Endoscopy

9

Jeffrey Silverstein, Eric Ballecer, Umair Nasir, and James Grendell

Esophagogastroduodenoscopy

Indications	Contraindications
Dyspepsia with alarm symptoms or age > 45 or unresponsive to therapy Dysphagia/odynophagia New onset GERD in older adults Persistent vomiting of unknown cause FAP Abnormal UGI tract X-ray GI bleeding Iron-deficiency anemia (normal colonoscopy) Portal HTN: Document or treat esophageal varices Abnormal radiologic findings Screening for Barrett's esophagus for patients with multiple risk factors	Patient unable to tolerate sedation Hemodynamically unstable patients

J. Silverstein (✉)
Department of Surgery, NYU Long Island School of Medicine, Mineola, NY, USA

E. Ballecer · U. Nasir
Department of Gastroenterology, NYU Long Island School of Medicine, NYU Langone—Long Island Hospital, Mineola, NY, USA
e-mail: umair.nasir@nyulangone.org

J. Grendell
Division of Gastroenterology, Hepatology and Nutrition, NYU Long Island School of Medicine, NYU Langone—Long Island Hospital, Mineola, NY, USA
e-mail: james.grendell@nyulangone.org

H. Ajouz et al. (eds.), *The ABSITE Blueprints*, https://doi.org/10.1007/978-3-031-32643-1_9

Surveillance

Surveillance	
Condition	**Surveillance**
Familial adenomatous polyposis	1–5 years starting at age 20–25
Barrett's esophagus	Non-neoplastic metaplasia: 3 years Low-grade intestinal metaplasia: 6–12 months
Esophageal varices following sclerotherapy and banding	Every 6–8 weeks, until all varices are obliterated, then yearly
Gastric ulcer	Every 6 weeks until healed with biopsy and brushings
Esophageal ulcer	Every 6 weeks until healed with biopsy and brushings
ASGE guidelines ➔ do not recommend screening for diagnoses of gastric atrophy, including intestinal metaplasia without dysplasia, treated achalasia, or a history of gastrectomy • Patients with pernicious anemia should have a single endoscopy with no follow-up	

Preoperative Consideration

Preoperative considerations	
Positioning	**Lying down on their left side** **Right side is down** ➔ for an acute UGI bleed (blood will pool in the fundus and may hide a Dieulafoy lesion in the fundus)
Anesthesia	• Some patients may not need sedation if using small-diameter endoscopes (<6 mm) • Topical anesthesia in the form of sprays may be used to improve tolerance • Indications for sedation ➔ moderate level adequate for most diagnostic and uncomplicated therapeutic interventions in the majority of patients Indications for general anesthesia ➔ patients with increased risk for aspiration, difficult airway management, or increased cardiopulmonary complications of endoscopy Throughout the procedure ➔ practice principles of safe sedation (continuous pulse oximetry and ECG monitoring)
Antibiotics	Because the risk of infection related to routine diagnostic upper endoscopy is low ➔ antibiotic prophylaxis is not recommended

Key Steps for EGD

Management of foreign bodies	
Case	**Management**
Object >6 cm long or > 2 cm wide	Endoscopic removal
Coins + symptomatic patient	Urgent removal

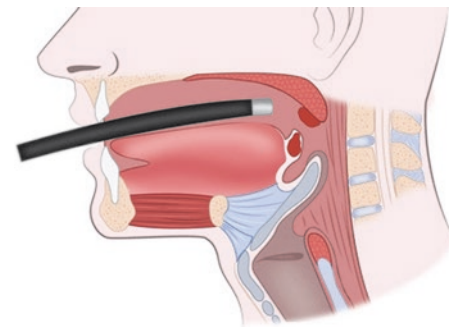
Management of foreign bodies	
Case	**Management**
Coin ingested + asymptomatic patient	Endoscopic retrieval if object remain >3–4 weeks
Sharp, pointed object	Urgent endoscopic removal
>2 magnets	Emergency endoscopic removal Children who present >12 h after ingestion are more susceptible to perforation and fistula (**ulceration of the gastric mucosa can occur in less than 8 h**)
Button battery ingestion + symptomatic	Emergency endoscopic retrieval
Button battery + asymptomatic + child <5 years + battery ≥20 mm in diameter	Urgent endoscopic retrieval
Button battery + asymptomatic + child >5 years + battery ≥20 mm in diameter	Serial X-ray at 48 h if battery >20 mm or 14 days if battery ≤20 mm
Button battery + asymptomatic patient + button battery retained in stomach after 10–14 days + battery <20 mm	Endoscopic removal
Any foreign body in esophagus >24 h	Endoscopy under GA + surgical consultation

