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An Evidence-Based Review of Gastrointestinal Bleeding Evaluation and Management in the Emergency Department

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EXECUTIVE SUMMARY

- Perform initial resuscitation according to standard indications: initial IV crystalloids and transfuse packed red blood cells for shock nonresponsive to crystalloids, ongoing significant bleeding, or hemoglobin level < 7 g/dL.
- Consider anticoagulation reversal for ongoing bleeding.
- Use the principles of the Glasgow-Blatchford score to identify patients appropriate for discharge.
- For patients suspected to be bleeding from peptic ulcers, administer a proton pump inhibitor.
- For patients suspected to be bleeding from esophageal varicies, administer octreotide and an antibiotic.
- Consult a gastroenterologist for significant bleeding to plan for endoscopy.

Introduction

Acute gastrointestinal (GI) bleeding is a common presentation to the emergency department (ED). GI bleeding is categorized traditionally as either upper or lower according to the source, separated anatomically by the ligament of Treitz, also known as the suspensory ligament of the duodenum. Upper GI bleeding typically presents with melena, hematemesis, or hematochezia, whereas lower GI bleeding typically presents with hematochezia.

Epidemiology and Etiology

Upper GI bleeding has an annual incidence of approximately 67 to 150 per 100,000, with estimated mortality rates between 6% and 15%.[1] The incidence has been decreasing in recent years, but without significant change in mortality or rebleeding after treatment.[2] Upper GI bleeding accounts for 75% of all acute GI bleeding cases. It is caused by several possible etiologies, including peptic ulcer disease (PUD), gastroduodenal erosions, esophageal and gastric varices, Mallory-Weiss tears, foreign body ingestion, Dieulafoy's lesion, angiodysplasia, or malignancies.[3] (*See Table 1.*) PUD accounts for 40-55% of all upper GI bleeding cases. It is associated with nonsteroidal anti-inflammatory drug (NSAID) use, *Helicobacter pylori* infection, and stress-related mucosal disease.[1,4] The most significant risk factor for developing gastric or esophageal varices bleeding is the presence of cirrhosis. In the United States, the mortality may be as high as 20% from one acute episode of variceal bleeding, with rebleeding rates of 25% to 30%.[5,6] In the setting of a possible variceal bleed, it also would be prudent for the provider to assume the patient may have hepatitis.

Table 1. Most Common Causes of Upper and Lower Gastrointestinal Bleeding[3,4,7]

Upper Gastrointestinal Bleeding	Lower Gastrointestinal Bleeding
• Peptic ulcer disease • Gastroduodenal erosions • Esophageal and gastric varices • Mallory-Weiss tears • Foreign body ingestions • Dieulafoy's lesion • Angiodysplasia • Malignancies	• Diverticulosis • Angiodysplasia • Colitis • Colon cancer • Inflammatory bowel disease

The annual incidence of lower GI bleeding is approximately 20 to 36 per 100,000, with a mortality rate of approximately 4%. The risk is elevated among the elderly population and males. Possible etiologies include diverticulosis, angiodysplasia, colitis, colon cancer, and inflammatory bowel disease.[4,7] Colonic diverticulosis is the most common etiology at 17% to 40%, and it is estimated that two-thirds of the population older than 80 years of age is affected by diverticular disease. Compared to those with upper GI bleeding, lower GI bleeding patients are more likely to have higher levels of hemoglobin (84% vs. 61%) and less likely to experience shock (19% vs. 35%).[1] Bleeds that originate from the colon require fewer blood transfusions than those that originate from the small intestine (36% vs. 64%); however, they have a rebleed rate of approximately 10% to 20%, and about 10% to 15% of cases require operative intervention. Chronic lower GI bleeding is responsible for 18% to 30% of cases of iron deficiency anemia presenting to the ED.[1]

Workup: History, Physical Exam, Orders

The initial approach to a patient with a GI bleed should focus on assessment of initial vital signs and a focused medical history, including the bleed location and description, quantity, and frequency of recurrence. Hemodynamic instability may be indicated by resting tachycardia, hypotension, syncope, orthostasis, and pallor. The provider's primary goal should be to assess the severity of the bleed, to identify potential sources, and to determine if management-altering ED interventions exist, such as providing intravascular volume resuscitation or achieving rapid hemostasis. Mild to moderate hypovolemia will lead to resting tachycardia, while orthostatic hypotension will result from a blood loss of greater than 15%. Blood volume loss greater than 40% will lead to supine hypotension.[8] Abdominal pain also can be a sign of an ischemic, inflammatory, or viscous perforation as the source of bleeding. Factors

associated with severe bleeding include tachycardia (likelihood ratio [LR], 4.9), hemoglobin less than 8 g/dL (LR, 4.5-6.2), or gross blood detected during nasogastric lavage in an upper GI bleed (LR, 3.1).[9]

