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Emergency Department Management Of Upper Gastrointestinal Bleeding In Pediatric Patients

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Abstract

Upper gastrointestinal bleeding is an uncommon problem in pediatric patients, accounting for 0.2% of complaints in children presenting to the emergency department. Managing children suspected of having an upper gastrointestinal bleed can be anxiety-provoking, as the differential diagnosis includes a range of benign to life-threatening conditions with the potential for significant morbidity and mortality if management is delayed. Common differential diagnoses of upper gastrointestinal bleeding will be reviewed, and the initial clinical evaluation and management of children with a suspected upper gastrointestinal bleed will be outlined.

Case Presentations

A 4-year-old boy with no chronic medical problems is evaluated in the ED after a single episode of quarter-sized bright red hematemesis. He has normal vital signs. His parents report no additional symptoms, but note that, on an as-needed basis, he is taking diphenhydramine for allergic rhinitis as prescribed by his pediatrician. At the bedside, you observe that he is eating lunch while watching cartoons. He has bilateral allergic shiners along with edematous and friable nasal mucosa, but the physical examination is otherwise unremarkable. You have a high suspicion for epistaxis and consider the need for further testing.

A 10-year-old boy with a history of biliary atresia, who underwent a Kasai procedure at the age of 3 months, presents with 2 episodes of vomiting containing a teaspoon of bright-red blood. His heart rate is 110 beats/min, and his vital signs are otherwise normal. He is alert and conversant. He has scleral icterus and a palpable spleen tip 3 cm below the left costal margin. He denies abdominal pain and any changes in his bowel pattern. A sample of the vomitus is brought to the ED, and bedside point-of-care testing for gastric blood is positive. You order laboratory tests for this patient and consider additional testing.

You are then called into the resuscitation room where you find a 16-year-old girl with no past medical history who reports a 1-week history of abdominal pain and 2 days of emesis. The emesis was initially only tinged with blood, but in the last 24 hours, it has contained "blood clots." She is diaphoretic, pale, and listless. Her heart rate is 140 beats/min and her blood pressure is 75/48 mm Hg. You ask the nurse to obtain intravenous access and give a normal saline bolus, and you emergently ask for consultation with a gastroenterologist. While waiting for a response, you contemplate your management options.

Introduction

Upper gastrointestinal (GI) bleeding is defined as bleeding that originates in the GI tract proximal to the ligament of Treitz, which is located at the duodenojejunal flexure. The causes of upper GI bleeding in children range from benign to life-threatening. Children presenting with life-threatening causes of acute upper GI bleeding are uncommon in the emergency department (ED), but significant morbidity can result if there are delays in recognition and treatment. These cases can be challenging and anxiety-provoking to the family, child, and medical care team.

Most upper GI bleeds present with hematemesis (the vomiting of blood), whereas melena or hematochezia are less common.[1] The color of the bleeding is bright red, dark red, or brown (with a "coffee-ground" appearance), depending on the amount of time hemoglobin has been denatured in the acidic gastric environment. Melena is the passage of dark or black stools per rectum that are often sticky ("tarry stools"), appear shiny, and may have a sickeningly sweet aroma.[2] Hematochezia is the rectal passage of bright-red or maroon-colored stools. In most cases, hematochezia is suggestive of bleeding from the descending colon.[2] However, in pediatric patients with rapid GI transit times and/or brisk blood loss, hematochezia may be from an upper GI source.

Relying on the best available evidence from the literature, we will review the differential diagnosis of upper GI bleeding in children, and discuss key points regarding the diagnosis and initial management of children with an upper GI bleed.

Critical Appraisal Of The Literature

A search of PubMed, Ovid MEDLINE®, and the Cochrane Database of Systematic Reviews was performed utilizing the search terms *pediatric gastrointestinal bleeding, upper gastrointestinal bleeding, gastrointestinal bleeding and children, acute gastrointestinal bleeding*, and *emergency gastrointestinal bleeding*. Search limits included human studies and ages birth to 18 years. The following were also queried: the Canadian Pediatric Society (www. cps.ca), the American Academy of Pediatrics (www. aap.org), and the North American Society of Pediatric Gastroenterology and Nutrition (www.naspghan. org). We found no clinical guidelines and no prospective randomized studies in the emergency medicine literature, and only a few studies involved children in the intensive care unit (ICU). Some adult upper GI bleeding literature was also reviewed for inclusion in the evaluation and management of upper GI bleeding.

Epidemiology, Etiology, And Pathogenesis

The incidence of pediatric patients with an acute upper GI bleed presenting to the ED is not well established.[3,4,5] Freedman estimates hematemesis accounts for 0.2% of all ED visits. However, in the intensive care setting, upper GI bleeding occurs in 6% to 25% of critically ill children.[6,7] Chaibou showed a 10.2% incidence of upper GI bleed in the ICU, but only 1.6% of the cases were clinically significant.[8] Mortality related to upper GI bleeding is not well documented in the emergency medicine literature. However, critically ill children with upper GI bleeding in the ICU (including both medical and postoperative patients) had a significantly higher mortality rate compared to those without upper GI bleeding (16% vs 1.3%).[6]

The etiology of upper GI bleeding varies by age and can be associated with benign or life-threatening causes. The pathophysiology of upper GI bleeding is related to the source of the bleeding. More common and less significant causes, such as swallowed blood from the nose or mouth, can be determined by a thorough history and physical examination. Most

clinically significant causes of upper GI bleeds are associated with ulcers, erosive esophagitis, gastritis, varices, and/or Mallory-Weiss tears.[9] A full discussion of the pathophysiology of each potential source of bleeding is beyond the scope of this issue, but a brief discussion on the pathogenesis of the most common significant causes are outlined here.

Ulcers, erosive esophagitis, and gastritis are often associated with an imbalance between cytotoxic components and cytoprotective factors in the upper GI tract. The toxic components include gastric acid, pepsin, and bile acids. The cytoprotective factors include the mucosal layer, local bicarbonate secretion, and mucosal blood flow. Physiologic stress, nonsteroidal anti-inflammatory drugs (NSAIDs) such as aspirin and ibuprofen, and infection with *Helicobacter pylori* are a few of the factors contributing to the imbalance leading to ulcers and erosions in the GI tract.[10]

Varices are dilated veins within the esophagus and sometimes within the stomach. They are associated with cirrhotic and noncirrhotic portal hypertension. Portal hypertension is a hemodynamic abnormality related to increased resistance to back pressure from within the hepatic intravascular system. This increased pressure is transmitted to the contiguous portal vein and its collaterals, resulting in esophageal varices, which increases the risk of rupture and bleeding.

Mallory-Weiss tears are mucosal tears at the gastroesophageal junction that cause bleeding. During vomiting or retching, a large pressure gradient at the gastroesophageal junction develops, and the elevation of the gastroesophageal junction above the diaphragm can lead to dilatation and tearing of the mucosa. Vomiting leading to Mallory-Weiss tears can be acute or chronic in nature.

