggest that use of Endo-Ease Discovery SB overtube for enteroscopy is a safe and effective technique for visualization of the small bowel.

Diagnostic and therapeutic options for small bowel conditions have traditionally been limited and frustrating for endoscopists. Push enteroscopy has remained the most commonly performed endoscopic procedure for visualization of the small bowel although only a small portion of small bowel can be visualized.[1-3] Recently, wireless capsule endoscopy, double-balloon enteroscopy (DBE), and single-balloon enteroscopy (SiBE) have improved the diagnostic yield compared with earlier methods.[4-8] Despite these significant developments, there still exists considerable room for improvement. Each of the currently available methods has limitations, and development of a new, rapid, safe, and effective technique for small bowel visualization is needed.

We report our experience with a novel endoscopic technique of small bowel visualization called spiral enteroscopy.

PATIENTS AND METHODS

This new method of spiral enteroscopy was attempted in 27 patients, 13 patients at Hospital Privado Frances,

Abbreviations: AVM, ateriovenous malformation; DSB, Endo-Ease Discovery SB; DBE, double-balloon enteroscopy; SiBE, single-balloon enteroscopy.

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Figure 1. Endo-Ease Discovery SB overtube.

Figure 2. Endo-Ease Discovery SB over the pediatric colonoscope.

Capsule Summary

What is already known on this topic

- Push enteroscopy has remained the most commonly performed endoscopic procedure for visualization of the small bowel, although wireless capsule endoscopy and double-balloon and single-balloon enteroscopy have improved the diagnostic yield.

What this study adds to our knowledge

- Spiral enteroscopy, by using an overtube over a pediatric colonoscope, was safe and effective in a case series of 27 patients, with a diagnostic yield of 33%.

Asunción, Paraguay, and 14 patients at Clinicum Pangtay in Tampico, Mexico. All patients were recruited from the clinics of the authors. Written informed consent was obtained from all patients. The study was approved by the institutional review boards at the respective hospitals. The indication for the procedure was obscure GI bleeding in all patients, defined as blood in stool and no bleeding source identified on EGD and colonoscopy. Three patients had a history of abdominal surgeries. Patients with surgical anatomy such as Billroth II or Roux-n-Y were excluded from the study. None of the patients had prior small bowel capsule endoscopy. All the procedures were done on an outpatient basis, and patients were discharged the same day. The outcomes of interest were depth of insertion, ease of procedure, and major and minor complications. A major complication was defined as perforation, significant bleeding requiring blood products, pancreatitis, or any hospital admission related to the procedure. A minor complication was defined as superficial esophageal trauma, sore throat less than 72 hours in duration, abdominal discomfort lasting less than 48 hours, and mild nausea or vomiting.

Only the immediate (ie, during endoscopy) and short-term (ie, within 3 days of endoscopy) complications were recorded in this study. Any visible trauma during endoscopy was recorded by using descriptive terms for estimating degree of trauma. Isolated or confluent subepithelial petechial-like lesions were considered mild trauma. Superficial disruption of the mucosa, submucosal blebs, and hematomas were considered moderate trauma. Esophageal tears and perforations were considered severe trauma. For short-term follow-up, all patients undergoing the procedure were called by their gastroenterologist in 48 to 72 hours and asked questions about pain, discomfort, swallowing difficulties, nausea, vomiting, fever, appetite, and changes in color and consistency of bowels.

Instruments

A standard video pediatric colonoscope (PCF-140L; Olympus America Inc, Center Valley, Pa) with a working length of 160 cm and an outer diameter of 11.5 mm was used as an enteroscope in all patients. The Endo-Ease Discovery SB (DSB; Spirus Medical Inc, Stoughton, Mass) was used to assist in advancing the pediatric colonoscope in the upper GI tract. The DSB is a single-use overtube with a working length of 130 cm, internal diameter 12.7 mm, and external diameter 17.5 mm. It has helical spirals 5 mm high at the distal 21 cm. The tube lightly connects to the existing enteroscopes by a "gentle lock" and rotates independently from the enteroscope. The lock can be disengaged and reengaged, allowing the option of advancing the enteroscope through the DSB when unlocked or performing spiral enteroscopy with the DSB when locked. To rotate the tube, the hands are placed on the 2 soft handles located just below the lock. A special curved mouthpiece with a bigger aperture to accommodate the DSB and the enteroscope was used (Fig. 1).