History taking should assess for the presence of comorbidities, alcohol use, and medication use, including NSAIDs, antiplatelet drugs, aspirin, or anticoagulants. Other important high-risk history factors include cirrhosis, hepatitis C, valve replacement, thromboembolism, cardiac disease such as atrial fibrillation, and recent travel or immigration (which increases the risk of *H. pylori*). (*See Table 2.*)

Table 2. Factors to Consider in the History for Patients With Gastrointestinal Bleeding

- Comorbidities
- Alcohol use
- Medication use, including NSAIDs, antiplatelets, aspirin, anticoagulants
- Cirrhosis
- Hepatitis C
- Valve replacement
- Thromboembolism
- Cardiac disease (i.e., atrial fibrillation)
- Recent travel or immigration (increased risk of *Helicobacter pylori* infection)

A description of the bleed will allow for categorization and narrowing of the etiology to upper GI bleeding or lower GI bleeding. Hematemesis is emesis with gross blood or clots. “Coffee-ground” emesis refers to hematemesis with dark specks of old blood, usually indicating the presence of lower GI bleeding or a brisk upper GI bleed. Hematochezia refers to the passage of bright red blood via the rectum. Hematochezia tends to occur in patients older than 65 years of age and has an associated mortality of 21%.[10] Melena refers to a characteristic odor along with tarry black stools. Ninety percent of melena originates proximal to the ligament of Treitz, although it also may originate from the oropharynx, the nasopharynx, the small bowel, or the right colon.[11]

The physical exam should focus on characteristic signs of chronic liver disease, as well as a digital rectal exam (DRE) to determine the source of the bleed. Clinical experience indicates that a subjective report of GI bleed can be easily misconstrued from a urinary or vaginal bleed or from ingestion of vitamins or foods with dyes. Therefore, a DRE should not be dismissed lightly, as it also may rule out other causes of GI bleeding, such as hemorrhoids or fissures. Examine the patient for evidence of jaundice, ascites, fluid wave, palmar erythema, spider angiomas, hepatosplenomegaly, and gynecomastia, which may suggest a variceal bleed source. In addition, examine for surgical abdominal scars, since aortoenteric fistulas in a patient with a history of abdominal aortic aneurysm or aortic graft may be life-threatening. Auscultate for harsh cardiac murmurs, which suggest mechanical valve replacement and open the possibility that the patient is on oral anticoagulation.

Mental status changes also may be an early sign of hypoperfusion in the elderly. Predictors for angiodysplasia include a history of renal disease, aortic stenosis, or hereditary hemorrhagic telangiectasia. Peptic ulcer disease may be indicated in a history of smoking, NSAID use, or prior treatment for *H. pylori* infection. Malignancy also should be considered in similar patients.

Certain factors are predictive of an upper GI bleed, including: a patient-reported history of melena (LR, 5.1-5.9), melena on exam (LR, 25), blood or “coffee grounds” detected on nasogastric (LR, 9.6), and a ratio of blood urea nitrogen (BUN) to serum creatinine greater than 30 (LR, 7.5).[9] Patients may endorse a history of prior bleeds from the same lesion, which occurs in up to 60% of upper GI bleeding patients.

Consider other comorbidities that can influence disease progression, including coronary artery disease and pulmonary disease, which can make patients more susceptible to significant anemia, or

coagulopathies, aspiration risk, and human immunodeficiency virus. In addition, volume-overloaded cardiac and renal patients pose challenges in volume resuscitation.[6]

There is an increased risk for acute coronary syndrome (ACS) in elderly patients with upper GI bleeding. The following increase the risk of ACS incidence in elderly patients with upper GI bleeding: diabetes (odds ratio [OR], 1.84), vasopressin or terlipressin use (OR, 1.51), liver cirrhosis (OR, 2.43), hemoglobin level (OR, 2.36), and history of ACS (OR, 1.98).[12] Most importantly, the provider should continue to reassess patients with GI bleeds for changes in mental status, pallor, recurrent bleeds, vital sign changes, and instability.

Following initial resuscitation in the hemodynamically unstable patient, evaluation labs should include complete blood count, international normalized ratio (INR), prothrombin time (PT) and partial thromboplastin time (PTT), BUN, and creatinine. In hepatic failure, coagulation studies identify patients at highest mortality risk with PT > 20 and INR > 6.5.[13] However, standard coagulation tests — INR, PT, and PTT — do not reliably detect or exclude a coagulopathy in patients with cirrhosis. A more reliable assessment of coagulation status includes thromboelastography (TEG), which measures clot formation, speed of clot formation, clot strength, and clot dissolution.[14] A type and screen also would be prudent in a moderate to significant bleed.

