Overview of colonoscopy in adults

AUTHORS: Linda Lee, MD, John R Saltzman, MD, FACP, FACG, FASGE, AGAF
SECTION EDITOR: Douglas G Adler, MD, FACG, AGAF, FASGE
DEPUTY EDITOR: Shilpa Grover, MD, MPH, AGAF

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INTRODUCTION

Colonoscopy is used both diagnostically and therapeutically and permits examination and treatment of the rectum, colon, and a portion of the terminal ileum. Performance of a high-quality colonoscopy examination requires understanding and mastery of cognitive and technical skills. A joint American Society of Gastrointestinal Endoscopy/American College of Gastroenterology Taskforce on Quality in Endoscopy advocated the following quality indicators before, during, and after colonoscopy [1,2] (see 'Quality indicators' below):

- Preprocedure – Attention must be paid to the general issues of timely scheduling, appropriate patient preparation, targeted history and physical examination, evaluation of bleeding risk, assessment for appropriate sedation, and team pause before commencing sedation. It is also important to understand appropriate indications and recommended surveillance intervals based upon the patient's risk factors (eg, family history of colorectal cancer, prior adenomatous polyps, hereditary colon cancer syndrome, or inflammatory bowel disease). Finally, obtaining informed consent with a detailed explanation of the risks associated with colonoscopy is essential.

- Intraprocedure – Performing a high-quality examination requires careful visualization of the entire colonic mucosa. Metrics such as cecal intubation rates, withdrawal times, and adenoma detection rates serve as surrogate, though imperfect, markers of careful visualization. In addition, a high-quality examination requires appropriate tissue acquisition (eg, surveillance biopsies in inflammatory bowel disease) and endoscopic

removal of all polyps less than 2 cm. Removal of polyps larger than 2 cm may require special endoscopic skills.

- Postprocedure – There must be immediate, complete, and accurate documentation (both written and photographic) of preparation quality and findings, as well as explicit recommendations for follow-up. Tissue samples taken during colonoscopy must be documented. Pathology results should be reviewed with results and recommendations communicated to the patient and referring providers. Finally, there should be a system for tracking adverse events.

This topic will review factors associated with performing a colonoscopy including indications, patient preparation, technical aspects, and adverse events. Issues related to colon cancer screening recommendations, bowel preparations for colonoscopy, procedural sedation, and the management of antiplatelet or anticoagulant medications in patients undergoing endoscopy, and special considerations for colonoscopy in the setting of the COVID-19 pandemic are discussed separately. (See "Screening for colorectal cancer: Strategies in patients at average risk" and "Screening for colorectal cancer in patients with a family history of colorectal cancer or advanced polyp" and "Overview of colon polyps" and "Bowel preparation before colonoscopy in adults" and "Gastrointestinal endoscopy in adults: Procedural sedation administered by endoscopists" and "Management of antiplatelet agents in patients undergoing endoscopic procedures" and "Management of anticoagulants in patients undergoing endoscopic procedures" and "COVID-19: Issues related to gastrointestinal disease in adults", section on 'Implications for endoscopy'.)

PATIENT SELECTION

Patient selection for colonoscopy focuses on the indication for the procedure and patient comorbidities to enable proper risk stratification.

The American Society for Gastrointestinal Endoscopy has outlined general principles for the appropriate use of endoscopy [3]. Endoscopy may be appropriate if any of the following criteria are fulfilled:

- The results are likely to change the patient's management
- Empiric treatment of a benign disease has failed
- A therapeutic intervention is anticipated
- It is being used as an alternative to radiologic evaluation

On the other hand, endoscopy is not indicated when the results are not expected to impact management or for the follow-up of benign diseases that have healed, unless surveillance of a premalignant condition is appropriate.

Indications — Colonoscopy is performed for both diagnostic and therapeutic indications (table 1) [2]. Diagnostic indications include screening or surveillance for colon cancer, evaluating signs and symptoms suggestive of possible colonic or distal small bowel disease, assessing a response to treatment in patients with known colonic disease (eg, inflammatory bowel disease), and evaluating abnormalities found on imaging studies. Therapeutic indications include stricture dilation, stent placement, colonic decompression, and foreign body removal. In addition, lesions found during diagnostic procedures may require therapeutic intervention (eg, polypectomy or treatment of a bleeding lesion). (See 'Diagnostic and therapeutic maneuvers' below.)

- **Screening or surveillance for colon cancer** – Colonoscopy is considered the gold standard for colon cancer screening and surveillance. The age at which screening starts will depend upon the patient's medical and family history. If polyps are found during colonoscopy, they should be removed endoscopically if at all possible. (See "Screening for colorectal cancer: Strategies in patients at average risk" and "Screening for colorectal cancer in patients with a family history of colorectal cancer or advanced polyp" and "Surveillance and management of dysplasia in patients with inflammatory bowel disease" and 'Polypectomy' below.)

  The interval for repeat screening or surveillance will again depend upon the patient's medical and family history, as well as the findings on prior colonoscopies. (See "Overview of colon polyps" and "Post-treatment surveillance after colorectal cancer treatment".)

- **Lower gastrointestinal bleeding** – Patients with active or recent hematochezia, positive fecal occult blood, or melena after an upper gastrointestinal source has been excluded should undergo colonoscopy for diagnosis and, if a source of bleeding is identified, potentially endoscopic therapy. In addition, unexplained iron deficiency anemia should be evaluated via colonoscopy, as colon cancer is an important cause of iron deficiency anemia in adults. (See "Approach to acute lower gastrointestinal bleeding in adults" and "Causes and diagnosis of iron deficiency and iron deficiency anemia in adults", section on 'Search for source of blood and iron loss'.)

- **Lower gastrointestinal symptoms** – Colonoscopy should be performed in patients with chronic, clinically significant diarrhea without an explanation. Random colon biopsies should be obtained throughout the colon to rule out microscopic colitis. Colonoscopy is

generally not indicated as part of the evaluation for chronic constipation unless warning signs are present (eg, anemia, weight loss) or the patient has not undergone recommended screening or surveillance. Whether to perform a colonoscopy in a patient with chronic abdominal pain will depend upon patient risk factors (eg, age >45 years), the character and location of the pain, and associated signs and symptoms. (See "Etiology and evaluation of chronic constipation in adults", section on 'Endoscopy' and "Evaluation of the adult with abdominal pain".)

- **Abnormal imaging** – Colonoscopy is indicated to evaluate abnormalities detected on imaging studies, including but not limited to barium enema, abdominal computed tomography (CT), positron emission tomography CT, or magnetic resonance imaging. Radiographic findings requiring colonoscopic evaluation include thickening of the wall of the colon or terminal ileum (image 1), mass lesions (figure 1), filling defects (image 2 and image 3), and strictures (image 4). In addition, colonoscopy may be indicated in patients with metastatic adenocarcinoma of unknown primary or who are found to have polyps on CT colonography (virtual colonoscopy), depending upon the size of the polyp (picture 1). (See "Overview of computed tomographic colonography", section on 'Indications' and "Overview of the classification and management of cancers of unknown primary site", section on 'Adenocarcinoma'.)

- **Evaluation for synchronous or metachronous cancer in patients with colon cancer** – Patients with colon cancer are at risk for synchronous cancer. As a result, patients with colon cancer require a complete examination of the colon. Ideally, this is done prior to surgery, though in some patients complete preoperative colonoscopy will not be possible (eg, due to inability to pass the colonoscope beyond an obstructing tumor). Such patients require colonoscopy soon after resection of the primary tumor. (See "Post-treatment surveillance after colorectal cancer treatment", section on 'Perioperative colonoscopy'.)

  Following treatment of the primary tumor, patients require routine surveillance to look for new polyps or metachronous cancer. Several expert groups have made recommendations regarding the timing and frequency of posttreatment endoscopic surveillance. (See "Post-treatment surveillance after colorectal cancer treatment", section on 'Postoperative endoscopic surveillance' and "Post-treatment surveillance after colorectal cancer treatment", section on 'Guidelines from major groups'.)

- **Intraoperative lesion localization** – Colonoscopy may be performed intraoperatively to identify a lesion identified on imaging or prior colonoscopy that is not apparent at surgery, such as a bleeding site or small mass. More commonly, colonoscopy is used to mark lesions identified during the procedure (picture 2A-C). In such cases, lesions are

typically tattooed a few centimeters distal to the lesion. Exactly where the tattoo was performed in relationship to the lesion must be clearly documented and communicated to the surgeon. (See "Tattooing and other methods for localizing gastrointestinal lesions".)

- **Inflammatory bowel disease** – Colonoscopy is often performed in patients with inflammatory bowel disease to assess the extent and/or severity of disease and to assess treatment responses. In addition, patients with colitis require routine surveillance for colonic dysplasia. (See "Endoscopic diagnosis of inflammatory bowel disease in adults" and "Surveillance and management of dysplasia in patients with inflammatory bowel disease".)

- **Evaluation of the terminal ileum** – In patients with suspected disease involving the distal small bowel, such as Crohn disease, carcinoid, and bleeding, colonoscopy can be used to evaluate the terminal ileum.

- **Therapeutic indications** – Therapeutic indications for colonoscopy include hemostasis, foreign body removal, decompression of sigmoid volvulus or colonic pseudoobstruction, balloon dilation of strictures, palliative treatment of bleeding or stenosed neoplasms, and percutaneous endoscopic cecostomy tube placement. (See "Rectal foreign bodies" and "Sigmoid volvulus" and "Acute colonic pseudo-obstruction (Ogilvie's syndrome)" and "Management of anastomotic complications of colorectal surgery" and "Enteral stents for the management of malignant colorectal obstruction".)

Contraindications — Colonoscopy is contraindicated in the following situations:

- When the risks of the colonoscopy outweigh the expected benefits
- Consent cannot be obtained for a non-urgent procedure
- A perforation is known or suspected
- Documented acute diverticulitis

It is important that the expected benefits of colonoscopy be carefully weighed against the risks, particularly in older adults and patients with comorbid illnesses because these patients are at increased risk for serious adverse events from colonoscopy. (See 'Adverse events' below.)

If a patient cannot be adequately sedated despite a reasonable attempt at moderate procedural sedation, colonoscopy should be delayed until adequate sedation can be provided (eg, monitored anesthesia care or general anesthesia). Finally, a suspected poor preparation is a relative contraindication to colonoscopy. (See 'Patient preparation' below and "Gastrointestinal endoscopy in adults: Procedural sedation administered by endoscopists".)

Important considerations — Before the procedure, patients should be evaluated for factors that may affect the ability to perform a colonoscopy safely and successfully, including:

- Anatomic issues, such as recent colonic surgery, history of abdominal and/or pelvic surgeries, abdominal hernias, and presence of a colostomy
- Comorbidities that may increase the risks associated with sedation (see "Gastrointestinal endoscopy in adults: Procedural sedation administered by endoscopists", section on 'Presedation evaluation')
- Comorbidities that may impact the ability of an assistant to apply abdominal pressure and/or position the patient during colonoscopy
- Presence of an implanted cardiac defibrillator and some pacemakers that may require special management during application of electrocautery
- Chronic use of medications such as benzodiazepines or narcotics or cannabinoid use [4] that may increase a patient's tolerance to the effects of sedation or may affect the quality of the bowel preparation
- A history of difficult intubation by anesthesia

PATIENT PREPARATION

Diet — Patients need to consume a low-residue diet or clear liquids for at least one day prior to elective colonoscopy [5]. A low-residue diet is low in fiber, and patients should be instructed to avoid foods that are high in fiber such as fruits, vegetables, and whole grains (table 2). Clear liquids include water, clear broth, coffee or tea (without milk), ices, gelatin, and fruit juices such as apple, grapefruit, and lemonade. Liquids that are red can be mistaken for blood in the colon or can obscure mucosal details and should be avoided. One trial found that there was no significant difference in preparation quality between patients treated with 4L of polyethylene glycol who were assigned to receive either a low-residue diet or clear liquids the day prior to the examination [6]. Similarly, a randomized trial with 230 patients who were receiving a sodium sulfate-based preparation assigned patients to either a low-residue diet for breakfast and lunch the day prior to the colonoscopy or to clear liquids [7]. Again, there was no difference between the groups with regard to preparation quality. However, patients in the low-residue arm reported greater satisfaction with the preparation and were less likely to cancel their procedure (9 versus 20 percent). Whether similar results would be seen outside of a randomized trial is not

yet known. Our approach is to recommend a low-residue diet for three days prior to colonoscopy, with only clear liquids allowed the day prior to the examination.

Patients typically take no food by mouth for four to eight hours prior to the procedure (sometimes longer if there is known or suspected delayed gastric emptying) and no liquids (other than sips with medications) for two hours [8]. Recommendations differ with regard to preprocedure fasting for elective procedures. The American Society for Anesthesiology (ASA) guidelines state that prior to a procedure, patients should fast a minimum of two hours following clear liquid ingestion or six hours for a light meal [9]. By contrast, the American College of Emergency Physicians states "recent food intake is not a contraindication for administering procedural sedation and analgesia, but should be considered in choosing the timing and target level of sedation" [10]. Our practice is to follow the ASA approach.

Medications — Most medications may be continued up to the time of colonoscopy and are taken with a small sip of water the day of the colonoscopy. Some medications may need to be adjusted prior to colonoscopy, such as medications for diabetes, due to decreased oral intake prior to the procedure. Oral iron should also be stopped at least five days before the colonoscopy since it makes the residual feces black, viscous, and difficult to purge.

Decisions regarding the management of antiplatelet agents or anticoagulants must weigh the risks of bleeding from the procedure with the probability of a thromboembolic event occurring while the antithrombotic medication is interrupted (table 3 and table 4) [11]. Furthermore, the urgency of the procedure and the availability of alternative tests must be evaluated. Management decisions about antithrombotic agents should be made following discussion with the patient and the clinician prescribing the medication. Aspirin and nonsteroidal antiinflammatory drugs in standard doses may be continued safely in patients having colonoscopy. (See "Management of anticoagulants in patients undergoing endoscopic procedures" and "Management of antiplatelet agents in patients undergoing endoscopic procedures" and "Gastrointestinal endoscopy in patients with disorders of hemostasis".)

Because the risk of infection related to routine diagnostic or therapeutic colonoscopy is low, antibiotic prophylaxis is not recommended for colonoscopy (table 5). (See "Antibiotic prophylaxis for gastrointestinal endoscopic procedures".)

Preprocedure testing — It is generally recommended that patients **not** undergo routine preprocedure laboratory testing, chest radiography, or electrocardiography [12]. Instead, preprocedure testing should be used selectively based on the patient's medical history, physical examination findings, and procedural risk factors.

We agree with 2014 guidelines from the American Society for Gastrointestinal Endoscopy that recommend preprocedure testing in the following settings [12]:

- Pregnancy testing for women of childbearing potential who provide an uncertain pregnancy history or who have a history suggestive of a current pregnancy (particularly if fluoroscopy is to be used).
- Coagulation studies for patients with active bleeding, a known or suspected bleeding disorder (including a history of abnormal bleeding), an increased risk of bleeding due to medication use (eg, ongoing anticoagulant use, prolonged antibiotic use), prolonged biliary obstruction, malnutrition, or other conditions associated with acquired coagulopathies.
- Chest radiograph for patients with new respiratory symptoms or decompensated heart failure.
- Hemoglobin/hematocrit for patients with preexisting significant anemia or active bleeding, or if there is a high risk of significant blood loss during the procedure.
- Blood typing for patients with active bleeding or anemia who are likely to need a blood transfusion.
- Serum chemistry testing for patients with significant endocrine, renal, or hepatic dysfunction if medications are to be used that may further impair function.

We do not routinely check coagulation studies for patients who are receiving anticoagulants if the medication has been held for an appropriate amount of time prior to the procedure. (See "Management of anticoagulants in patients undergoing endoscopic procedures", section on 'High or uncertain risk procedures'.)

Bowel preparation — An excellent bowel preparation is critical for colonoscopy because it permits visualization of the entire colonic mucosa and increases the safety of therapeutic maneuvers [13,14]. Poor preparation leads to increased procedure time, risk of adverse events, and probability of missing lesions [15]. Multiple bowel preparations exist, with the ideal preparation being effective, safe, and palatable. It is important to consider the patient's comorbid illnesses and the timing of the preparation when choosing an appropriate preparation or combination of preparations [16]. (See "Bowel preparation before colonoscopy in adults".)