Differential Diagnosis

The most common causes of upper GI bleeding in children vary by age.[1,5,11] **(See Table 1.)** The overall incidence of hematemesis in children is unknown since many cases are likely to be self-limited and unreported, or are managed in the outpatient setting by primary care providers. Many of these self-limited cases have less-worrisome nongastrointestinal causes. Swallowing of maternal blood at the time of delivery or from breast milk is common in infants and neonates who are otherwise well-appearing. Epistaxis is a common problem in children, and in most children, blood emanates from the nares. However, some children may ingest the blood and develop hematemesis instead of the more classic presentation of a nosebleed. Epistaxis can result from the mechanical trauma of nose-picking, irritation from a nasal foreign body, or friable mucosa secondary to another process (such as allergic rhinitis or viral upper respiratory infections). Blood can also be transported from the sinuses and swallowed. Inquiring about a history of sinusitis or sinus symptoms can be helpful in establishing the diagnosis. Oral causes include poor gum health, dental disease, and mucosal disruptions from ulcers or trauma. Primary ulcers or trauma can also disrupt palatal or pharyngeal mucosa leading to bleeding. Patients with oral, palatal, or pharyngeal sources of bleeding may report symptoms of dysphagia or odynophagia. Obtaining a recent history of oral or pharyngeal surgery can suggest surgical site bleeding. Less obvious nongastrointestinal causes of "bleeding" are foods and drinks whose appearance can be mistaken for blood.

Upper GI bleeds are rare in the first month of life. If suspected, they should be distinguished from swallowed maternal blood. Hemorrhagic disease of the newborn should be considered in neonates who did not receive intramuscular vitamin K at birth. In infants and toddlers, reflux esophagitis is more likely, compared to children and adolescents.[12] Other considerations include caustic or foreign body ingestions affecting the esophagus or stomach. Older children and adolescents are more likely to have causes similar to adults, such as ulcers. The incidence of peptic ulcer bleeding has been estimated to be 0.5 to 0.9/100,000 in the pediatric population.[13]

Historically, the etiology of clinically significant upper GI bleeding has remained relatively unchanged. In 1979 retrospective single-center study of 68 children aged < 19 years, Cox and Ament found that the 5 most common sources of upper GI bleeding were duodenal ulcers, gastric ulcers,

Table 1. Differential Diagnosis Of Apparent Upper Gastrointestinal Bleeding In Pediatric Patients

Neonates and Infants	Children and Adolescents
• Esophagitis • Gastritis • Gastric or duodenal ulcer • Coagulopathy (infectious, vitamin K deficiency) • Vascular malformation • Hemophilia • Maternal NSAID use • Swallowed blood: ◦ Maternal blood during feeds ◦ Epistaxis ◦ Gingival bleeding ◦ Nasal trauma from nasal suction or NG tube ◦ Oral trauma	• Esophagitis • Gastritis • Gastric or duodenal ulcer • Mallory-Weiss tear • Esophageal/gastric varices • Foreign body or caustic ingestion • Vascular malformation • Pill ulceration • NSAID use • Swallowed blood: ◦ Epistaxis ◦ Gingival bleeding ◦ Nasal trauma ◦ Oral trauma

Abbreviations: NG, nasogastric; NSAID, nonsteroidal anti-inflammatory drug.

esophagitis, gastritis, and esophageal varices.[14] In a 2013 descriptive single-center study, Rafeey and colleagues reviewed all diagnostic endoscopic procedures performed for upper GI bleeding. They found erosive esophagitis to be the most common cause of upper GI bleeding (40%), followed by gastritis/erosions (32%), esophageal varices (7%), and peptic ulcer disease (4%). Age-related analysis showed erosive esophagitis to be more common in the younger age group, and gastritis to be more common in older children and adolescents.[15]

Foreign body ingestion (including button batteries) is an uncommon cause of upper GI bleeding, but it carries a significantly increased risk of morbidity and mortality.[16] In a retrospective data report from the United States Centers for Disease Control and Prevention covering the time between 1997 and 2010, button batteries were implicated in 58% of battery-related injuries in children seen in the ED, and all fatalities were associated with button batteries.[17] With the marked increase in demand for products using small batteries, the index of suspicion must remain high for foreign body/button battery ingestion as a possible cause of upper GI bleeding.[18]

Prehospital Care

Prehospital care for upper GI bleeding begins with monitoring and managing airway, breathing, and circulation. In the presence of significant blood loss, emergency medical service providers should immediately assess for and treat hypovolemia and hypovolemic shock. The patient may exhibit signs of shock, such as hypotension, tachycardia, delayed capillary refill, cool and mottled skin, respiratory distress, or change in mental status. Immediate intravenous access should be obtained, and fluid resuscitation should be initiated with isotonic fluids during transport to the most appropriate facility. In a child with findings of pallor or respiratory distress, oxygen should be administered, as oxygen-carrying capacity may be low in a child with significant anemia from blood loss.

Emergency Department Evaluation

The initial evaluation of a patient with upper GI bleeding should start with assessment of the airway, breathing, and circulation with special focus on hemodynamic stability. A focused history and physical examination targeted at elucidating potential causes of bleeding should be rapidly obtained. **Table 2 (see page 5)** summarizes common historical elements and physical findings for pediatric patients with suspected upper GI bleeding.

History

The clinical history should include questions regarding the specifics of the course of bleeding, a detailed description of the hematemesis material, the severity of bleeding, the estimated blood loss, the time period of the bleeding, and any other associated symptoms. Signs and symptoms such as scleral icterus, jaundice, easy bruising, and change in stool color can provide clues to an underlying liver disorder. A history of recurrent epistaxis or nasal/oral trauma may warrant a search for a nasopharyngeal source of bleeding. A choking episode or a sudden onset of hematemesis or vomiting in a previously well child should raise suspicion for foreign body or caustic ingestion, keeping in mind that children who are frightened by the event or the potential consequences of their actions may not always provide the most reliable history. Children and adolescents taking pills can develop pill esophagitis, which can be associated with an upper GI bleed.

To avoid unnecessary testing, it is important to obtain a history of recent ingestions, as many ingested substances can be mistaken for blood.[1,19] Colored substances that may mimic blood in emesis or stool include candy (red licorice), drinks (fruit punch), snacks (hot or spicy flavored snacks), vegetables (beets, cherries, strawberries), and medications (phenytoin, rifampin). Substances that can present as a black color include medications (bismuth, iron), fruits/vegetables (spinach, blueberry), and candy (black licorice).[1]

The specific details of hematemesis, coffee-ground emesis, melena, or hematochezia should be sought. The majority of studies reveal that the most common clinical presentations for upper GI bleeding are hematemesis (73%), melena (21%), and coffee-ground emesis (6%).[20] In the same study, the authors also report that a history of melena was associated with more significant bleeding than hematemesis or coffee-ground emesis. Additionally, a source of bleeding was less likely to be found during endoscopy in children with upper GI bleeding for > 1 month or in children with intermittent bleeding than in children with upper GI bleeding for < 1 month or in children with persistent bleeding.

