Chapter 3
Endoscopic Detection

Joseph M. Polito II and Caroline Polito

Introduction

Occult gastrointestinal (GI) bleeding refers to the presentation of a positive fecal occult blood test without an obvious cause for the blood loss [1]. Once a patient presents with occult GI bleeding, it is important to determine if iron deficiency anemia is present. In patients with a positive fecal occult blood test but no evidence of anemia, a colonoscopy should be considered. In patients with upper GI symptoms, an upper endoscopy should be performed as well [2, 3]. Upper GI symptoms include heartburn, difficulty swallowing, stomach pain, nausea, and vomiting [4]. For patients who have a positive fecal occult blood test and an iron deficiency anemia, both an upper endoscopy and colonoscopy are recommended [2, 3]. If upper endoscopy and colonoscopy do not indicate the source of the bleeding, the next step is to evaluate the small bowel [5]. The majority of these patients will undergo a wireless capsule endoscopy [6].

Upper Endoscopy

Upper endoscopy allows for the visualization of the esophagus, stomach, and proximal duodenum. It can also be used to sample tissue [7]. Typically upper endoscopies are performed using a high-definition white light endoscope [8]. Patients with

J. M. Polito II (✉)
Albany Medical Center, Medicine, Albany, NY, USA
e-mail: JPolito@AlbanyGI.com

C. Polito
Stony Brook University Medical Center, Renaissance School of Medicine, Stony Brook, NY, USA
e-mail: Caroline.polito@Stonybrookmedicine.edu

M. Tadros, G. Y. Wu (eds.), *Management of Occult GI Bleeding*, Clinical Gastroenterology, https://doi.org/10.1007/978-3-030-71468-0_3

upper GI symptoms, especially symptoms indicative of gastroesophageal reflux disease (GERD), often receive upper endoscopies [9]. In addition, if imaging of the upper GI tract shows suspected neoplasms, ulcers, strictures, mucosal abnormalities, or obstructions, an upper endoscopy may be performed [7]. Lesions in the upper digestive tract are often detected in those who test positive for fecal occult blood or have an iron deficiency anemia [10–13]. Upper GI symptoms are also associated with the detection of lesions in the upper digestive tract. However, the prevalence of lesions in the upper GI tract is greater than or equal to that of colonic lesions even in those without symptoms [10–13]. Upper GI sources of bleeding are found in 36–56% of patients with an iron deficiency anemia [14–16] and in 29% of patients who test positive for fecal occult blood and do not have an iron deficiency anemia. Approximately 50% of these patients will be symptomatic [14]. In addition, 5–17% of patients have both upper and lower GI lesions [14–16]. Upper endoscopy can employ a number of therapeutic interventions including biopsy, polypectomy, dilation of strictures, stent placement, removal of foreign bodies, percutaneous gastrostomy tube placement, treatment of GI bleeding with injection, banding, coagulation, sclerotherapy, and endoscopic therapy for esophageal intestinal metaplasia [7].

Colonoscopy

Colonoscopy is the preferred approach for evaluation of the colon, rectum, and the distal portion of the terminal ileum and can detect a wide range of lesions, including polyps, diverticula, cancers, and angiodysplasias. It allows for the visualization of the entire colonic mucosa as well as the ability to obtain tissue biopsies [17]. While colonoscopy is effective in reducing colon cancer rates overall, it is more effective in reducing the risk of rectal and left sided colon cancer than right sided colon cancer [18]. One technique to improve visualization is retroflexion, which is when the colonoscope is bent into a U-shape to allow the viewing lens to look backwards. Reflexion is often used in the right colon to improve the effectiveness of colonoscopy given the fact that right sided colon polyps can be located on the backs of haustral folds in the cecum and ascending colon [19]. Retroflexion in the right colon is successful in over 90% of cases with very low complication rates while yielding a significant improvement in the adenoma detection rate [20]. Good bowel preparation is important for all colonoscopies and is necessary for proper visualization. An excellent bowel prep will allow for 95% of the mucosal surface to be seen allowing for a high adenoma detection rate while a poor bowel prep will result in fecal matter blocking visualization and require a repeat bowel preparation [21]. Diagnostic indications include screening or surveillance for colon cancer, evaluating signs and symptoms suggestive of colonic or distal small bowel disease such as gastrointestinal bleeding or diarrhea, assessing a response to treatment for patients with colonic diseases like inflammatory bowel disease, and evaluating abnormalities found on imaging studies [17] including barium enema [22], abdominal computed tomography (CT) [23], positron emission tomography (PET) [24], and magnetic resonance

imaging (MRI) [25]. Some radiographic findings that are considered abnormal and may warrant performing a colonoscopy include thickening of the wall of the colon or terminal ileum [26], mass lesions [27], and strictures [28]. It also can be used for therapeutic interventions, such as stricture dilation, stent placement, colonic decompression, and foreign body removal [17]. Colonoscopies are generally considered the gold standard for colon cancer screening and surveillance. If polyps are found during the colonoscopy, they are usually removed endoscopically if possible [29].

Small Bowel Evaluation

If a complete endoscopy and colonoscopy with adequate visualization do not reveal the source of occult gastrointestinal bleeding, evaluation of the small bowel is recommended [1]. Wireless capsule endoscopy is the preferred initial approach for evaluating the small bowel [1]. Other endoscopic options include push enteroscopy [30], single balloon endoscopy, double balloon endoscopy [31] and spiral enteroscopy.

Wireless Capsule Endoscopy

Wireless capsule endoscopy is generally the first choice for evaluating suspected small bowel bleeding. Wireless video endoscopy, also referred to as video capsule endoscopy (VCE), is a noninvasive technology designed to provide diagnostic imaging of the small intestine. It can also provide limited visualization of the esophagus, stomach, and cecum. The images acquired from wireless capsule endoscopy are of high resolution and have a 1:8 magnification, which is greater than that of a conventional endoscope. This allows for visualization of individual villi. The capsule moves passively, does not inflate the bowel, and images the mucosa in a collapsed state [31]. The main advantages of wireless capsule endoscopy are that it is relatively noninvasive and permits examination of the entire length of the small bowl most of the time. Its main disadvantage is that it cannot be guided nor steered and it does not allow for tissue sampling or therapeutic intervention. In addition, not all of the small bowel mucosa is visualized as the capsule passes through the small intestine while being pushed along by peristalsis [31]. The diagnostic yield of capsule endoscopy is highest when it is performed as close as possible to the bleeding episode [32–35]. Double-ended wireless video capsules, which can capture images from both ends of the video capsule, have also been developed for the examination of the colon [36].