Bowel preparations are often described with terms such as unsatisfactory/inadequate, poor, fair, good, and excellent. To standardize descriptions, systems for reporting bowel preparation

quality have been developed, including the Boston bowel preparation scale [17]. The score ranges from 0 to 3 (picture 3) for individual colonic segments: the right side of the colon (including the cecum and ascending colon), the transverse section of the colon (including the hepatic and splenic flexures), and the left side of the colon (including the descending colon, sigmoid colon, and rectum). These segment scores are summed for a total Boston bowel preparation scale score, which ranges from 0 (poor) to 9 (excellent):

- Score 0: Unprepared colon with mucosa not seen because of solid stool that cannot be cleared
- Score 1: Portion of the mucosa of the colon segment seen, but other areas of the colon segment not seen well because of staining, residual stool, and/or opaque liquid
- Score 2: Minor amount of residual staining, small fragments of stool and/or opaque liquid, but most mucosa of the colon segment seen well
- Score 3: Entire mucosa of colon segment seen well with no residual staining, small fragments of stool, and/or opaque liquid

SEDATION ASSESSMENT

Options for sedation for colonoscopy include no sedation, moderate procedural sedation, or deep sedation. Deciding upon the appropriate approach requires an assessment of the patient's sedation needs and risks prior to the colonoscopy [18,19]. This includes a complete history of factors that might make sedation more difficult such as prior difficulties with sedation, chronic narcotic or benzodiazepine use, diminished mental capacity, and agitation or severe anxiety. Special attention should be paid to whether the patient has an increased risk for difficult airway management (eg, obesity, non-visibility of the uvula, prior history of difficult intubation) or increased cardiopulmonary adverse events of endoscopy (eg, comorbidities, obesity, older age). (See "Gastrointestinal endoscopy in adults: Procedural sedation administered by endoscopists".)

Although deep sedation with propofol is associated with greater patient satisfaction, faster post-procedure recovery time, and in some studies shorter procedure time, it does not lead to improvements in other clinically important outcomes such as cecal intubation rates or adenoma detection rates [20,21]. Use of anesthesia during colonoscopy may be associated with increased adverse events, including perforation following polypectomy, bleeding, abdominal pain, and adverse events associated with anesthesia [22] as well as aspiration pneumonia [23]. Furthermore, when administered by an anesthesiologist or dedicated nurse, deep sedation substantially increases the total cost of the procedure [24]. It is important to note that in some cases the additional costs associated with the administration of deep sedation may not be

covered by a patient's health insurance. (See "Gastrointestinal endoscopy in adults: Procedural sedation administered by endoscopists".)

INFORMED CONSENT

Informed consent encompasses all the interactions between the health care provider and the patient. Informed consent includes full disclosure with a clear and complete explanation of all portions of the procedure. (See "Informed procedural consent".)

Five essential elements to discuss in preparation for any procedure include [25]:

- Nature of the procedure
- Benefits
- Risks
- Alternatives
- Limitations of the procedure

The use of clear and simple language is critical during the process of obtaining consent. For example, colonoscopy may be explained as "a procedure in which a doctor passes a flexible tube with a light and a camera through your anus into your colon." Discussion of the possible risks of colonoscopy, including frequent and less frequent but severe adverse events, must occur and be tailored to the specific patient and procedure. Incidences of possible adverse events should be mentioned. (See 'Adverse events' below.)

Written documentation of the consent process is mandatory. In addition, when needed, the use of translators and materials written in a language in which the patient is fluent are also important.

EQUIPMENT

Routine colonoscopy is performed using a high-definition white-light colonoscope. Both adult and pediatric colonoscopes are used for colonoscopy in adults (with pediatric colonoscopes often being used for women or patients with a history of abdominal surgery). The choice of colonoscope does not affect cecal intubation rates or times [26]. Adult colonoscopes have a diameter of approximately 13 mm, whereas pediatric colonoscopes have a diameter of approximately 11 mm. Use of a pediatric colonoscope may enable easier passage through narrowed or fixed areas of the colon. However, the smaller diameter makes the pediatric colonoscope more flexible, which predisposes to loop formation. The choice of an adult versus

pediatric colonoscope is typically a matter of endoscopist preference. Occasionally the endoscopist may need to change from one type of colonoscope to the other to facilitate completion of the colonoscopy (see 'Looping' below). An ultra-slim colonoscope with a diameter of approximately 9.5 mm may be particularly helpful in patients with tight turns.

Variable stiffness colonoscopes allow the endoscopist to stiffen the shaft of the colonoscope and appear to increase cecal intubation rates [27]. Often the colonoscope is stiffened after passage through the sigmoid colon to reduce loop formation. The colonoscope is typically loosened during withdrawal, retroflexion, or passage around tight turns.

Various accessories are available that can be passed through the accessory channel of a colonoscope. These include biopsy forceps, brushes, snares, baskets, nets, injection needles, hemostatic clips, and argon plasma coagulation probes.

COLONOSCOPE ADVANCEMENT AND MUCOSAL INSPECTION

Colonoscopy routinely begins with the patient in the left lateral decubitus position, with the exception of patients with a colostomy, who typically remain supine. The first step is inspection of the perianal region and digital rectal examination. Topical anesthetic lubricating gel should be used for patients with perianal discomfort, whereas standard lubricant can be used for patients without discomfort. The tip of the colonoscope is then inserted into the rectum with air or CO_2 insufflation, suctioning of residual fluid, and pulling back of the colonoscope to enable visualization. The rectosigmoid junction is at approximately 15 to 20 cm, at which point the colon enters the peritoneum. Particular care must be taken when advancing the colonoscope in patients with colonic strictures or significant diverticulosis, as air insufflation can increase the risk of perforation in such patients. (See 'Perforation' below.)

Important techniques used during colonoscopy include using the up-down and left-right knobs and aspirating air. Using the knobs is particularly helpful in negotiating turns. Although gentle air insufflation helps visualization as the colonoscope is advanced, filling the colon with air lengthens and distends the colon, which may cause discomfort and increase the difficulty of the procedure. Aspirating the air will deflate and shorten the colon, bringing the next fold closer to the tip of the colonoscope, reducing abdominal discomfort and often aiding with scope advancement. The use of carbon dioxide instead of air to insufflate may reduce distension and patient discomfort as well [28]. Although limited data suggest that carbon dioxide insufflation in patients with underlying pulmonary disease is not associated with an increased risk of respiratory depression or carbon dioxide retention, additional studies are needed [28-30].

Distending the lumen of the colon with water may facilitate advancement of the colonoscope with decreased pain [31-33]. This technique may be especially helpful when navigating a left colon filled with numerous diverticula that make it difficult to identify the colonic lumen. Studies support decreased sedation requirements and improved patient tolerance with the use of water rather than air insufflation; however, some studies suggested decreased adenoma detection rates (ADRs) [32,34-36]. In a meta-analysis with 16 randomized trials that compared insufflation with water and insufflation with air, insufflation with water was associated with less pain (-1.57 point difference in pain score on a 0 to 10 scale, 95% CI -2.00 to -1.14), a higher likelihood of being able to complete the examination without sedation or analgesia (risk ratio [RR] 1.20, 95% CI 1.14 to 1.27), and higher ADRs (RR 1.16, 95% CI 1.04 to 1.30) [33]. There was no difference in cecal intubation rate.

Intubating the terminal ileum can be performed with two different approaches. The colonoscope may be advanced through the opening of the valve by direct visualization during forward movement. Alternatively, the colonoscope may be positioned in the cecum near the appendiceal orifice and slowly withdrawn, with the tip of the colonoscope angled toward the direction of the valve opening in an attempt to "hook" the valve.

Looping — A major barrier to successful advancement of the colonoscope to the cecum is looping. Looping occurs due to the attachment of the sigmoid and transverse colon to a mobile mesentery (figure 2). Advancing the colonoscope becomes more difficult, and in some cases, attempts to advance the colonoscope result in reverse movement of the colonoscope tip, termed paradoxical movement. In addition to impeding advancement of the colonoscope, looping can cause pain and perforation. Pain occurs due to the presence of sensory receptors in the mesentery responding to torsion, distension, compression, and stretching. Repeated loop reduction during the colonoscopy is critical and requires pulling back the colonoscope while applying torque, often clockwise. Stopping any maneuver if it causes significant pain, pressure, or difficulty is important to decrease the risk of adverse events. Loops formed in the instrument shaft outside the patient should be removed by rotating the colonoscope, keeping the lumen in view.

Applying abdominal pressure and changing the patient's position are important adjunctive techniques to enable passage of the colonoscope to the cecum. Abdominal pressure was the most important non-instrumental factor for cecal intubation in patients referred for incomplete colonoscopy [37]. Loops should be removed before the assistant applies pressure to help prevent loop further formation.

Asking the patient to demonstrate the location of abdominal discomfort may also help identify the appropriate area to apply pressure. In addition, abdominal pressure should be applied to

abdominal hernias. In such patients, loops that form within the hernia may lead to entrapment of the colonoscope [38].

The use of a lower abdominal compression device may reduce the need for manual pressure and patient repositioning in patients with a BMI 30 to 40 kg/m^2 [39]. Furthermore, the use of this type of device may reduce the frequency of staff-related musculoskeletal pain experienced [40]. While not widely available, an alternative method for determining where to apply pressure is magnetic endoscopic imaging. Magnetic endoscopic imaging provides real-time three-dimensional views of the colonoscope shaft configuration and its location within the abdomen. This information can aid with loop reduction and can be used to identify where to provide external pressure [41,42].

Changing the patient's position also may aid advancement of the colonoscope. In addition to the standard left lateral position, patients may be positioned in a supine, right lateral, or prone position. One study demonstrated that position changes were effective two-thirds of the time in allowing forward advancement of the colonoscope or improved luminal visualization [43].

Inspection

Essential elements — Careful inspection of the colonic mucosa is primarily performed during withdrawal of the colonoscope. In addition to polyps (and tumors if present), the presence of erythema, erosions, ulcers, diverticula, melanosis coli, hemorrhoids, and condyloma should be noted. A withdrawal time of at least six minutes improves adenoma detection rates, but inspection technique appears to be as important as time spent inspecting [44,45]. The following techniques are important for ensuring optimal visualization:

- Cleaning the colon of residual fluid during insertion and withdrawal. Residual stool may be aspirated into a plastic trap for microbiology analysis if needed.
- Clearing bubbles with simethicone in the water flushes used during insertion or withdrawal.
- Adequate insufflation during withdrawal.
- Visualizing the entire circumference of the colon by moving the tip of colonoscope in a systematic "circular" pattern.
- Second examination of the proximal colon from hepatic flexure to cecum on withdrawal or retroflexion in the right colon [46-48].
- Inspecting behind and in between folds.

- Repeated inspection of areas by back and forth movement of the colonoscope, especially around turns.

- Reducing colonic contractions by cleaning during colonoscope advancement to minimize suctioning upon withdrawal. Antispasmodics may also be used, although studies have failed to demonstrate improved ADRs with their use [49].

- Changing the patient's position during withdrawal has been shown to improve adenoma detection rates, with the following positions used based upon the location of the tip of the colonoscope: cecum to hepatic flexure, left lateral position; transverse colon, supine position; splenic flexure and descending colon, right lateral position [50].

- Careful inspection of vascularity and areas with mucus since flat lesions may manifest only as subtle changes to the vascular pattern or may be obscured by adherent mucus.

- Having experienced nurses, fellow trainees, and assistants examine the colonic mucosa simultaneously with the endoscopist has led to improved ADRs [51,52].

The endoscopist cannot always accurately identify the location of the colonoscope tip in the colon. Identifying position by the distances marked on the shaft of the colonoscope is not reliable due to looping, although approximately 60 to 80 cm of the instrument will typically be inserted upon reaching the cecum once loops have been removed. Only the terminal ileum (picture 4), cecum (picture 5), and rectum (picture 6) can be recognized 100 percent of the time by experienced endoscopists. The appendiceal orifice (picture 7) and ileocecal valve (picture 8) with two lipomatous lips identify the cecum. Care must be taken not to confuse the cecum with a tight turn or the appendiceal orifice with a diverticulum. The hepatic and splenic flexures may be identified by the bluish hue of adjacent organs (the liver and spleen, respectively) visualized through the colonic mucosa (picture 9). The transverse colon typically has a triangular fold configuration (picture 10).

Enhanced visualization tools — Multiple options are available to enhance visualization to improve polyp detection during colonoscopy, though many require specialized equipment and training. These imaging enhancements include narrow band imaging, magnification endoscopy, and chromoendoscopy. These techniques are not routinely used but may be employed in certain circumstances (eg, detecting dysplasia in patients with inflammatory bowel disease). In a systematic review and network meta-analysis that compared the efficacy of different endoscopic techniques in increasing ADRs, low-cost measures optimizing existing resources (water-aided colonoscopy, second observer, dynamic position change) were associated with a moderate increase in ADR compared with high-definition colonoscopy alone (odds ratio [OR] 1.29, 95% CI 1.17-1.43) [53]. Low-cost measures appeared to be as effective as enhanced

imaging techniques (chromoendoscopy, narrow-band imaging, flexible spectral imaging color enhancement, blue laser imaging) (OR 1.21, 95% CI 1.09–1.35). However, the use of enhanced scopes (full-spectrum endoscopy, extra-wide-angle-view colonoscopy, dual focus) was not associated with significant increases in ADR during high-definition colonoscopy.

Add-on devices to the colonoscope (cap, Endocuff, EndoRing, G-EYE and AmplifEYE) enhance colonic mucosal visualization and have been shown to modestly increase ADR (OR 1.18, 95% CI 1.07-1.29). A meta-analysis of randomized controlled trials, high-quality case-control, cohort, and observational studies (>10 subjects) mostly using Endocuff showed an increase in the sessile serrated polyp detection rate with a pooled rate of 12.3 percent as compared with 6.4 percent with standard colonoscopy (OR 1.81, 95% CI 1.6-2.0) [54].

Artificial intelligence (AI)–assisted polyp detection — Computer-aided diagnosis can improve ADRs [55-61]. However, the efficacy of this technology has not been demonstrated in the detection of advanced adenomas. In a systematic review and meta-analysis of five randomized trials that included 4354 patients, colonoscopies performed with a computer-aided detection (CADe) system had higher pooled ADRs as compared with conventional colonoscopy [61]. CADe resulted in higher adenoma per colonoscopy regardless of size and polyp location. While CADe also resulted in a higher sessile serrated lesion per colonoscopy (relative risk [RR] 1.52; 95% CI 1.14-2.02), rates of advanced ADR were not significantly different (RR 1.35; 95% CI 0.74-2.47). However, no difference in ADR, detection of sessile serrated polyps or advanced adenomas between AI-assisted and standard colonoscopy was detected in a retrospective study at a large academic medical center [62]. Similarly, no significant difference in ADR between AI-assisted and standard colonoscopy (71.4 versus 65.0 percent, p = 0.09) was reported in a randomized trial from the United Kingdom where Endocuff Vision was used in approximately 70 percent of patients in each arm [63]. Three CADe systems have been approved for use in the United States by the Food and Drug Administration including GI Genius, EndoScreener, and SKOUT [64-66].

A systematic review and network meta-analysis of randomized controlled trials that assessed the impact of AI compared with other endoscopic interventions aimed at increasing ADR such as distal attachment devices, dye-based/virtual chromoendoscopy, water-based techniques, and balloon-assisted devices included 94 randomized controlled trials with 61,172 patients and 20 discrete study interventions [67]. ADRs for AI were significantly higher as compared with autofluorescence imaging, dye-based chromoendoscopy, Endocap, Endocuff, Endocuff vision, EndoRing, flexible spectral imaging color enhancement, full-spectrum endoscopy, high definition, linked color imaging, narrow band imaging, water exchange, and water immersion. Further studies are needed to determine if the use of computer-aided polyp diagnosis methods

can consistently provide reliable and reproducible accuracy in the detection and characterization of colorectal polyps, improve detection of advanced polyps and sessile serrated polyps, improve polyp detection in endoscopists with a high ADR, and improve long-term patient outcomes.