Patients with acute bleeding should have normocytic red blood cells. Since blood is absorbed as it passes through the small bowel and patients may have decreased renal perfusion, patients who have acute upper GI bleeding typically exhibit an elevated BUN to creatinine ratio. Values > 36:1 suggest upper GI bleeding as the etiology on the bleed, with an increased likelihood with higher ratios.[15]

In a retrospective review, lactate greater than 4 conferred a 6.4-fold increased odds of in-hospital mortality (94% specificity, $P < 0.001$). Controlling for age, initial hematocrit, and heart rate, every one-point elevation in lactate conferred a 1.4-fold increase in the odds of mortality.[16]

Additional testing should be tailored to a specific patient's comorbidities and suspicion for specific disease. A chemistry panel may help to determine other metabolic derangements if malignancy is known or suspected, including those caused by acute renal failure, hyponatremia, hypercalcemia, hypophosphatemia and hyperphosphatemia, and hypokalemia and hyperkalemia. In cardiovascular disease with hypotension, trending cardiac biomarkers with serial electrocardiograms may be beneficial in assessing for cardiac ischemia. In patients with suspected liver involvement and altered mental status, an ammonia level would be appropriate.[2]

Risk Stratification and Prediction

Using clinical variables, scoring tools have been developed and validated to risk stratify short- and long-term morbidity and mortality in the GI hemorrhage patient. (*See Table 3.*) Traditionally used in upper GI bleeding, the Glasgow-Blatchford Score (GBS) was designed to predict the need for intervention in adult patients being considered for hospital admission due to GI bleeding by classifying them into low-risk and high-risk groups. The GBS includes hemoglobin, systolic blood pressure, tachycardia, history of syncope, melena, liver disease, and heart failure. A score of more than 6 out of 23 is associated with a greater than 50% risk of needing an intervention.[17] Notably, in the original study, the authors concluded that those with a score of 0 were safe for discharge, but subsequent research has shown that a GBS score of 1 also is low risk and appropriate for discharge.[17]

Table 3. Upper Gastrointestinal Bleeding Clinical Prediction Scores and Inclusion Criteria

Clinical Prediction Tool	Function	Components of Calculation

Table 3. Upper Gastrointestinal Bleeding Clinical Prediction Scores and Inclusion Criteria

Glasgow-Blatchford Score (GBS)	• Differentiates upper gastrointestinal bleeding patients into low risk and high risk • Determines which patients are candidates for discharge to outpatient management	• Hemoglobin • Blood urea nitrogen • Initial systolic blood pressure (SBP) • Tachycardia • Gender • Melena on exam • Recent syncope • Hepatic disease history
Clinical Rockall Score (pre-endoscopy)	• Determines severity of gastrointestinal bleeding, prior to endoscopy	• > 60 years of age • SBP < 100 mmHg • Heart rate > 100 • Comorbidities including renal failure, liver failure, and/or disseminated malignancy
Complete Rockall Score (post-endoscopy)	• Determines severity of gastrointestinal bleeding, post-endoscopy	• > 60 years of age • SBP < 100 mmHg • Heart rate > 100 • Comorbidities including renal failure, liver failure, and/or disseminated malignancy • Diagnosis including Mallory-Weiss tear, malignancy of upper gastrointestinal tract, or other diagnosis • Description of bleed
AIMS65	• Determines risk of in-hospital mortality from upper gastrointestinal bleeding	• Albumin < 3 g/dL (30 g/L) • International normalized ratio > 1.5 • Altered mental status • SBP < 90 mmHg • Age > 65 years old

The Rockall score and the AIMS65 score are used to calculate the mortality rate of upper GI bleeds. There are two separate Rockall scores: one pre-endoscopy related to mortality, and a second post-endoscopy to calculate overall mortality and rebleeding risks. The clinical Rockall score was designed to predict mortality at the time of upper GI bleeding patient presentation. The complete, or post-endoscopic, Rockall score was used to stratify a patient's risk for rebleeding and mortality after endoscopy, using variables of age, comorbidities, presence of shock, and endoscopic stigmata. Both Rockall scores range from 0 to 11 points, with higher scores correlating with a higher risk of a poor outcome.[3]

The AIMS65 score is a newer and simpler approach to the GBS score and is designed to predict inpatient mortality in upper GI bleeding. The score was determined by a study in which investigators found five factors associated with increased inpatient mortality: albumin less than 3.0 g/dL, INR > 1.5, altered mental status with Glasgow Coma Scale score less than 14, systolic blood pressure less than 90 mmHg, and age older than 65 years. Mortality was shown to increase significantly as risk factors increase, with one risk factor correlating to 1% mortality, and five risk factors correlating to 25% mortality.[18]