The DSB has been approved by the Food and Drug Administration. The DSB also has the Conformité Européene mark for use in Europe.

Procedure

The patients were placed in the left lateral decubitus position for the procedure and received monitored anesthesia with propofol/midazolam hydrochloride/fentanyl or general anesthesia, according to the anesthesiologist's preference. The DSB device was well lubricated and placed over the enteroscope. The distal end of the DSB was positioned 25 cm from the tip of the enteroscope and locked into place with the DSB proximal collar (Fig. 2). The DSB and enteroscope were advanced to the ligament of Trietz with gentle push and rotation of the DSB. The DSB collar was unlocked,

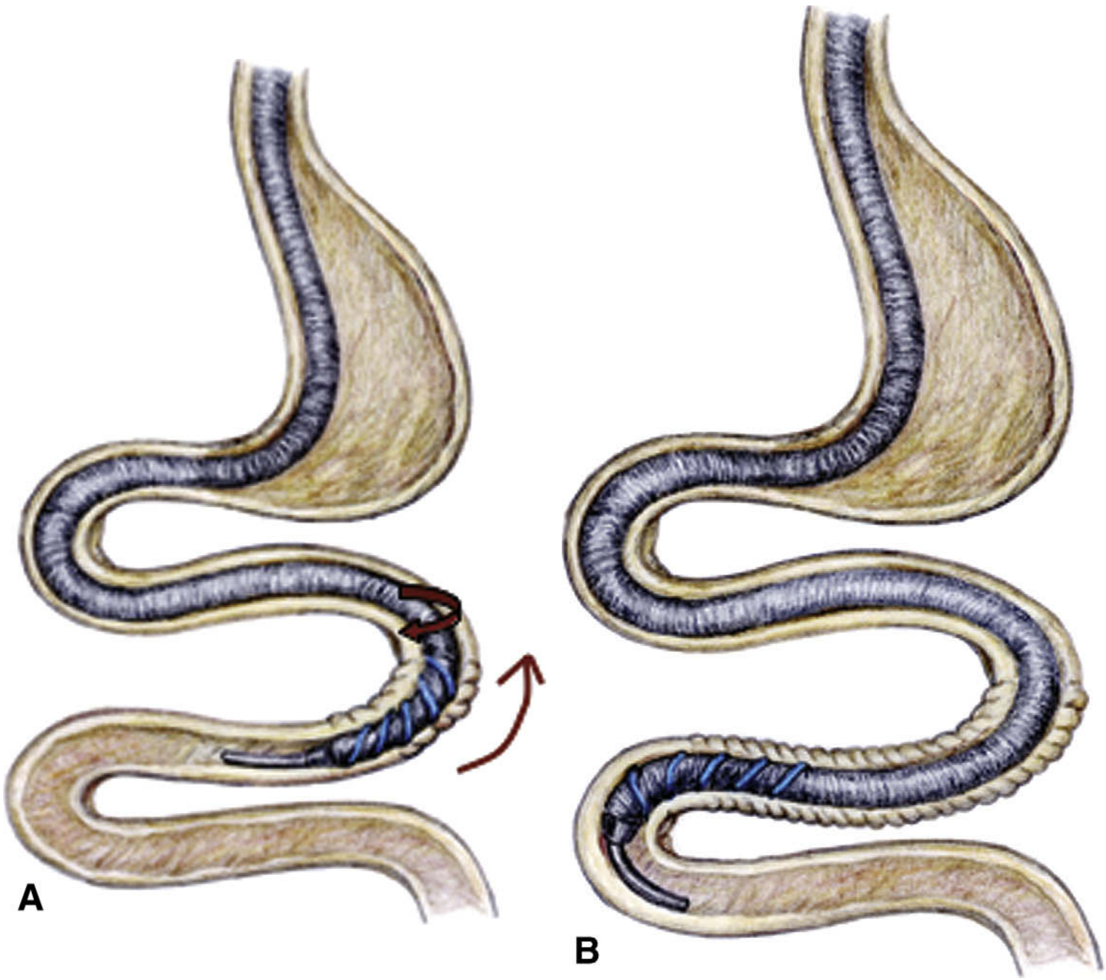

Figure 3. A and **B,** The clockwise rotation of Endo-Ease Discovery SB overtube results in pleating of small bowel over it.