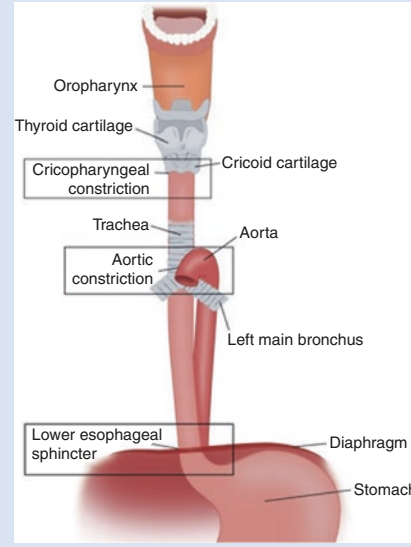
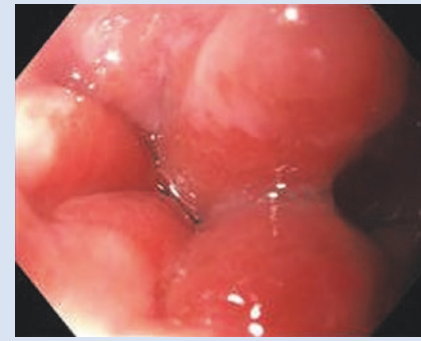
Indications for endoscopy in patients with foreign body ingestion	
Emergent endoscopy	Esophageal obstruction (evidenced by an inability to handle oral secretions) Disk batteries in the esophagus Sharp-pointed objects in the esophagus
Urgent Endoscopy (within 24 h)	Esophageal foreign objects that are not sharp-pointed Esophageal food impaction without complete obstruction Sharp-pointed objected in the stomach or duodenum Objects >6 cm in length at or above the proximal duodenum Magnets within endoscopic reach Caustic substances GI bleeding

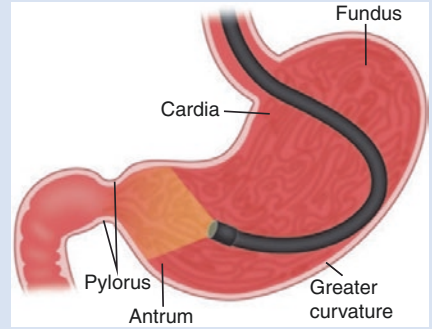
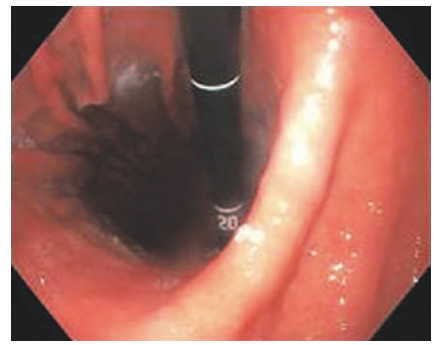
Indications for endoscopy in patients with foreign body ingestion	
Non-urgent endoscopy	Coins in the esophagus may be observed for 12–24 h in asymptomatic patients Blunt objects in the stomach that are >2.5 cm in diameter Disk batteries and cylindrical batteries that are in the stomach in patients without signs of gastrointestinal injury ➔ may be observed for up to 48 h (disk batteries that are >20 mm are unlikely to pass ➔ should be removed) Blunt objects that fail to pass the stomach in three to 4 weeks Blunt objects distal to the duodenum that remain in the same location for more than a week (deep small bowel enteroscopy or surgery may be required depending on the location of the object)

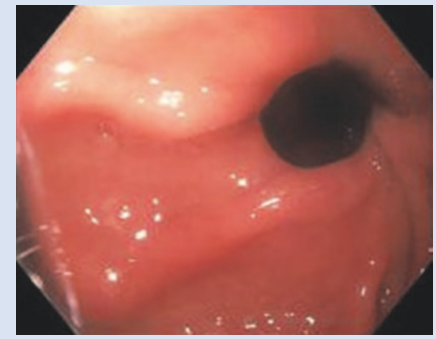
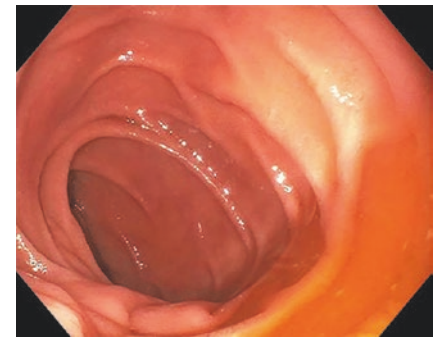
Research	
Reference	**Findings**
American Pediatric Surgical Association. Pediatric surgery not a textbook (NaT): gastroduodenal foreign bodies	Honey is recommended immediately on recognition of button battery ingestion as it coats the battery, stopping the energy release and damage to the adjacent mucosa