DIAGNOSTIC AND THERAPEUTIC MANEUVERS

A variety of diagnostic and therapeutic maneuvers can be performed during colonoscopy. The most common maneuver is tissue sampling. Other interventions include:

- Endoscopic hemostasis (picture 11) (see "Argon plasma coagulation in the management of gastrointestinal hemorrhage" and "Endoscopic clip therapy in the gastrointestinal tract: Bleeding lesions and beyond" and "Approach to acute lower gastrointestinal bleeding in adults", section on 'Colonoscopy')
- Dilation of colonic or anastomotic strictures (see "Management of anastomotic complications of colorectal surgery", section on 'Strictures')
- Stent placement for malignant disease (movie 1) (see "Enteral stents for the management of malignant colorectal obstruction")
- Endoscopic mucosal resection and endoscopic submucosal dissection of gastrointestinal tumors (see "Overview of endoscopic resection of gastrointestinal tumors")
- Foreign body removal (image 5 and picture 12A-B) (see "Rectal foreign bodies", section on 'Endoscopy')
- Placement of a colonic decompression tube (see "Acute colonic pseudo-obstruction (Ogilvie's syndrome)", section on 'Colonoscopic decompression')
- Percutaneous endoscopic cecostomy tube placement (see "Acute colonic pseudo-obstruction (Ogilvie's syndrome)", section on 'Colonoscopic decompression')

Tissue sampling — Visible lesions identified during colonoscopy should be sampled or removed for pathology. Because the colonic mucosa lacks pain receptors, patients generally do not feel pain with these maneuvers. Tissue sampling includes biopsies, brushings, and polypectomy [68]. Specimens obtained can be sent for histology, cytology, microbiology, or virology, depending upon the clinical situation. When submitting samples, the endoscopist should provide the pathologist, cytologist, or microbiologist with the patient's clinical history,

endoscopic findings, and questions to be answered. Access to the endoscopy report and photographs of the sampled area may also be helpful.

Polypectomy — Most polyps less than 2 cm in size can be removed endoscopically, as well as many larger polyps, although larger polyps may require referral to an endoscopist with expertise in the removal of large polyps [69]. Small polyps (≤3 mm) may be completely removed using cold biopsy forceps and appeared noninferior to cold snare polypectomy, while cold snare is preferred for larger polyps up to 9 mm [70,71]. Even larger polyps may require snare resection with electrocautery. Advanced endoscopic mucosal resection and endoscopic submucosal dissection techniques are used for large polyps (typically greater than 2 cm) (picture 13). Nearly all pedunculated polyps without invasive cancer can be removed endoscopically. If polyps are too numerous for removal, representative samples should be obtained. (See "Endoscopic removal of large colon polyps" and "Clinical manifestations and diagnosis of familial adenomatous polyposis", section on 'Clinical manifestations'.)

Endoscopists should not attempt removal of polyps beyond their skill or comfort level. In such cases, the lesion may be sampled with biopsies although this may also interfere with future attempts at endoscopic resection, the area (but not the lesion) tattooed, and the patient referred to an endoscopist with expertise in the removal of large or difficult polyps. In some cases, endoscopic removal is not possible, and surgical resection is required.

PHOTODOCUMENTATION AND REPORTING

All colonoscopic procedures should include a complete report detailing the extent of the colon examined, quality of the preparation, and all normal and abnormal findings encountered. Photodocumentation greatly enhances the record and should be included when possible. The following are components of a complete report [72]:

- Patient name along with the names of the personnel performing the procedure (endoscopist, nurses, assistants).
- Date and time of procedure.
- Patient's age and sex.
- Documentation of informed consent.
- Type of facility where the colonoscopy was performed.
- American Society of Anesthesiologists classification (table 6).

- Indication(s) for the procedure.
- Sedation details, including the type, dose, level of sedation, and the provider responsible for sedation.
- Extent of the examination, including reasons for an incomplete procedure, if applicable, with photodocumentation of landmarks in the cecum (appendiceal orifice, ileocecal valve, and terminal ileum, if intubated).
- Bowel preparation type, dose, and quality.
- Difficulty of the procedure, patient tolerance, and any special maneuvers required to complete the examination.
- Type of instrument used, with model and instrument number either in the procedure or nursing report.
- Colonoscopic findings with descriptions of the location, size, and morphology of lesions and whether pathology samples were obtained. For polyps, removal method, completeness of removal, whether the tissue was retrieved, and tattoo placement (if done) should be documented.
- Unplanned events or adverse events, including any interventions performed as a result. This should include immediate events and, ideally, events occurring within 30 days following the colonoscopy.
- Endoscopist's assessment based on colonoscopy findings and available clinical data.
- Documentation of communication of pathology results with the patient and referring provider(s).
- Recommendations including further tests, referrals, medication changes, and appointments.

ADVERSE EVENTS

The risk of serious complications following colonoscopy is low. In a review of 12 studies with 57,742 screening colonoscopies, serious harm occurred in 2.8 per 1000 examinations [73]. Over 85 percent of the adverse events occurred in the setting of polypectomy. In a second study that used a database with 2.3 million colonoscopies performed between 1997 and 2004, the overall rate of adverse events resulting in hospitalization was 1.98 per 1000 examinations [74]. A third

study pooled data from 21 studies with nearly 2 million colonoscopies from 2001 to 2012 and reported perforation in 0.5 per 1000 colonoscopies, post-colonoscopy bleeding in 2.6 per 1000 colonoscopies and death in 2.9 per 100,000 colonoscopies [75].

The mortality rate related to colonoscopy is 0.007 percent [76].

However, the risk of colonoscopy is not constant across groups. Older adults are at increased risk for serious adverse events compared with younger patients. In a study of 53,220 colonoscopies, patients aged 80 to 84 years had a higher rate of serious adverse events compared with patients aged 66 to 69 years (8.8 per 1000 procedures versus 5.0 per 1000 procedures) [77]. The risk of serious adverse events was also increased among patients with comorbid conditions such as a history of stroke, chronic obstructive pulmonary disease, atrial fibrillation, and heart failure.

Adverse events related to sedation — Cardiopulmonary adverse events are the most frequent complication related to procedural sedation. Reducing the risk of sedation-associated adverse events requires appropriate anesthesia risk assessment of patients; management of high-risk patients by qualified medical personnel; appropriate monitoring before, during, and after the procedure; and delay of non-urgent procedures in unstable patients. adverse events related to procedural sedation are discussed in detail elsewhere. (See "Adverse events related to procedural sedation for gastrointestinal endoscopy in adults".)

Adverse events related to preparation — All bowel preparations can cause adverse effects, which include fluid and electrolyte disturbances, nausea, vomiting, abdominal bloating, abdominal discomfort, aspiration, and esophageal tears from vomiting. Adverse events related to the various colonoscopy preparations are discussed in detail elsewhere. (See "Bowel preparation before colonoscopy in adults".)

Bleeding — Bleeding is usually associated with polypectomy and rarely accompanies diagnostic colonoscopy [78]. The reported rates of postpolypectomy bleeding vary (typically 1 to 2 percent), with higher rates seen with the removal of larger polyps (ie, >2 cm) especially on the right side of the colon [78-85]. The risk of postpolypectomy bleeding may be increased in patients with thrombocytopenia or coagulopathies. It has been suggested that overall, endoscopists should have postpolypectomy bleeding rates of less than one percent [44]. In addition to the increased risk seen with polypectomy, the risk of bleeding is increased with other therapeutic maneuvers such as stricture dilation and endoscopic mucosal resection. (See "Gastrointestinal endoscopy in patients with disorders of hemostasis".)

Postpolypectomy bleeding may be immediate or delayed. Immediate bleeding is associated with polypectomy techniques that may occur with or without the use of cautery current

polypectomy. It often is recognized during the colonoscopy, in which case it typically can be treated immediately and controlled using endoscopic hemostatic methods. If not recognized at the time of colonoscopy, it can usually be managed by a repeat colonoscopy to identify and treat the bleeding site. (See "Management and prevention of bleeding after colonoscopy with polypectomy", section on 'Immediate bleeding' and "Endoscopic clip therapy in the gastrointestinal tract: Bleeding lesions and beyond", section on 'Postpolypectomy bleeding'.)

Delayed bleeding is typically seen five to seven days after the procedure, but it has been reported up to four weeks later. It is thought to occur due to sloughing of an eschar that was covering a blood vessel or due to extension of the cautery-induced zone of thermal necrosis to non-injured tissue, which could result in bleeding if it involves a blood vessel. Patients may present with hematochezia or with melena, depending upon the location of the bleeding (bleeding from the right colon may present as melena). Delayed bleeding can often be managed with colonoscopy to identify and treat the bleeding site. (See "Management and prevention of bleeding after colonoscopy with polypectomy", section on 'Delayed bleeding'.)

Perforation — Perforations typically occur by one of three mechanisms: (1) mechanical trauma from pressure exerted by the colonoscope on the wall of the colon (often in the rectosigmoid region) or at the site of a stricture; (2) barotrauma, where pressure in the colon exceeds the bursting pressure of a colonic region (typically the cecum); or (3) from electrocautery injury during polypectomy. Perforation rates during colonoscopy vary with the procedure being performed [73,74,86]:

- Screening colonoscopy: 0.01 to 0.1 percent
- Anastomotic stricture dilation: 0 to 6 percent
- Crohn disease stricture dilation: 0 to 18 percent
- Stent placement: 4 percent
- Colonic decompression tube placement: 2 percent
- Colonic endoscopic mucosal resection 0 to 5 percent

Due to the mechanism of injury (mechanical trauma or barotrauma), perforations from a screening or diagnostic colonoscopy are typically large. On the other hand, perforations from a therapeutic colonoscopy may be small and located at the site of the therapeutic intervention, though such patients may also suffer perforations due to mechanical trauma or barotrauma.

Mortality rates from iatrogenic colonic perforation range from 0 to 0.65 percent [87]. Risk factors for perforation include advanced age, multiple comorbidities, diverticulosis, obstruction, resection of polyps over 1 cm in size that are located in the right colon, and other therapeutic maneuvers [73,74,85,88,89]. Anesthesia for sedation may increase the risk of perforation

compared with moderate procedural sedation (eg, with a narcotic and benzodiazepine) [22,90]. However, other studies have not noted this association [89,91,92]. Additional risk factors for perforation include reduced mobility of the colon, existing weakness in the colon wall, previous incomplete attempt at endoscopic removal of a colonic lesion, performance of colonoscopy by a non-gastroenterologist, and endoscopist inexperience [74,89,93-96]:

- Reduced colon mobility can result from adhesions, diverticula, radiation therapy, malignancy, or infection.
- Mucosal abnormalities may occur as a result of inflammatory bowel disease, malignancy, infection, radiation therapy, necrosis, or a partial tear. These abnormalities may cause weakness in the colon wall and predispose to perforation [95].
- Endoscopists with low procedure volume have increased rates of perforation [93,94].

In general, perforation rates greater than 1 in 1000 screening colonoscopies or 1 in 500 for all colonoscopies should initiate evaluation of the endoscopist's technique [44]. (See 'Quality indicators' below.)

Techniques to decrease the risk of perforation include creating a fluid cushion by injection of submucosal fluid underneath large or flat polyps before resection, avoiding dilation in patients with significant inflammation in the area to be dilated, minimizing air insufflation during placement of a colonic stent, and avoiding colonic stent placement in patients who are or will be receiving bevacizumab [72,97]. (See "Enteral stents for the management of malignant colorectal obstruction", section on 'Stenting in the setting of adjunctive therapy'.)

Symptoms will vary depending upon the location and size of perforation, the degree of fecal seepage into the peritoneum, and the patient's comorbidities. Colonic perforation may be retro- or intraperitoneal. The ascending colon, hepatic and splenic flexures, and descending colon are retroperitoneal, whereas the distal rectum is below the peritoneum (figure 3). The most common symptom of a colonic perforation is abdominal pain. Other symptoms include fever, nausea, vomiting, dyspnea, chest pain, scapular pain, and neck pain. However, patients with retroperitoneal perforations may have minimal or atypical symptoms. The physical examination may be notable for diffuse or localized abdominal tenderness with peritoneal signs.

If perforation is suspected, immediate abdominal radiographs (plain and upright or lateral decubitus) and an upright chest radiograph should be obtained to look for free air under the diaphragm, retroperitoneal air, pneumomediastinum, pneumothorax, or subcutaneous emphysema. If plain films are normal but there is a high suspicion of perforation, an abdominopelvic computed tomography scan with water-soluble contrast should be obtained

since it has higher sensitivity for detecting extraluminal air than plain films (particularly for retroperitoneal perforations) [98]. (See "Overview of gastrointestinal tract perforation".)

Management includes giving the patient nothing by mouth and starting intravenous fluids and intravenous broad-spectrum antibiotics. Surgical consultation should be obtained immediately. Large perforations typically require surgery. A minority of patients can be managed nonsurgically. Such patients have a clean colon with no signs of peritonitis and improve symptomatically over 24 hours. Usually these patients have a retroperitoneal perforation and/or sustained the perforation during a therapeutic colonoscopy. Reported success rates for nonsurgical management are variable (between 33 to 64 percent in some series) [99-101]. Successful endoscopic clip closure of perforations has been reported and may be attempted if the perforation is visualized at the time of the colonoscopy and is accessible [102,103]. However, colonoscopy is contraindicated in patients with a suspected perforation and is not used to treat perforations recognized after completion of the colonoscopy. (See "Endoscopic clip therapy in the gastrointestinal tract: Bleeding lesions and beyond", section on 'Perforations and fistulas' and "Endoscopic removal of large colon polyps", section on 'Complications' and "Enteral stents for the management of malignant colorectal obstruction", section on 'Stenting in the setting of adjunctive therapy'.)

Surgical treatment is indicated in patients with diffuse peritonitis, patients who deteriorate while undergoing nonsurgical treatment, and patients with a concomitant colonic lesion that requires surgery (eg, colorectal cancer) [88]. Pneumoperitoneum alone is not an indication for surgery [97].

Postpolypectomy syndrome — Postpolypectomy syndrome results from electrocoagulation injury to the bowel wall, creating a transmural burn and focal peritonitis without frank perforation. Clinical manifestations include pain, fever, focal abdominal tenderness, and leukocytosis one to five days following polypectomy. Management includes intravenous hydration, antibiotics, and bowel rest. Outpatient management has been reported in reliable patients with mild symptoms. (See "Postpolypectomy coagulation syndrome".)

Infection — The rate of infection related to gastrointestinal endoscopy is very low. Cases of hepatitis B, hepatitis C, and bacterial transmission related to defective equipment and/or breaches in protocols for proper endoscope reprocessing have been reported. (See "Antibiotic prophylaxis for gastrointestinal endoscopic procedures" and "Preventing infection transmitted by gastrointestinal endoscopy" and "Epidemiology and transmission of hepatitis C virus infection", section on 'Other percutaneous exposures'.)

Gas explosion — Gas explosion is exceedingly rare and results from the ignition of hydrogen or methane gas in the colonic lumen from use of electrosurgical energy. The gas results from an incomplete or poor preparation or from the use of incompletely absorbable carbohydrate preparations such as lactulose, mannitol, or sorbitol. The use of argon plasma coagulation (APC) for bleeding control from radiation-induced proctitis has been associated with gas explosions when enemas were used before a sigmoidoscopy or the colonoscopy preparation was poor quality [104]. A death has been reported as a result of gas explosion during colonoscopy [105].

Gas explosion has also been reported in a patient who had previously undergone colectomy for Gardner syndrome [106]. The patient was found to have rectal polyps on proctoileoscopy. The polyps were treated with APC, resulting in the explosion, with multiple rectal and ileal perforations. The patient had not received a preparation prior to the procedure.

QUALITY INDICATORS

Multiple quality indicators have been proposed for colonoscopy including cecal intubation rates, withdrawal times, and adenoma detection rates (ADRs) [2]. ADRs are calculated based upon screening colonoscopies in asymptomatic patients ≥50 years of age who are at average risk for colon polyps and colon cancer. In addition, ADRs are based only upon complete examinations with adequate preparations. The goal of applying quality indicators is to improve colonoscopy performance and decrease the number of lesions (particularly adenomas) missed during colonoscopy.