and the enteroscope was advanced through the DSB past the ligament of Trietz. The DSB was then advanced by clockwise rotation to just proximal to the endoscope bending section, about 12 cm from the tip, and relocked (Fig. 3A and B). By rotation of the DSB, advancement was continued until the pleating of small bowel with rotation was no longer effective. The enteroscope was then unlocked from the DSB and pushed through the overtube for added depth of small-bowel intubation. The DSB was then gradually withdrawn by anticlockwise rotation of the DSB, and the small-bowel mucosa was examined. Maximal depth of insertion was estimated by previously described endoscopic criteria.[9,10] In a setting when prompt endoscope extubation may have become necessary, rapid anticlockwise rotation would have achieved rapid withdrawal of the DSB.

RESULTS

Twenty-seven patients underwent spiral enteroscopy (Table 1). The DSB could not be used in 2 of the 27 patients. One had a Schatzki ring identified during upper endoscopy, so enteroscopy was not attempted, and in the other patient the DSB could not be advanced into the esophagus. Spiral enteroscopy advancement was successful in all 25 patients in whom it was attempted. The average depth of insertion was 175 cm (range 80-340 cm) past the ligament of Treitz, and the average time for the procedure was 36.5 minutes (range 19-65 minutes). The findings included duodenal ulcer in 1 patient and angioectasias (arteriovenous malformations [AVMs]) in 8 patients (Fig. 4). All the AVMs were cauterized with a bipolar probe. The cauterization was relatively easier because the DSB enabled excellent control of the small-bowel withdrawal.

There were no major complications. Eleven patients had minor complications. In 6 patients (22%), superficial esophageal mucosal trauma was noted during withdrawal of the enteroscope, and 7 patients (28%) complained of postprocedure sore throat, which resolved in 72 hours without any intervention.

DISCUSSION

Endoscopic diagnosis and treatment of small-bowel conditions is an important and challenging area for

TABLE 1. Details of patients undergoing spiral enteroscopy

Patient No.	Age (y)	Sex	Weight (kg)	Height (cm)	Prior abdominal surgery	Time of procedure (min)	Depth of insertion (cm)	Endoscopic findings	Complications
1	51	M	80	155	No	38	200		mt
2	76	F	50	150	No				Unable to intubate, st
3	58	F	74	160	No	19	180		st
4	54	F	76	160	No	26	120	AVM	
5	24	M	80	175	No	32	200	AVM	mt
6	48	F	67	153	No	34	95		
7	29	F	59	160	No	26	220	DU	
8	29	M	70	166	No	31	340	AVM	st, mt
9	39	F	70	154	No	39	250		
10	43	F	69	166	No	48	80		
11	40	F	47	154	No	52	120		st
12	30	M	67	157	No	48	140	AVM	
13	33	M	70	168	No	47	280		mt
14	53	F	74	155	No	65	180		
15	44	M	58	157	No	57	280	AVM	st
16	29	M	100	183	No	24	240		
17	33	F	104	174	No	21	300		
18	54	M	87	164	No			Schatzki	Did not complete
19	77	F	65	155	Yes	44	90		
20	50	F	62	158	No	25	90	AVM	st
21	48	F	66	157	Yes	36	140		mt
22	33	M	70	165	No	26	110	AVM	
23	49	M	77	180	No	39	140		st, mt
24	23	M	70	180	No	31	100		
25	27	M	80	170	Yes	28	110		
26	51	M	60	168	No	44	160	AVM	
27	68	M	77	165	No	32	210		st

M, Male; *F,* female; *mt,* mucosal trauma; *st,* sore throat; *DU,* duodenal ulcer.

gastroenterologists. Push enteroscopy is the most widely used endoscopic procedure, but only about 60 to 120 cm of small bowel can be visualized.[2,3] Further advancement is generally limited by intragastric or small-bowel looping. New techniques such as DBE and SiBE have been tried to overcome these obstacles by using techniques designed to pleat the small bowel on the endoscope and overtube. They work on the principle of push-pull advancement through the small bowel by alternately inflating and deflating the balloons on the overtube and the enteroscope (in DBE).[7,8]