Wireless video endoscopy identifies causes of small bowel bleeding more often than push enteroscopy in most reports [37–45]. Studies have suggested that wireless capsule endoscopy is equal to or more sensitive than other methods for the diagnosis of small bowel sources of blood loss. A meta-analysis of 14 observational studies

compared wireless capsule endoscopy with other procedures for suspected small bowel bleeding and estimated that the overall yield of wireless capsule endoscopy was 63%, which is significantly higher than push enteroscopy with a yield of 26% and barium studies with a yield of 8% [37]. Overall, the yield of wireless video endoscopy for occult small bowel bleeding has been reported to be in the range of 30–70% [6, 32, 33, 37–40, 42, 46–52]. One trial of 89 patients with suspected small bowel bleeding that compared capsule endoscopy with push enteroscopy found that performing capsule endoscopy before push enteroscopy was a more effective strategy than beginning with push enteroscopy. The capsule endoscopy first strategy significantly reduced the percentage of patients needing a second procedure from 79% to 25% [53]. In another randomized trial of 136 patients with suspected small bowel bleeding who had undergone upper endoscopy, colonoscopy, and push enteroscopy, patients were assigned to either capsule endoscopy or radiographic evaluation. The diagnostic yield for capsule endoscopy was 30% in comparison to radiographic evaluation with a 7% yield, but the rate of recurrent bleeding between the two groups was the same [48]. Another study involving 305 patients undergoing capsule endoscopy for suspected small bowel bleeding did not find a significant difference between those with a positive and negative video capsule endoscopy. It also did not find a difference in rebleeding rates between those who underwent treatment and those who did not [54]. Repeat capsule endoscopy is recommended for patients whose initial capsule endoscopy is negative given that the entire small bowel mucosa may not be visualized with a single pass and could miss the source of GI bleeding. The capsule does not follow an axial path but rather tumbles and is unable to see behind all of the folds of the small intestine [55].

Push Enteroscopy

Push enteroscopy is an alternative means of visualization of the small bowel. It involves oral passage of a push enteroscope or a pediatric colonoscope past the ligament of Treitz. In the case of the enteroscope, the instrument is 200–250 cm long but the depth of insertion can be limited by looping within the stomach or small bowel or by patient discomfort. About 25–80 cm of the jejunum distal to the ligament of Treitz can be evaluated [56]. The amount of jejunum that can be viewed can be increased when an overtube designed to reduce looping in the stomach is used. However, it has not been conclusively determined whether or not this improves the diagnostic and therapeutic ability of push enteroscopy [57, 58].

Multiple studies have determined that the diagnostic yield of push enteroscopy in identifying bleeding lesions is estimated to be between 3% and 70% [2] with angioectasia being the most common diagnosis [59–61]. One benefit of push enteroscopy in comparison to wireless capsule endoscopy is that it can sample tissue and perform therapeutic maneuvers which include clipping of bleeding lesions or ablation and hemostasis of bleeding using bipolar cautery.

In a study of 95 patients with suspected small bowel bleeding who underwent push enteroscopy, it was concluded that many lesions detected during enteroscopy were within reach of a standard endoscope. This indicates that a careful repeat standard upper endoscopy may be appropriate prior to push enteroscopy or other diagnostic procedures [59].

Single Balloon

Single balloon enteroscopy allows for both evaluation and therapeutic intervention in the small bowel. Single balloon enteroscopy consists of a long, 1400 mm enteroscope, an overtube with a distal inflatable balloon, and a control unit to inflate and deflate the balloon. The overtube is designed to minimize looping of the small bowel while pleating it back over the overtube and the enteroscope [62]. It can be used anterograde via the mouth or retrograde via the rectum with intubation and advancement proximal to the ileocecal valve. Single balloon enteroscopy is typically performed with fluoroscopic assistance and the use of CO_2 instead of air for insufflation of the bowel as CO_2 is absorbed more quickly across the bowel mucosa (Fig. 3.1). Using air for the insufflation of the bowel can prolong the procedure time and single balloon enteroscopy requires higher volumes of gas insufflation, which can cause discomfort and limit advancement of the enteroscope [62]. Bowel prep is not required for enteroscopy. The enteroscope is initially advanced as far as possible using the same technique as a standard endoscope. The tip of the enteroscope is hooked on a fold in the bowel to stabilize it and the

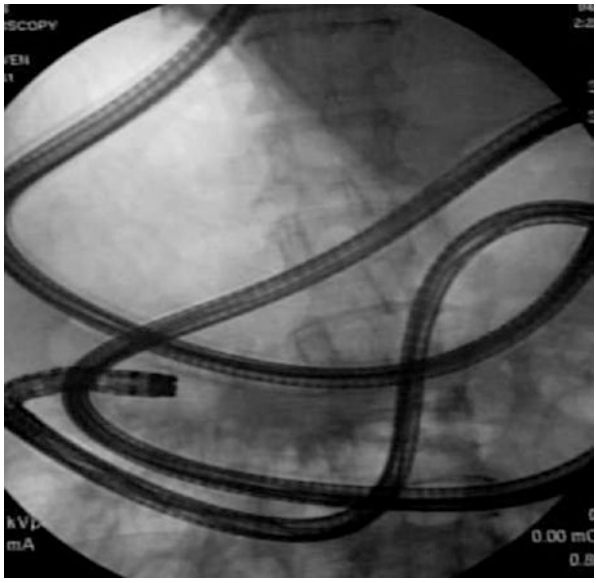

Fig. 3.1 Fluoroscopic image of single balloon enteroscopy

overtube is then advanced over the enteroscope. The balloon is inflated and both the enteroscope and overtube are withdrawn together. The balloon is deflated and the enteroscope is then advanced as far as possible at which point the process is repeated [62]. This results in pleating of the bowel over the overtube and subsequent shortening of the bowel. The combination of anterograde and retrograde enteroscopy can potentially allow for complete evaluation of the small bowel. Single balloon enteroscopy is a safe procedure with <1% risk of perforation during diagnostic procedures [62].

Double Balloon

Double balloon enteroscopy is similar to single balloon enteroscopy. The primary difference is that the enteroscope has a distal balloon in addition to the overtube balloon. The enteroscope is advanced as far as possible and the balloon is inflated to anchor its position [56]. The overtube is then advanced towards the end of the enteroscope at which point the overtube balloon is inflated and both enteroscope and overtube are withdrawn together pleating the bowel in an accordion like fashion over the overtube. The enteroscope balloon is deflated and the process is repeated. Double balloon enteroscopy allows for complete evaluation of the jejunum and ileum [56]. It is typically done in an antegrade fashion but can be done retrograde via the rectum. Diagnostic yields for obscure GI bleeding range from 40% to 80% [56]. Perforation is rare but is more common in patients who have had prior bowel surgery. Pancreatitis has been reported as a complication of double balloon enteroscopy as well [56].

Spiral Enteroscopy

Spiral enteroscopy allows for antegrade evaluation of the small bowel. It involves an overtube with a soft raised helix at its distal end. The enteroscope is manually turned in a clockwise manner to cause pleating of the small bowel on the enteroscope [63]. It has a shorter examination time in comparison to double-balloon and single-balloon enteroscopy as well as more stability during withdrawal but it requires two operators [64]. Motorized spiral enteroscopy have recently been developed that would allow for single operator use [65]. The drive motor is located in the endoscope handle and is activated by foot pedals, which controls the direction and speed of rotation of a coupler located in the middle of the endoscope's insertion tube [66]. Studies have shown that motorized spiral enteroscopy have short procedural durations and high depth of maximum insertion while maintaining a high diagnostic and therapeutic efficacy [67].