Obtaining an estimation of the amount of blood loss is important in the history, but estimates can be inaccurate. Tebruegge et al evaluated the ability of observers to visually estimate blood loss and found visual estimates by both lay people and healthcare professionals to be highly inaccurate. Parents had a tendency to overestimate blood loss while physicians tended to underestimate blood loss.[21]

NSAID use is associated with peptic ulcers and erosions.[22] Grimaldi-Bensouda et al evaluated the use of NSAIDs as a risk factor for developing upper GI bleeding in children. Medication use 4 weeks prior to the onset of bleeding was assessed. The au-

thors discovered that NSAID doses were within the recommended doses for antipyretic and analgesic treatment. The duration of use was, on average, < 2 days. Interestingly, NSAID use prior to upper GI bleed had an odds ratio (OR) of 8.2 (95% confidence interval [CI], 2.6-26.0) for all age groups combined. NSAID use in the 2-month to 7-year age group had an OR of 14.1 (95% CI, 2.8-71.2), and, in the 8- to 16-year age group, an OR of 3.4 (95% CI, 0.6-21.3).[12] In another small retrospective study of children aged < 2 years presenting to the ED with upper GI bleeding, Kalyoncu et al found 56% had erosive gastritis related to antipyretic use.[23] In addition to NSAID use, a detailed medication history is important, as other medications may play a role in hematemesis. Children being treated with antiplatelet or anticoagulation therapy may be more vulnerable to bleeding. Medication-induced esophagitis or gastritis may also be contributing factors in the development of GI bleeding.

Physical Examination

Careful review and monitoring of vital signs is essential in the evaluation and management of patients with suspected upper GI bleeding. Since children rarely have primary cardiac, pulmonary, or renal conditions, keep in mind that blood pressure can be maintained through reflex homeostatic mechanisms until the later stages of blood loss. Through similar homeostatic mechanisms, tachycardia is an

Table 2. Diagnostic Clues For Select Causes Of Upper Gastrointestinal Bleeding In Pediatric Patients

Clinical History	Clinical Findings
Caustic Ingestion	
• History of caustic ingestion • Odynophagia and/or dysphagia • Mouth pain • Refusal to eat or drink	• Intraoral bleeding • Burns on lips, mouth, or pharynx • Dyspnea, coughing, tachypnea • Drooling • Swollen, erythematous intraoral tissue
Foreign Body Ingestion	
• History of ingested foreign body • Odynophagia and/or dysphagia • Refusal to eat or drink	• Well-appearing or anxious • Dyspnea • Drooling • Positive x-ray
Factitious Disorder by Proxy	
• Inconsistent history among caregivers • Guardian with medical background	• Normal physical examination • Normal laboratory studies (if obtained)
Gastroesophageal Reflux Disease/Esophagitis	
• Persistent vomiting • Irritability (infants & neurologically delayed children) • Chest pain/heartburn (older children) • Odynophagia and/or dysphagia	• Failure to grow, weight loss • Foul-smelling breath • Occult blood in stool
Mallory-Weiss Tear	
• Acute onset of vomiting or retching followed by hematemesis	• Black, tarry stool • Occult blood in stool
Infection	
• Ill contacts • Immune-compromised state • Immune suppression therapy (eg, posttransplant, inflammatory bowel) • Chest pain / heartburn • Odynophagia and/or dysphagia	• Oral lesions • Fever • Leukocytosis • Occult blood in stool
Esophageal Varices	
• Liver disease/portal hypertension • Infection of umbilical stump as neonate • Umbilical catheter as neonate	• Hepatosplenomegaly • Hemodynamic instability • Signs/symptoms of liver disease • Anemia, thrombocytopenia • Pale complexion
Nasal-Oropharyngeal Bleeding	
• Recent oral, nasal, or pharyngeal surgery (eg, tonsillectomy) • Epistaxis • Nasal trauma (eg, nose picking, fall)	• Dried/fresh blood in nasal passages • Bleeding in oropharynx • Friable nares and/or oropharynx

early and sensitive sign of severe acute blood loss.[5] While hypotension in a patient with an upper GI bleed is an ominous sign, a normal blood pressure reading alone does not rule out an emergent situation. Hemodynamic changes may not be seen in patients with chronic blood loss, as compensatory mechanisms in other organ systems (including release of catecholamines, adrenocorticotropic hormone, antidiuretic hormone, renin, angiotensin, aldosterone, glucocorticoids, and prostaglandins) may have already taken place.[2] The presence of orthostatic pressures may also suggest acute volume loss, while a narrowed pulse pressure may be a sign of impending vascular collapse.[2] Fever can be indicative of infection or sepsis leading to coagulopathy as a cause of bleeding.

Although a well-appearing child does not rule out a significant upper GI bleed, it is important to note the child's general appearance and mental status in order to gauge the need for immediate or emergent intervention. A change in mental status may be suggestive of decreased cerebral perfusion associated with anemia and blood volume loss.

Most nonworrisome causes of upper GI bleeding can be found on physical examination. A detailed inspection of the oral-nasal-pharyngeal mucosa is important to look for actively bleeding or oozing vessels, friable mucosa, and/or foreign bodies. Cutaneous hemangiomas and mucocutaneous telangiectasias suggest the presence of visceral vascular malformations. Scleral icterus, facial skin telangiectasias, and jaundice are clues to underlying liver disease. The intensity of the red or pink or paleness of the palpebral conjunctiva provides a rough approximation of the degree of anemia and blood loss.

Abdominal distension should raise concern for bowel obstruction, ascites, or perforation. Tenderness, particularly in the epigastric or left upper quadrant area, may be indicative of a duodenal or gastric ulcer or pancreatitis. A palpable and/or firm liver may suggest hepatomegaly and underlying liver disease. Caution should be taken in patients with cirrhosis or end-stage liver disease who may have a misleadingly normal or a shrunken liver; a nonpalpable liver does not exclude hepatic etiology of GI bleeding. A palpable spleen may suggest the presence of an enlarged spleen from portal hypertension. Likewise, prominent abdominal vessels or caput medusa on the abdominal wall are also suggestive of portal hypertension. The presence of 1 or more of these signs of portal hypertension increases the chances of esophageal varices or hypertensive gastropathy as the source of bleeding.

Risk Stratification

Once an upper GI bleed is suspected, it is imperative to obtain proper consultation and to start definitive treatment as soon as possible and avoid unnecessary laboratory or radiographic tests. Several ICU and endoscopy studies have evaluated risk factors associated with clinically significant upper GI bleeding in children. In a study of 208 children managed in the ICU, Cochran et al showed that shock (OR 17.4; 95% CI, 3.5-87.2), operative procedure > 3 hours (OR 3.6; 95% CI, 1.4-8.9), and trauma (OR 20.9; 95% CI, 1.9-236.4) are risk factors for upper GI bleeding.[6] In another ICU study, Chaibou showed that respiratory failure, coagulopathy, and a pediatric risk mortality score of ≥ 10 were 3 independent risk factors for clinically significant bleeding.[8] Cleveland et al reported on results of endoscopies performed for upper GI bleeding over an 11-year period and found that the presence of melena was associated with more significant bleeding than hematemesis and coffee-ground emesis.[20]

Various risk stratification scores have been developed and used in adults to classify patients being evaluated for suspected upper GI bleeding as low-risk, but no similar tool exists for children.[25,26] Freedman et al sought to identify predictors for children with a significant upper GI bleed presenting to the ED.[27] Significant upper GI bleeding was defined as a drop in hemoglobin of > 2 g/dL within 48 hours, administration of blood transfusion within 48 hours of presentation, and the need for endoscopy or a surgical procedure to stop bleeding or one performed emergently (within 4 hours of presentation). Of 613 subjects studied, 4% met the definition of clinically significant upper GI bleeding.