Evidence shows that the GBS, used at presentation to the ED, may allow for early discharge of 16% to

25% of all patients presenting with acute upper GI bleeding.[3] GBS was shown to be superior to the Rockall and AIMS65 scores in predicting the high-risk GI bleed and the need for admission, intervention, blood transfusion, or surgery.[7,12,19] In a retrospective review of 12 studies, pooled sensitivity and specificity for the GBS were 0.98 (95% confidence interval [CI], 0.97-0.98) and 0.16 (95% CI, 0.15-0.16), respectively. A cutoff score of 0 resulted in a sensitivity of 0.99 (95% CI, 0.98-1) and a specificity of 0.08 (95% CI, 0.07-0.09). The GBS with a cutoff score of 0 had the highest sensitivity and was superior to clinical Rockall and AIMS65 risk scores in identifying patients who were at low risk for experiencing adverse outcomes within 30 days after a sentinel bleed.[17]

In another study, investigators compared GBS and pre-endoscopic Rockall scores with clinical triage decision in 1,244 patients for the decision to admit to the intensive care unit or floor. They found that clinical decision-making by ED physicians performed better compared with triage decisions guided by GBS or Rockall alone.[20] For prediction of rebleeding and mortality, all tests had either no significant difference or performed equally poorly.

In unstable upper GI bleeding in cirrhotic liver disease, researchers compared three scoring tools to predict mortality. The Model for End-stage Liver Disease (MELD) score outperformed the GBS and pre-endoscopic Rockall score with an area under the curve (AUC) of 0.736 (95% CI, 0.629-0.842; $P = 0.001$), whereby GBS and pre-endoscopic Rockall obtained an AUC of 0.527 (95% CI, 0.393-0.661; $P = 0.709$) and AUC 0.591 (95% CI, 0.465-0.717; $P = 0.208$), respectively.[21]

Initial Resuscitation

The first priority in managing the patient is correcting fluid loss in restoring hemodynamic stability. Volume resuscitation should be initiated with crystalloid IV fluids with the use of large-bore (16 to 18 gauge) peripheral IV lines or a central venous catheter if peripheral access is not attainable. Administer packed red cells according to standard indications: shock not responsive to crystalloid, ongoing blood loss, or critical anemia (e.g., hemoglobin level < 7 g/dL).

Consider if the patient has a coexistent coagulopathy. The definition of coagulopathy is a condition in which the patient’s clotting ability is impaired. However, for some clinicians, the term also includes thrombotic states. Because of the complexity of the homeostatic pathways, coagulopathy and a thrombotic state can exist at the same time. Some practitioners also consider that slightly abnormal results on coagulation screening laboratory tests without actual clinical bleeding also can indicate coagulopathy. The history taking and physical examination of the patient are vital to discovery and management, since various conditions can result in similar laboratory abnormalities. For example, end-stage liver disease and disseminated intravascular coagulation produce thrombocytopenia and similar changes in coagulation profiles, but the management for these conditions is extremely different.

The first principle in the management of coagulopathies is to avoid correction of laboratory abnormalities with replacement products unless a clinical bleeding problem exists, a surgical procedure is required, or both. There is a lack of good quality evidence in the use of replacement products to treat major bleeding in coagulopathic patients. There are a limited number of studies that have analyzed the benefits of anticoagulation reversal in patients with GI bleeding, so most recommendations are based on expert opinion extrapolated from studies in patients with bleeding elsewhere.

Current guidelines recommend prothrombin complex concentrate (PCC) for life-threatening bleeds in patients taking warfarin. PCC is a concentrate of factors II, IX, and X, with variable amounts of factor VII. The dosing strategy has been based on the presenting INR, with further guidance based on the response to therapy. However, fixed dosing also may be as effective.

The direct-acting oral anticoagulants (DOACs), such as the thrombin-inhibitor dabigatran etexilate, or the activated Factor X inhibitors, including rivaroxaban, apixaban, or edoxaban, have specific reversal agents (idarucizumab or coagulation factor Xa [recombinant] inactivated, respectively). The ability of these reversal agents to correct the

laboratory-assessed coagulopathy has been studied, but there is little clinical evidence that such reversal slows bleeding or produces clinical benefits in patients on these DOACs.