In this study, we describe our initial experience with a novel small-bowel pleating technology using the DSB and a pediatric colonoscope. The DSB is a specialized overtube with a raised helix at the distal end. The clockwise rotation of the DSB, which mimics the motion of a corkscrew, pleats the small-bowel onto the overtube. Small-bowel pleating is accomplished without apparent twisting of the small bowel because the mesentery attachment to the small bowel resists the rotation of the small bowel. An average of 175 cm of small bowel was visualized. Estimating the length of small bowel visualized can be

Figure 4. Endoscopic image of AVM during spiral enteroscopy.

difficult. Previous studies have demonstrated that physicians can be trained to estimate depths of insertion with a reasonable degree of accuracy.[9] We used a similar model (Akerman Endo-Trainer; Spirus Medical Inc) to train the investigators to estimate depths of insertion.[10]

The diagnostic yield of spiral enteroscopy in this study was 33%. The diagnostic yield of DBE for obscure GI bleeding has been reported to be 54% to 79%.[6,7] The reasons for our lower yield may be due to a younger patient population and that spiral enteroscopy was the initial approach undertaken and no patients had prior capsule endoscopy done, which could have guided us during enteroscopy.

Enteroscopy with DSB is a technically straightforward and safe procedure. It was successfully completed in 25 of 27 patients. In the 2 patients in whom the procedure was not performed, 1 had a Schatzki ring, and hence the procedure was not attempted; in the second, we were unable to introduce the DSB past the upper esophageal sphincter. Otherwise, we did not encounter any difficulties intubating the esophagus. The DSB has an outer diameter of 17.5 cm, which is within the range of outer diameters of commercially available overtubes. Minor complications such as minimal mucosal trauma and self-limiting sore throat were seen in about 44% patients. Although the total number of patients is small, this complication rate is much lower than that reported for overtube push enteroscopy.[11] None of the patients had major mucosal trauma or perforations. Esophageal perforation is thought to result from ''pinch injury'' as a result of entrapment of mucosa between the endoscope and the overtube during the process of sliding the overtube over the endoscope during its insertion.[12] The DSB is tapered and soft at the distal end to minimize ''pinch injury.'' Long-term follow-up data were not collected in this study. All patients were contacted in 48 to 72 hours and asked about any complications. We feel that complications beyond this time period are rare, although rare cases have been reported. Also, the gastroenterologists would very likely have been contacted if there were any other complications. However, lack of long-term follow-up data remains a weakness of this study. In contrast to spiral enteroscopy, the complication rate of DBE has been reported to be minor in 0.9% and severe in 0.6% to 1% of patients. It is much higher (3.4%-4.3%) if therapeutic procedures are performed.[13-15] However, this comparison may be unfair because this was a pilot study with a small number of patients.

The DSB has many features that make it a safe and easy device to use. The shaft is uniformly more flexible at the distal end and transitions gradually to a less flexible proximal end, resulting in optimal integration of torque transmission and flexibility. The locking device on the DSB allows spiral enteroscopy and standard push enteroscopy techniques to be used in conjunction to advance the enteroscope through the small bowel. During withdrawal of the enteroscope, the DSB is rotated anticlockwise, which results in the pleated small bowel gradually coming off the device, allowing for controlled, careful examination of the small-bowel mucosa.

Use of a pediatric colonoscope with a 3.2-mm channel allows for the use of all the standard accessories, allowing biopsies, polypectomies, hemostasis with argon plasma coagulation (APC), clips, etc. It also offers the possibility of total enteroscopy by approaching the distal small bowel through the anal route. Enteroscopy with the use of DSB with the pediatric colonoscope does not require specialized enteroscopes. This may offer potential widespread adoption of the technology with relatively low costs for the procedure. Spiral enteroscopy also has potential advantages over DBE and SiBE, including speed of advancement through the small bowel, excellent controlled withdrawal especially useful for therapeutic maneuvers, and ability to completely withdraw the enteroscope and maintain position in the small bowel. However, the larger diameter of the DSB is a disadvantage. This was a prototype device, and future designs include a smaller-diameter overtube. We have also successfully used the DSB in visualizing the small bowel by using the retrograde approach (data not included).[16] This has the potential of achieving total enteroscopy.

