

Achieving cecal intubation in the very difficult colon CME

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Cecal intubation is defined as insertion of the colonoscope tip into the cecal caput so that the medial wall of the cecum proximal to the ileocecal valve can be fully inspected. Although colonoscopists outside the United States sometimes undertake colonoscopy without intending to intubate the cecum,¹ the intent to achieve full cecal intubation or reaching an ileocolonic anastomosis is the norm in the United States. The U.S. Multisociety Task Force on Colorectal Cancer² and a combined task force of the American Society for Gastrointestinal Endoscopy and the American College of Gastroenterology^{3,4} have made recommendations on quality indicators for the technical performance of colonoscopy. Targets for successful cecal intubation rates are 90% for all colonoscopies and 95% for screening colonoscopies.^{3,4} Patients with procedures aborted for poor preparation, severe colitis, or when the intention of the procedure is to treat a known lesion distal to the cecum (and the cecum has been previously intubated) need not be counted in the denominator when cecal intubation rates are calculated. The recommended rates for cecal intubation are based on published experience from both academic⁵⁻⁹ and community¹⁰⁻¹² colonoscopists.

That the recommended rates are not 100% obviously reflects that complete colonoscopy either is not or may not be possible in every patient. However, maximizing cecal intubation rates results in positive outcomes. Patients with incomplete colonoscopy incur the cost, risk, and inconvenience of other procedures, usually barium enema¹³ or CT colonography,^{14,15} to complete the colorectal examination. If radiographic studies show lesions proximal to the extent of incomplete colonoscopy, another attempt at colonoscopy may be needed. Such patients may severely test the skills of even the most experienced colonoscopists.

This review discusses an approach to patients with technically difficult colons, with a goal of guiding experienced colonoscopists to techniques and equipment that allow successful intubation in even the most difficult cases.

METHODS

A MedLine review of English articles was performed using the terms “failed colonoscopy,” “incomplete colonoscopy,” and “colonoscopy technique.” Reference lists of identified articles and book chapters on colonoscope insertion were reviewed to find additional references. I also relied on his personal experience, including performing colonoscopy in patients in whom colonoscopy had been previously attempted by others but was incomplete, as described in previous publications.^{16,17}

The anatomic cause of difficult colonoscopy can usually be categorized into either an angulated or narrowed sigmoid colon or a redundant colon.

LEVELS OF EVIDENCE

There are no randomized controlled trials comparing 2 or more techniques in patients with difficult colons. There are randomized trials evaluating technologies that might assist colonoscope insertion in general, but in which the end point was cecal intubation rates in consecutive patients rather than patients with prior incomplete or known difficult colonoscopies. All the data directly addressing the approach to difficult colons describe techniques or equipment and the rate of success in case series of patients with either difficult colons or previous incomplete colonoscopies. In most series, the physicians who performed the first incomplete or difficult colonoscopy and the subsequent attempt were the same physicians or from the same group of physicians. Thus, only low-level evidence is available on this topic.

CLASSIFYING THE CAUSE OF A TECHNICALLY DIFFICULT COLONOSCOPE INSERTION

Characterizing the reason for a difficult insertion in patients referred with previous incomplete colonoscopy by other endoscopists^{16,17} indicates that the anatomic