Evidence-Based Management of Upper GI Bleeding

In an acute bleed, the initial hemoglobin level may be at the patient's baseline. Patients with acute bleeding should have normocytic red blood cells. The presence of microcytic red blood cells (or iron deficiency anemia) suggests chronic bleeding. In general, if the platelet count is less than 50,000, transfusion of platelets is indicated if the INR > 2. PCC also should be considered. Additionally, for every four units of packed red blood cells (PRBCs), a unit of fresh frozen plasma (FFP) should be transfused because red blood cells do not contain coagulation factors.[22]

Tranexamic acid (TXA) is an antifibrinolytic agent that reduces the depletion of fibrin by slowing the conversion of plasminogen into plasmin, thus supporting clot formation. The authors of a meta-analysis evaluating the utility of TXA vs. cimetidine, lansoprazole, and placebo for upper GI bleeding found no difference in rebleeding rates for TXA vs. placebo, but there was a mortality benefit with TXA compared to placebo. However, the mortality benefit was not seen when TXA was compared to cimetidine or lansoprazole. More evidence is needed, but TXA should be considered in severe upper GI bleeding.[10]

In patients who present with acute GI bleeding, protein pump inhibitors (PPIs) are used routinely as first-time agents. First developed to treat peptic ulcers, PPIs inhibit parietal cell H+/K+/Atpase pump and decrease acid production. Despite the widespread use of PPIs, there is limited evidence to support their use in upper GI bleeding. Patients with known peptic ulcer disease are the most likely to benefit from the use of PPIs. (*See Table 4.*) In one study, researchers found that PPIs reduced the rate of rebleeding and the need for surgery in patients who had endoscopy-confirmed ulcers.[23] However, patients who received a PPI experienced no overall survival benefit. A meta-analysis found that PPIs decreased the rate of rebleeding and reduced the need for surgery and repeat endoscopy. PPIs also may provide a significant survival benefit in Asian populations.

Table 4. Evidence-Based Management of Upper Gastrointestinal Bleeding

Intervention	Situations for Which Intervention Is Most Effective	Comments
Proton-pump inhibitors	Bleeding from peptic ulcers	Pantoprazole 80 mg IV bolus, followed by 8 mg/h IV infusion
Somatostatin analogues	Bleeding from esophageal varices	Octreotide 25 to 50 mcg IV bolus, followed by 25 to 50 mcg/h IV infusion
Antibiotics	Bleeding from esophageal varices	Ceftriaxone 1 g IV
Gastroenterology consult	Patients with significant upper GI bleed	Upper gastrointestinal endoscopy for localization of bleeding and application of direct intervention: epinephrine injections, thrombin injection, thermocoagulation
Correction of coagulopathy	Life-threatening bleeding	Prothrombin complex concentrate

Although PPI may provide some benefit in patients who have peptic ulcers, the role of these medications is less clear in patients who present with upper GI bleeding of unknown origin. For patients presenting with undifferentiated upper GI bleeding, no meaningful improvement in any patient-oriented outcomes

has been found with the use of PPIs.

Guidelines currently recommend treating patients with an initial PPI, such as pantoprazole 80 mg IV bolus, followed by a continuous infusion of 8 mg per hour for 72 hours. However, recent studies have questioned the need for prolonged infusion. In a 2014 analysis, Sacher et al found that intermittent PPI therapy does not appear to be inferior to a bolus plus continuous infusion therapy for patients receiving treatment for high-risk bleeding ulcers.[5]

Somatostatin is an endogenous peptide hormone that indirectly reduces splanchnic, hepatic, and azygous flow by inhibiting glucagon's vasodilatory effects.[10] A somatostatin analogue, most commonly octreotide, has been used widely for the treatment of variceal GI bleeding. However, it appears to provide minimal clinical benefits. Octreotide inhibits gastric hormone secretion and can decrease bleeding from esophageal varices. For suspected variceal bleeding, octreotide typically is administered as 25 to 50 mcg/ IV bolus, followed by an infusion of 25 to 50 mcg IV/hour. Somatostatin analogues may increase the rate of early endoscopic success and may slightly reduce the need for blood products in patients presenting with variceal bleeding. However, no data indicate that they offer any decrease in mortality.

In the management of upper GI bleeding, the theoretic benefit of vasopressin results from its ability to cause vasoconstriction in the splanchnic circulation, and, therefore, to reduce portal hypertension. However, vasopressin also causes systemic vasoconstriction that can lead to myocardial and widespread vascular ischemia. Although there may be a theoretical benefit of vasopressin use in patients with variceal bleeding, the drug increases the risks to patients who present with bleeding from peptic ulcers because the bleeding is mostly arterial.[5] Studies showing somatostatin to have fewer adverse effects and better control of bleeding have caused vasopressin to fall out of favor.[10] In the ED setting, there may be a role for vasopressin as a third-line agent in patients presenting in extremis from a likely variceal bleed. However, no data suggest that the benefit of using vasopressin outweighs the risks when used to treat upper GI bleeding from an unknown source.[5]