Type	Overtube	Depth of Insertion	Procedure time	Completion Rate*	Diagnostic Yield
Capsule	No	Reaches cecum 85% of the time [68]	480 min [68]	51.2–94.2% [69–71]	48–60.9% [69, 72]
Push	Can be with or without [73]	46–80 cm beyond the ligament of Treitz with overtube [44, 57, 60, 74–80]	30 min [60, 74, 75]	0%	15–80% [81, 82]
Single balloon	Yes	Antegrade: 133–270 cm Retrograde: 73–199 cm [83–87]	53–69 min [86, 88]	0–24% [83, 89–91]	41–65% [83–87, 89–93]
Double balloon	Yes	Antegrade: 220–360 cm Retrograde: 124–183 [94–98]	73–123 min [94–98]	92% [95, 97–103]	40–80% [88–92, 104]
Spiral	Yes	175–262 cm (anterograde or retrograde) [105–107]	34–37 min [105–107]	8–92.6% [103, 108]	12–75% [64, 83–87, 89–93, 105–107]

*Total small bowel visualization

Intraoperative Enteroscopy

Intraoperative enteroscopy involves the insertion of an endoscope through an enterotomy site, orally, or rectally during surgery [109, 110]. The surgeon telescopes the bowel over the endoscope, allowing for visualization of the entire length of the small bowel in more than 90% of patients. The diagnostic yield has been reported to be between 60% and 88% with rates of recurrent bleeding of 13–60% [2]. There can, however, be associated morbidity and mortality. Complications from intraoperative enteroscopy including serosal tears, avulsion of the superior mesenteric vein, congestive heart failure, azotemia, and prolonged ileus have been reported [110]. A large, multidisciplinary study looking at intraoperative enteroscopy for patients who had bleeding or anemia had a diagnostic yield of 69%. Segmental resection was performed in 90% of these patients with a symptom recurrence rate of 20%. There were no serious complications reported [111].

Technical Aspects

Endoscope technology has seen significant advances in recent years. Available endoscopes in the United States have been designed with improved resolution and magnification compared to earlier models, thus allowing for the ability to distinguish submillimeter closely approximated lesions. Upper endoscopes generally have outer diameters of 9.2–10.8 mm with slimmer 5.8 mm diameter endoscopes

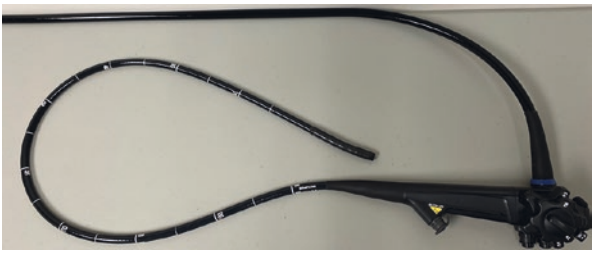

Fig. 3.2 Olympus GIF 190 upper endoscope

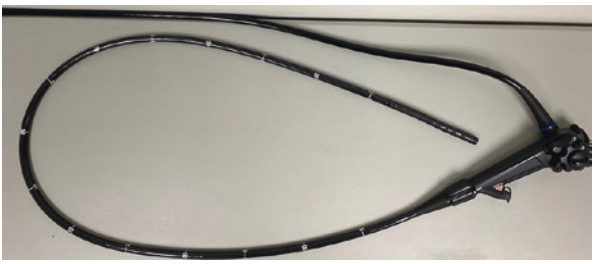

Fig. 3.3 Olympus CF 190 colonoscope

available for specific clinical situations such as esophageal strictures. Working lengths range from 1030 mm to 1100 mm allowing for intubation of the third portion of the duodenum (Fig. 3.2).

Available colonoscopes have outer diameters ranging from 9.5 mm for pediatric colonoscopes to 13.2 mm for adult colonoscopes depending on the manufacturer. Field of vision is generally 140 degrees up to 170 degrees for some colonoscopes [112] (Fig. 3.3).

A pixel is defined as a tiny area of illumination on a display screen. Standard Resolution (SD) is defined as a 4:3 (width: height) aspect ratio with a 640 × 480 pixel lines resulting in over 300,000 pixels to produce the image. Modern endoscopes allow for high definition (HD) imaging which produces increased image detail and thus the ability to discern more subtle mucosal lesions. HD endoscope systems allow for 1080 × 1024 up to 1920 × 1080 pixel format. In addition to high definition, many endoscopes have variable degrees of magnification as well as a near focus mode to improve detection of subtle lesions [112].

Endoscopes have left/right and up/down controls which allow for angulation of the tip (Fig. 3.4). A working channel allows for the use of various instruments such as biopsy forceps, snares, and coagulation devices to be passed through the endoscope (Fig. 3.5). Water irrigation and suction are also available to help clear visual fields of fecal residue or blood (Fig. 3.6). Variable stiffness colonoscopes allow for adjustment of the stiffness of the colonoscope to reduce looping [113] (Fig. 3.7).

Looping during colonoscopy most commonly occurs in the sigmoid colon and transverse colon, which results in paradoxical retrograde or static movement of the colonoscope relative to the bowel during antegrade intubation of the bowel. Looping is often associated with “redundant” colons and can reduce cecal intubation rates. Cecal intubation rates for endoscopists are a quality measure and should be at least 90–95% [114]. Risk factors for failure to reach the cecum include poor bowel

Fig. 3.4 Colonoscope control knobs

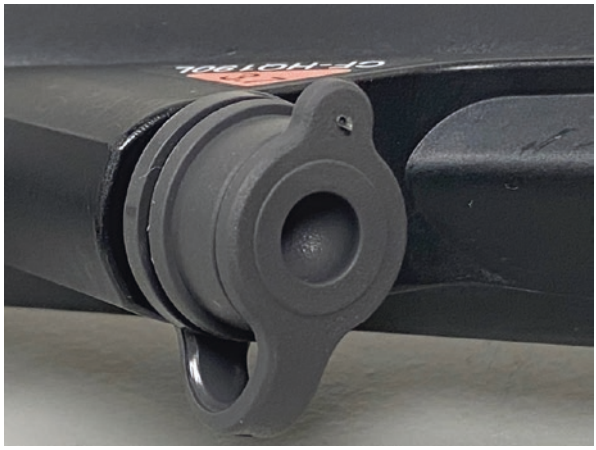

Fig. 3.5 Working channel cap

Fig. 3.6 Colonoscope tip with suction, irrigation, and biopsy channels

Fig. 3.7 Variable stiffness control

preparation and female sex. Women have longer colons relative to men, increasing the risk of looping during colonoscopy [115]. Once the cecum has been reached, the colonoscope is slowly withdrawn using maneuvers that allow for careful inspection of the mucosa and haustral folds. The colonoscope is retroflexed in the rectum by bending backwards on itself to inspect the distal rectum. A similar maneuver is used in upper endoscopy to look back up at the cardia of the stomach, which is not well seen upon entering the stomach from the esophagus if only a forward view is utilized [116].