In a systematic review of six studies with 465 patients who underwent tandem colonoscopies, the overall adenoma miss rate was 22 percent, with smaller adenomas being more likely to be missed [107]:

- 1 to 5 mm: 26 percent miss rate
- 5 to 10 mm: 13 percent miss rate
- ≥10 mm: 2 percent miss rate

The importance of adenoma detection has been demonstrated in multiple studies [108-110]:

- In a study of 45,026 patients who underwent screening colonoscopy, interval colorectal cancer (ie, cancer that developed between the time of the screening colonoscopy and the time scheduled for follow-up colonoscopy) was detected in 42 patients [108]. The endoscopists' ADRs were associated with the risk of developing an interval colorectal cancer. The rates of interval colorectal cancer were 34 per 100,000 person-years for endoscopists with an adenoma detection rate <11 percent, 22 per 100,000 person-years

with an adenoma detection rate of 11 to 14.9 percent, 26 per 100,000 person-years with an adenoma detection rate of 15 to 19.9 percent, and 2 per 100,000 person-years with an adenoma detection rate ≥20 percent.

- A second study looked at 314,872 colonoscopies performed for various indications in patients ≥50 years of age [109]. ADRs were calculated based on screening examinations but did not take into account preparation quality or whether the cecum was reached during the examination. ADRs ranged from 7.4 to 52 percent. The rates of interval cancer declined linearly with increasing adenoma detection rate. For endoscopists with an adenoma detection rate of ≤19 percent, there were 98 interval cancers per 100,000 person-years, whereas for endoscopists with an adenoma detection rate of ≥33.5 percent, the rate was 48 per 100,000 person-years. After adjusting for confounders, the risk of interval cancer decreased 3 percent for every 1 percent increase in adenoma detection rate (HR 0.97, 95% CI 0.96-0.98).

Colorectal cancers may also be missed during colonoscopy. Studies suggest that colonoscopy will miss 2 to 6 percent of colorectal cancers. (See "Clinical presentation, diagnosis, and staging of colorectal cancer", section on 'Colonoscopy'.)

The following quality indicators were identified by a consensus panel from the American Society for Gastrointestinal Endoscopy and American College of Gastroenterology in guidelines that were updated in 2015 [2]:

- There is an appropriate indication for the colonoscopy. (See 'Indications' above.)
- Informed consent is obtained, including specific discussion of the risks associated with colonoscopy. (See 'Informed consent' above.)
- Recommended postpolypectomy and post-cancer resection surveillance intervals are followed. (See 'Indications' above.)
- Recommended ulcerative colitis/Crohn disease surveillance intervals are followed. (See 'Indications' above.)
- The quality of the preparation is documented in the procedure note and adequate to allow screening and surveillance recommendations to be followed. (See 'Photodocumentation and reporting' above.)
- Colonoscopists have acceptable cecal intubation rates (visualization of the cecum by notation of landmarks and photodocumentation of landmarks should be present in every procedure). Effective colonoscopists should be able to intubate the cecum in ≥90 percent

of all cases and in ≥95 percent of cases when the indication is screening in a healthy adult. This does not include procedures aborted due to poor preparation or severe colitis, or those performed for the focused intent of managing strictures or large, previously diagnosed polyps.

- Colonoscopists have ADRs of at least 25 percent in patients who are over the age of 50 years and are undergoing screening colonoscopy (30 percent in men and 20 percent in women).
- The mean withdrawal time is ≥6 minutes in colonoscopies with normal results that are performed in patients with intact anatomy.
- Biopsies specimens are obtained in patients with chronic diarrhea. (See 'Indications' above.)
- An appropriate number and distribution of biopsy samples are obtained in patients undergoing ulcerative colitis and Crohn colitis surveillance. The goal is four biopsies per 10 cm section of involved colon, or approximately 32 specimens per case of pancolitis. (See "Surveillance and management of dysplasia in patients with inflammatory bowel disease", section on 'Role of random biopsies'.)
- Mucosally based pedunculated polyps and sessile polyps <2 cm in size are endoscopically resected, or documentation of unresectability is obtained. (See 'Polypectomy' above.)
- Perforation rates by procedure type (all indications versus screening) are monitored. In general, the perforation rate should not exceed 1 in 500 colonoscopies overall, and 1 in 1000 screening colonoscopies. (See 'Perforation' above.)
- Incidence of postpolypectomy bleeding is monitored. In general, the incidence of postpolypectomy bleeding should be less than 1 percent. (See 'Bleeding' above.)
- Postpolypectomy bleeding is managed nonoperatively in ≥90 percent of cases. (See 'Bleeding' above.)

In clinical practice in the United States, provider ADR rates greatly exceed the recommended benchmark of 25 percent. In a report from a US-based registry (GI Quality Improvement Consortium) of 2,646,833 colonoscopies performed between 2014 and 2018, the average ADR for screening colonoscopies per endoscopist was 37 percent, 44 percent in males and 31 percent in females [111]. This suggests that higher ADR performance can be routinely achieved by practicing endoscopists.

One factor that has received significant attention is withdrawal time [112-115]. In a study of 2053 screening colonoscopies, endoscopists with a mean withdrawal time of ≥6 minutes had a higher neoplasia detection rate than those with a withdrawal time of less than 6 minutes (28 versus 12 percent), including advanced neoplasia (6 versus 3 percent) [112]. Similarly, in a prospective study of 315 gastroenterologists and 15,955 patients, endoscopists with a mean withdrawal time of ≥6 minutes were 1.8 times more likely to detect one or more polyps [113]. However, another prospective study that included 4429 consecutive colonoscopies performed by 67 endoscopists failed to find a statistically significant difference in polyp detection for polyps ≥5 mm for those who had median withdrawal times of ≥6 minutes compared with those with shorter withdrawal times (odds ratio 1.2; 95% CI 0.9-1.6) [114].

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Colon polyps".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topics (see "Patient education: Colonoscopy (The Basics)")
- Beyond the Basics topics (see "Patient education: Colonoscopy (Beyond the Basics)")

SUMMARY AND RECOMMENDATIONS

- Colonoscopy includes visualization of the rectum, colon, and the distal portion of terminal ileum, with real-time assessment and interpretation of the findings encountered. (See 'Introduction' above.)

- Colonoscopy is indicated for the diagnostic evaluation of signs and symptoms of a wide variety of gastrointestinal disorders, for colon cancer screening, and for therapeutic interventions (table 1 and table 7 and table 8). (See 'Indications' above.)

- Preparation for colonoscopy typically involves the ingestion of a low-residue diet or clear liquids for at least one day prior to the examination, combined with an oral gastrointestinal lavage. Most medications may be continued up to the time of colonoscopy, but management of antiplatelet agents and anticoagulants must take into account the procedure-related risk of bleeding and the risk of thrombosis. Antibiotic prophylaxis is not required for patients undergoing colonoscopy. (See 'Patient preparation' above and "Management of antiplatelet agents in patients undergoing endoscopic procedures" and "Management of anticoagulants in patients undergoing endoscopic procedures".)

- Routine colonoscopy is performed using a high-definition white-light colonoscope. Multiple accessories are available to aid with diagnostic and therapeutic maneuvers. In addition, options are available to enhance visualization during colonoscopy (eg, chromoendoscopy), although many require specialized equipment and training. (See 'Equipment' above.)

- A variety of diagnostic and therapeutic maneuvers can be performed during colonoscopy. The most common maneuver is tissue sampling, including routine polypectomy. (See 'Diagnostic and therapeutic maneuvers' above.)

  Other interventions include:

  - Endoscopic hemostasis
  - Dilation of colonic strictures
  - Stent placement for malignant disease
  - Endoscopic mucosal resection and endoscopic submucosal dissection of large colonic polyps
  - Colonic decompression tube placement
  - Percutaneous endoscopic cecostomy tube placement
  - Foreign body removal

- Serious adverse events of colonoscopy are rare (approximately 3 per 1000 screening colonoscopies) and include adverse events of sedation, adverse events related to the preparation, bleeding, and perforation. (See 'Adverse events' above and "Adverse events related to procedural sedation for gastrointestinal endoscopy in adults" and "Bowel preparation before colonoscopy in adults".)

- Bleeding is usually associated with polypectomy and rarely accompanies diagnostic colonoscopy. Postpolypectomy bleeding occurs in approximately 1 to 2 percent of polypectomies, with higher rates seen with the removal of larger polyps. Patients may present with hematochezia or melena days to weeks after the colonoscopy. The majority of patients can be managed with a repeat colonoscopy to both identify and treat the source of bleeding. (See 'Bleeding' above and "Management and prevention of bleeding after colonoscopy with polypectomy".)

- Perforation rates vary with the procedure being performed, with rates of 0.01 to 0.1 percent for screening colonoscopy. The most common symptom of a colonic perforation is abdominal pain. Other symptoms include fever, nausea, vomiting, dyspnea, chest pain, scapular pain, and neck pain. However, patients with retroperitoneal perforations may have minimal or atypical symptoms. The physical examination may be notable for diffuse or localized abdominal tenderness with peritoneal signs. (See 'Perforation' above.)

  If perforation is suspected, immediate abdominal radiographs (plain and upright or lateral decubitus) and an upright chest radiograph should be obtained. If plain films are normal but there is a high suspicion of perforation, an abdominopelvic computed tomography scan with water-soluble contrast should be obtained. All patients with perforations should receive intravenous fluids and broad-spectrum antibiotics. Many patients with perforations will require surgery, though nonsurgical management may be possible in those with small perforations without evidence of peritonitis.

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Topic 13927 Version 46.0

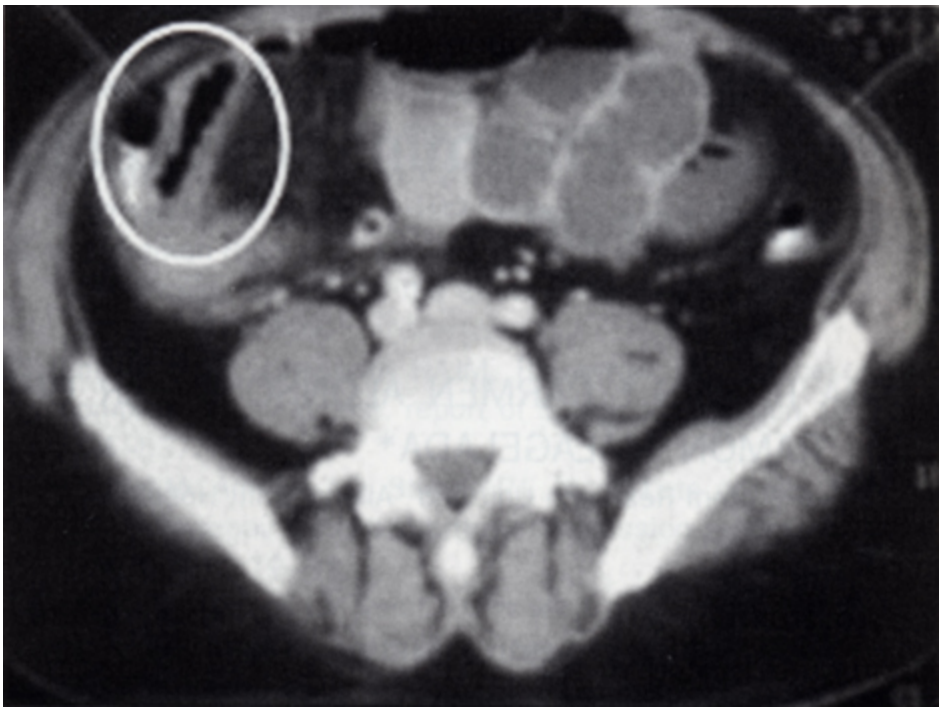
GRAPHICS

Indications for colonoscopy

Signs/symptoms
Abnormal imaging
Lower gastrointestinal bleeding and unexplained iron deficiency anemia
Lower gastrointestinal symptoms (eg, chronic diarrhea)
Screening/surveillance
Colon polyp
Colon cancer
Inflammatory bowel disease
Therapeutic
Polypectomy
Localization of lesion
Foreign body removal
Decompression of sigmoid volvulus
Decompression of colonic pseudo-obstruction
Balloon dilation of strictures
Palliative treatment of bleeding or stenosed neoplasms
Placement of percutaneous endoscopic cecostomy tube

Graphic 83296 Version 1.0

Abdominal computed tomography scan showing thickening of the distal ileum



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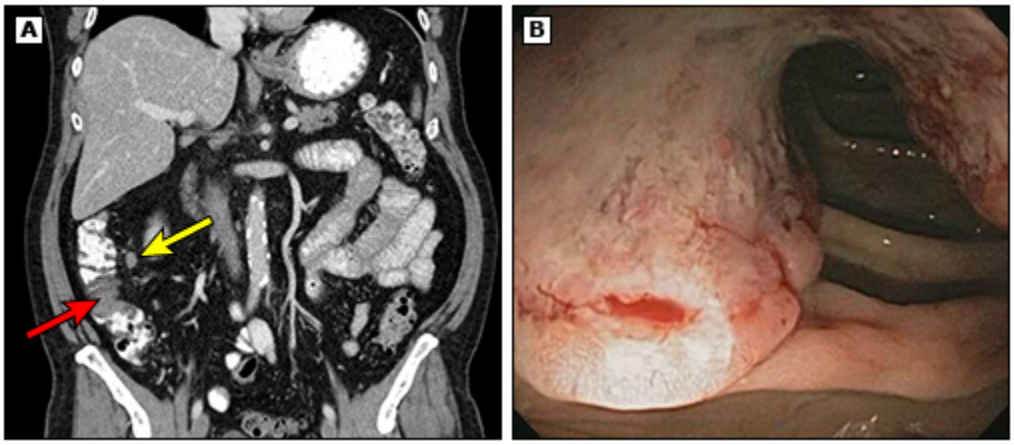
Graphic 79520 Version 4.0

Colon cancer seen on CT scan and colonoscopy

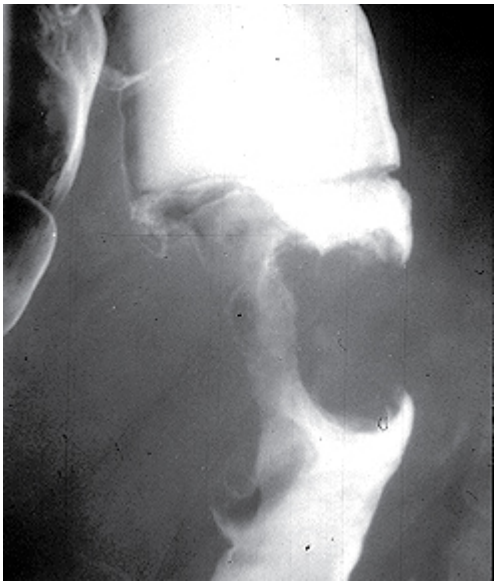


(A) Computed tomographic (CT) scan showing a filling defect in the ascending colon (red arrow) along with an involved lymph node (yellow arrow).

(B) Colon cancer identified in the ascending colon on subsequent colonoscopy.

Graphic 83618 Version 1.0

Cancer of the colon as seen on barium enema

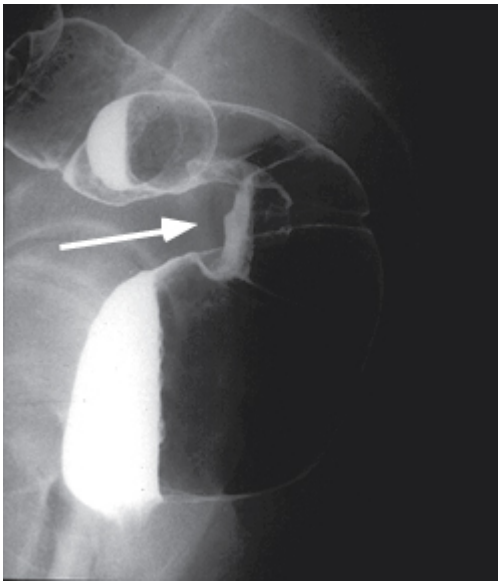


Double contrast barium enema shows an apple-core lesion surrounding the lumen of the descending colon.