Propranolol is a nonselective beta-blocker that reduces the hepatic venous pressure gradient. Therefore, it is useful in the prophylaxis of variceal hemorrhage and the prevention of recurrent bleeding. Researchers have found a 20% reduction in death with the use of propranolol.[10]

For patients with variceal bleeding, antibiotics offer a survival benefit. Patients with cirrhosis often are immunocompromised, and infections are thought to occur as a result of the translocation of intestinal bacteria from the digestive system into the bloodstream. In a meta-analysis, Chavez-Tapia et al evaluated 12 trials that involved cirrhosis patients with GI bleeding who received prophylactic antibiotics.[24] The patients who received antibiotics exhibited lower infection rates, with a significant reduction in the rates of pneumonia, spontaneous bacterial peritonitis, urinary tract infections, and bacteremia. Mortality was decreased overall in patients who received antibiotics. The studies involved various antibiotic regimens, with no single agent appearing to be superior. Given the survival benefit, all patients with suspected variceal bleeds should receive prophylactic antibiotics in the ED. Early studies tended to use oral fluoroquinolones. With increased resistance to fluoroquinolones, IV ceftriaxone maybe a better choice.

For patients with significant upper GI bleeding, early consultation with the gastroenterologist is recommended. The consultant should determine the timing of endoscopy. Sarin et al compared early (six hours) vs. late (six to 24 hours) endoscopy in 502 cases of suspected upper GI bleeding. They found no difference between the groups regarding mortality, the need for surgery, or the rate of transfusion.[5]

Endoscopy plays an important role in both diagnosis and treatment of GI bleeding. It can clarify the nature of the disease process and allows the provider to intervene to stop the bleeding. Interventions during endoscopy include epinephrine injection, thrombin injection, and/or thermocoagulation for ulcers or Dieulafoy's lesions. Therapeutic options for variceal bleeding include variceal banding.[10]

In cases in which bleeding originates from a variceal source and immediate endoscopy is not available, different devices can be placed in the lower esophagus to apply direct pressure on the variceal veins and

stop bleeding. Options for devices include the Sengstaken-Blakemore tube, the Linton tube, and the Minnesota tube. In unstable patients, these devices may serve as temporary agents. They can cause esophageal necrosis and rupture. Although these devices are reserved as last-line therapy for unstable patients who cannot undergo immediate endoscopy, they do not have a role in the standard management of patients with upper GI bleeding.[5]

The role of surgery and interventional radiology has changed over the years. As endoscopic therapy becomes used more widely, the rate of surgical intervention for upper GI bleeding continues to decline significantly. Now, angioembolization is considered a second-line treatment in the 5% to 10% of patients who do not respond to medical and endoscopic treatment, whereas surgery is considered third line.[10]

In patients with upper GI bleeding who experience continued bleeding after endoscopic therapy, interventional radiology has a role. The mortality associated with various interventional radiology techniques tends to be less than with surgical procedures, which makes them reasonable alternatives for surgical patients who have bleeding after endoscopy.[5]

Evidence-Based Management Principles for Lower GI Bleeding

Lower GI bleeding is classified into three groups: occult, moderate, and severe. Patients with occult lower GI bleeding usually have microcytic hypochromic anemia. The stool will be guaiac positive. Patients with severe lower GI bleeding are hemodynamically unstable with decreased urine output. Typically, the patient presents with hematochezia. The classic patient with this presentation is older than 65 years of age and has an associated mortality in this case of 20%.[10]

A lower GI bleed is any bleeding that occurs distal to the ligament of Treitz. The most likely source is the colon, but the small bowel and even upper GI tract also must be considered as a source in the differential.

There are multiple causes of lower GI bleeding. Diverticulosis is the most common (30%), followed by anal rectal disease (15-20%), ischemia (12%), inflammatory bowel disease (9%), neoplasm (6%), and arteriovenous malformations (3%).

Colonoscopy is considered the initial diagnostic method of choice. It can identify the source of lower GI bleeding in 74% to 80% of patients. Colonoscopy has the ability not only to localize the bleed, but also to allow treatment with clips, epinephrine injection, or laser photocoagulation. Regarding the timing of colonoscopy, researchers have found no improved outcome when comparing colonoscopy within eight hours compared to within 48 hours of presentation.[10]

Nuclear scintigraphy can be used to detect the location of bleeding when the hemorrhage is occurring at a rate between 0.1 and 0.5 mL/min. (*See Table 5.*) The sensitivity is about 86%, which is more sensitive than mesenteric angiography, but the specificity is only 50%. In addition, the patient must be bleeding actively during the test. Another major disadvantage is the inability to perform interventions during the study.[25]

Table 5. Evidence-Based Management of Lower Gastrointestinal Bleeding

Intervention	Situations for Which Intervention Is Most Effective	Comments
Nuclear scintigraphy	Active bleeding	Can localize bleeding site when hemorrhage rate is between 0.1 and 0.5 mL/min (low volume active hemorrhage)
Angiography	Active bleeding	Can localize bleeding site when hemorrhage rate is 5 mL/min (high volume active hemorrhage). Can treat bleeding with selective vasopressin infusion or angioembolism.