Endoscopic technology that enhances visualization of the mucosa and microvasculature compared to white light endoscopy has also been developed. Narrow Band Imaging utilizes an electronically activated filter allowing only blue and green light [117], which is absorbed by hemoglobin thus making blood and vascular structures dark and enhancing differences between the mucosa and the surrounding vasculature [118]. This technology has improved the detection of flat or carpet-like polyps and the ability to differentiate neoplastic from non-neoplastic tissue [119].

Endoscopies are not without risks. Preprocedural complications that arise from preparation for an endoscopy include respiratory distress or arrest from sedation, possibly with oxygen saturation dropping below 80% [120] as well as potential medication allergic reactions and side effects, such as cardiorespiratory complications from using diazepam (Valium) and midazolam (Versed) [121]. Midazolam is commonly used for conscious sedation and has been known to cause grand mal seizures [122]. Bowel preparations also come with a variety of potential complications, which include hypoglycemia in diabetic patients since the patient is required to be NPO for 6–8 hrs before the procedure and fluid and electrolyte imbalances can result from the preparations. Examples of electrolyte imbalances include hyperphosphatemia following a phosphate bowel preparation, especially in patients with renal failure [123], hypocalcemia [124], and hypovolemia. The use of topical anesthetic agents run the risk of disruption in pharyngeal motor function [125], angioneurotic edema, and in the case of using topical benzocaine, acute toxic methemoglobinemia [126].

Colonoscopies have a number of potential procedural complications. Perforation is estimated to occur in approximately 0.2% of diagnostic colonoscopies. One

retrospective review found that 64% of perforations are rectosigmoid and 13% are cecal [127]. Perforation may be due to direct mechanical trauma from force at the tip of the endoscope or pneumatic distension when intraluminal pressure exceeds 210 mmHg [128]. In therapeutic colonoscopy, there is deliberate mucosal injury when performing a polypectomy or biopsy, which may directly cause perforation. As a result, the site of perforation in a polypectomy is most commonly the site of the polyp. Hemorrhage, endocarditis [129], bacteremia [130], splenic injury [131], and vasovagal reactions are other risks of colonoscopies.

The most serious complications involving upper endoscopies are perforation and hemorrhage. Perforations during upper endoscopies occur at a rate of 0.02–0.2% [125]. The most common site for perforation is the distal third of the esophagus [132]. Angulation of the posterior wall of the stomach may make it difficult to navigate and the distal third of the esophagus is most likely to be inflamed or have a tumor. Other risks include infection, aspiration, Mallory-Weis tears [133], and cardiac dysrhythmia [134].

References

1. Gerson LB, Fidler JL, Cave DR, Leighton JA. ACG clinical guideline: diagnosis and management of small bowel bleeding. Am J Gastroenterol. 2015 Sep;110(9):1265.
2. Raju GS, Gerson L, Das A, Lewis B. American Gastroenterological Association (AGA) institute medical position statement on obscure gastrointestinal bleeding. Gastroenterology. 2007 Nov 1;133(5):1694–6.
3. Bull-Henry K, Al-Kawas FH. Evaluation of occult gastrointestinal bleeding. Am Fam Physician. 2013 Mar 15;87(6):430–6.
4. Hunt R, Quigley E, Abbas Z, et al. Coping with common gastrointestinal symptoms in the community: a global perspective on heartburn, constipation, bloating, and abdominal pain/discomfort May 2013. J Clin Gastroenterol. 2014 Aug 1;48(7):567–78.
5. Pasha SF, Leighton JA, Das A, et al. Double-balloon enteroscopy and capsule endoscopy have comparable diagnostic yield in small-bowel disease: a meta-analysis. Clin Gastroenterol Hepatol. 2008 Jun 1;6(6):671–6.
6. Liao Z, Gao R, Xu C, Li ZS. Indications and detection, completion, and retention rates of small-bowel capsule endoscopy: a systematic review. Gastrointest Endosc. 2010 Feb 1;71(2):280–6.
7. Early DS, Ben-Menachem T, Decker GA, Evans JA, Fanelli RD, Fisher DA, Fukami N, Hwang JH, Jain R, Jue TL, Khan KM. Appropriate use of GI endoscopy. Gastrointest Endosc. 2012 Jun 1;75(6):1127–31.
8. Ezoe Y, Muto M, Horimatsu T, et al. Magnifying narrow-band imaging versus magnifying white-light imaging for the differential diagnosis of gastric small depressive lesions: a prospective study. Gastrointest Endosc. 2010 Mar 1;71(3):477–84.
9. Lichtenstein DR, Cash BD, Davila R, et al. Role of endoscopy in the management of GERD. Gastrointest Endosc. 2007 Aug 1;66(2):219–24.
10. Levin B, Lieberman DA, McFarland B, Smith RA, Brooks D, Andrews KS, Dash C, Giardiello FM, Glick S, Levin TR, Pickhardt P. Screening and surveillance for the early detection of colorectal cancer and adenomatous polyps, 2008: a joint guideline from the American Cancer Society, the US multi-society task force on colorectal cancer, and the American College of Radiology. CA Cancer J Clin. 2008 May;58(3):130–60.