The most common cause of a significant upper GI bleed was varices. Risk factors for significant bleeding included older age (9.7 vs 2.9 years), moderate to large amount of coffee-ground emesis or fresh blood, hematochezia, melena, significant medical history, unwell appearance, and heart rate outside normal range. The presence of any 1 of the following identified all children with clinically significant hemorrhage: melena, hematochezia, unwell appearance, or a moderate to large volume of fresh blood in vomitus. The diagnostic test characteristics of having any 1 of these 4 features showed a sensitivity of 100% (95% CI, 84%-100%), specificity of 72% (95% CI, 68%-75%), positive predictive value of 14% (95% CI, 9%-20%), negative predictive value of 100% (95% CI, 99%-100%), and a likelihood ratio of 3.6 (95% CI, 3.1%-4.1%). The study also found that 63% of children with clinically significant upper GI bleeding had a past medical history notable for diseases of the GI tract, diseases that predisposed them to bleeding, recurrent vomiting syndromes, indwelling devices that may have resulted in erosion of the gastrointestinal mucosa, and systemic diseases that placed them at risk for bleeding. In a meta-analysis that included 1776 adult patients, results showed that a nasogastric lavage with blood or coffee-ground material or a serum blood urea

nitrogen (BUN):creatinine ratio of > 30 increased the likelihood of an upper GI bleed.[28]

Pongprasobchai and colleagues developed a model for distinguishing variceal bleeding in adult patients.[29] Three factors identified as predictive of variceal bleeding include a prior diagnosis of liver disease or signs of chronic liver disease, red vomitus, and red nasogastric aspirate. In predicting variceal bleeding, the sensitivity was 85%, specificity was 81%, accuracy was 82%, positive predictive value was 50%, and the negative predictive value was 96%. In an attempt to develop a prediction rule for varices in children, Gana et al found that a cut-off value of < 130 using the derived prediction rule equation of (0.75 x platelets/spleen length z-score + 5) + 2.5 x albumin had a sensitivity of 94% and a specificity of 81% in predicting varices.[30] Spleen length z-score was derived from measured spleen length on ultrasound and expressed as a standard deviation score relative to the established reference spleen length for age.

Diagnostic Studies

In order to determine whether the vomitus is bloody, a Gastroccult® test can be performed. The Hemoccult® test commonly used to check for blood in samples obtained per rectum may produce false-negative results in the presence of acid from the stomach. Gastroccult® kits incorporate more alkali to neutralize the gastric acid in the emesis and are a more reliable indicator of the presence of blood in suspected hematemesis.[30] In cases of neonatal hematemesis, when it is unclear whether the source of blood is endogenous to the neonate or maternal in origin, the Apt-Downey test can be performed. The test is based on differences between the protein subunits of fetal and adult hemoglobin. Adult hemoglobin is made of 2 alpha and 2 beta subunits, whereas fetal hemoglobin is comprised of 2 alpha and 2 gamma subunits. Sodium hydroxide is added to the sample of blood in question. In the presence of sodium hydroxide, fetal hemoglobin remains pink, while adult hemoglobin turns yellow-brown.

Laboratory Studies

Laboratory testing in a well-appearing and clinically stable patient is of limited value. In patients who are ill-appearing or who are hemodynamically unstable, tests to consider include a complete blood count (CBC), blood type and crossmatch, prothrombin time (PT), international normalized ratio (INR), partial thromboplastin time (PTT), and a complete metabolic profile (CMP) with sodium, potassium, chloride, carbon dioxide, BUN, creatinine, aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, albumin, and total bilirubin. A low mean corpuscle volume level along with an elevated red cell distribution width suggests chronic blood loss resulting in iron deficiency. Thrombocytopenia may be associated with splenic sequestration from splenomegaly related to portal hypertension.[31] In an ill-appearing patient with evidence of shock, thrombocytopenia may also indicate sepsis.

PT, PTT, INR, and albumin are markers of hepatic function. Isolated coagulopathy or coagulopathy in conjunction with hypoalbuminemia suggests underlying liver dysfunction. While elevated liver enzymes suggest hepatic pathology, normal liver enzymes do not fully exclude liver problems, as patients with end-stage liver disease or cirrhosis may have normal or only mildly elevated liver enzymes in the setting of significant liver dysfunction.

Patients with an upper GI bleed may have an elevated BUN:creatinine ratio, as red blood cell proteins are digested and reabsorbed by enzymes in the GI tract. In a study of 11 children, a BUN:creatinine ratio of ≥ 30 had a sensitivity of 98% and a specificity of 68% in detecting an upper GI bleed.[32] These findings parallel those by Felber et al in an earlier retrospective study of 40 children with an upper GI bleed.[33] As there are many causes of an elevated BUN:creatinine ratio, this finding may have limited use in the ED setting.

Imaging Studies

X-rays should be considered in infants, toddlers, and young children in whom there is suspicion of foreign body ingestion (eg, clinical findings of coughing, drooling, dysphagia, odynophagia, altered mental status, and/or feeding refusal). Symptomatic esophageal foreign bodies constitute a medical emergency, and the timing of endoscopy should be discussed urgently with a gastroenterologist. A gastroenterologist should also be contacted in most cases of suspected upper GI bleeding to assess the need for diagnostic endoscopy.