Table 5. Evidence-Based Management of Lower Gastrointestinal Bleeding

Gastroenterology consult	Patients with significant lower gastrointestinal bleed	Colonoscopy for localization of bleeding and application of direct intervention: epinephrine injections, thrombin injection, laser photocoagulation
Correction of coagulopathy	Life-threatening bleeding	Prothrombin complex concentrate

When colonoscopy fails to localize the bleeding source or when bleeding is too brisk for colonoscopy to be useful, angiography can be used. Angiography requires bleeding of 5 mL/min to localize a source. It provides the potential for diagnosis and intervention, including vasopressin selective infusion and selective angioembolization. Disadvantages include low sensitivity (only 30% to 47%) and the need for fairly brisk bleeding at the time of the study to detect the bleeding site. However, for patients who present with brisk, active bleeding, emergency angiography and vasopressin infusion can improve operative mobility, mortality, and outcome.

Although the colon is the likely source, the small bowel also may be involved. Options to evaluate the small bowel include wireless capsule endoscopy and push endoscopy. Push endoscopy or enteroscopy offers therapy options and can reach more distal than a standard endoscopy; however, it is limited to evaluating the proximal 60 cm of the small intestine.

If the index of suspicion for upper GI bleeding is high, upper endoscopy should be performed once the patient is adequately resuscitated.

An endoscopy consult should be obtained early in the hospital stay for a patient with acute lower GI bleeding. There are two main limitations with colonoscopy to detect the source of lower GI bleeding. First, visualization of a potential bleeding source that is not actively bleeding does not exclude the presence of another source. Furthermore, identification of more than one bleeding source is common.

In patients with ongoing bleeding or high-risk clinical features (hemodynamic instability, advanced age, current aspirin use, prolonged PT, multiple comorbidities), colonoscopy should be performed within 24 hours of presentation after preparation.[26]

Although lower GI bleeding typically indicates a source that originates from the colon or rectum, up to 15% of patients have a bleeding source in the upper GI tract. Colonoscopy often is used as a diagnostic test and potential therapeutic procedure, but it is unclear if early colonoscopy is associated with improved clinical outcomes. For patients who have symptoms of lower GI bleeding and who are hemodynamically unstable, guidelines strongly recommend exclusion of an upper GI source of bleeding based on data from a prior trial showing that up to 15% of patients with severe hematochezia ultimately had upper GI tract bleeding.

In patients with lower GI bleeding and coagulopathy, there is no robust evidence that correcting the coagulopathy is beneficial. Guidelines suggest consideration of endoscopic treatment in patients with INR of 1.5 to 2.5 prior to or concomitant with administration of reversal agents. The guidelines conditionally recommend that anticoagulation reversal agents be considered in patients with INR > 2.5 prior to endoscopy, along with platelet transfusion to maintain a platelet count of 50,000 per microliter of blood.

The evidence for non-colonoscopy interventions are of low quality, but the guidelines strongly recommend radiographic intervention in patients who have persistent hemodynamic instability, inadequate response to resuscitation, and ongoing bleeding. The guidelines assume that an upper GI tract bleeding source should have been excluded and that these patients are not likely to tolerate bowel prep and/or colonoscopy. In these cases, CT angiography is recommended to localize the bleeding source. Surgical

exploration is recommended when other options have failed to identify and control the source of bleeding in the unstable patient.

Although the evidence quality is low, guidelines strongly recommend against stopping aspirin in patients who have established high-risk cardiovascular disease and GI bleeding. While aspirin increases the risk for recurrent bleeding, there is still an overall mortality benefit with aspirin from its reduction in the rate of cardiac ischemic events. NSAIDs should be avoided if possible, particularly in patients with diverticulosis or angioectasia as a source.[27]

GI Bleeding in Pediatric Patients

Studies regarding GI bleeding in pediatric patients are considerably fewer in number than adult studies, with most occurring in the critical care setting.[28] However, similar to adults, up to 20% of all episodes of GI bleeding in children have an upper GI bleeding source.[29] In the United States, the most common causes of upper GI bleeding in pediatric patients are gastric and duodenal ulcers, esophagitis, gastritis, and varices.[30] (*See Table 6.*)