Key Steps for EGD

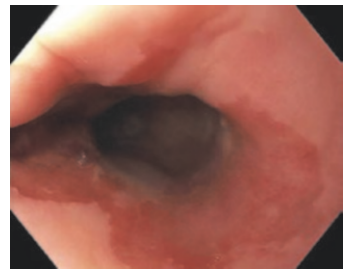
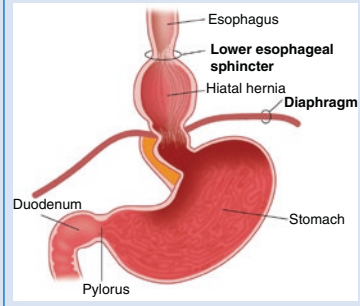
Key steps of the procedure		
Key Steps	**Description**	**Figure**
Insertion	The endoscope is inserted into the oral cavity and advanced over the tongue until visualization of the epiglottis and vocal cords Gentle pressure is then applied to advance the scope into the esophageal introitus Having the patient's chin tilted toward the chest facilitates entry of the scope into the esophagus	
Esophageal examination	Upon entry into the esophageal lumen, air is insufflated and the mucosa inspected	
Mid-esophagus	Long, straight tube characterized by smooth, pale pink squamous mucosa	

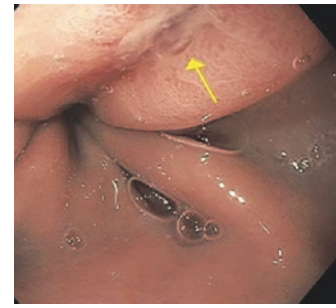
Key steps of the procedure		
Key Steps	**Description**	**Figure**
Normal areas of narrowing of the esophagus include:	Common regions for foreign body impaction in the esophagus at three areas of physiologic narrowing: 1. Upper esophageal sphincter (18 cm from incisors) 2. Thoracic esophagus at crossover of the aortic arch (22 cm from incisors) 3. Lower esophageal sphincter (40 cm from esophagus)	
Distal esophagus	It is important to examine the distal esophagus for erosions or erythema at this stage, as the remainder of the exam may alter the appearance of this area and make later examination inaccurate	
Gastroesophageal junction	Esophagogastric junction is generally at 40 cm from incisors Squamocolumnar junction(Z-line): Is the area where the squamous epithelial lining of the esophagus meets the columnar lining of the stomach Difference between Z-line and diaphragmatic pinch aids in differentiating between Barrett's and hiatal hernia	
Stomach	Once you enter the body of the stomach Suction dry the gastric pool of secretions Straighten the endoscope and hold it at a right angle to the patient	

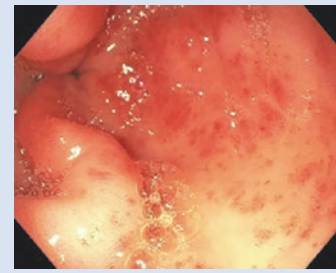
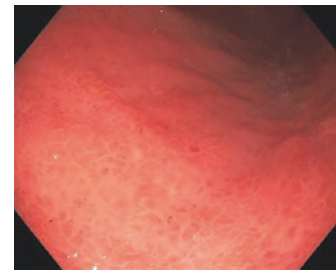
Key steps of the procedure		
Key Steps	**Description**	**Figure**
Examining antrum and body of stomach	Continue insufflation and advancement of the endoscope ➔ you will see the antral/body junction, and then the pylorus, which will often be oriented at the 1–2 o'clock position on the screen	
Body vs antrum of stomach	The incisura angularis is reached by following the lesser curvature, and it divides the gastric body from the antrum A gastric fold that serves as a landmark to distinguish the body of stomach from the antrum of stomach The antral mucosa is smooth	 Gastric body  Incisura angularis
Stomach	Presence of characteristic rugae folds The lesser curvature is at the 12 o'clock position, the posterior gastric wall is at the 3 o'clock position, and the greater curvature is at the 6 o'clock position	