Three patients had a history of prior abdominal surgeries. We did not experience any difficulty in advancing the DSB through the small bowel in these patients. The average procedural time was 36 minutes to examine an average length of 113 cm past the ligament of Treitz. No mucosal damage was seen in these patients. It is possible that, in the event that the adherent small bowel cannot be pleated on to the DSB, the unique shape of the spiral allows the mucosa to slip over it without causing mucosal damage. Patients with a surgically altered anatomy such as Billroth II or Roux-n-Y procedures were excluded from this study. Recently, we have successfully performed spiral enteroscopy on these patients (data not included). No small bowel trauma was seen, and the rotation of the DSB advanced it normally through the small bowel.

In conclusion, spiral enteroscopy with the DSB is a new, exciting, and evolving small-bowel pleating technology that is safe, effective, and rapid with excellent control of advancement and withdrawal. Further studies will be needed to better understand the role of spiral enteroscopy in management of small-bowel disease.

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EDITORIAL

Spiral enteroscopy: a new twist on overtube-assisted endoscopy

The spiral is a spiritualized circle. In the spiral form, the circle, uncoiled, unwound, has ceased to be vicious; it has been set free.

Vladimir Nabokov

Until recently, the small bowel remained beyond the reach of direct endoscopic inspection outside the operating room. No matter how hard the endoscopist pushed a floppy tube, the twists and contours of the gut eventually ganged up, loops formed, and forward motion ended. Novel endoscope designs, like the Sondé enteroscope that relied on gut motility to move the tip through the bowel, proved too limiting to ever attain widespread use. The use of semirigid overtubes was fraught with complications, often pinching or creating shearing forces at the overtube tip.[1] Ultimately, the devices did not enable much deeper insertion than standard push enteroscopy.[2] Variable stiffness enteroscopes offered marginally deeper insertion without an overtube, but did not clearly improve diagnostic yield, and they never made it into widespread commercial production.[3] While other areas of GI endoscopy evolved and flourished, small-bowel imaging remained the province of the radiologist.

Deep small-bowel imaging emerged from the barium age with the advent of capsule endoscopy. Although it is a quantum leap beyond contrast studies, capsule endoscopy still does not offer the ability to insufflate the gut or repeatedly inspect suspicious areas, much less perform biopsies or apply therapy. Furthermore, the erratic nature of capsule passage may lead to incomplete visualization of portions of the small bowel. Enter double-balloon enteroscopy (DBE) (Fujinon, Wayne, NJ) in 2001 as the first endoscope system that could reliably pass deeply into the small bowel. The device allows significantly greater direct endoscopic visualization of the small bowel, with reported average depths of antegrade insertion more than 200 cm beyond the ligament of Treitz, and about 130 cm proximal to the ileoceal valve when inserted anally.[4]

Visualization of the entire small bowel has been rarely reported from the antegrade approach only, but more frequently by combining an antegrade and a retrograde procedure. Yamamoto et al[5] reported achieving total enteroscopy by combined routes in 86% of patients in whom it was attempted. May et al[6] reported 45% total enteroscopy success. Single-balloon endoscopy (SBE) (Olympus America, Center Valley Pa), an iteration of DBE that simply forgoes the second balloon at the tip of the endoscope, arrived soon after DBE and also allows deep enteroscopy. Depth of insertion of SBE has been less well studied than with DBE, but at least 1 case of total enteroscopy with SBE has been reported.[7]

Despite its success, balloon enteroscopy has been slow to catch on in the United States, even at major referral centers. The reasons for this are not immediately clear, especially when groups offering diagnostic capsule enteroscopy proliferate. DBE and SBE may lack traction because of the perceived long learning curve for the technique, or due to a reluctance to purchase the additional equipment that is necessary. However, it more likely relates to the long procedure times reported (well over an hour in most series), combined with relatively low reimbursement.

> Instead of ''pushing a noodle,'' the spiral overtube pulls the small bowel over an essentially stationary endoscope. Its simplicity adds to its appeal.