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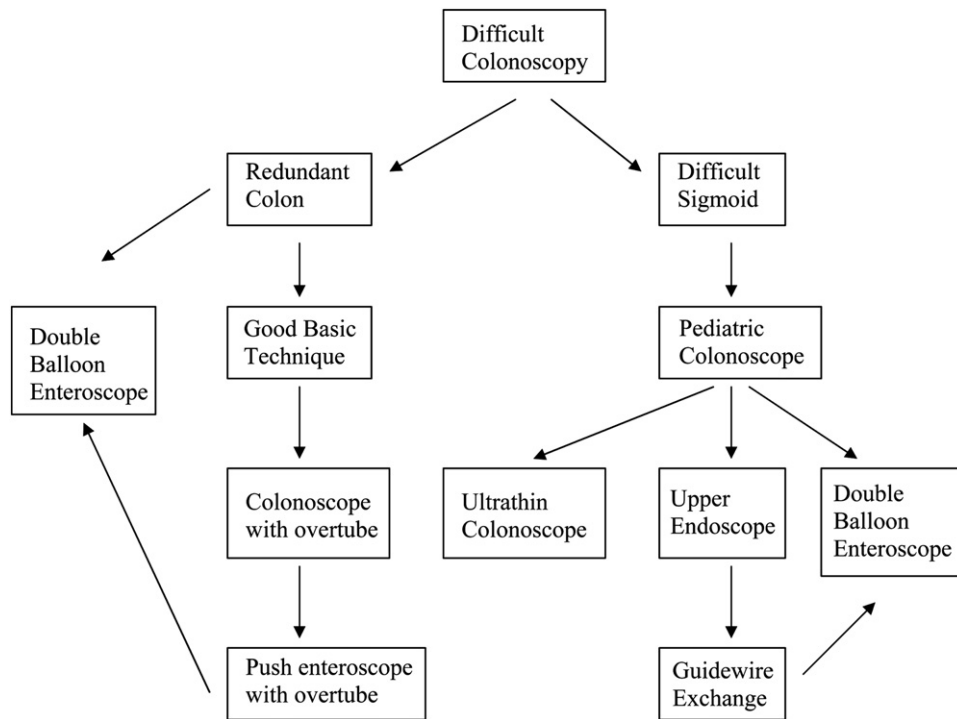


Figure 1. Algorithm for achieving cecal intubation in the very difficult colon.

cause of difficult colonoscopy can usually be categorized into 1 of 2 problems: (1) the angulated and/or narrowed sigmoid colon and (2) the redundant colon. This classification directly leads to an approach to colonoscopy in these patients, as described in Figure 1. Support for techniques and equipment in Figure 1 is described below.

For the patient with prior incomplete colonoscopy, the cause of difficulty is typically evident from reviewing the record of the previous attempt at colonoscopy, which often explicitly states the nature of the difficulty in passing the instrument, or by discussion with the patient, or gleaned from an initial exploratory attempt by the endoscopist.

THE DIFFICULT SIGMOID COLON

The sigmoid can create an obstacle to instrument passage because of angulation or narrowing. Published experience indicates that the solution is to use a narrower instrument shaft or one with both a narrower shaft and shorter bending section.¹⁶⁻¹⁸ Narrow diameter facilitates passage of angulation and occasionally, because of greater flexibility of the instrument shaft, seems to allow forward movement through areas that feel “fixed” to larger-diameter endoscopes. Pediatric colonoscopes have insertion tube diameters about 2 mm smaller than standard colonoscopes, which results in a reduction in cross-sectional surface area of the instrument tip of 22%. Therefore, the pediatric colonoscope is usually used first for the patient with a very difficult sigmoid colon. If the pediatric colono-

scope cannot be passed through narrowing or angulation, then an upper endoscope will almost invariably pass benign angulations.¹⁶⁻¹⁸ An 8.6-mm diameter upper endoscope has an insertion tube cross-sectional surface area that is 54% less than a standard colonoscope, and the bending section is shorter and has a tighter turning radius compared with colonoscopes. The disadvantage of the upper endoscope is its shorter length, but strict adherence to loop reduction and straightening, combined with vigorous abdominal pressure, allows cecal intubation with an upper endoscope in about two thirds of cases.¹⁶⁻¹⁸

If an upper endoscope cannot be passed to the cecal tip, the technique of guidewire exchange can be used to remove the upper endoscope from the colon and replace it with the longer pediatric colonoscope.¹⁹ This technique is usually successful in allowing a pediatric colonoscope to pass through an angulated sigmoid, even when an initial attempt at passing the pediatric colonoscope without the guidewire had been unsuccessful. In this technique, the upper endoscope is first passed as far as possible into the colon (typically this is at least as far as the transverse colon). After the guidewire has been advanced into the colon lumen, the upper endoscope is withdrawn while simultaneously the guidewire is advanced to maintain the guidewire tip position in the proximal colon. The guidewire should have a soft tip at the end that is advanced into the colon, to prevent perforation of the colon. Otherwise the shaft of the wire should be quite stiff to prevent any loop formation as the upper endoscope is withdrawn. An alternative approach to prevent the wire from looping