Courtesy of Jonathan Kruskal, MD.

Graphic 75818 Version 3.0

Rectal cancer as seen on barium enema

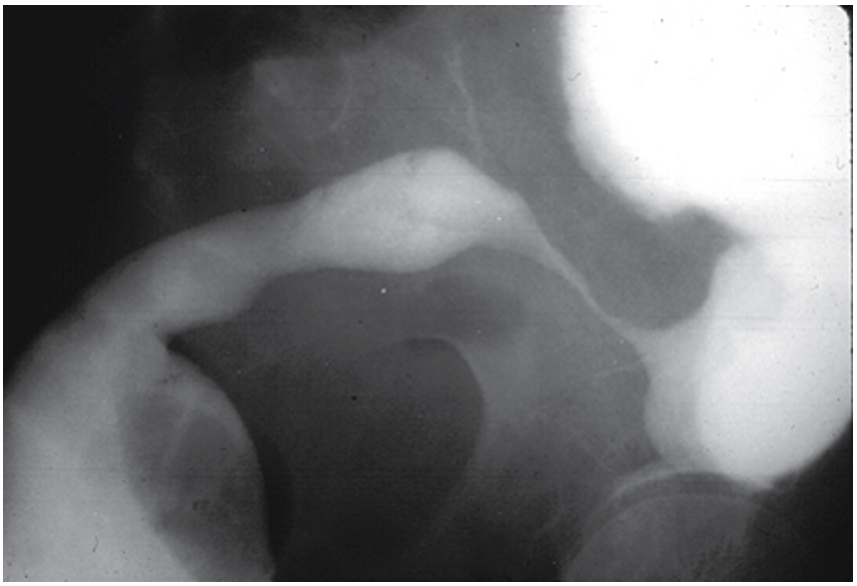


Double-contrast barium enema shows an eccentric mass arising from the anterior wall of the rectum (arrow).

Courtesy of Jonathan Kruskal, MD, PhD.

Graphic 82202 Version 3.0

Sigmoid cancer developing in ulcerative colitis, as seen on barium enema

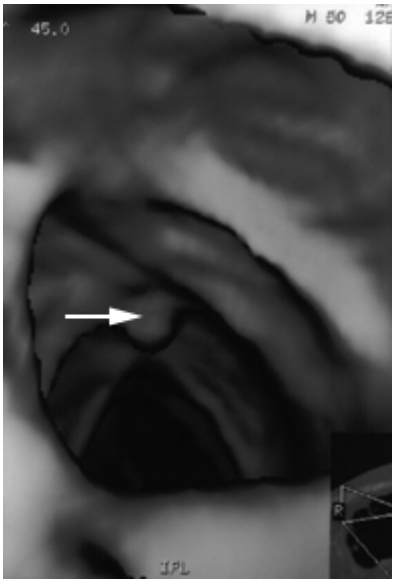


Barium enema study demonstrates a focal stricture in the sigmoid colon caused by an infiltrating cancer. The adjacent bowel is featureless and folds are absent, findings characteristic of chronic ulcerative colitis.

Courtesy of Norman Joffe, MD.

Graphic 63411 Version 3.0

Colonic polyp

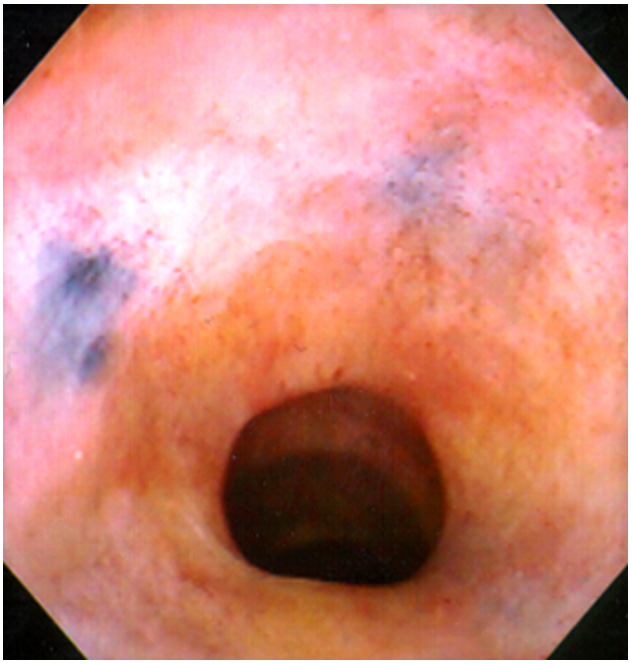


Virtual colonoscopy shows a small polyp (arrow) in the transverse colon.

Courtesy of Jonathan Kruskal, MD, PhD.

Graphic 71187 Version 1.0

India ink at polypectomy scar

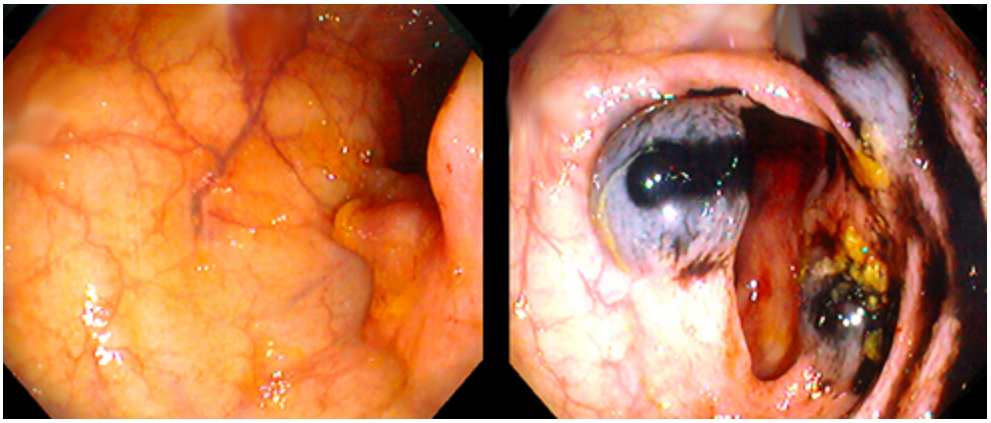


India ink staining is visible at the site of a polypectomy scar.

Courtesy of Jerome D Waye, MD.

Graphic 77062 Version 1.0

India ink staining

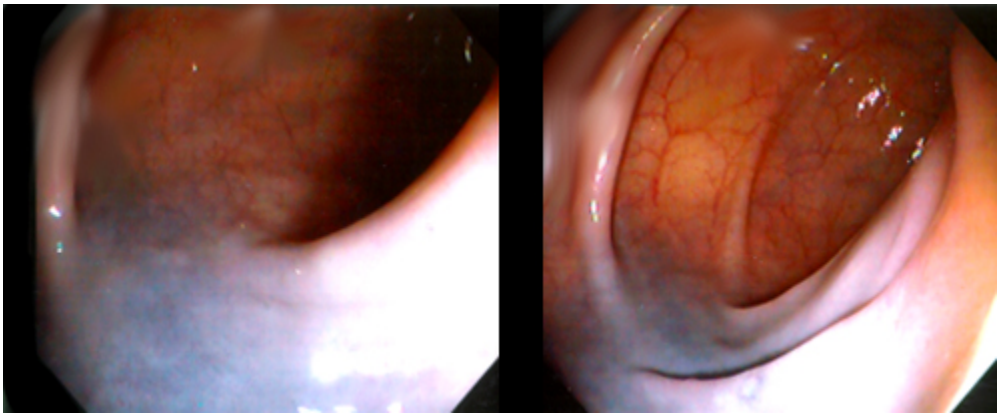


A flat lesion is visible at the three o'clock position during colonoscopy (left panel). The lesion has been stained circumferentially for later identification of the site (right panel).

Courtesy of Jerome D Waye, MD.

Graphic 69334 Version 1.0

India ink staining



Persistent India ink staining is visible on colonoscopy two years after polypectomy.

Courtesy of Jerome D Waye, MD.

Graphic 78733 Version 1.0

Dietary fiber content of frequently consumed foods

Food	Fiber, g/serving
Fruits	
Apple (with skin)	3.5/1 medium-sized apple
Apricot (fresh)	1.8/3 apricots
Banana	2.5/1 banana
Cantaloupe	2.7/half edible portion
Dates	13.5/1 cup (chopped)
Grapefruit	1.6/half edible portion
Grapes	2.6/10 grapes
Oranges	2.6/1 orange
Peach (with skin)	2.1/1 peach
Pear (with skin)	4.6/1 pear
Pineapple	2.2/1 cup (diced)
Prunes	11.9/11 dried prunes
Raisins	2.2/packet
Strawberries	3.0/1 cup
Juices	
Apple	0.74/1 cup
Grapefruit	1.0/1 cup
Grape	1.3/1 cup
Orange	1.0/1 cup
Vegetables	
Cooked	
Asparagus	1.5/7 spears
Beans, string, green	3.4/1 cup
Broccoli	5.0/1 stalk
Brussels sprouts	4.6/7-8 sprouts
Cabbage	2.9/1 cup (cooked)
Carrots	4.6/1 cup

Cauliflower	2.1/1 cup
Peas	7.2/1 cup (cooked)
Potato (with skin)	2.3/1 boiled
Spinach	4.1/1 cup (raw)
Squash, summer	3.4/1 cup (cooked, diced)
Sweet potatoes	2.7/1 baked
Zucchini	4.2/1 cup (cooked, diced)
Raw	
Cucumber	0.2/6-8 slices with skin
Lettuce	2.0/1 wedge iceberg
Mushrooms	0.8/half cup (sliced)
Onions	1.3/1 cup
Peppers, green	1.0/1 pod
Tomato	1.8/1 tomato
Spinach	8.0/1 cup (chopped)
Legumes	
Baked beans	18.6/1 cup
Dried peas	4.7/half cup (cooked)
Kidney beans	7.4/half cup (cooked)
Lima beans	2.6/half cup (cooked)
Lentils	1.9/half cup (cooked)
Breads, pastas, and flours	
Bagels	1.1/half bagel
Bran muffins	6.3/muffin
Cracked wheat	4.1/slice
Oatmeal	5.3/1 cup
Pumpernickel bread	1.0/slice
White bread	0.55/slice
Whole-wheat bread	1.66/slice
Pasta and rice cooked	
Macaroni	1.0/1 cup (cooked)
Rice, brown	2.4/1 cup (cooked)

Rice, polished	0.6/1 cup (cooked)
Spaghetti (regular)	1.0/1 cup (cooked)
Flours and grains	
Bran, oat	8.3/oz
Bran, wheat	12.4/oz
Rolled oats	13.7/1 cup (cooked)
Nuts	
Almonds	3.6/half cup (slivered)
Peanuts	11.7/1 cup

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Graphic 82094 Version 5.0

Procedure-related bleeding risk from gastrointestinal procedures

Higher-risk procedures
Polypectomy*
Biliary or pancreatic sphincterotomy
Treatment of varices
PEG placement[¶]
Therapeutic balloon-assisted enteroscopy
EUS with FNA[Δ]
Endoscopic hemostasis
Tumor ablation
Cystgastrostomy
Ampullary resection
EMR
Endoscopic submucosal dissection
Pneumatic or bougie dilation
PEJ
Low-risk procedures
Diagnostic (EGD, colonoscopy, flexible sigmoidoscopy) including mucosal biopsy
ERCP with stent (biliary or pancreatic) placement or papillary balloon dilation without sphincterotomy
Push enteroscopy and diagnostic balloon-assisted enteroscopy
Capsule endoscopy
Enteral stent deployment (controversial)
EUS without FNA
Argon plasma coagulation
Barrett's ablation

EGD: esophagogastroduodenoscopy; ERCP: endoscopic retrograde cholangiopancreatography; PEG: percutaneous endoscopic gastrostomy; EUS: endoscopic ultrasound; FNA: fine-needle aspiration; EMR: endoscopic mucosal resection; PEJ: percutaneous endoscopic jejunostomy.

* Among patients undergoing colonic polypectomy, the size of the polyp influences the risk of bleeding, and it may be more appropriate to categorize polyps less than 1 cm in size as low risk for bleeding.

¶ PEG on aspirin or clopidogrel therapy is low risk. Does not apply to dual antiplatelet therapy.

Δ EUS-FNA of solid masses on aspirin/nonsteroidal anti-inflammatory drugs is low risk.

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Graphic 50700 Version 8.0

Condition-related risk of thromboembolic complications

High-risk conditions
Atrial fibrillation associated with valvular heart disease (including the presence of a mechanical valve)
Atrial fibrillation associated with congestive heart failure or a left ventricular ejection fraction of <35 percent
Atrial fibrillation associated with a history of a thromboembolic event
Atrial fibrillation associated with hypertension, diabetes, or age >75 years
Mechanical valves in the mitral position
Mechanical valves in patients who have had a prior thromboembolic event
Coronary stents placed within one year
Acute coronary syndrome
Nonstented percutaneous coronary intervention after myocardial infarction
Low-risk conditions
Deep vein thrombosis
Chronic or paroxysmal atrial fibrillation that is not associated with valvular disease
Bioprosthetic valves
Mechanical valves in the aortic position

Original figure modified for this publication. Anderson MA, Ben-Menachem T, Gan SI, et al. Management of antithrombotic agents for endoscopic procedures. Gastrointest Endosc 2009; 70:1060. Illustration used with the permission of Elsevier Inc. All rights reserved.

Graphic 77634 Version 2.0

Antibiotic prophylaxis for endoscopic procedures

Patient condition	Procedure contemplated	Antibiotic prophylaxis
High risk:		
Prosthetic heart valve or prosthetic material used for valve repair History of endocarditis Unrepaired cyanotic congenital heart disease (including palliative shunts and conduits) Repaired congential heart disease with residual defects at the site of or adjacent to a prosthetic device Completely repaired congenital heart defects with prosthetic material or device during the first six months after the repair Cardiac valvulopathy in a transplanted heart	Stricture dilation Variceal sclerotherapy ERCP/obstructed biliary tree	Not recommended
	Other endoscopic procedures, including EGD and colonoscopy (with or without biopsy/polypectomy), variceal ligation	Not recommended
Moderate risk:		
Most other congenital abnormalities Acquired valvular dysfunction (eg, rheumatic heart disease) Hypertrophic cardiomyopathy Mitral valve prolapse with regurgitation or thickened leaflets	Esophageal stricture dilation Variceal sclerotherapy	Not recommended
	Other endoscopic procedures, including EGD and colonoscopy (with or without biopsy/polypectomy), variceal ligation	Not recommended
Low risk:		
Other cardiac conditions (CABG, repaired septal defect or patent ductus, mitral valve prolapse without valvular regurgitation, isolated secundum atrial septal defect, physiologic/functional/innocent heart murmurs, rheumatic fever without valvular dysfunction, pacemakers, implantable defibrillators)	All endoscopic procedures	Not recommended
Obstructed bile duct without cholangitis	ERCP with complete drainage	Not recommended

Obstructed bile duct with cholangitis	ERCP with anticipated incomplete drainage	Recommended (continue antibiotics after procedure)
Pancreatic cystic lesion	ERCP, EUS-FNA	Recommended
Cirrhosis acute gastrointestinal bleed (required for patients with or without endoscopic procedures)	All endoscopic procedures	Recommended
Ascites, immunocompromised patient	Stricture dilation Variceal sclerotherapy Other endoscopic procedures, including EGD and colonoscopy (with or without biopsy/polypectomy), variceal ligation	No recommendation
All patients	Percutaneous endoscopic feeding tube placement	Recommended (parenteral cephalosporin or equivalent)
Vascular graft		AHA: Recommended antibiotic usage within 6 months of procedure ASGE: Antibiotics not recommended
Prosthetic joints	All endoscopic procedures	Not recommended

This summary table is based upon recommendations from the American Society of Gastrointestinal Endoscopy (Banerjee, S, Shen, B, Baron, T, et al. Gastrointest Endosc 2008; 67:791) and the American Heart Association (Wilson, W, Taubert, KA, Gewitz, M, et al. Circulation 2007; 116:1736 and Nishimura, RA, Carabello, BA, Faxon, DP, et al. Circulation 2008; 118:887). NOTE: See other table ("Antibiotic regimens: Prophylaxis for endoscopic procedures") for specific regimens.