Key steps of the procedure		
Key Steps	**Description**	**Figure**
Gastric cardia and fundus	Retroflex the scope to view the gastric cardia, fundus, lesser curvature, and GE junction	
Pylorus	The scope can then slowly be advanced into the antrum and toward the pylorus	 Pylorus
Duodenum	Duodenal bulb: Semicircular folds are the hallmark of its architecture The duodenal bulb is inspected for inflammation or ulceration, and then the scope is advanced into the descending duodenum Descending duodenum (second portion) possesses the ampulla of Vater, which may be seen medially Further advancement with a sharp medial turn yields visualization of the third portion of the duodenum	

Pathological Findings

Pathological findings			
Findings	**Description**	**Figure**	**Management**
Barrett's esophagus	Metaplastic process in which normal squamous epithelium of the esophagus is replaced by epithelium that has gastric and intestinal components, characterized by goblet cell		Endoscopic surveillance with four-quadrant biopsies (1 cm interval): • Non-neoplastic metaplasia ➔ every 3 years • Low-grade intestinal metaplasia ➔ every 6–12 months • High-grade intestinal metaplasia ➔ endoscopic or surgical resection or ablation
Hiatal hernia	A portion of the stomach has herniated through the esophageal hiatus ➔ columnar-lined mucosa and top of the gastric folds will be seen proximal to the extrinsic narrowing of the lumen caused by the diaphragmatic pinch **Becomes most evident when the scope is retroflexed** (must be included in all EGDs). Will see if the crura are appropriately tight **Normal Z-line position: 30–40 cm from incisor: Variation raises concern for type 1 hiatal hernia** **Inability to pass scope into the duodenum with observed large hiatal hernia likely indicates volvulized paraesophageal hernia**		See esophagus chapter

Pathological findings			
Findings	**Description**	**Figure**	**Management**
Mallory-Weiss tear	Longitudinal mucosal and submucosal tear near GEJ Associated with retching Accounts for 5–10% of upper GI bleeding		Acid suppression Antiemetics EGD therapy with bleeding: Thermal coagulation, clipping
Schatzki ring	Non-malignant concentric fibrous thickening at GE junction with squamous epithelium above and columnar below		Biopsy Symptomatic ➔ dilation
Cameron erosion	Occur within the sac of a hiatal hernia Rarely cause overt GI bleeding but may produce occult blood loss, resulting in iron-deficiency anemia		Acid suppression Antiemetics Hiatal hernia repair
Varices	Dilated submucosal veins in response to portal hypertension Tenuous mucosa and easily excoriated Found in 30% of patients with cirrhosis and portal hypertension (30% of that group bleeds)		Nonselective beta blocker Variceal ligation ➔ medium to large size Acute hemorrhage: • Octreotide and vasopressin • EGD: Banding, stent if esophageal • Balloon tamponade Refractory bleeding or rebleeding ➔ TIPS

Pathological findings			
Findings	**Description**	**Figure**	**Management**
Dieulafoy's lesion/arteriovenous malformation	Dilated submucosal vessel that erodes the gastric epithelium without the presence of an ulcer Typically found in proximal stomach along lesser curvature		EGD especially effective during active bleeding
Gastric antral vascular ectasia	"Watermelon stomach" Longitudinal rows of red flat stripes radiating from the pylorus toward the antrum Associated with liver cirrhosis and systemic sclerosis		Episodic transfusions EGD: Argon plasma coagulation, laser therapy, radiofrequency ablation Antrectomy if endoscopy fails
Portal hypertensive gastropathy	Associated with cirrhosis Congestion and hyperemia of the stomach; snakeskin appearance; can lead to diffuse oozing		Nonselective beta blocker Bleeding: • Med: Octreotide, PPI • EGD with thermal therapy for focal areas Refractory: TIPS, liver transplant

Troubleshooting

Troubleshooting		
Problem	**Description**	**Management**
Excessive motility	Can make examination and intervention difficult	Option to use glucagon to "calm"
Excessive mucus and bubbles	Obscured view	Irrigation typically sufficient Can use simethicone dissolved in saline reduces surface tension of bubbles
Foreign material (food) or blood/clot	Obscures view ➔ increases risk of complication	Can give prokinetic agent 60–90 min prior to procedure