would be to place it under fluoroscopic control, although I have not found this to be necessary. The guidewire should also have a length of at least 360 to 480 cm. A Savary guidewire works well for this purpose, but the Savary wire typically used to guide esophageal dilation is too short. After the upper scope is entirely withdrawn from the colon, the stiff end of the wire outside the patient is “back fed” through a pediatric colonoscope (passed backward through the working channel from instrument tip through the biopsy port on the control head). Back feeding is enabled by passing a polypectomy snare down the working channel of the pediatric colonoscope in the forward (or usual) direction until it exits the colonoscope tip. The stiff tip of the guidewire is then inserted retrograde at least several centimeters into the snare sheath and pushed backward up the pediatric colonoscope inside the snare sheath. The snare sheath protects the channel from the wire tip and allows the wire tip to pass the angle in the instrument channel at the control head. The pediatric colonoscope is now advanced through the sigmoid colon over the guidewire. Unless there is a frank stricture, the pediatric colonoscope (which would not pass previously) will typically pass readily. The explanation may be that the wire maintains straightening of the sigmoid angle achieved by passage of the gastroscope. Tip deflection in the direction of the lumen and/or pulling small amounts of wire out of the patient as the colonoscope is advanced can facilitate passage of the colonoscope through the sigmoid colon. Once the sigmoid angulation is clearly passed, the guidewire is withdrawn entirely, and the pediatric colonoscope is advanced to the cecum by use of standard technique.

An alternative to these techniques for dealing with the angulated sigmoid colon is to use a long endoscope (colonoscope length or longer) with the diameter of a thin upper endoscope. Examples that have been used successfully include the Fujinon (Wayne, NJ) double-balloon endoscope (diameter 8.5 or 9.4 mm, length 200 cm)²⁰⁻²² and the Pentax (Pentax of America, Golden, Col) “ultra-thin” colonoscope (diameter 9.8 mm, length 130 cm).²³

Regardless of the instrument used, passing an angulated sigmoid colon may require patience and exquisite control of both the instrument shaft and tip deflection to successfully negotiate an angulated, narrowed section. In my experience, this level of control of the instrument tip is maximized by the “left-hand shaft grip,” which allows the operator to simultaneously operate the up-down and left-right controls while inserting or withdrawing the instrument shaft (at least for short distances) with the left hand.²⁴ Gentle “jiggling” of the instrument shaft and/or infusion of water may also facilitate passage of a sharp sigmoid angle.

Once an angulated sigmoid has been passed, straightening the endoscope as much as possible and as soon as possible is always preferred.

Many series have reported that colonoscopy is more difficult in women, and about 75% of the cases of previously failed colonoscopies by other endoscopists in the series quoted above were in women.^{16,17} The reasons why difficult colonoscopy occurs more often in women include pelvic surgery and different anatomy compared with men, including a particularly acute rectosigmoid angle in thin women.

THE REDUNDANT COLON

In a published experience with 162 incomplete colonoscopies performed by other endoscopists, a redundant colon exceeded the angulated sigmoid as a cause of incomplete colonoscopies^{16,17} (Table 1). The colonoscopy report from the previous attempt typically makes note of redundancy, excessive looping, or that the colonoscopist “ran out of scope” before the cecum was intubated. In patients with redundant colons, strict attention to proper fundamental colonoscopy technique, without resorting to special equipment or special colonoscopes, resulted in successful cecal intubation in three fourths of patients, and the remainder required either longer instruments or overtubes to complete cecal intubation.^{16,17} On the basis of this published experience in performing colonoscopy in patients with prior incomplete colonoscopies by others,^{16,17} and anecdotal experience in being asked to assist when either experienced fellows or gastroenterologist partners were “stuck” and unable to complete a cecal intubation, the following are some of the steps and maneuvers most likely to be helpful.