Certainly there appears to be a need for a simpler, faster method for performing deep enteroscopy; and the idea of an ''active'' overtube is not new. Devices originally designed to speed colonoscopy have been modified for enteroscopy. The ShapeLock device (USGI, Palo Alto, Calif), a multi-linked, flexible overtube that can be converted into a rigid conduit by tensing connecting cables with a lever, was originally designed to reduce looping during difficult colonoscopies. It was modified and used successfully in small trials for enteroscopy.[8] However, its large outer diameter as well as production and marketing decisions relegated it to ''wait and see'' status. The Spirus Discovery threaded overtube (Spirus Medical Inc, Stoughton, Mass), which was also originally designed (and has been commercially available) as a colonoscopy aid, was recognized by a group of intrepid endoscopists as a tool that may have utility in the small bowel. The article by Akerman et al[9] in this month's *Gastrointestinal Endoscopy* represents the results of their initial investigation.

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In this proof of concept case series, the investigators used a 130-cm flexible plastic overtube with an outer diameter of 17.5 mm, and a 5-mm thread at the tip (total maximum diameter 18.5 mm), along with a 160-cm pediatric colonoscope to examine 27 patients with obscure GI bleeding. The overtube could not be passed in 2 patients because of concerns about a Schatski's ring in one and difficulty intubating the esophagus in another. They describe reaching an average depth of insertion of 176 cm beyond the ligament of Treitz (range 80-340 cm), with an average procedure time of 36.5 minutes (range 19-65 minutes). Bleeding sites were identified in 9 of 25 patients (36%) and treated in 8. There were no major complications, although sore throat and esophageal mucosal injuries were noted in 22% and 28%, respectively. No direct mention was made of the difficulty or ease of the procedure; however, the authors describe the device as enabling a slow, controlled withdrawal during which bipolar cautery was applied to bleeding sites.

The investigators intended first and foremost to show that spiral enteroscopy, as it is fittingly called, can reliably allow endoscopic visualization of a significant portion of the proximal small bowel. Furthermore, they hoped to show that this could be done safely and in a time-efficient manner.

Two of these endpoints appear to have been reached. The average procedure time in this series approximates times reported for standard push enteroscopy, with or without an overtube, and is about half the time we expect to spend doing DBE or SBE. Of course, the procedure duration is largely controlled by the operator. The study suggests that the maximum depth reachable with spiral enteroscopy is fairly obvious to the operator and further attempts at advancement gain no additional ground. This occurs either because enough small bowel has pleated onto the overtube that the threads slip with additional rotation or the overtube simply will not turn further. The point of maximal insertion with DBE is less clear. Even at depths of 200 cm or more, repeating cycles of advance and withdrawal may result in additional gain, especially when modifications such as insertion of a stiffening wire or application of abdominal pressure are added. Yamamoto describes completing total antegrade enteroscopy only after persisting more than 4 hours (personal communication). It remains unclear from the current literature what depths and yields would be achieved if DBE or SBE were limited to 30 minutes.

Spiral enteroscopy appears to be reasonably safe, at least in this small series. Although follow-up was not ideal, no major complications were reported. Sore throat and mucosal abrasions would be expected with manipulation—especially prolonged rotation—of a large overtube. No pinch or shearing injuries from the interface of the overtube and the endoscope were reported, possibly because the tip of the overtube had been fitted with a soft, snug seal. It is notable that small-bowel trauma from the rotating threads was not reported and that the device did not appear to cause torque injury to the stomach or intestine. Again, no formal imaging or other investigation beyond soliciting patient complaints was pursued. The investigators chose not to proceed in a patient with a Schatski's ring and another in whom initial intubation proved difficult. With the device in general use, such restraint may not be universal.

Newer versions of the overtube have a smaller outer diameter and a softer thread that comes in a standard version and a lower-profile version, so esophageal trauma may be less of a problem. The trade-off, however, is that the smaller overtubes can only be used with dedicated enteroscopes with an outer diameter no greater than 9.4 mm (such as the enteroscopes designed for single- and double-balloon procedures, which retail for $37,000 and $47,000, respectively) and will not be usable with the "off the shelf" pediatric colonoscope. In the initial series, one physician rotated the overtube and another guided the endoscope. The 2-physician model is not practical in most endoscopy suites, and it remains to be seen how easily one station—either overtube rotation or endoscope control—can be handled by a nurse or technician. Finally, all patients underwent propofol sedation for the procedure, and it is unclear whether many patients would tolerate spiral enteroscopy with midazolam and fentanyl sedation.