11. Chen YK, Gladden DR, Kestenbaum DJ, Collen MJ. Is there a role for upper gastrointestinal endoscopy in the evaluation of patients with occult blood-positive stool and negative colonoscopy? Am J Gastroenterol. 1993 Dec;1:88(12).
12. Geller AJ, Kolts BE, Achem SR, Wears R. The high frequency of upper gastrointestinal pathology in patients with fecal occult blood and colon polyps. Am J Gastroenterol. 1993 Aug;1:88(8).
13. Hsia PC, Al-Kawas FH. Yield of upper endoscopy in the evaluation of asymptomatic patients with Hemoccult--positive stool after a negative colonoscopy. Am J Gastroenterol. 1992 Nov;1:87(11).
14. Rockey DC, Cello JP. Evaluation of the gastrointestinal tract in patients with iron-deficiency anemia. N Engl J Med. 1993 Dec 2;329(23):1691–5.
15. Till SH, Grundman MJ. Lesson of the week: prevalence of concomitant disease in patients with iron deficiency anaemia. BMJ. 1997 Jan 18;314(7075):206.
16. Kepczyk MT, Kadakia CS. Prospective evaluation of gastrointestinal tract in patients with iron-deficiency anemia. Dig Dis Sci. 1995 Jun 1;40(6):1283–9.
17. Rex DK, Petrini JL, Baron TH, et al. Quality indicators for colonoscopy. Am J Gastroenterol. 2006 Apr;101(4):873.
18. Doubeni CA, Corley DA, Quinn VP, et al. Effectiveness of screening colonoscopy in reducing the risk of death from right and left colon cancer: a large community-based study. Gut. 2018 Feb 1;67(2):291–8.
19. Miyamoto H, Naoe H, Oda Y, et al. Impact of retroflexion in the right colon after repeated forward-view examinations. JGH Open. 2018 Dec;2(6):282–7.
20. Cohen J, Grunwald D, Grossberg LB, Sawhney MS. The effect of right colon retroflexion on adenoma detection: a systematic review and meta-analysis. J Clin Gastroenterol. 2017 Oct;51(9):818.
21. Clark BT, Rustagi T, Laine L. What level of bowel prep quality requires early repeat colonoscopy: systematic review and meta-analysis of the impact of preparation quality on adenoma detection rate. Am J Gastroenterol. 2014 Nov;109(11):1714.
22. Rex DK, Rahmani EY, Haseman JH, et al. Relative sensitivity of colonoscopy and barium enema for detection of colorectal cancer in clinical practice. Gastroenterology. 1997 Jan 1;112(1):17–23.
23. Freeny PC, Marks WM, Ryan JA, Bolen JW. Colorectal carcinoma evaluation with CT: preoperative staging and detection of postoperative recurrence. Radiology. 1986 Feb;158(2):347–53.
24. Ogunbiyi OA, Flanagan FL, Dehdashti F, et al. Detection of recurrent and metastatic colorectal cancer: comparison of positron emission tomography and computed tomography. Ann Surg Oncol. 1997 Dec 1;4(8):613–20.
25. Sun L, Wu H, Guan YS. Colonography by CT, MRI and PET/CT combined with conventional colonoscopy in colorectal cancer screening and staging. World J Gastroenterol: WJG. 2008 Feb 14;14(6):853.
26. Schreyer AG, Rath HC, Kikinis R, et al. Comparison of magnetic resonance imaging colonography with conventional colonoscopy for the assessment of intestinal inflammation in patients with inflammatory bowel disease: a feasibility study. Gut. 2005 Feb 1;54(2):250–6.
27. Tedesco FJ, Waye JD, Avella JR, Villalobos MM. Diagnostic implications of the spatial distribution of colonic mass lesions (polyps and cancers): a prospective colonoscopic study. Gastrointest Endosc. 1980 Aug 1;26(3):95–7.
28. Gumaste V, Sachar DB, Greenstein AJ. Benign and malignant colorectal strictures in ulcerative colitis. Gut. 1992 Jul 1;33(7):938–41.
29. Regula J, Rupinski M, Kraszewska E, et al. Colonoscopy in colorectal-cancer screening for detection of advanced neoplasia. N Engl J Med. 2006 Nov 2;355(18):1863–72.

30. Appleyard M, Fireman Z, Glukhovsky A, et al. A randomized trial comparing wireless capsule endoscopy with push enteroscopy for the detection of small-bowel lesions. Gastroenterology. 2000 Dec 1;119(6):1431–8.
31. Wang A, Banerjee S, Barth BA, et al. Wireless capsule endoscopy. Gastrointest Endosc. 2013 Dec 1;78(6):805–15.
32. Hartmann D, Schmidt H, Bolz G, et al. A prospective two-center study comparing wireless capsule endoscopy with intraoperative enteroscopy in patients with obscure GI bleeding. Gastrointest Endosc. 2005 Jun 1;61(7):826–32.
33. Pennazio M, Santucci R, Rondonotti E, et al. Outcome of patients with obscure gastrointestinal bleeding after capsule endoscopy: report of 100 consecutive cases. Gastroenterology. 2004 Mar 1;126(3):643–53.
34. Goenka MK, Majumder S, Kumar S, et al. Single center experience of capsule endoscopy in patients with obscure gastrointestinal bleeding. World J Gastroenterol: WJG. 2011 Feb 14;17(6):774.
35. Yamada A, Watabe H, Kobayashi Y, et al. Timing of capsule endoscopy influences the diagnosis and outcome in obscure-overt gastrointestinal bleeding. Hepato-Gastroenterology. 2012 May;59(115):676–9.
36. Hong SN, Kang SH, Jang HJ, Wallace MB. Recent advance in colon capsule endoscopy: What's new? Clin Endosc. 2018 Jul;51(4):334.
37. Triester SL, Leighton JA, Leontiadis GI, et al. A meta-analysis of the yield of capsule endoscopy compared to other diagnostic modalities in patients with obscure gastrointestinal bleeding. Am J Gastroenterol. 2005 Nov;100(11):2407.
38. Lewis BS, Swain P. Capsule endoscopy in the evaluation of patients with suspected small intestinal bleeding: results of a pilot study. Gastrointest Endosc. 2002 Sep 1;56(3):349–53.
39. Delvaux MM, Saurin JC, Gaudin JL, et al. Comparison of wireless endoscopic capsule and push-enteroscopy in patients with obscure occult/overt digestive bleeding: results of a prospective, blinded, multicenter trial. Gastrointest Endosc. 2002;55:5.
40. Van Gossum A. A prospective comparative study between push enteroscopy and wireless video capsule in patients with obscure digestive bleeding. Gastrointest Endosc. 2002;97:AB-88
41. Beejay UA, Haber GB, Rasul I, et al. A pilot trial comparing the diagnostic utility and reproduceability of given (R) diagnostic imaging system to conventional enteroscopy in the evaluation of chronic obscure gastrointestinal bleeding. Am J Gastroenterol. 2002;97(9S):S299.
42. Ell C, Remke S, May A, et al. The first prospective controlled trial comparing wireless capsule endoscopy with push enteroscopy in chronic gastrointestinal bleeding. Endoscopy. 2002 Sep;34(09):685–9.
43. Mylonaki M, Fritscher-Ravens A, Swain P. Wireless capsule endoscopy: a comparison with push enteroscopy in patients with gastroscopy and colonoscopy negative gastrointestinal bleeding. Gut. 2003 Aug 1;52(8):1122–6.
44. Adler DG, Knipschield M, Gostout C. A prospective comparison of capsule endoscopy and push enteroscopy in patients with GI bleeding of obscure origin. Gastrointest Endosc. 2004 Apr 1;59(4):492–8.
45. Mata A, Bordas JM, Feu F, et al. Wireless capsule endoscopy in patients with obscure gastrointestinal bleeding: a comparative study with push enteroscopy. Aliment Pharmacol Ther. 2004 Jul;20(2):189–94.
46. Mergener K, Schembre DB, Brandabur JJ, et al. Clinical utility of capsule endoscopy-a single center experience. Am J Gastroenterol. 2002;9(97):S299–300.
47. Scapa E, Jacob H, Lewkowicz S, et al. Initial experience of wireless-capsule endoscopy for evaluating occult gastrointestinal bleeding and suspected small bowel pathology. Am J Gastroenterol. 2002 Nov;97(11):2776.
48. Laine LA, Sahota A, Shah A. Does capsule endoscopy improve outcomes in obscure GI bleeding: randomized controlled trial of capsule endoscopy vs. dedicated small bowel radiography. Gastro Endosc. 2009 Apr 1;69(5):AB99.