Complications of EGD

Complications and their treatment		
Complications	**Characteristics**	**Management**
Perforation	Occurs in 0.002–0.01% of cases Predisposing factors: Anterior cervical osteophyte, Zenker's diverticulum, esophageal stricture, malignancy, duodenal diverticula If stable: UGI series or CT with oral contrast for localization	Small perforations ➔ can be managed conservatively with bowel rest and antibiotics Repeat EGD for clip, stent or suture placement (highly operator dependent) If unstable or large perforation ➔ emergent OR
Cardiopulmonary event	Account for 60% of complications associated with EGD Includes: Aspiration pneumonia, PE, MI	Hypoxia: Open airway, supplemental O_2, collapse stomach, remove scope Cardiac: Collapse stomach, remove scope, stop sedation, ACLS protocol
Infection	Result of procedure or poorly cleaned equipment Transient bacteremia reported as high as 8%	
Bleeding	Very rare Risk increased for diagnostic EGD with thrombocytopenia Increased risk with esophageal dilation, PEG tube placement, endoscopic mucosal resection Mallory-Weiss tear can occur <0.5%	Hemodynamically stable (small hematemesis or coffee grounds) ➔ supportive care Ongoing bleeding ➔ endoscopic treatment

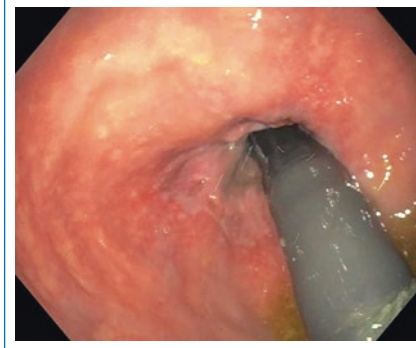
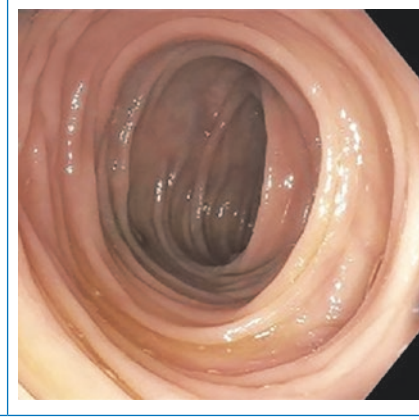
Colonoscopy

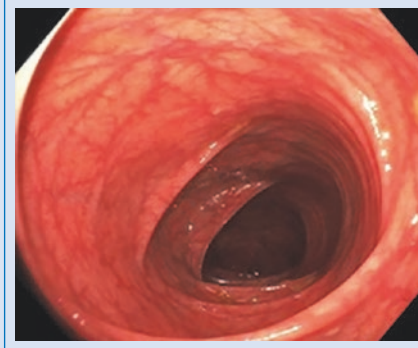
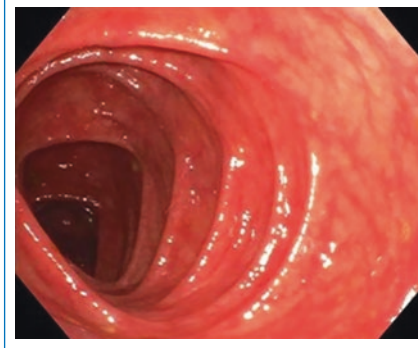
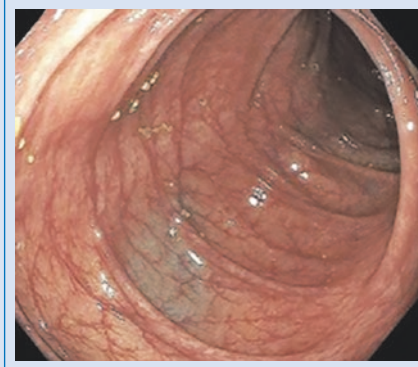
Indications	Contraindications
Lower gastrointestinal bleeding and endoscopic decompression Partially obstructing cancer Foreign body Sigmoid volvulus Elective: Screening, staging, surveillance, signs/symptoms • Colon cancer, polyp • Inflammatory bowel disease • Iron-deficiency anemia • Radiographic abnormality	Relative: Cardiopulmonary instability and coagulopathy Absolute: Acute severe colitis, enteric perforation