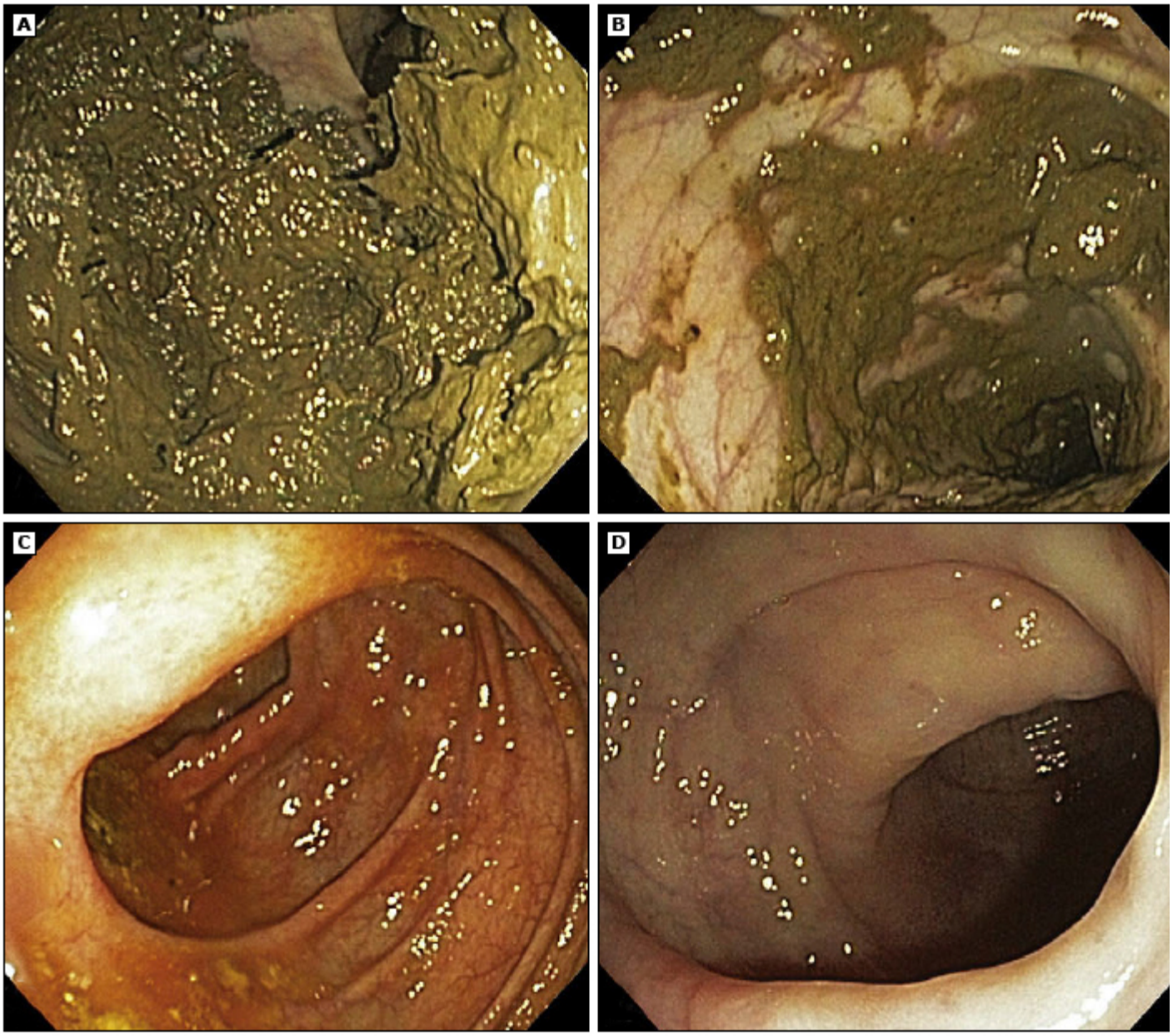
CABG: coronary artery bypass graft; ERCP: endoscopic retrograde cholangiopancreatography; EGD: esophagogastroduodenoscopy; EUS-FNA: endoscopic ultrasound with fine needle aspiration; AHA: American Heart Association; ASGE: American Society for Gastrointestinal Endoscopy.

Modified with permission from: Hirota WK, Petersen K, Baron TH, et al. Guidelines for Antibiotic Prophylaxis for GI

Endoscopy. Gastrointest Endosc 2003; 58:475. Copyright © 2003 Elsevier.

Graphic 51133 Version 5.0

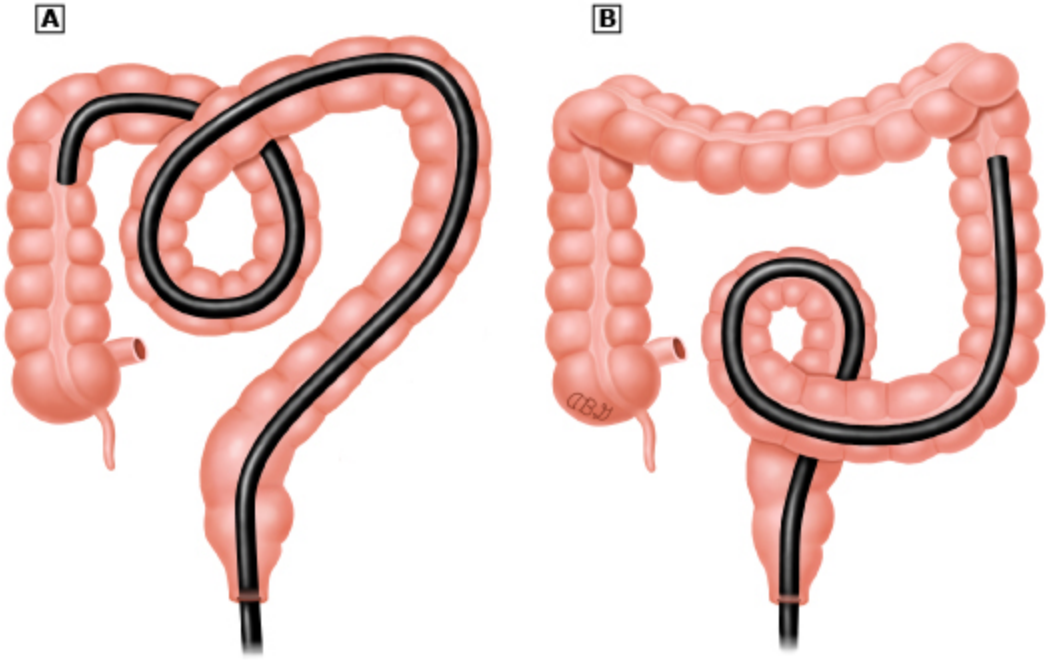
Boston bowel preparation scale



The BBPS. A: Segment score 0, unprepared colon segment with mucosa not seen because of solid stool that cannot be cleared. B: Segment score 1, portion of mucosa of the colon segment seen, but other areas of the colon segment not well seen because of staining, residual stool, and/or opaque liquid. C: Segment score 2, minor amount of residual staining, small fragments of stool and/or opaque liquid, but mucosa of colon segment seen well. D: Segment score 3, entire mucosa of colon segment seen well with no residual staining small fragments of stool and/or opaque liquid.

Graphic 104523 Version 1.0

Looping during colonoscopy

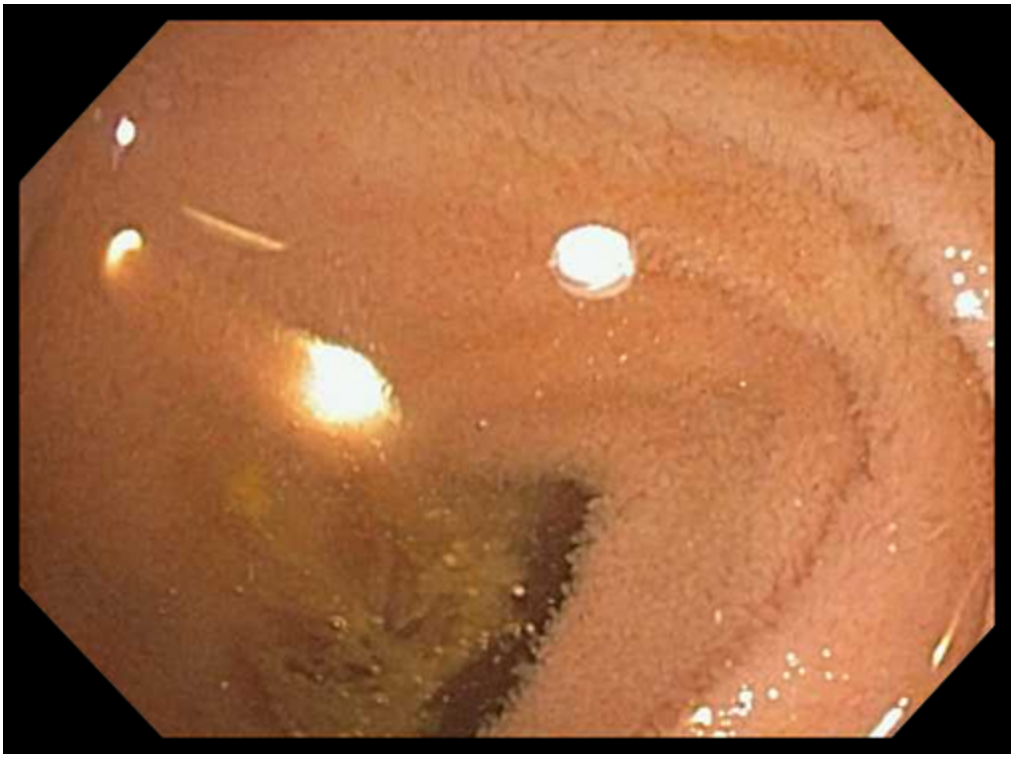


(A) (on left) Shows a "gamma" loop in the transverse colon.

(B) (on right) Shows an "alpha" loop in the sigmoid colon.

Graphic 82950 Version 2.0

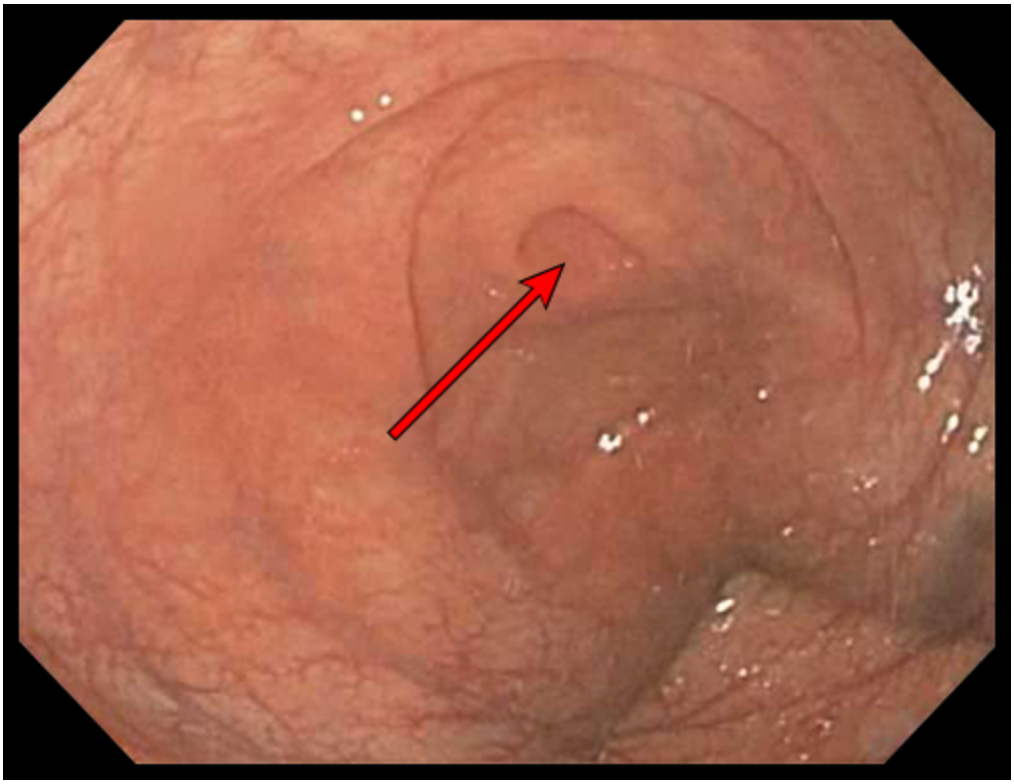
Terminal ileum



Terminal ileum seen during colonoscopy. Numerous villi can be seen covering the surface of the terminal ileum.

Graphic 83345 Version 1.0

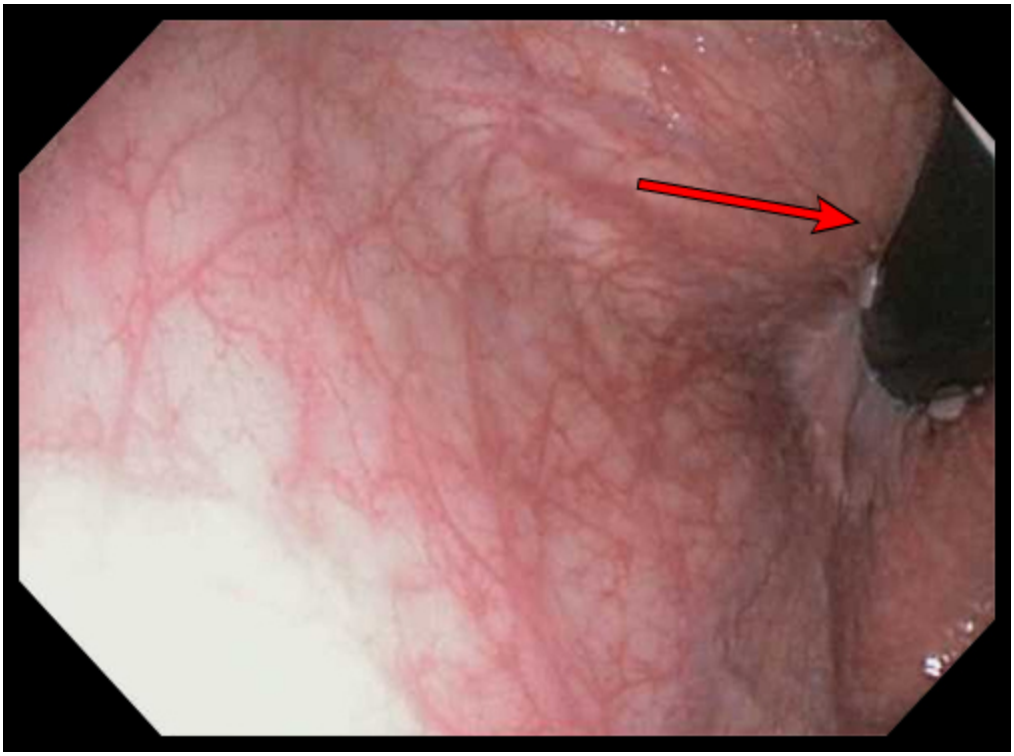
Cecum



Cecum seen during colonoscopy. The crescent-shaped structure is the appendiceal orifice (arrow).