First, which instrument should be selected for an attempt at cecal intubation in the redundant colon? Standard colonoscopes are stiffer than pediatric colonoscopes and resist looping better. If a patient is referred with a known redundant colon, many prefer the variable stiffness device (myself included), although this preference lacks literature support. There is no evidence that variable stiffness improves cecal intubation rates in routine colonoscopies and no convincing evidence that it makes a clinically important difference in patients with previously failed colonoscopies.²⁵ Variable stiffness continues to be a colonoscope feature for which there is limited evidence of any clinical benefit but that, like many endoscopes and accessories, some physicians maintain a personal preference.²⁵

Anecdotally, the use of variable stiffness in the very difficult colon is similar to its use in a routine colonoscopy. The sigmoid is typically passed with the instrument shaft in the flexible mode, followed by straightening of the instrument shaft. If continued passage results in loop or bend formation, then the instrument shaft is straightened again, the shaft is placed in the stiff (typically in the stiffest) setting, and insertion is tried again. Simultaneous application of abdominal pressure may be needed to

TABLE 1. Reasons for failure to complete prior colonoscopies in 185 consecutive patients with prior incomplete colonoscopy from another gastroenterologist or surgeon (one primary reason for failure was assigned to each case)

Reason for failure	No.
Sigmoid stricture, angulation, fixation, severe diverticulosis, or diverticulitis	60
Looping or redundancy	91
Abdominal wall hernia	3
Difficulty in sedating	11
Spasm	1
Radiation colitis	1
Hypotension	1
Reason unclear	17

From references 16 and 17, including an additional 24 previously unpublished cases.

TABLE 2. Equipment used during colonoscopy in the 180 patients in whom cecal intubation or intubation to an ileocecal anastomosis (n = 1) was successful

Adult colonoscope alone	72
Adult colonoscope with external straightener	17
Olympus colonoscope straightener	16
Shapelock	1
Pediatric colonoscope alone	49
Pediatric colonoscope after guidewire exchange	11
Pediatric colonoscope with external straightener	4
Olympus colonoscope straightener	3
Shapelock	1
Upper endoscope alone	19
Enteroscope alone	1
Enteroscope with external straightener	7
Olympus enteroscope straightener	4
Shapelock	3

From references 16 and 17, including an additional 23 previously unpublished cases.

prevent loop or bend formation. If stiffening the instrument shaft appears to be useful in advancing through one portion of the colon, experience indicates it may later interfere with passage of a more proximal portion of the colon. Thus, attempting advancement in both the flexible and stiff modes may be needed at different times during insertion.

It is critical that all loops and bends in the instrument shaft are fully reduced. If there is not excellent 1-to-1 transmission of shaft movement to tip motion or if there is more than 90 cm of instrument in the patient, there is likely a loop or bend in the shaft. Withdrawal with torque until the instrument shaft “feels” straight is essential. Failure to withdraw sufficiently is the most common error in redundant colons. In some instances, it may be best to remove the instrument until the tip is in the rectum, followed by reinsertion with strict attention to straightening as each turn is passed. Overinsufflation should be avoided and suctioning can be extremely useful in reaching and passing turns without pushing more colonoscope into the patient. Sound fundamentals with strict attention to straightening is typically my personal first-line approach to patients referred with prior incomplete colonoscopies when the cause was a redundant colon.^{16,17}

Position change may be decisive in the very difficult redundant colon. Rotating the patient into the right lateral decubitus position seems underused and may particularly be decisive in advancing the instrument tip from the ileocecal valve or just distal to the valve into the cecal caput.

Abdominal pressure is typically needed, and if necessary several locations should be tried in rapid succes-

sion.²⁶ In my experience assistants are variably effective in their application of abdominal pressure. Vigor and enthusiasm seem to matter, although we discourage hard pressure in the left upper quadrant to reduce the theoretic risk of splenic injury resulting directly from manual pressure. Pressure is best applied after the instrument is withdrawn to the point that it “feels” straight. Suspected sigmoid looping is best countered by left lower quadrant or lower midline pressure. Transverse colon loops can be countered by upward pressure across the mid or lower abdomen. With the instrument tip in the ascending colon, pressure on the right lateral abdomen or upward pressure under the cecum may be decisive. In some instances, resorting to “four-handed” pressure in which 2 assistants cover the abdomen with pressure has proven successful.^{16,17} If the scope is palpable by the assistant during loop formation, the instrument is straightened and pressure is applied over the area where the loop was felt and before the next attempt at insertion. In many instances removing abdominal pressure is preferable during instrument withdrawal and straightening because firm pressure may resist unwinding of loops in the instrument shaft.