Treatment

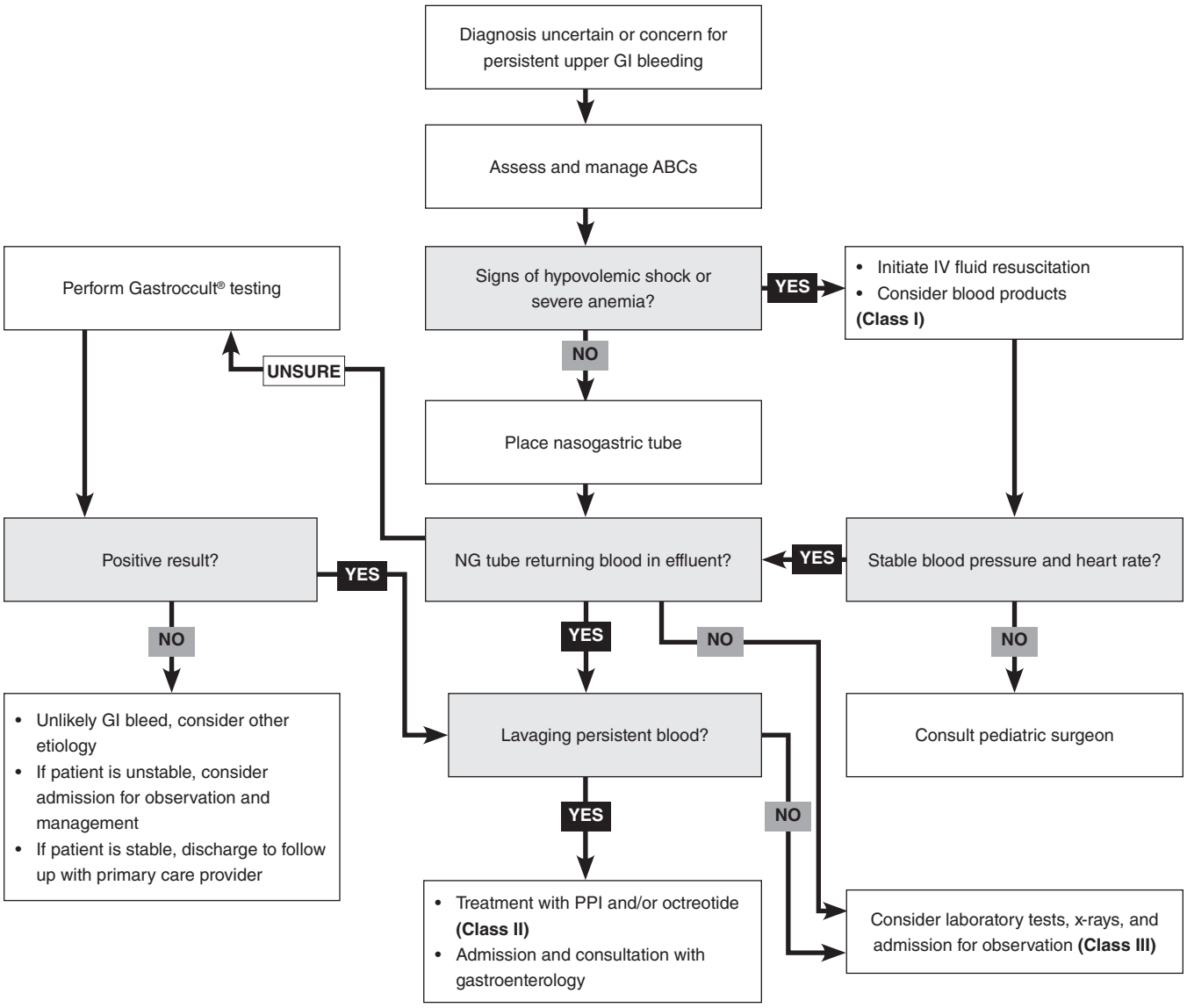
Initial Management

In patients who are ill-appearing, 2 large-bore intravenous lines should be placed. Volume resuscitation should be initiated using sequential 20 mL/kg boluses of isotonic fluids. If blood loss is ongoing or rapid, replacement with packed red blood cells and clotting factors/fibrinogen (as appropriate for the situation) may be needed.[1,34,35] Fresh-frozen plasma can be considered in the setting of coagulopathy at an initial dose of 10 mL/kg.[36]

Nasogastric Tube Placement

Nasogastric (NG) tube placement and lavage should be considered for pediatric patients with suspected upper GI bleeding when the diagnosis is uncertain or there is concern for persistent GI bleeding.[2,5,36] Lavage allows for sampling of gastric contents to

Clinical Pathway For Emergency Department Management Of Upper Gastrointestinal Bleeding In Children



Abbreviations: ABCs, airway, breathing, and circulation; GI, gastrointestinal; IV, intravenous; NG, nasogastric; PPI, proton pump inhibitor.

Class Of Evidence Definitions

Each action in the clinical pathways section of *Pediatric Emergency Medicine Practice* receives a score based on the following definitions.

Class I
- Always acceptable, safe
- Definitely useful
- Proven in both efficacy and effectiveness

Level of Evidence:
- One or more large prospective studies are present (with rare exceptions)
- High-quality meta-analyses
- Study results consistently positive and compelling

Class II
- Safe, acceptable
- Probably useful

Level of Evidence:
- Generally higher levels of evidence
- Nonrandomized or retrospective studies: historic, cohort, or case control studies
- Less robust randomized controlled trials
- Results consistently positive

Class III
- May be acceptable
- Possibly useful
- Considered optional or alternative treatments

Level of Evidence:
- Generally lower or intermediate levels of evidence
- Case series, animal studies, consensus panels
- Occasionally positive results

Indeterminate
- Continuing area of research
- No recommendations until further research

Level of Evidence:
- Evidence not available
- Higher studies in progress
- Results inconsistent, contradictory
- Results not compelling

confirm the presence of blood, localizing bleeding to the upper GI tract, estimating the rate of bleeding, and preventing hyperammonemia in patients with liver disease.[2,36] Relative contraindications to NG tube placement include esophageal foreign bodies, caustic ingestions, and recent surgery or banding. The specific type and brand of NG tube will vary from institution to institution, but it is typically a double-lumen vented NG tube that is appropriately sized for age. Appropriate intragastric placement of the NG tube should be verified per institution-specific guidelines. Lavages are performed by infusing 3 to 5 mL/kg aliquots of room temperature normal saline via the NG tube. The older practice of using iced saline for gastric lavage has been shown to be ineffective in slowing down bleeding in canine gastric ulcers.[37] Iced or cooled saline is no longer recommended and may induce iatrogenic hypothermia, particularly in infants and young children.

Following infusion, the aliquot is immediately withdrawn from the NG tube. Serial lavages should be performed until the effluent returns clear. If effluent cannot be withdrawn, the position of the NG tube should be adjusted or the patient should be repositioned. The appearance and volume of the effluent and the number and volume of lavages needed to achieve a clear effluent should be noted. Effluent that persistently contains bright-red blood after 3 or more aliquots of lavages is indicative of ongoing bleeding and constitutes an emergent situation. Effluent that is initially coffee-ground color or red and then clears after 2 or 3 aliquots of lavage suggests a slower rate of bleeding or previous bleeding that has stopped. Effluent that shows no evidence of coffee-ground or bloody material suggests a non-GI source of bleeding or that the source is beyond the pylorus. Potential risks of NG tube placement (such as disrupting esophageal/gastric varices or dislodging a gastric clot) are possible, but unlikely, with the overall benefits of NG tube lavage outweighing the risks.[1,2,38,39]

Surgical Consultation

A gastroenterologist should be contacted for most cases of suspected upper GI bleeding. The gastroenterologist can aid in the decision regarding the need for and timing of endoscopy. When there is ongoing blood loss associated with hemodynamic instability that is refractory to volume resuscitation, surgical colleagues should be consulted. Hemodynamically unstable patients are not ideal candidates for endoscopy and may require emergent exploratory laparotomy to locate and treat the source of bleeding. In the setting of refractory hemodynamic instability and/or significant coagulopathy, the benefits and risks of proceeding with any procedure or surgery need to be carefully considered on a case-by-case basis.