Table 6. Common Causes of Pediatric Gastrointestinal Bleeding[2]

Neonates	• Swallowed maternal blood • Anorectal fissures • Necrotizing enterocolitis • Malrotation • Hirschsprung’s disease • Coagulopathy
Infants	• Anorectal fissures • Allergic colitis • Intussusception • Meckel diverticulum • Hemolytic uremic syndrome • Henoch-Schönlein purpura • Lymphonodular hyperplasia • Gastrointestinal duplications
Children	• Infectious diarrhea • Juvenile polyposis syndrome • Inflammatory bowel disease

In neonates, potential etiologies include vitamin K deficient bleeding or hemorrhagic disease of the newborn, stress gastritis or ulcers (which can occur spontaneously or be due to critical illness), congenital anomalies including intestinal duplications or vascular anomalies, milk protein intolerance, infectious and necrotizing enterocolitis, Hirschsprung’s disease, midgut volvulus, or coagulopathies caused by congenital coagulation factor deficiency, infection, or liver failure.[31-34]

In infants to adolescents, common etiologies of upper GI bleeding are similar to those of adults, including Mallory-Weiss syndrome, presence of esophageal or gastrointestinal foreign body, esophagitis, peptic ulcers and gastritis, pill esophagitis associated with antibiotics or NSAIDs, hepatic vein obstruction (Budd-Chiari syndrome), or esophageal varices due to liver disease caused by cystic fibrosis, biliary atresia, and portal vein thrombosis.[35,36]

Hereditary conditions also should be on the differential because they rarely can cause GI bleeding. These include hereditary hemorrhagic telangiectasia (Osler-Weber-Rendu syndrome), Kasabach-Merritt syndrome, duplication cysts, gastric polyps, annular pancreatitis, or antral or duodenal web.[37-39]

Swallowed maternal blood always should be on the differential for infants up to the first few months of life, as blood can be ingested during delivery or while nursing and can mimic GI bleeding. While fetal hemoglobin is still detectable, the Apt-Downey test can be used to distinguish between a maternal and a fetal source. The Apt-Downey test adds an alkaline solution to the blood sample, retaining hemoglobin as red or pink in the fetal hemoglobin and discolors adult hemoglobin to a brownish-yellow.[40]

The clinical presentation is similar to that of adults, with hematemesis, melena, or hematochezia present due to various etiologies. However, because of the short intestinal transit time, neonates and infants with upper GI bleeding are more likely than adults to present with hematochezia. Management should focus on resuscitation if hemodynamic instability is present or suspected, as neonates and infants have smaller reserves of blood volume compared to adults and can decompensate precipitously. Unfortunately, modern diapers with enhanced absorbency can hold a significant volume of blood, which can be visually deceptive to the parent and provider. Monitor for a severe upper GI bleeding by assessing for melena or hematochezia, tachycardia of more than 20 beats per minute above mean heart rate for age, prolonged capillary refill, a decrease in hemoglobin of greater than 2 g/dL, or a need for fluid bolus or blood transfusion.[41,42]

The physical examination should include observation for superficial signs of bruising, petechiae, mucosal bleeding, or telangiectasias, which can suggest immune thrombocytopenia or Osler-Weber-Rendu, as well as large vascular malformations that can suggest gastrointestinal hemangiomatosis. The abdominal exam may have evidence of splenomegaly, prominent vasculature, or protruding abdomen, which can suggest portal hypertension and varices as the source of bleeding.[43]

Management of bleeds in children follows a similar protocol to adults. A nasogastric tube can be used in patients presenting with unexplained GI bleeding that may need to be differentiated as upper GI bleeding or lower GI bleeding. Imaging can be used, with a focus on the differential diagnosis in mind. Necrotizing enterocolitis (NEC) is uncommon in term neonates, with an incidence of 1 in 20,000. On ultrasound, seven sonographic findings provide evidence of NEC, including portal venous gas, pneumatosis intestinalis, increased wall echogenicity, thickening or thinning of the bowel, absent perfusion, and free echogenic fluid. The presence of three of seven findings has a sensitivity of 82% (95% CI, 60-95%) and specificity of 78% (95% CI, 52-94%) for poor outcomes associated with NEC.[31]

Pharmacologic options for general upper GI bleeding include acid suppression with pantoprazole and vasoactive agents such as octreotide based on studies in adults.[44] Further treatment can be implemented and adapted from the adult model.

Conclusion

GI bleeding is a common presentation to the ED, and patients can present at any age with varying complexity and severity. A detailed history, including medication, coupled with astute awareness of hemodynamic stability with frequent re-evaluation is paramount. Applying current transfusion guidelines and early GI consultation will lead to improved outcomes.

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