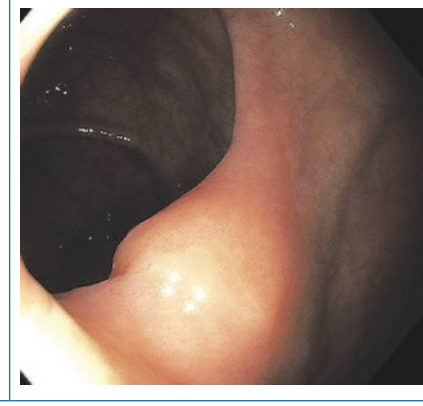
Surveillance	
Condition	**Surveillance**
Polyps (in general)	No polyp ➔ 10 years Hyperplastic <10 mm in rectosigmoid ➔ 10 years 1–2 tubular adenoma <10 mm ➔ 5–10 years 3–10 tubular adenoma ➔ 3 years >10 tubular adenoma ➔ <3 years Tubular adenoma >10 mm ➔ 3 years Villous adenoma ➔ 3 years Serrated polyps ➔ 3 years
Familial adenomatous polyposis	Colonoscopy: Annually starting at 12
Lynch syndrome	Every 1–2 years starting at age 20–25
Peutz-Jeger syndrome	Colonoscopy every 2–3 years starting in adulthood
MUTYH-associated polyposis (MAP)	Every 1–2 years starting at age 20–25
Inflammatory bowel disease	Start 8 years after diagnosis or when diagnosed with PSC • Every 1–3 years • Four biopsies every 10 cm from cecum to rectum Patient with Hartmann pouch/residual rectum: Every 1–3 years

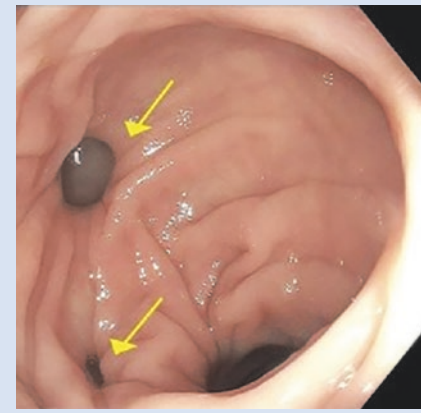
Preoperative considerations/preparation	
Bowel preparation	Polyethylene glycol or magnesium citrate are the most common • Risk: Dehydration, decreased kidney function Sigmoidoscopy: Only need fleet enema

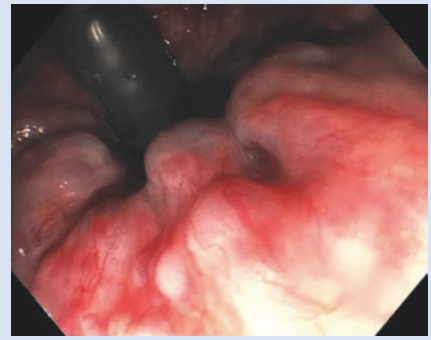
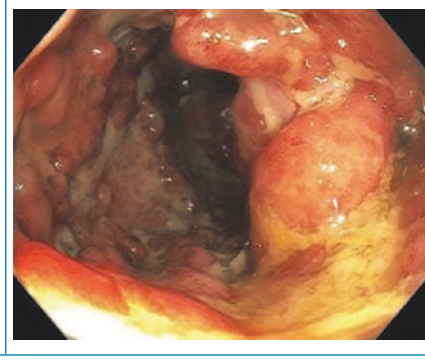
Key procedural steps and anatomy for colonoscopy		
Positioning	Left lateral decubitus or frog-leg positions are most used Endoscopy performed through an ostomy ➔ supine position	
Tips for endoscope advancement	"Slide by technique": Pushing the tip slightly forward repetitively in the predicted direction of the lumen Can use either air/carbon dioxide insufflation or water irrigation ➔ insufflation lengthens the colon Be careful not to overinflate which can make it more difficult to advance More irrigation can sometimes help to advance	