49. Park JJ, Cheon JH, Kim HM, et al. Negative capsule endoscopy without subsequent enteroscopy does not predict lower long-term rebleeding rates in patients with obscure GI bleeding. Gastrointest Endosc. 2010 May 1;71(6):990–7.
50. Koulaouzidis A, Yung DE, Lam JH, et al. The use of small-bowel capsule endoscopy in iron-deficiency anemia alone; be aware of the young anemic patient. Scand J Gastroenterol. 2012 Sep 1;47(8–9):1094–100.
51. Lepileur L, Dray X, Antonietti M, et al. Factors associated with diagnosis of obscure gastrointestinal bleeding by video capsule enteroscopy. Clin Gastroenterol Hepatol. 2012 Dec 1;10(12):1376–80.
52. Koulaouzidis A, Rondonotti E, Giannakou A, Plevris JN. Diagnostic yield of small-bowel capsule endoscopy in patients with iron-deficiency anemia: a systematic review. Gastrointest Endosc. 2012 Nov 1;76(5):983–92.
53. De Leusse A, Vahedi K, Edery J, et al. Capsule endoscopy or push enteroscopy for first-line exploration of obscure gastrointestinal bleeding? Gastroenterology. 2007 Mar 1;132(3):855–62.
54. Min YW, Kim JS, Jeon SW, et al. Long-term outcome of capsule endoscopy in obscure gastrointestinal bleeding: a nationwide analysis. Endoscopy. 2014 Jan;46(01):59–65.
55. Cave DR, Fleischer DE, Leighton JA, et al. A multicenter randomized comparison of the Endocapsule and the Pillcam SB. Gastrointest Endosc. 2008 Sep 1;68(3):487–94.
56. Chauhan SS, Manfredi MA, Dayyeh BK, et al. Enteroscopy. Gastrointest Endosc. 2015 Dec 1;82(6):975–90.
57. Benz C, Jakobs R, Riemann JF. Do we need the overtube for push-enteroscopy? Endoscopy. 2001 Aug;33(08):658–61.
58. Taylor AC, Chen RY, Desmond PV. Use of an overtube for enteroscopy-does it increase depth of insertion? A prospective study of enteroscopy with and without an overtube. Endoscopy. 2001 Mar;33(03):227–30.
59. Zaman A, Katon R. Push enteroscopy for obscure GI bleeding yields a high incidence of proximal lesions within the reach of standard endoscopy. Gastrointest Endosc. 1997;45(4):AB103.
60. Foutch PG, Sawyer R, Sanowski RA. Push-enteroscopy for diagnosis of patients with gastrointestinal bleeding of obscure origin. Gastrointest Endosc. 1990 Jul 1;36(4):337–41.
61. Lewis BS, Wenger JS, Waye JD. Small bowel enteroscopy and intraoperative enteroscopy for obscure gastrointestinal bleeding. Am J Gastroenterol. 1991 Feb 1;86(2)
62. Manno M, Barbera C, Bertani H, et al. Single balloon enteroscopy: technical aspects and clinical applications. World J Gastrointest Endosc. 2012 Feb 16;4(2):28.
63. Akerman PA. Spiral enteroscopy versus double-balloon enteroscopy: choosing the right tool for the job. Gastrointest Endosc. 2013 Feb 1;77(2):252–4.
64. Baniya R, Upadhaya S, Subedi SC, Khan J, Sharma P, Mohammed TS, Bachuwa G, Jamil LH. Balloon enteroscopy versus spiral enteroscopy for small-bowel disorders: a systematic review and meta-analysis. Gastrointest Endosc. 2017 Dec 1;86(6):997–1005.
65. Mans L, Arvanitakis M, Neuhaus H, Devière J. Motorized spiral enteroscopy for occult bleeding. Dig Dis. 2018;36:325–7.
66. Neuhaus H, Beyna T, Schneider M, Devière J. Novel motorized spiral enteroscopy: first clinical case. Gastrointest Endosc. 2016 May 1;83(5):AB637.
67. Beyna T, Arvanitakis M, Schneider M, Gerges C, Böing D, Devière J, Neuhaus H. Motorised spiral enteroscopy: first prospective clinical feasibility study. Gut. 2021;70(2):261–7.
68. Swain P, Fritscher-Ravens A. Role of video endoscopy in managing small bowel disease. Gut. 2004 Dec 1;53(12):1866–75.
69. He C, Lai H, Huang J, Li A, Xue Q, Liu S, Ren Y. Su1274 comparing diagnostic yield of preoperative capsule endoscopy with double balloon Enteroscopy in patients with overt small intestinal bleeding. Gastrointest Endosc. 2018 Jun 1;87(6):AB307.
70. Vuik FE, Moen S, Nieuwenburg SA, Kuipers EJ, Spaander MC. Applicability of colon capsule endoscopy as pan-endoscopy: from bowel preparation, transit times, and completion rate to rating times and patient acceptance. Endoscopy. 2020 Apr;52(S 01):OP69.