These comments reflect my anecdotal sense of which standard maneuvers are underused when difficulty is encountered in the redundant colon. A full discussion of sound standard technique is available elsewhere.²⁶ If available, some experts would use fluoroscopy²⁷ or an magnetic electronic imaging^{28,29} device to determine the

location and nature of any loops, thereby optimizing loop reduction maneuvers and the placement of the assistants' hands for abdominal pressure. There is no convincing evidence that these devices contribute substantially to improving cecal intubation in very difficult colons.²⁷ I never use these devices in patients with previous incomplete colonoscopy.

If meticulous attention to standard technique (straightened instrument shaft), maximal use of position change, and abdominal pressure are unsuccessful in the redundant colon, then the next approach is to either use a longer instrument or an overtube or both. Overtubes are back loaded onto the chosen colonoscope. Simple sigmoid overtubes can be successful if looping is occurring in the sigmoid colon. Olympus (Center Valley, Pa) makes a 60-cm reusable black flexible tube that has been successfully used in previously incomplete colonoscopies.^{16,17} USGI Medical (San Clemente, Calif) offers the ShapeLock device (in lengths of 60 and 80 cm) on a limited basis. The device has been reported to provide successful sigmoid straightening in previously incomplete colonoscopies.³⁰⁻³² The device consists of a reusable tube of metal links and a disposable sheath that covers the outside and inside of the reusable tube. In one mode, the tube is extremely flexible. When the handle is closed, the metal links lock and the tube becomes rigid in whatever shape it held when the handle was closed. After back loading onto the colonoscope or an enteroscope in the flexible mode, the colonoscope is advanced through the sigmoid and straightened, and the ShapeLock is advanced over the straightened colonoscope in the flexible mode and then locked in place. In my experience, the device tip may reach the splenic flexure or even to the distal transverse colon. It is very effective in preventing sigmoid looping but will typically not prevent transverse colon looping. It does have the relative advantage of a highly hydrophilic inner sheath, and there is very little tendency of the instrument to "stick" in the overtube. The reusable metal link portion currently costs \$3200 (60 cm length) or \$3600 (80 cm length) and the disposable sheaths are \$110 and \$140, respectively.

Another device that may have value in this setting is the Endo-Ease, which is commercially available from Spirus Medical (Stoughton, Mass)³³ and costs \$95 for a 70-cm version and \$115 for a 90-cm version. This device is an overtube with a plastic spiral screw on it. It is back loaded to a point about 20 cm from the tip of a pediatric colonoscope and then locked to the colonoscope shaft. After the tip passes the rectosigmoid colon in the usual fashion, the scope and the straightener are advanced as a unit by a "screwing" action (rotating the overtube in a clockwise direction). When the overtube is fully inserted, it is unlocked from the insertion tube and the colonoscope is advanced through the overtube. I have not used this device and am not aware of others' experience with it, specifically in the setting of previously incomplete colonoscopies or

very difficult colonoscopies. An alternative approach to resisting looping is stiffening wires. Early devices caused damage to the colonoscope channel.³⁴ The Zutron Colonoscope Stiffening Device (Zuton Medical, Kansas City, Mo) is a reusable wire that can be used to stiffen the colonoscope after the tip has reached the transverse colon. Its effectiveness in very challenging colons remains uncertain.