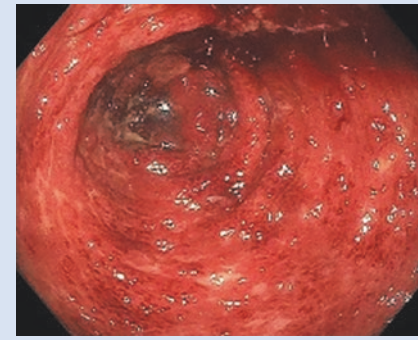
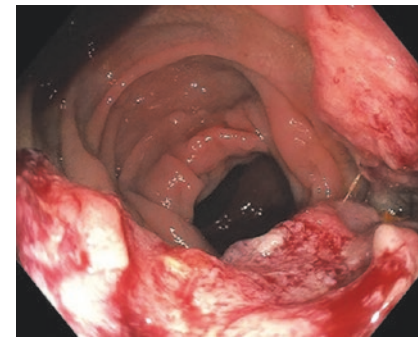
Key procedural steps and anatomy for colonoscopy		
Looping	Difficult to advance or reverse movement of the endoscope due to mobile mesentery ➔ Can stiffen the endoscope to move through a loop ➔ Can apply external abdominal pressure once a loop is removed to help prevent further looping ➔ Reduction: Withdraw while applying clockwise or counterclockwise torque and re-advance while maintaining torque	
Inspection and insertion	First anatomical structure encountered is the anus/rectum Anal verge: Perianal area evaluated for various conditions including abscesses, fissures, fistulae, condyloma, malignancy Dentate line: Squamocolumnar junction ➔ change in color/texture of mucosal lining 2 cm from anal verge Rectal valves: Folds of Houston (lower, middle, upper) Retroflexion: Turning the endoscope within the rectum to view the anal verge from its interior	
Rectosigmoid junction	Rectosigmoid junction: Tortuous area beginning approximately 15–20 cm from anal verge	
Descending colon	Straight segment with circular appearance	

Key procedural steps and anatomy for colonoscopy		
Splenic flexure	Bluish-gray hue	
Transverse colon	Triangular haustra and prominent taenia coli	
Hepatic flexure	Bluish color	
Ascending/ cecum colon	Short segment coming to a blind end Thickened taenia	
Appendiceal orifice	Small slit in a “whirl” of mucosal folds	

Key procedural steps and anatomy for colonoscopy		
Ileocecal valve	Thickened fold, may have prolapsing small bowel mucosa, biliary discharge, or bubbles Terminal ileum: hypertrophic mucosa, villi and no haustra, Peyer patches (more prominent in children and young adults) Intubation (entering): Via direct visualization or by positioning the endoscope by the appendiceal orifice and withdrawing with the tip angled in the direction of the valve ➔ hooking	

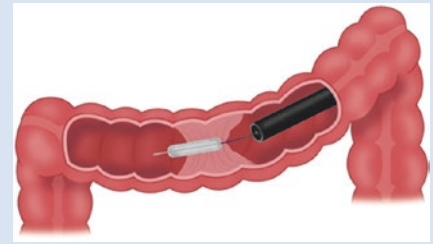
Pathological findings		
Polyps	Inflammatory (pseudopolyp): Not true polyps • Irregular shaped areas of intact mucosa in areas of localized inflammation • Results from mucosal ulceration and regeneration	
	Hamartomatous: Benign tumor-like growths (non-neoplastic)	
	Sessile serrated lesions: Heterogenous group • Hyperplastic: Metaplastic, non-neoplastic Most common non-neoplastic <1 cm: Low risk of cancer development • Adenomas: May have dysplasia, can develop into cancer	
	Adenomatous: (most common neoplastic) • Sessile: Base and top have same diameter • Pedunculated: Narrow base • Flat: Height less than ½ diameter of lesion • Depressed: Thickness less than adjacent mucosa • Histology: Tubular (80%), villous, tubulovillous • Low- or high-grade dysplasia	
Diverticulosis	Sac-like outpouchings of mucosa and submucosa through the muscularis propria Happens at points where arterial vessels penetrate colon wall Not true diverticula: Does not contain all layers Can lead to lower GI bleeding	

Pathological findings		
Angiodysplasia	Tortuous submucosal vessel Can lead to lower GI bleeding	
Hemorrhoid	Engorged vascular cushions that stretch the mucosa leading to bulging within the lumen Located within the anal canal Internal: Above dentate line External: Below dentate line Can lead to lower GI bleeding	
Ischemic colitis	Compromised blood flow and reperfusion leading to mucosal sloughing with ulcerations and/or necrosis ➔ Ultimately resulting in bleeding Tends to occur in "watershed" areas of the arterial blood supply: Distal transverse colon, splenic flexure (Griffith's point), rectosigmoid (Sudeck's point)	
Crohn's	Crohn disease is characterized by transmural inflammation of any part of the gastrointestinal tract, thickening, cobblestoning, and strictures	
	Cobblestoning: Linear and curvilinear ulcers Discontinuous lesions: "Skip areas" near normal tissue	