71. Luo YY, Pan J, Chen YZ, Jiang X, Zou WB, Qian YY, Zhou W, Liu X, Li ZS, Liao Z. Magnetic steering of capsule endoscopy improves small bowel capsule endoscopy completion rate. Dig Dis Sci. 2019 Jul 15;64(7):1908–15.
72. Cavallaro F, Tontini GE, Bozzi R. Feasibility, safety and diagnostic yield of Omom CE, a new capsule endoscopy system: the first experience in Caucasian patients. Gastroenterol Pancreatol Liver Disord. 2017;4(7):1–4.
73. Chauhan SS, Manfredi MA, Dayyeh BK, Enestvedt BK, Fujii-Lau LL, Komanduri S, Konda V, Maple JT, Murad FM, Pannala R, Thosani NC. Enteroscopy. Gastrointestinal endoscopy. 2015;82(6):975–90.
74. Benz C, Jakobs R, Riemann JF. Does the insertion depth in push enteroscopy depend on the working length of the enteroscope? Endoscopy. 2002 Jul;34(07):543–5.
75. Sharma BC, Bhasin DK, Makharia G, Chhabra M, Vaiphei K, Bhatti HS, Singh K. Diagnostic value of push-type enteroscopy: a report from India. Am J Gastroenterol. 2000 Jan 1;95(1):137–40.
76. Taylor AC, Buttigieg RJ, McDonald IG, Desmond PV. Prospective assessment of the diagnostic and therapeutic impact of small-bowel push enteroscopy. Endoscopy. 2003 Nov;35(11):951–6.
77. Ell C, Remke S, May A, Helou L, Henrich R, Mayer G. The first prospective controlled trial comparing wireless capsule endoscopy with push enteroscopy in chronic gastrointestinal bleeding. Endoscopy. 2002 Sep;34(09):685–9.
78. Mata A, Bordas JM, Feu F, Gines A, Pellise M, Fernández-Esparrach G, Balaguer F, Pique JM, Llach J. Wireless capsule endoscopy in patients with obscure gastrointestinal bleeding: a comparative study with push enteroscopy. Aliment Pharmacol Ther. 2004 Jul;20(2):189–94.
79. Chong J, Tagle M, Barkin JS, Reiner DK. Small bowel push-type fiberoptic enteroscopy for patients with occult gastrointestinal bleeding or suspected small bowel pathology. Am J Gastroenterol (Springer Nature). 1994 Dec 1;89(12).
80. May A, Nachbar L, Schneider M, Ell C. Prospective comparison of push enteroscopy and push-and-pull enteroscopy in patients with suspected small-bowel bleeding. Am J Gastroenterol. 2006 Sep 1;101(9):2016–24.
81. Nakamura M, Niwa Y, Ohmiya N, Miyahara R, Ohashi A, Itoh A, Hirooka Y, Goto H. Preliminary comparison of capsule endoscopy and double-balloon enteroscopy in patients with suspected small-bowel bleeding. Endoscopy. 2006 Jan;38(01):59–66.
82. Hayat M, Axon AT, O'Mahony S. Diagnostic yield and effect on clinical outcomes of push enteroscopy in suspected small-bowel bleeding. Endoscopy. 2000 May;32(05):369–72.
83. Tsujikawa T, Saitoh Y, Andoh A, Imaeda H, Hata K, Minematsu H, Senoh K, Hayafuji K, Ogawa A, Nakahara T, Sasaki M. Novel single-balloon enteroscopy for diagnosis and treatment of the small intestine: preliminary experiences. Endoscopy. 2008 Jan;40(01):11–5.
84. Upchurch BR, Sanaka MR, Lopez AR, Vargo JJ. The clinical utility of single-balloon enteroscopy: a single-center experience of 172 procedures. Gastrointest Endosc. 2010 Jun 1;71(7):1218–23.
85. Ramchandani M, Reddy DN, Gupta R, Lakhtakia S, Tandan M, Rao GV, Darisetty S. Diagnostic yield and therapeutic impact of single-balloon enteroscopy: series of 106 cases. J Gastroenterol Hepatol. 2009 Oct;24(10):1631–8.
86. Khashab MA, Lennon AM, Dunbar KB, Singh VK, Chandrasekhara V, Giday S, Canto MI, Buscaglia JM, Kapoor S, Shin EJ, Kalloo AN. A comparative evaluation of single-balloon enteroscopy and spiral enteroscopy for patients with mid-gut disorders. Gastrointest Endosc. 2010 Oct 1;72(4):766–72.
87. Domagk D, Mensink P, Aktas H, Lenz P, Meister T, Luegering A, Ullerich H, Aabakken L, Heinecke A, Domschke W, Kuipers E. Single-vs. double-balloon enteroscopy in small-bowel diagnostics: a randomized multicenter trial. Endoscopy. 2011 Jun;43(06):472–6.
88. Lenz P, Domagk D. Double-vs. single-balloon vs. spiral enteroscopy. Best Pract Res Clin Gastroenterol. 2012 Jun 1;26(3):303–13.

89. May A, Färber M, Aschmoneit I, Pohl J, Manner H, Lotterer E, Möschler O, Kunz J, Gossner L, Mönkemüller K, Ell C. Prospective multicenter trial comparing push-and-pull enteroscopy with the single-and double-balloon techniques in patients with small-bowel disorders. Am J Gastroenterol. 2010 Mar 1;105(3):575–81.
90. Kawamura T, Yasuda K, Tanaka K, Uno K, Ueda M, Sanada K, Nakajima M. Clinical evaluation of a newly developed single-balloon enteroscope. Gastrointest Endosc. 2008 Dec 1;68(6):1112–6.
91. Takano N, Yamada A, Watabe H, Togo G, Yamaji Y, Yoshida H, Kawabe T, Omata M, Koike K. Single-balloon versus double-balloon endoscopy for achieving total enteroscopy: a randomized, controlled trial. Gastrointest Endosc. 2011 Apr 1;73(4):734–9.
92. Aktas H, de Ridder L, Haringsma J, Kuipers EJ, Mensink PB. Complications of single-balloon enteroscopy: a prospective evaluation of 166 procedures. Endoscopy. 2010 May;42(05):365–8.
93. Frantz DJ, Dellon ES, Grimm IS, Morgan DR. Single-balloon enteroscopy: results from an initial experience at a US tertiary-care center. Gastrointest Endosc. 2010 Aug 1;72(2):422–6.
94. Heine GD, Hadithi M, Groenen MJ, Kuipers EJ, Jacobs MA, Mulder CJ. Double-balloon enteroscopy: indications, diagnostic yield, and complications in a series of 275 patients with suspected small-bowel disease. Endoscopy. 2006 Jan;38(01):42–8.
95. Yamamoto H, Kita H, Sunada K, Hayashi Y, Sato H, Yano T, Iwamoto M, Sekine Y, Miyata T, Kuno A, Ajibe H. Clinical outcomes of double-balloon endoscopy for the diagnosis and treatment of small-intestinal diseases. Clin Gastroenterol Hepatol. 2004 Nov 1;2(11):1010–6.
96. Di Caro S, May A, Heine DG, Fini L, Landi B, Petruzziello L, Cellier C, Mulder CJ, Costamagna G, Ell C, Gasbarrini A. The European experience with double-balloon enteroscopy: indications, methodology, safety, and clinical impact. Gastrointest Endosc. 2005 Oct 1;62(4):545–50.
97. Gross SA, Stark ME. Initial experience with double-balloon enteroscopy at a US center. Gastrointest Endosc. 2008 May 1;67(6):890–7.
98. Mehdizadeh S, Ross A, Gerson L, Leighton J, Chen A, Schembre D, Chen G, Semrad C, Kamal A, Harrison EM, Binmoeller K. What is the learning curve associated with double-balloon enteroscopy? Technical details and early experience in 6 US tertiary care centers. Gastrointest Endosc. 2006 Nov 1;64(5):740–50.
99. Yamamoto H, Sekine Y, Sato Y, Higashizawa T, Miyata T, Iino S, Ido K, Sugano K. Total enteroscopy with a nonsurgical steerable double-balloon method. Gastrointest Endosc. 2001 Feb 1;53(2):216–20.
100. Nakase H, Matsuura M, Mikami S, Chiba T. Diagnosis and treatment of obscure GI bleeding with double balloon endoscopy. Gastrointest Endosc. 2007 Sep 1;66(3):S78–81.
101. May A, Nachbar L, Schneider M, Neumann M, Ell C. Push-and-pull enteroscopy using the double-balloon technique: method of assessing depth of insertion and training of the enteroscopy technique using the Erlangen Endo-trainer. Endoscopy. 2005 Jan;37(01):66–70.
102. Möschler O, May A, Müller MK, Ell C. Null for the German DBE study group. Complications in and performance of double-balloon enteroscopy (DBE): results from a large prospective DBE database in Germany. Endoscopy. 2011 Jun;43(06):484–9.
103. Messer I, May A, Manner H, Ell C. Prospective, randomized, single-center trial comparing double-balloon enteroscopy and spiral enteroscopy in patients with suspected small-bowel disorders. Gastrointest Endosc. 2013 Feb 1;77(2):241–9.
104. Sanaka MR, Navaneethan U, Kosuru B, Yerneni H, Lopez R, Vargo JJ. Antegrade is more effective than retrograde enteroscopy for evaluation and management of suspected small-bowel disease. Clin Gastroenterol Hepatol. 2012 Aug 1;10(8):910–6.
105. Akerman PA, Agrawal D, Chen W, Cantero D, Avila J, Pangtay J. Spiral enteroscopy: a novel method of enteroscopy by using the endo-ease discovery SB overtube and a pediatric colonoscope. Gastrointest Endosc. 2009 Feb 1;69(2):327–32.