In a descriptive study by Rafeey et al of all diagnostic endoscopic procedures for upper GI bleeding, bleeding stopped spontaneously in 25% of patients, 57% of bleeding stopped with medical therapy, and endoscopic therapy was required in 18% of patients.[15] One patient died due to perforation from a foreign body.

Medical Management

The predominance of peptic ulcer disease as a cause of, or a factor in, upper GI bleeding supports the use of acid suppression, in most cases. With limited pediatric data available on acid suppression in upper GI bleeding, the use of acid suppression therapy in children is largely derived from adult data.[1,19,40] Of the options for acid suppression therapy, proton pump inhibitors (PPIs) have been shown to be superior to histamine-2 (H_2)–receptor blockers in treating adults with an upper GI bleed associated with peptic ulcer disease.[41,42,43] In patients with suspected gastric or duodenal ulceration as a cause of blood loss, a PPI should be started. Pediatric dosing in these circumstances has not been published. One pediatric review recommends using pantoprazole at the following dosages: Children < 40 kg: 0.5 to 1 mg/kg/day intravenous (IV) once daily; children ≥ 40 kg: 20 to 40 mg IV once daily (maximum 40 mg/dose).[19] Alternatively, omeprazole may also be used at a dose of 1 mg/kg/dose IV every 12 to 24 hours with the goal of maintaining gastric pH > 4.5.

In adults, an initial bolus of 80 mg IV of pantoprazole or esomeprazole is given, followed by a continuous drip at 8 mg/h. Continuous infusion dosing guidelines for PPIs in children are not available. Some centers have adopted an approach of starting with a bolus of 1 mg/kg of pantoprazole or esomeprazole followed by a continuous infusion of 0.1 mg/kg/h (maximum adult dose of 8 mg/h).[19] Pantoprazole and esomeprazole are the most widely available intravenous PPIs in the United States.

H_2-receptor blockers have also been used historically in children, but, with the demonstrated effectiveness of PPIs over H_2-receptor blockers in adults, PPIs are increasingly being used. If a PPI is not readily available, H_2-receptor blockers can be used. Ranitidine can be dosed as a continuous infusion (1 mg/kg bolus followed by infusion of 2 to 4 mg/kg/day) or as bolus infusions (3 to 5 mg/kg/day divided every 8 hours).[19]

Locally acting drugs (such as magnesium hydroxide, aluminum hydroxide, and sucralfate) can play a complementary role in treating peptic ulcer disease. However, because they have the potential to make endoscopic visualization of lesions more difficult, their use should be discussed with a gastroenterologist first.

Octreotide is a synthetic somatostatin analog with a long half-life that is thought to inhibit gastric secretion and reduce splanchnic and azygous blood flow in patients with portal hypertension.[44,45] In

children with portal hypertension, octreotide has been shown to significantly reduce bleeding from esophageal varices.[46] In patients with suspected or known varices as a source of bleeding, octreotide should be started.[1,19] The dose of octreotide starts with a 1 mcg/kg bolus (maximum, 50 mcg) followed by a continuous infusion of 1 to 2 mcg/kg/h.[19,47,48] Some authors have suggested increasing the infusion rate every 8 hours, as needed, to a maximum of 4 mcg/kg/h.[19] Eroglu et al evaluated octreotide use in patients with upper GI bleeding with and without portal hypertension.[46] Twenty-one patients with portal hypertension received octreotide infusion, and bleeding cessation occurred in 71%. In contrast, 12 children without portal hypertension who received octreotide infusion had a 50% rate of bleeding cessation. In patients with a significant upper GI bleed in which the cause is unclear and endoscopy cannot be performed, both acid suppression and octreotide therapy should be considered until a diagnosis is established.[27]

In the setting of coagulopathy, intravenous vitamin K should be considered at a dose of 1 to 2 mg/dose for infants and 5 to 10 mg for children.[36] Vitamin K is necessary for synthesis of clotting factors II, VII, IX, and X. It is fat-soluble and requires bile salts for absorption. Consideration should be given to administration of vitamin K for upper GI bleeding in children with fat malabsorption conditions such as cholestatic liver disease, pancreatic disease, and intestinal disorders.

Vasopressin is classified as a vasoconstrictor and antidiuretic hormone. It is a potent vasoconstrictor that helps to decrease blood flow to the viscera and decrease portal pressure. Due to concerns of possible cardiac, peripheral, and bowel ischemia side effects, its use has been limited in the setting of upper GI bleeds. The advent and effectiveness of octreotide has reduced the need for vasopressin, but it can be considered in a severe upper GI bleed that is emergent and unresponsive to other forms of therapy.[36] Vasopressin can be dosed at 0.002 to 0.005 units/kg/min as a continuous drip.[5] Terlipressin is a newer synthetic analogue of vasopressin with a longer half-life that has been used mainly in adult variceal bleeding. There have been case reports of its use in children. Erkek reported a 10-month-old infant with septic shock and a nonvariceal upper GI bleed that was refractory to conventional therapy with omeprazole, sucralfate, fresh-frozen plasma, and octreotide, who had improved after 2 days of therapy with terlipressin.[49]

Endoscopy

Endoscopy can serve both diagnostic and therapeutic purposes.[50,51] It has been reported that adult patients with a nasal-gastric aspirate containing coffee-ground fluid or blood have an increased risk of active hemorrhage and should undergo emergent endoscopy.[52] The need for and the timing of endoscopy should be made in consultation with a gastroenterologist. The diagnostic yield of endoscopy in most studies ranges from 57% to 88%.[14,20,51] The highest yield of endoscopy is typically when it is performed within 24 hours of presentation, as bleeding is reduced after the initiation of medical therapy. Endoscopy is relatively contraindicated if the patient is clinically and/or hemodynamically unstable, in shock, suffering from myocardial ischemia, or has significant coagulopathy or profound anemia.[36]

Time- And Cost-Effective Strategies

- Prompt intravenous access is essential in managing pediatric patients with suspected upper GI bleeding.
- The history and physical examination should be directed at finding the source of bleeding, determining the severity and rate of bleeding, and eliciting the signs and symptoms of upper GI bleeding.
- Screening laboratory studies for patients with an upper GI bleed should include: CBC, CMP, PT, PTT, and INR. Blood type and crossmatch should be ordered if there are significant findings on history or physical examination. NG tube lavage should be performed in the presence of worrisome signs and symptoms.
- Treatment with intravenous acid blockade should be initiated if there is a suspicion of peptic ulcer disease. Octreotide should be added for suspicion of variceal bleeding. If there is evidence of significant bleeding, both therapies can be initiated prior to definitive diagnosis. Concomitant consultation with a pediatric gastroenterologist is recommended.
- Children presenting with suspected gastrointestinal bleeding with significant signs or symptoms should be observed for at least 24 hours.