We have described use of a 215-cm push enteroscope with a 90-cm enteroscope overtube to achieve cecal intubation in redundant colons.^{16,17} This approach takes advantage of both increased endoscope length and an overtube. The importance of liberally lubricating the enteroscopy overtube cannot be over emphasized. The double-balloon enteroscope (DBE) has these same advantages plus the advancement mechanisms provided by insufflation and deflation of the enteroscope and overtube balloons. High but not perfect success rates of cecal intubation with the DBE system have been described.^{20-22,35} Enthusiasm for newer approaches is likely to make DBE the instrument of choice for previously incomplete colonoscopies in centers in which the device is available, but there are many units in which DBE is not currently available and no evidence exists that DBE is a superior approach compared to other technologies described here. The use of overtubes in the colon is generally safe and does not require fluoroscopy.^{16,17} Like colonoscopes, overtube advancement should not continue when fixed resistance to advancement is palpated by the hand advancing the overtube. Measures such as longer scopes or overtubes are, of course, still combined with position change or abdominal pressure as needed. Overtubes are potentially dangerous and are not advised when narrow or angulated sigmoid is the cause of insertion difficulty.

There is no evidence at this time to suggest whether a new colonoscopy platform, such as Neoguide³⁶ or Inventuscope,³⁷ would have value in difficult colonoscopy. Similarly, the role of colonoscopic-assist devices that pull the colonoscope forward, such as ColonoSight³⁸ is unknown at this writing. Diagnostic-only endoscope devices, such as capsule colonoscopy^{39,40} or the Aero-Scope,^{41,42} might prove successful for proximal colon visualization in the setting, but their role is akin to that of radiographic techniques, such as double-contrast barium enema or CT colonography, in that they lack therapeutic capability.

PUBLISHED EXPERIENCE IN PREVIOUSLY FAILED COLONOSCOPY

Table 1 summarizes data from 2 published reports totaling 161 consecutive cases^{16,17} plus an additional 24 previously unpublished consecutive cases in which colonoscopy was performed by me in patients in whom there was a previous unsuccessful attempt at cecal intubation by another gastroenterologist or a surgeon. The

overall success rate of cecal intubation in these 185 consecutive cases was 97% with no perforations occurring. Of interest is that, although a redundant colon or angulated sigmoid was the cause of previous failure in the great majority of patients, small numbers of failures were the result of inability to sedate the patient, and abdominal wall hernias accounted for a few cases. These were overcome by the use of propofol sedation and continuous manual reduction of the hernias, respectively.

The 5 failures to complete cecal intubation were due to extreme redundancy in 4 cases and a transverse colon abdominal hernia that could not be manually reduced in 1 case. Whether DBE might have resulted in completed colonoscopies in the 5 patients with failed colonoscopies remains unknown.

In reviewing the measures used to achieve success in these cases, note that most patients were successfully colonoscoped by standard or pediatric colonoscopes and careful attention to technique. However, a distinct minority required the use of special equipment (Table 2). Because the experience is not controlled, others might have had equal success with different approaches. However, the experience is instructive from the perspective of types of problems encountered and the approach used by one expert with a special interest in colonoscopy. Importantly, this experience was accumulated largely before the availability of DBE.^{20,22,35} As noted earlier, because few centers currently have DBE and DBE is not proven superior to the approaches outlined in Table 1, the experience is still informative. The relative therapeutic capabilities of these standard instruments versus DBE (eg, for polypectomy in the proximal colon) remain unknown.

Anecdotally, I recommend that colonoscopy in patients with previous failure be scheduled with sufficient time allotted to make the attempt. In some instances it may be necessary to try multiple instruments and use several ancillary techniques. Allowing sufficient time on the schedule will ensure that various methods can be explored if needed. A high comfort level with repeated manipulations of the colon is valuable.

CONCLUSIONS

Difficult colonoscopies or previously failed colonoscopies can usually be characterized as an angulated sigmoid colon or redundant colon, and this classification guides the technical approach to completing the examination.^{16,17} No controlled data are available to determine which technical approach is optimal in various settings. Case series indicate that experts using a variety of techniques can achieve very high success rates of cecal intubation, even in patients with previously failed attempts at colonoscopy and technically quite difficult colons.^{16,17} The relative merits of DBE in these cases versus more widely available instruments remain uncertain.

DISCLOSURE

The author reports the following conflict: research support from Olympus Corporation.

Abbreviation: DBE, double-balloon enteroscope.

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