Graphic 83347 Version 1.0

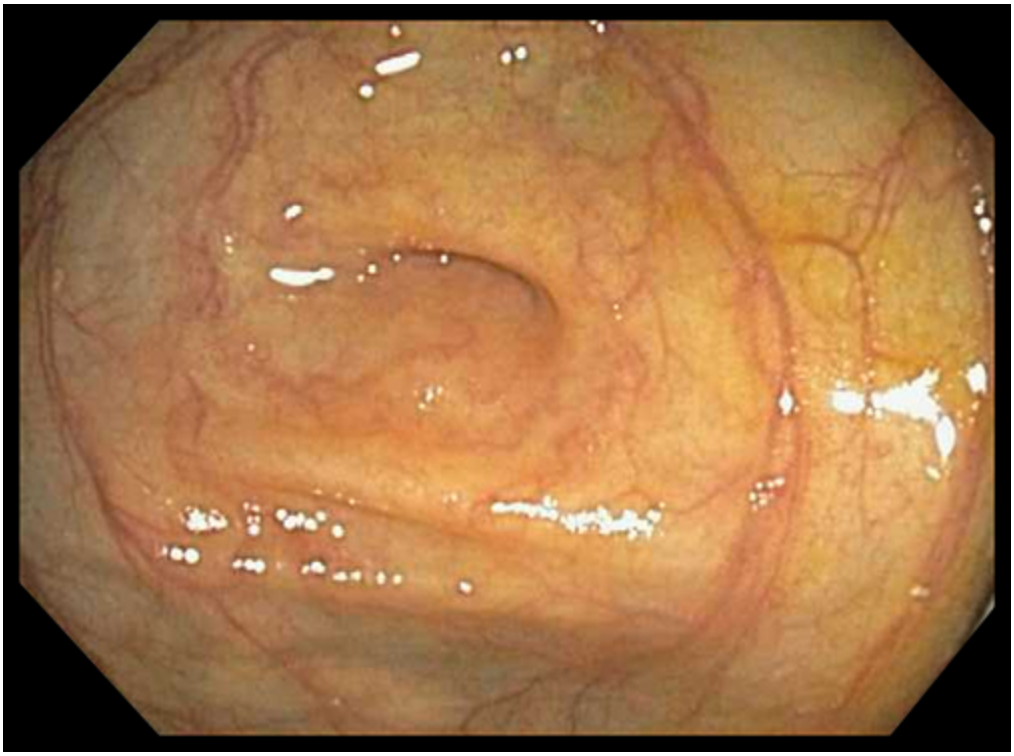
Rectum



Rectum seen during colonoscopy. The colonoscope is in a retroflexed position, allowing for visualization of the lower rectum. The colonoscope is visible in the upper right corner of the image (arrow).

Graphic 83343 Version 1.0

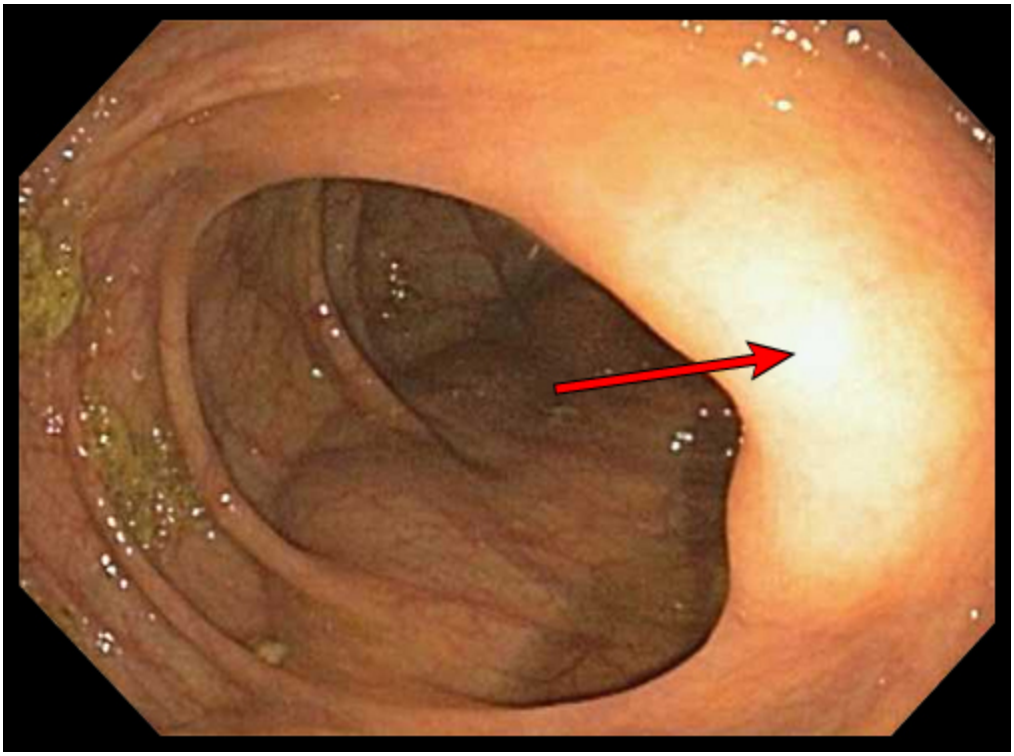
Appendiceal orifice



Appendiceal orifice seen during colonoscopy.

Graphic 83339 Version 1.0

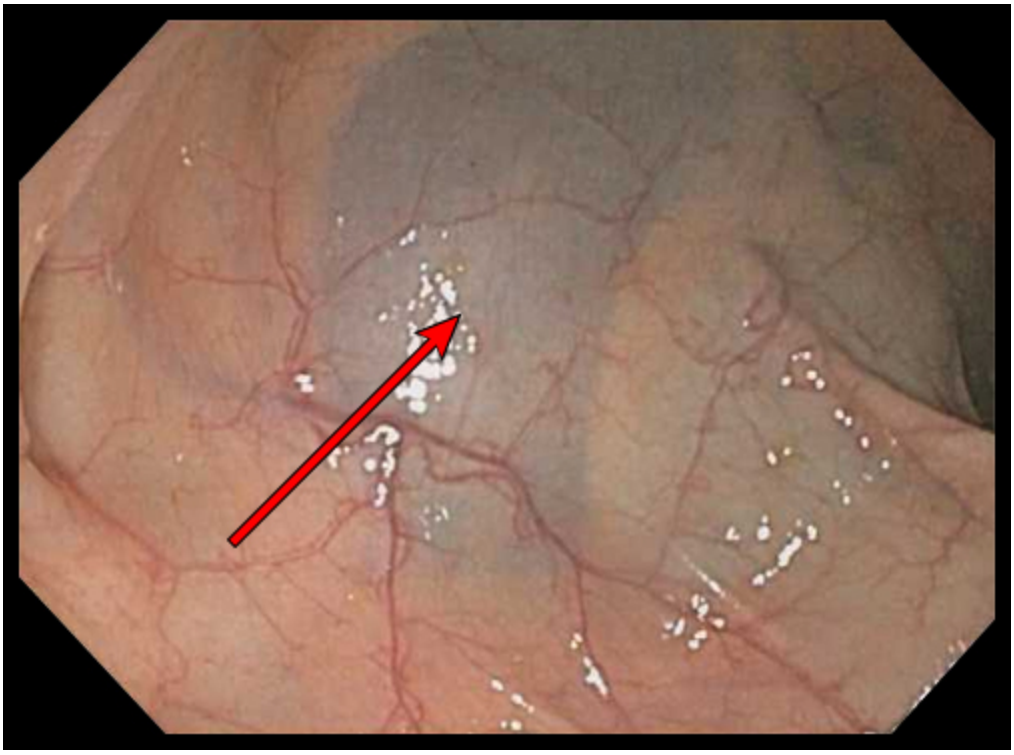
Ileocecal valve



Ileocecal valve seen during colonoscopy. One defining characteristic of the ileocecal valve is the lipomatous lips (arrow).

Graphic 83342 Version 2.0

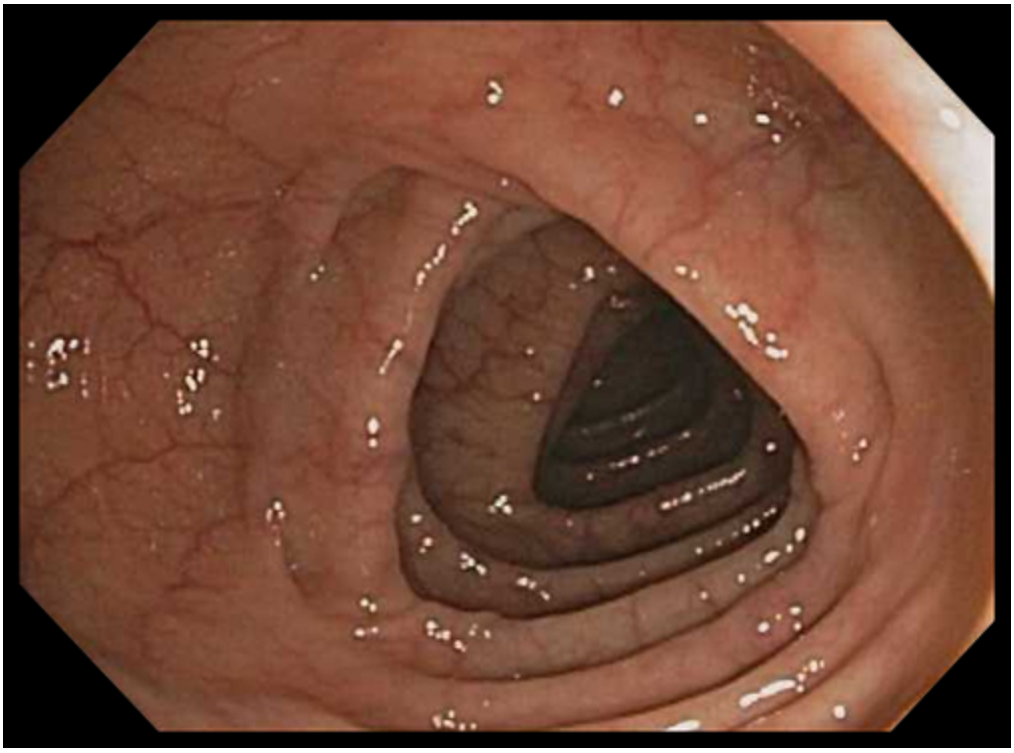
Hepatic flexure



Hepatic flexure seen during colonoscopy. The liver can be seen through the wall of the colon (arrow).

Graphic 83341 Version 1.0

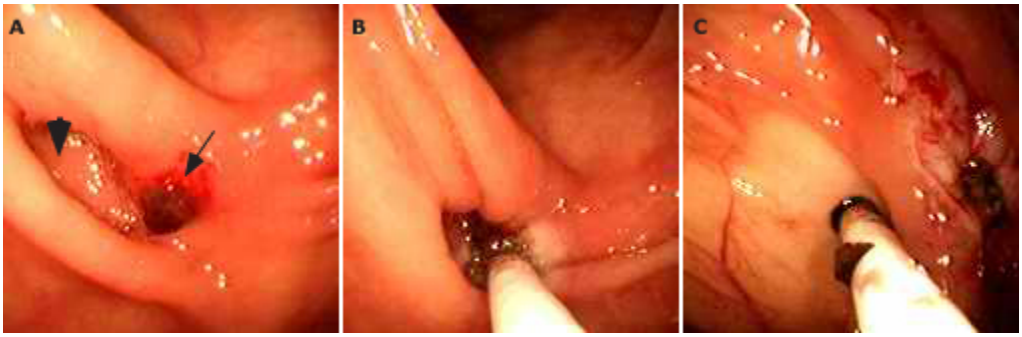
Transverse colon



Transverse colon seen during colonoscopy. The triangular shape seen here is characteristic of the transverse colon.

Graphic 83346 Version 1.0

Treatment of a bleeding colonic diverticulum

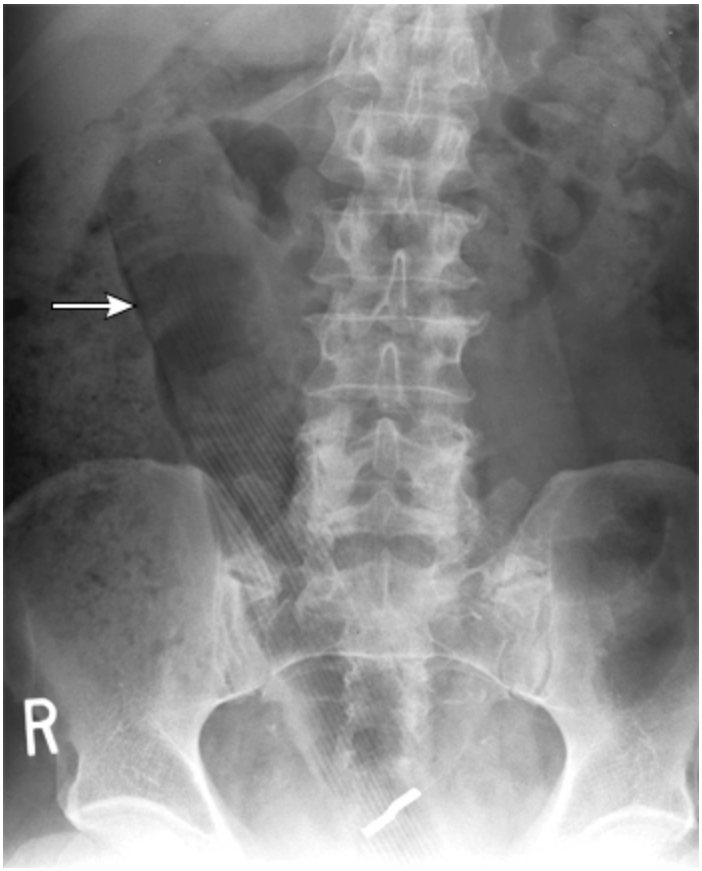


An oozing visible vessel (arrow) can be seen at the mouth of a sigmoid diverticulum (arrowhead, Panel A). The vessel was treated with combination endoscopic therapy using epinephrine injection (1:10,000 dilution) followed by Gold probe electrocautery (Panel B). The area was then tattooed with India ink for easy identification in the event of rebleeding or the need for surgery.

Courtesy of Rome Jutabha, MD.

Graphic 58198 Version 2.0

Colonic foreign body

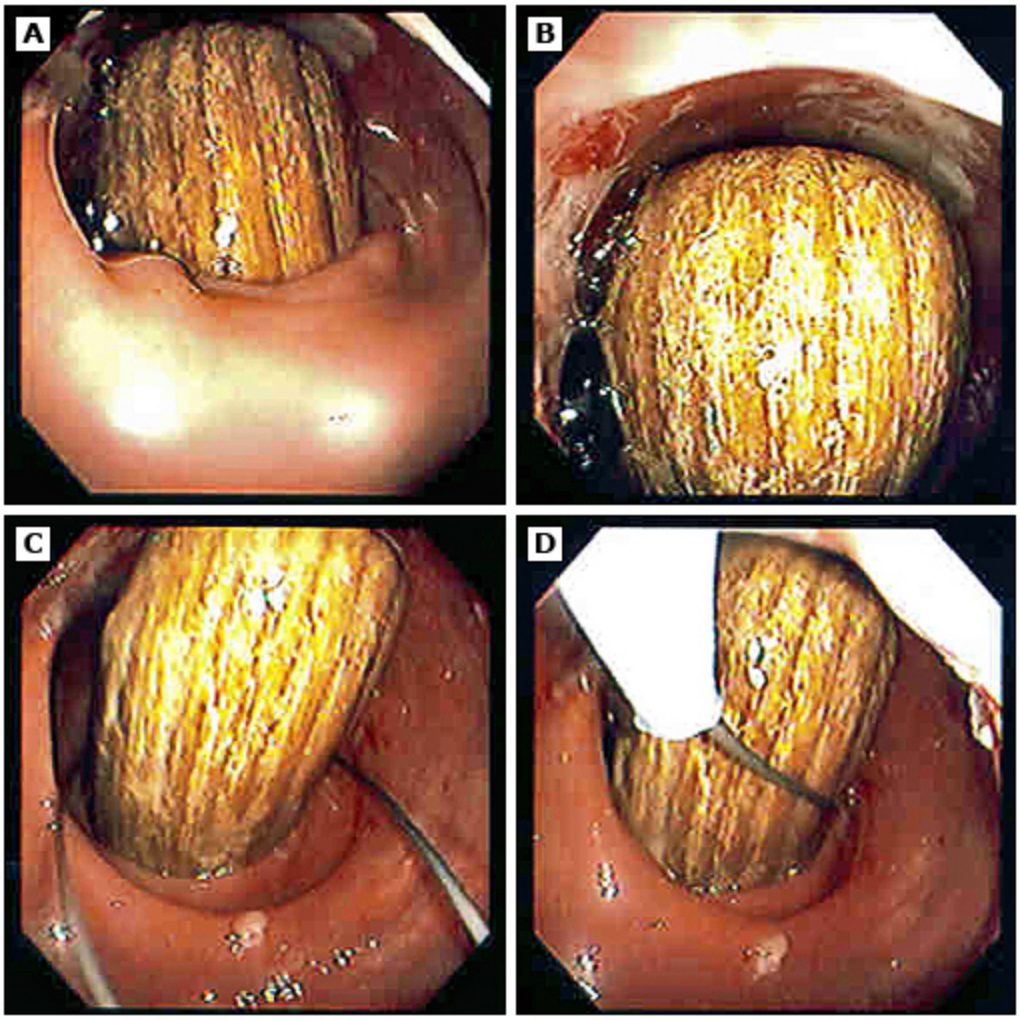


Plain film demonstrating a Billy club extending toward the right upper quadrant (arrow).