Disposition

There are no guidelines addressing the indications for hospitalization in pediatric patients with suspected upper GI bleeding. In general, a conservative approach is suggested. Based on a limited number of studies, it is reasonable to hospitalize patients with any worrisome clinical signs or symptoms. Patients with significant upper GI bleeding of a known or unknown source should be admitted and observed in the ICU setting. An initial well appearance of a child with an upper GI bleed admitted to the hospital should not be cause for complacency, as children with

bleeding from sources such as deep ulcers and varices can decompensate quickly. All medical staff should be aware of this possibility, and maintain vigilant monitoring for changes in vital signs and clinical status. **Table 3** summarizes indication for hospitalization of children with upper GI bleeding.

Special Circumstances

Lavage Through Existing Gastrostomy Tubes

The use of an existing gastrostomy tube for gastric lavage may be appropriate in some patients with hematemesis. However, lavaging through a gastric tube may lead to false-negative findings and/or underestimating the severity of gastrointestinal bleeding. The reason is twofold. First, the size of a gastrostomy tube can vary between 12F and 20F in most pediatric patients. Second, the position of the gastrostomy tube varies from patient to patient. The position can be anywhere between the greater curvature and the gastric antrum. Smaller gastrostomy tube size and positioning of the gastrostomy tube at a high or nondependent location of the stomach where fluids do not tend to accumulate increase the chances of misdiagnosis or underestimation. Thus, emergency clinicians should strongly consider placing an adequately sized NG tube, even in patients with existing gastric tubes, when the index of suspicion for GI bleeding is high or the consequences of delaying a diagnosis or underestimating the severity of a GI bleed is significant. The sensitivity and specificity of gastrostomy versus nasal-gastric lavage has not been well characterized.

Table 3. Indications For Hospitalization Of Children With Upper Gastrointestinal Bleeding

Significant Clinical Features	Indications for Hospitalization
Abnormal history	• Chronic medical condition (cardiac, pulmonary, gastrointestinal, renal, hematological, oncological) • Liver disease • History of omphalitis, umbilical infection, umbilical catheter as neonate
Persistent symptoms	• Hematemesis • Melena • Hematochezia • Vomiting • Abdominal pain
Abnormal vital signs	• Fever • Tachycardia • Hypotension • Tachypnea for age • Altered mentation
Abnormal liver tests	• Coagulopathy • Transaminitis • Hyperbilirubinemia
Abnormal CBC	• Anemia • Thrombocytopenia
Abnormal BMP	• Elevated BUN/creatinine • Significant electrolyte abnormalities
Abnormal examination	• Unwell appearance • Scleral icterus • Jaundice • Bruising • Palpable liver/spleen • Abdominal distension • Abdominal tenderness • Ascites • Visible abdominal vessels

Abbreviations: BMP, basal metabolic panel; BUN, blood urea nitrogen; CBC, complete blood count.

Summary

Upper GI bleeding is an uncommon problem in children, but one that carries significant morbidity and mortality if management is delayed. Timely management begins with recognizing basic worrisome signs and symptoms. This recognition will aid in determining the most appropriate evaluation and intervention. Basic evaluation to consider for children with significant upper GI bleeding includes a CBC, blood type and crossmatch, CMP, and coagulation studies (PT, PTT, and INR). In addition, patients with worrisome signs or symptoms should undergo gastric lavage via an appropriately sized NG tube designed for aspiration of air and gastric contents. In the setting of suspected significant upper GI bleeding, a gastroenterologist should be consulted immediately to assess the need for endoscopy. Endoscopy serves diagnostic and therapeutic purposes. All patients with an upper GI bleed should be kept NPO (nothing by mouth) until a clinical or endoscopic diagnosis is established. Treatment with an intravenous PPI should be considered for bleeding when the etiology is related to erosive esophagitis, gastritis, peptic ulcer disease, or reflux esophagitis. Bleeding associated with esophageal or gastric varices can be managed with a bolus of octreotide followed by a continuous infusion. In the context of significant bleeding or in an ill-appearing child where the diagnosis is uncertain, therapy with both acid blockade and octreotide should be considered. Stable patients with ongoing blood loss, a significant past medical history, poor ability to follow up, or an unclear etiology require admission for observation and gastroenterologist consultation.

Case Conclusions

The 4-year-old boy's history of allergic rhinitis and friable nasal mucosa provided evidence for the likely source of bleeding to be the nasal passages. You determined that no testing was necessary, and you discharged him for outpatient follow-up with his primary care provider within a week.

Based on the 10-year-old boy's history of biliary atresia and the scleral icterus and palpable spleen tip on examination, you suspected an underlying liver disease and portal hypertension as potential etiologies of his GI bleeding. You ordered a CBC, PT, PTT, INR, CMP, and type and crossmatch. At the bedside, you began fluid replacement and placed an appropriately sized NG tube for gastric lavage to determine the location, rate, and severity of bleeding. Prompt consultation with a gastroenterologist was made to expedite endoscopy planning for diagnostic and therapeutic purposes. The CBC revealed anemia, and his platelets were low. NG tube lavage revealed the presence of bright red blood that cleared after the third aliquot. The patient then underwent endoscopy, which showed portal-hypertensive gastropathy and esophageal varices. A rubber band was placed around the varices during endoscopy to reduce further bleeding. The patient was admitted to the hospital and observed for 24 hours after endoscopy.

The 16-year-old girl's physical examination and recent onset of abdominal pain leads you to suspect peptic ulcer disease as a possible etiology. You ordered a CBC, PT, PTT, INR, CMP, and type and crossmatch and started fluid replacement. You also placed an NG tube for gastric lavage to determine the location, rate, and severity of bleeding. You consulted a gastroenterologist to expedite endoscopy. The CBC revealed anemia, but her platelet count was normal. NG tube lavage revealed bright-red blood that cleared after the third aliquot. The endoscopy revealed a bleeding duodenal ulcer associated with H pylori infection. To achieve hemostasis, the gastroenterologist injected the ulcer with epinephrine and placed a hemostatic clip directly onto the ulcer. The girl was admitted to the hospital and observed for 24 hours.

Risk Management Pitfalls In The Management Of Upper Gastrointestinal Bleeding In Pediatric Patients (Continued on page 13)

1. **"The patient had epigastric pain with a lot of blood in the stool without hematemesis, so I didn't consider the source of bleeding to be upper GI."**
   While most upper GI bleeds present with hematemesis, it less commonly presents with melena or hematochezia. However, in pediatric patients with rapid GI transit times and/or brisk blood loss, hematochezia may occur from an upper GI source.

2. **"The nurse showed me some of the emesis, and it appeared to be only a small amount, so I discharged the patient home to follow up with the primary care physician."**
   Consideration should be given to further investigation of any child with hematemesis. Clinicians tend to underestimate blood loss, and parents tend to overestimate blood loss.

3. **"I didn't consider a variceal bleed, as the patient had normal liver enzymes and no hepatomegaly on examination."**
   Caution should be noted with cirrhosis or end-stage liver disease where a patient may have a misleadingly normal or shrunken liver. Additionally, normal liver enzymes do not fully exclude liver problems as a patient with cirrhosis or end-stage liver disease may have normal or only mildly elevated liver enzymes in the setting of significant liver dysfunction.