Pathological findings		
Ulcerative colitis	Circumferential and continuous inflammation	
	Pseudopolyps: Irregular shaped areas of intact mucosa in areas of localized inflammation. Results from mucosal ulceration and regeneration May involve rectum alone (ulcerating proctitis) or extend proximally to involve various lengths or all of the colon	
C. Difficile	Raised yellow or white plaques up to 2 cm in diameter Can be scattered with intermittent normal mucosa or more continuous/circumferential	
Neoplasia	Mass that is partially or completely obstructing Can be fungating (ulcerated/necrotic), exophytic, polypoid, bleeding, friable	

Complications of colonoscopy and their management		
Complication	**Characteristics**	**Management**
Anesthetic related	Arrhythmias, vasovagal reactions, myocardial infarction, aspiration	Hypoxia: Open airway, supplemental O2, collapse colon, remove scope Cardiac: Collapse colon, remove scope, stop sedation, ACLS protocol
Perforation	Can result from force against bowel wall, barotrauma and/or therapeutic procedure Rate approximately 0.01% to 0.1% Risk factors: Advanced age, multiple comorbidities, diverticulosis, obstruction, polyp resection >1 cm (especially right colon)	Immediate abdominal radiograph if suspected ➔ CT scan if X-ray negative and high suspicion NPO, IV fluids, IV broad-spectrum antibiotics Endoscopic closure by clips, clamps or suturing Surgical consultation
Bleeding	Most commonly due to polypectomy Can be immediate or delayed Rate of 0.1% to 0.6%	Immediate: Coagulation, clipping Delayed (5–7 days): If symptomatic then repeat colonoscopy with therapy
Post polypectomy syndrome	Transmural burn resulting in localized peritonitis due to use of electrocoagulation Incidence of 0.003% to 0.1% Present 1–5 days after colonoscopy: Fever, localized abdominal pain/ peritoneal signs, and leukocytosis	Does not require surgical intervention IV hydration, antibiotics, and bowel rest until symptoms resolve
Infection	Transient bacteremia present in about 4% of cases Signs and symptoms are rare Likely related to defective equipment or breaches in protocol	No antibiotic prophylaxis needed: No proven causation
Gas explosion	When combustible levels of hydrogen or methane are present within the lumen and energy is used (electrocautery or argon plasma) Risk factors: Incompletely absorbed mannitol, lactulose, sorbitol, poor preparation	Preventive measure: Use carbon dioxide

Diagnostic and Therapeutic Maneuvers

Diagnostic and therapeutic maneuvers		
Maneuvers	**Description**	
Tissue sampling	Tissue sampling: Polypectomy • Hot (energy) or cold • Biopsy forceps or snare Mucosal lesions and/or neoplasms require biopsy For pedunculated masses, a wire loop with a coagulation current may also be used to remove suspicious tissue	
Hemostasis	Argon plasma coagulation, encoclip, epinephrine injection, electrocautery	
Stent placement	Only uncovered stents in the US Covered available outside the US Ideal placement: Middle section traversing obstruction Maintain soft stool to avoid impaction Highest success rate in left side lesions Used for palliation or bridge to surgery Complications: Migration, perforation, occlusion	
Dilation	Balloon Strictures Can be used for stenotic anastomosis Complications: Perforation	
Mucosal resection	Endoscopic mucosal resection (EMR) Large snares for en bloc resection or piecemeal (typically polyp >20 mm) Prior to resection inject solution into submucosa to raise it Consider tattooing Complications: Bleeding, perforation	

Quality Indicators for Endoscopy

Quality indicators	
Cecal intubation	Proceduralist should have success of: • ≥90% overall • ≥95% for screening cases
Adenoma detection rate	Rate of at least 25% in those over the age of 50 for screening cases
Withdrawal time	≥6 min
Chronic diarrhea	Must obtain biopsies
Biopsy distribution for IBD	Four biopsies per 10 cm of involved colon
Polypectomy	Mucosally based pedunculated and sessile polyps <2 cm are resected Unresectability must be documented
Perforation	Rates cannot exceed 1/500 overall and 1/1000 for screening
Post polypectomy bleeding	Should be less than 1% Should be managed non-operatively in ≥90% of cases