Courtesy of Scott Steele, MD.

Graphic 58085 Version 3.0

Endoscopic view and snare of the Billy club

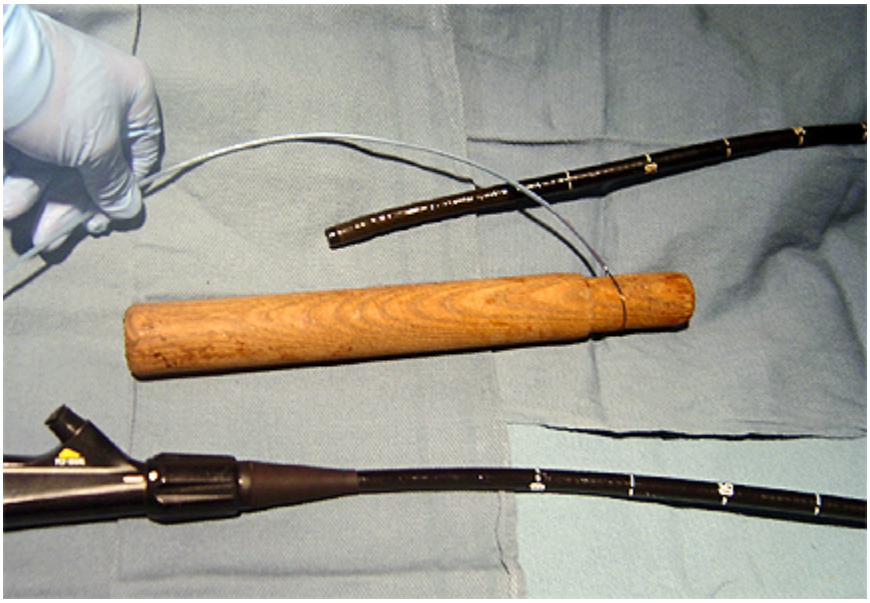


A polypectomy snare is deployed around the Billy club, and gentle traction under direct visualization is used to guide the foreign body toward the rectum for transanal extraction.

Courtesy of Justin A Maykel, MD.

Graphic 61271 Version 2.0

Snare extraction of the Billy club

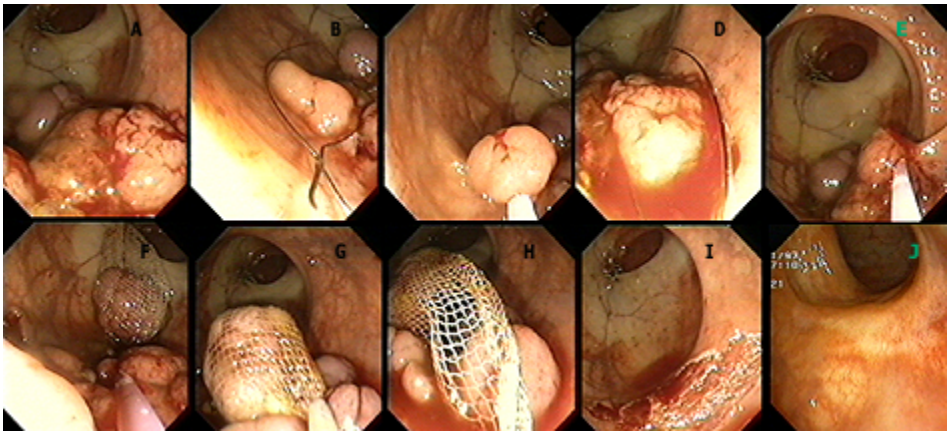


Picture demonstrating the Billy club following successful transanal extraction. The colonoscope is also visible.

Courtesy of Justin A Maykel, MD.

Graphic 76634 Version 2.0

Resection of a large sessile colonic polyp



(A) Sessile polyp in the sigmoid colon measuring approximately 4 cm; (B/C) A monofilament stiff snare is applied tangentially to ensnare a flat portion of the lesion. For complete resection, it is advisable to begin working from a lateral margin of the polyp; (D/E) In repeated maneuvers the polyp is resected in a piecemeal technique. (F) A retrieval net is used to collect the resected pieces; (G/H) The net can be opened and closed repeatedly without losing the previously collected pieces; (I) Resection site after complete mucosectomy; (J) Clean scar at follow-up three months later.

Courtesy of Uwe Seitz, MD, Sabine Bohnacker, MD, and Nib Soehendra, MD.

Graphic 62455 Version 2.0

American Society of Anesthesiologists Physical Status (ASA PS) Classification System

ASA PS classification	Definition	Examples, including, but not limited to:
ASA I	A normal healthy patient	Healthy, nonsmoking, no or minimal alcohol use.
ASA II	A patient with mild systemic disease	Mild diseases only without substantive functional limitations. Current smoker, social alcohol drinker, pregnancy, obesity (30<BMI<40), well-controlled DM/HTN, mild lung disease.
ASA III	A patient with severe systemic disease	Substantive functional limitations; one or more moderate to severe diseases. Poorly controlled DM or HTN, COPD, morbid obesity (BMI ≥40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESKD undergoing regularly scheduled dialysis, premature infant PCA <60 weeks, history (>3 months) of MI, CVA, TIA, or CAD/stents.
ASA IV	A patient with severe systemic disease that is a constant threat to life	Recent (<3 months) MI, CVA, TIA, or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARDS, or ESKD not undergoing regularly scheduled dialysis.
ASA V	A moribund patient who is not expected to survive without the operation	Ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction.
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes	

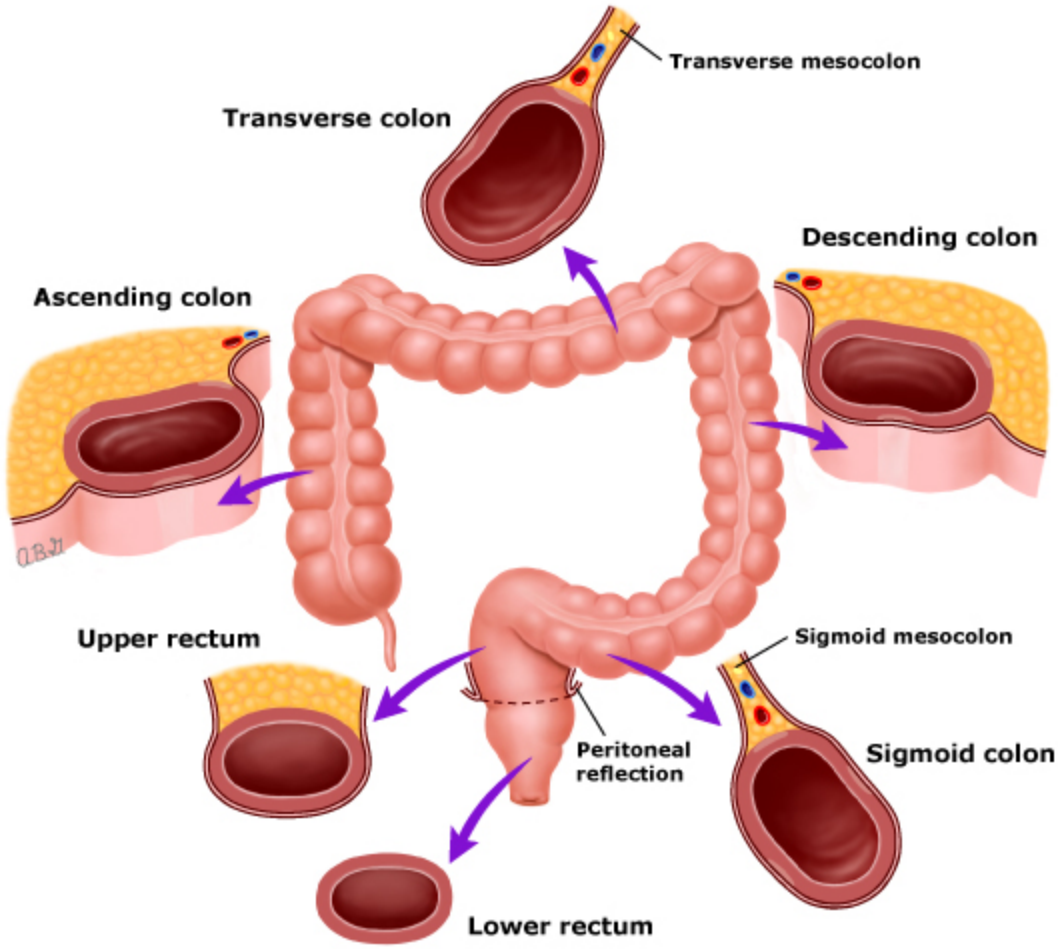
The addition of "E" to the numerical status (eg, IE, IIE, etc) denotes Emergency surgery (an emergency is defined as existing when delay in treatment of the patient would lead to a significant

increase in the threat to life or body part).

BMI: body mass index; DM: diabetes mellitus; HTN: hypertension; COPD: chronic obstructive pulmonary disease; ESKD: end-stage kidney disease; PCA: post conceptual age; MI: myocardial infarction; CVA: cerebrovascular accident; TIA: transient ischemic attack; CAD: coronary artery disease; DIC: disseminated intravascular coagulation; ARDS: acute respiratory distress syndrome.

Graphic 87504 Version 9.0

Idealized representation of the peritoneal and mesenteric relationships at various levels of the colon and rectum



Both the transverse and sigmoid colon are located intraperitoneally; at these levels, the visceral peritoneum forms a complete covering over the exterior of the bowel (the serosa), which is continuous with the mesentery (transverse and sigmoid mesocolon). In contrast, the ascending and descending colon lie within the lateral peritoneal cavity with their posterior and lateral surfaces in the retroperitoneum. At these levels, the visceral peritoneum is only present anteriorly and medially; there is no true mesentery, since the developing mesentery has fused to the posterior parietal peritoneum. The upper portion of the rectum lies above the peritoneal reflection. The anterior surface is covered by peritoneum (which forms the rectovesical pouch in men and the rectouterine pouch in women); there is no serosa over its posterior surface. The lower rectum lies beneath the peritoneum and has no serosal layer.

Graphic 81248 Version 3.0

US multi-society task force recommendations for post-colonoscopy follow-up in average-risk adults with normal colonoscopy or adenomas*

Baseline colonoscopy finding	Recommended interval for surveillance colonoscopy	Strength of recommendation	Quality of evidence
Normal	10 years¶	Strong	High
1 to 2 tubular adenomas <10 mm	7 to 10 yearsΔ	Strong	Moderate
3 to 4 tubular adenomas <10 mm	3 to 5 years	Weak	Very low
5 to 10 tubular adenomas <10 mm	3 years	Strong	Moderate
Adenoma ≥10 mm	3 years	Strong	High
Adenoma with tubulovillous or villous histology	3 years◇	Strong	Moderate
Adenoma with high-grade dysplasia	3 years◇	Strong	Moderate
>10 adenomas on single examination§	1 year	Weak	Very low
Piecemeal resection of adenoma ≥20 mm	6 months	Strong	Moderate¥

CRC: colorectal cancer.

* All recommendations assume examination complete to cecum with bowel preparation adequate to detect lesions >5 mm in size; recommendations do not apply to individuals with a hereditary CRC syndrome, personal history of inflammatory bowel disease, personal history of hereditary cancer syndrome, serrated polyposis syndrome, malignant polyp, personal history of CRC, or family history of CRC, and must be judiciously applied to such individuals, favoring the shortest indicated interval based on either history or polyp findings.

¶ Follow-up may be with colonoscopy or other screening modality for average-risk individuals.

Δ Patients with recommendations issued before 2020 for shorter than 7- to 10-year follow-up after diagnosis of 1 to 2 tubular adenomas may follow original recommendations. If feasible, physicians may re-evaluate patients previously recommended an interval shorter than 10 years and reasonably choose to provide an updated recommendation for 7- to 10-year follow-up, taking into account factors such as quality of baseline examination, polyp history, and patient preferences.

◇ Assumes high confidence of complete resection.

§ Patients with >10 adenomas or lifetime >10 cumulative adenomas may need to be considered for genetic testing based on absolute/cumulative adenoma number, patient age, and other factors such as family history of CRC (refer to UpToDate text).

¥ Refer to US Multi-Society Task Force recommendations for endoscopic removal of colorectal lesions.

Graphic 127123 Version 5.0

US multi-society task force recommendations for post-colonoscopy follow-up in average-risk adults with serrated polyps*

Baseline colonoscopy finding	Recommended interval for surveillance colonoscopy	Strength of recommendation	Quality of evidence
≤20 HPs in rectum or sigmoid colon <10 mm¶	10 years[Δ]	Strong	Moderate
≤20 HPs proximal to sigmoid colon <10 mm¶	10 years	Weak	Very low
1 to 2 SSPs <10 mm	5 to 10 years	Weak	Very low
3 to 4 SSPs <10 mm	3 to 5 years	Weak	Very low
5 to 10 SSPs <10 mm	3 years	Weak	Very low
SSP ≥10 mm	3 years	Weak	Very low
SSP with dysplasia◇	3 years	Weak	Very low
HP ≥10 mm	3 to 5 years[§]	Weak	Very low
TSA	3 years	Weak	Very low
Piecemeal resection of SSP ≥20 mm	6 months	Strong	Moderate[¥]

SSP: sessile serrated polyp; HP: hyperplastic polyp; TSA: traditional serrated adenoma; CRC: colorectal cancer.

* All recommendations assume examination complete to cecum with bowel preparation adequate to detect lesions >5 mm in size; recommendations do not apply to individuals with a hereditary CRC syndrome, personal history of inflammatory bowel disease, personal history of hereditary cancer syndrome, serrated polyposis syndrome, or malignant polyp, personal history of CRC, or family history of CRC, and must be judiciously applied to individuals with a personal or family history of CRC, favoring the shortest indicated interval based on either history or polyp findings.

¶ Patients with cumulative >20 hyperplastic polyps distributed throughout the colon, with at least 5 being proximal to the rectum, as well as those with 5 serrated polyps proximal to the rectum >5 mm, with at least two ≥10 mm meet criteria for serrated polyposis syndrome and may require specialized management.

Δ Follow-up may be with colonoscopy or other screening modality for average risk individuals.

◇ Assumes high confidence of complete resection.

§ A 3-year follow-up interval is favored if concern about consistency in distinction between SSP and HP locally, bowel preparation, or complete excision, whereas a 5-year interval is favored if low concerns for consistency in distinction between SSP and HP locally, adequate bowel preparation, and confident complete excision.

¥ Refer to US Multi-Society Task Force recommendations for endoscopic removal of colorectal lesions.

Graphic 127124 Version 4.0

Contributor Disclosures

Linda Lee, MD Consultant/Advisory Boards: Boston Scientific [Advanced endoscopy]; Fujifilm Medical Systems USA [Advanced endoscopy]. All of the relevant financial relationships listed have been mitigated. **John R Saltzman, MD, FACP, FACG, FASGE, AGAF** No relevant financial relationship(s) with ineligible companies to disclose. **Douglas G Adler, MD, FACG, AGAF, FASGE** Consultant/Advisory Boards: Abbvie [Endoscopy]; Boston Scientific [Endoscopy]; Endorotor [Endoscopy]; Merit [Endoscopy]; Olympus [Endoscopy]. Speaker's Bureau: Abbvie [Pancreatology, general GI]. All of the relevant financial relationships listed have been mitigated. **Shilpa Grover, MD, MPH, AGAF** No relevant financial relationship(s) with ineligible companies to disclose.

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Conflict of interest policy

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