The less certain endpoint—and this is true with almost all reports of deep enteroscopy techniques—remains the actual depth of insertion. The authors describe reaching depths of up to 300 cm beyond the ligament of Treitz, with an average depth reached of 175 cm. These distances are similar to those reported, at least in the North American experience, to double-balloon enteroscopy. However, reports of depth of insertion in deep enteroscopy are like reports from fishermen concerning the size of the fish that got away: they are almost entirely subjective, have not been studied in any standardized manner, and are probably exaggerated. Measuring depth of insertion in DBE relies on adding the sum of multiple advancements minus estimates of slippage.[10] Although 1 cycle may be fairly accurate, the accumulated errors, especially toward the end of the procedure, when slippage may exceed advancement, make these estimates highly suspect. At a recent international consensus meeting on DBE, the participants just barely achieved a 50% vote in favor of using the cumulative cycle technique for estimating depth of insertion, and then only because no better technique appears to exist.[11] Radiographic estimates and measuring during withdrawal are equally unreliable. In practice, many centers in which DBE is performed have abandoned attempts at formal measurement and rely on estimates of the general segment of bowel reached (ie, midjejunum, proximal ileum, etc). In a recent article on SBE, no mention at all was made of depth of insertion.[7] During spiral enteroscopy, measurement of depth of insertion relies on visual estimates of the amount of small bowel that is seen passing the tip of the scope during both insertion and withdrawal. Comparing depth of insertion in vivo to the experience with a pig intestine model may help in making these estimations, but it does not guarantee accuracy.[12] That said, in one abstract in which 2 patients with tumors were identified by spiral enteroscopy, the estimated depth of the lesion closely matched the location at surgery.[13]

Although it was not a stated endpoint, the diagnostic yield of spiral endoscopy in this series (33%) appears low, at least when compared to data from DBE series, which report identifying bleeding sources in about 75% of cases.[14] These yields seem low, even compared to older literature on push enteroscopy, which reports identifying obscure bleeding in 45% to 80% of cases.[15] This may mean that actual depth of insertion was less than estimated, or, as the authors point out, this may be a factor of the patient population and patient selection. This Central and South American group of patients had not undergone the same rigorous work-up prior to deep enteroscopy as those patients in North American, Japanese, and European series (ie, no mention of transfusion requirement prior to the study, no capsule enteroscopy, CT scanning, etc). Clearly, formal studies in other populations are needed.

Nevertheless, spiral enteroscopy represents a dramatic shift not only in how we perform small-bowel endoscopy but in how we think of endoscopy in general. Instead of ''pushing a noodle,'' the spiral overtube pulls the small bowel over an essentially stationary endoscope. Its simplicity adds to its appeal. Combine this with relatively rapid achievement of maximum depth of insertion, which makes deep enteroscopy more financially appealing to busy endoscopy centers, and spiral enteroscopy begins to sound like it may earn a place on the endoscopists' growing shelf.

However, as with all new technologies, impediments and unintended consequences can cast shadows on even the most promising devices. Can we be sure that the rotational forces of the overtube won't traumatize the bowel or other structures in other circumstances, such as inflammatory bowel disease, extensive abdominal surgery, etc? Can the device be removed quickly in case of an emergency? What is the learning curve for the average endoscopist? What conditions will render spiral enteroscopy unsuccessful or even dangerous?

Ultimately, we will have to wait for additional studies in other patient populations, performed by investigators without a financial interest in the technology in order to better assess the diagnostic yield of spiral endoscopy. This technology, along with any other new enteroscopy devices, will need to be measured against balloon enteroscopy, which represents today's reference standard for nonsurgical enteroscopy, both in terms of an objective measure of depth of insertion as well as diagnostic and therapeutic outcomes.

Those of us who perform deep enteroscopy look forward to seeing additional studies of spiral enteroscopy. We will then be able to tell whether it represents a real advance or is another idea that held promise but fails to deliver. Ultimately, we await a device—whether it is a modification of the spiral system or something completely different—that will allow reliable, total nonsurgical enteroscopy in one session. Until that time, we will continue to use unsatisfying surrogate markers like depth of insertion and diagnostic yield to tell us how far we are along that path.

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Abbreviations: *DBE, double-balloon enteroscopy; SBE, single-balloon enteroscopy.*

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