106. Buscaglia JM, Dunbar KB, Okolo PI, Judah J, Akerman PA, Cantero D, Draganov PV. The spiral enteroscopy training initiative: results of a prospective study evaluating the discovery SB overtube device during small bowel enteroscopy (with video). Endoscopy. 2009 Mar;41(03):194–9.
107. Judah JR, Draganov PV, Lam Y, Hou W, Buscaglia JM. Spiral enteroscopy is safe and effective for an elderly United States population of patients with numerous comorbidities. Clin Gastroenterol Hepatol. 2010 Jul 1;8(7):572–6.
108. Judah JR, Collins D, Gaidos JK, Hou W, Forsmark CE, Draganov PV. Prospective evaluation of gastroenterologist-guided, nurse-administered standard sedation for spiral deep small bowel enteroscopy. Dig Dis Sci. 2010 Sep 1;55(9):2584–91.
109. Zaman A, Sheppard B, Katon RM. Total peroral intraoperative enteroscopy for obscure GI bleeding using a dedicated push enteroscope: diagnostic yield and patient outcome. Gastrointest Endosc. 1999 Oct 1;50(4):506–10.
110. Ress AM, Benacci JC, Sarr MG. Efficacy of intraoperative enteroscopy in diagnosis and prevention of recurrent, occult gastrointestinal bleeding. Am J Surg. 1992 Jan 1;163(1):94–9.
111. Green J, Schlieve CR, Friedrich AK, et al. Approach to the diagnostic workup and management of small bowel lesions at a tertiary care center. J Gastrointest Surg. 2018 Jun 1;22(6):1034–42.
112. Bhat YM, Dayyeh BK, Chauhan SS, et al. High-definition and high-magnification endoscopes. Gastrointest Endosc. 2014 Dec 1;80(6):919–27.
113. Xie Q, Chen B, Liu L, Gan H. Does the variable-stiffness colonoscope makes colonoscopy easier? A meta-analysis of the efficacy of the variable stiffness colonoscope compared with the standard adult colonoscope. BMC Gastroenterol. 2012 Dec;12(1):151.
114. Hoff G, Holme Ø, Bretthauer M, et al. Cecum intubation rate as quality indicator in clinical versus screening colonoscopy. Endosc Int Open. 2017 Jun;5(06):E489–95.
115. Witte TN, Enns R. The difficult colonoscopy. Can J Gastroenterol Hepatol. 2007;21(8):487–90.
116. Ahlawat R, Ross AB. Esophagogastroduodenoscopy. StatPearls [Internet] 2018 Oct 27. StatPearls Publishing.
117. Gono K, Obi T, Yamaguchi M, et al. Appearance of enhanced tissue features in narrow-band endoscopic imaging. J Biomed Opt. 2004 May;9(3):568–78.
118. Singh R, Mei SC, Sethi S. Advanced endoscopic imaging in Barrett's oesophagus: a review on current practice. World J Gastroenterol: WJG. 2011 Oct 14;17(38):4271.
119. Chiu HM, Chang CY, Chen CC, et al. A prospective comparative study of narrow-band imaging, chromoendoscopy, and conventional colonoscopy in the diagnosis of colorectal neoplasia. Gut. 2007 Mar 1;56(3):373–9.
120. Hart R, Classen M. Complications of diagnostic gastrointestinal endoscopy. Endoscopy. 1990 Sep;22(05):229–33.
121. Arrowsmith JB, Gerstman BB, Fleischer DE, Benjamin SB. Results from the American Society for Gastrointestinal Endoscopy/US Food and Drug Administration collaborative study on complication rates and drug use during gastrointestinal endoscopy. Gastrointest Endosc. 1991 Jul 1;37(4):421–7.
122. Alexander JA, Smith BJ. Midazolam sedation for percutaneous liver biopsy. Dig Dis Sci. 1993 Dec 1;38(12):2209–11.
123. Fine A, Patterson J. Severe hyperphosphatemia following phosphate administration for bowel preparation in patients with renal failure: two cases and a review of the literature. Am J Kidney Dis. 1997 Jan 1;29(1):103–5.
124. Oliveira L, Wexner SD, Daniel N, DeMarta D, Weiss EG, Nogueras JJ, Bernstein M. Mechanical bowel preparation for elective colorectal surgery. Dis Colon Rectum. 1997 May 1;40(5):585–91.
125. Zubarik R, Eisen G, Mastropietro C, Lopez J, Carroll J, Benjamin S, Fleischer DE. Prospective analysis of complications 30 days after outpatient upper endoscopy. Am J Gastroenterol. 1999;94(6):1539–45.

126. Brown CM, Levy SA, Susann PW. Methemoglobinemia: life-threatening complication of endoscopy premedication. Am J Gastroenterol. 1994;89(7):1108–9.
127. Gedebou TM, Wong RA, Rappaport WD, Jaffe P, Kahsai D, Hunter GC. Clinical presentation and management of iatrogenic colon perforations. Am J Surg. 1996 Nov 1;172(5):454–8.
128. BURT AV. Pneumatic rupture of the intestinal canal: with experimental data showing the mechanism of perforation and the pressure required. Arch Surg. 1931 Jun 1;22(6):875–902.
129. Hall C, Dorricott NJ, Donovan IA, Neoptolemos JP. Colon perforation during colonoscopy: surgical versus conservative management. Br J Surg. 1991 May;78(5):542–4.
130. Low DE, Shoenut JP, Kennedy JK, Sharma GP, Harding GK, Den Boer B, Micflikier AB. Prospective assessment of risk of bacteremia with colonoscopy and polypectomy. Dig Dis Sci. 1987 Nov 1;32(11):1239–43.
131. Taylor FC, Frankl HD, Riemer KD. Late presentation of splenic trauma after routine colonoscopy. Am J Gastroenterol. 1989 Apr;1:84(4).
132. Berry BE, Ochsner JL. Perforation of the esophagus: a 30 year review. J Thorac Cardiovasc Surg. 1973 Jan 1;65(1):1–7.
133. Penston JG, Boyd EJ, Wormsley KG. Mallory-Weiss tears occurring during endoscopy: a report of seven cases. Endoscopy. 1992 May;24(04):262–5.
134. Levy N, Abinader E. Continuous electrocardiographic monitoring with Holter electrocardiocorder throughout all stages of gastroscopy. Am J Dig Dis. 1977 Dec 1;22(12):1091–6.