4. **"The patient had a history of hematemesis with epigastric pain. I suspected the source to be ulcer-related, so I ordered oral sucralfate and an intravenous dose of a PPI."**
   Locally acting drugs, such as magnesium hydroxide, aluminum hydroxide, and sucralfate, can play a complementary role in treating peptic ulcer disease. However, because they have the potential to make endoscopic visualization of lesions more difficult, their use should be discussed with a gastroenterologist.

5. **"On arrival, the patient was tachycardic from an upper GI bleed. NG lavage was performed and the fluid cleared. The patient's heart rate improved after several normal saline boluses, and he appeared stable, so I admitted him to the basic unit. Later, the child decompensated and ended up in the ICU requiring emergent endoscopy."**
   Patients with significant upper GI bleeding should be admitted and observed in the ICU setting for at least 24 hours. The initial well appearance of a child with an upper GI bleed admitted to the hospital should not be cause for complacency, as children with bleeding from sources such as deep ulcers and varices can decompensate quickly.

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Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study will be included in bold type following the reference, where available. The most informative references cited in this paper, as determined by the author, will be noted by an asterisk (*) next to the number of the reference.

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Risk Management Pitfalls In The Management Of Upper Gastrointestinal Bleeding In Pediatric Patients (Continued from page 12)

6. **"The NG aspirate looked bright red and the Hemoccult® test was negative, so I discharged the patient home with the assumption that the red was food coloring."**
The Hemoccult® test commonly used to check for blood in samples obtained per rectum may produce false-negative results in the presence of acid from the stomach. The Gastroccult® kits incorporate more alkali to neutralize the gastric acid in the emesis and are a more reliable indicator of the presence of blood in suspected hematemesis.

7. **"I placed an NG tube and initially noted bright-red blood in the aspirate. After several lavages with saline, it cleared. Since the bleeding stopped, I discharged the patient home with a prescription for a PPI and recommended close follow-up with the primary care physician."**
Effluent that is initially red on NG lavage and then clears suggests either a slower rate of bleeding or previous bleeding that has stopped. Patients with upper GI bleeds should be admitted for consultation with a gastroenterologist for possible endoscopy to determine the source and management of the upper GI bleed.

8. **"The toddler was spitting up blood and drooling on presentation; however, the NG aspirate was negative for gross blood and laboratory studies were normal, so I discharged him home with recommendations to follow up with the primary care physician within 24 hours."**
Foreign body ingestion (including button batteries) is an uncommon cause of upper GI bleeding, but it carries a significant increased risk of morbidity and mortality. The index of suspicion must remain high for foreign body ingestion as a possible cause of upper GI bleeds.

9. **"The patient had a gastrostomy tube and a history of coffee-ground emesis. Gastric lavage through the gastrostomy tube was negative for any blood, so the patient was discharged home."**
The use of gastrostomy tubes for lavage may lead to false-negative findings and/or underestimation of the severity of bleeding. Emergency clinicians should strongly consider placing an adequately sized NG tube even in patients with existing gastric tubes when the index of suspicion for GI bleeding is high or the consequences of delaying a diagnosis or underestimating the severity of a GI bleed is significant.

10. **"The toddler had multiple episodes of hematemesis in the ED. I passed an NG tube and started gastric lavage with ice-cold fluids to slow down the bleed."**
The older practice of using iced saline for gastric lavage is no longer recommended and may induce iatrogenic hypothermia, particularly in infants and young children.

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CME Questions

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1. Which of the following best describes upper gastrointestinal bleeding?
   a. Bleeding proximal to the second portion
   b. Bleeding proximal to the ligament of Treitz
   c. Bleeding proximal to the pylorus
   d. Bleeding proximal to the duodenal bulb

2. Which of the following is the most likely etiology of hematemesis in a happy and well-appearing, breast-fed 4-week-old baby delivered to first-time parents? The baby does not spit up and growth is consistent at the 50th percentile.
   a. Gastric ulcer from oral-gastric suctioning at delivery
   b. Ingested maternal blood
   c. Ingested foreign body
   d. *H pylori*-associated gastritis

3. Which of the following has been associated with upper GI bleeding from NSAID use?
   a. Peptic ulcer disease
   b. Esophageal varices
   c. *H pylori*-associated gastritis
   d. Coagulopathy

4. Palpable spleen and visible prominent abdominal wall vessels are suggestive of which of the following conditions?
   a. Portal hypertension
   b. Hepatitis
   c. Peptic ulcer disease
   d. Constipation

5. A previously healthy 2-year-old boy presents with hematemesis and drooling after being left alone in the family's living room for 5 minutes while the parents were preparing dinner. In addition to a CBC, which of the following tests should be included in the initial evaluation of this patient?
   a. Chest x-ray
   b. Upper endoscopy
   c. Barium study
   d. Ultrasound of liver and spleen

6. A 14-year-old boy with idiopathic portal vein thrombosis is seen in the ED for 3 episodes of vomiting bright-red blood. He has tachycardia with pale, palpebral conjunctiva and a palpable spleen 4 cm below the left costal margin. An NG tube is placed, and gastric lavage is performed. After 6 aliquots of lavage, there is still bright-red blood return. What is the best interpretation of the gastric lavage results?
   a. Ongoing bleeding, most likely superior to the pylorus
   b. Ongoing bleeding, most likely distal to the pylorus
   c. Previous bleeding that has most likely ceased, proximal to the pylorus
   d. Previous bleeding that has most likely ceased, distal to the pylorus

7. **Which of the following therapies would be the most effective initial treatment for a child with suspected peptic ulcer disease?**
   a. Pantoprazole
   b. Sucralfate
   c. Cimetidine
   d. Octreotide

8. **Which of the following treatments would be the most effective medical treatment for a child with hematemesis associated with esophageal varices?**
   a. Octreotide
   b. Cimetidine
   c. Aluminum hydroxide
   d. Epinephrine

9. **All of the following signs or symptoms are worrisome in a child with hematemesis EXCEPT:**
   a. Tachycardia
   b. Orthostatic hypotension
   c. Epistaxis
   d. Severe abdominal pain
   e. Thrombocytopenia

Physician CME Information

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Needs Assessment: The need for this educational activity was determined by a survey of medical staff, including the editorial board of this publication; review of morbidity and mortality data from the CDC, AHA, NCHS, and ACEP; and evaluation of prior activities for emergency physicians.

Target Audience: This enduring material is designed for emergency medicine physicians, physician assistants, nurse practitioners, and residents.

Goals: Upon completion of this activity, you should be able to: (1) demonstrate medical decision-making based on the strongest clinical evidence; (2) cost-effectively diagnose and treat the most critical ED presentations; and (3) describe the most common medicolegal pitfalls for each topic covered.

Objectives: Upon completion of this article, you should be able to: (1) differentiate the causes of upper gastrointestinal bleeding in children; (2) describe the initial evaluation of children with suspected upper gastrointestinal bleeding; and (3) demonstrate the initial management of children with suspected upper gastrointestinal bleeding.

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