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Novel Emergency Medicine Curriculum Utilizing Self- Directed Learning and the Flipped Classroom Method: Gastrointestinal Emergencies Small Group Module

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## Novel Emergency Medicine Curriculum Utilizing Self-Directed Learning and the Flipped Classroom Method: Gastrointestinal Emergencies Small Group Module

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### ABSTRACT:

**Audience and type of curriculum:** This curriculum created and implemented at The Ohio State University Wexner Medical Center was designed to educate our emergency medicine (EM) residents, PGY-1 to PGY-3, as well as medical students and attending physicians.

**Introduction/Background:** Gastrointestinal (GI) emergencies comprise approximately 12% of emergency department (ED) visits.<sup>1</sup> Residents must be proficient in the differential diagnosis and management of the wide variety of GI emergencies. The flipped classroom curricular model emphasizes self-directed learning activities completed by learners, followed by small group discussions pertaining to the topic reviewed. The active learning fostered by this curriculum increases faculty and learner engagement and interaction time typically absent in traditional lecture-based formats.<sup>2-4</sup> Studies have revealed that the application of knowledge through case studies, personal interaction with content experts, and integrated questions are effective learning strategies for emergency medicine residents.<sup>4-6</sup> The Ohio State University EM Residency didactic curriculum recently transitioned to a “flipped classroom” approach.<sup>7-10</sup> We created this innovative curriculum aimed to improve our residency education program and to share educational resources with other EM residency programs. This proposed curriculum utilizes an 18-month curricular cycle. The flipped classroom curriculum maximizes didactic time and resident engagement, fosters intellectual curiosity and active learning, and meets the needs of today’s learners.<sup>3,6,11</sup>

**Objectives:** We aim to teach the presentation and management of GI emergencies through the creation of a flipped classroom design. This unique, innovative curriculum utilizes resources chosen by education faculty and resident learners, study questions, real-life experiences, and small group discussions in place of

# CURRICULUM

traditional lectures. In doing so, a goal of the curriculum is to encourage self-directed learning, improve understanding and knowledge retention, and improve the educational experience of our residents.

**Methods:** The educational strategies used in this curriculum include: small group modules authored by education faculty and content experts, based on core emergency medicine content. This program also includes resident submitted questions that were developed during review of the content. The Socratic Method, used during small group sessions encourages active participation; small groups also focus on synthesis and application of knowledge through discussion of real life experiences. The use of free open access medical education (FOAM) resources allows learners to work at their own pace and maximize autonomy in resident learning.

**Topics:** Emergency medicine, flipped-classroom, medical education, GI emergencies, pedagogy, teaching.



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## Learner Audience:

Interns, Junior Residents, Senior Residents, Attending Physicians and Faculty Members

## Length of Curriculum:

The entire didactic curriculum was developed to utilize an 18-month curricular cycle; therefore, resident learners experience each curricular topic twice in the course of their residency training. The gastrointestinal emergencies module consists of eight 45-60 minute small group sessions.

## Topics:

Emergency medicine, flipped-classroom, medical education, GI emergencies, pedagogy, teaching.

## Objectives:

We aim to teach the presentation and management of GI emergencies through the creation of a flipped classroom design. This unique, innovative curriculum utilizes resources chosen by education faculty and resident learners, study questions, real-life experiences, and small group discussions in place of traditional lectures. In doing so, a goal of the curriculum is to encourage self-directed learning, improve understanding and knowledge retention, and improve the educational experience of our residents.

## Brief introduction:

The flipped classroom learning approach is becoming more commonly recognized as the preferred curricular model for mature learners, specifically those in medical education. This particular model is a natural fit for the hands-on, experiential emergency medicine learner.<sup>4</sup> The active learning fostered by this curriculum increases faculty and learner engagement and interaction time, which is typically absent in traditional lecture based formats.<sup>5,12</sup> Education literature shows that resident

learners prefer learning activities that involve small group discussion, are case/skill based, and emphasize the application of newly obtained knowledge.<sup>3,4</sup> This educational model also provides a clear channel for the incorporation of evidence-based medicine and increases opportunities for educator-learner conversations. A successful flipped classroom curriculum fosters learner accountability and provides robust opportunities for formal assessment in various emergency medicine milestones.<sup>4,9,12</sup> For these reasons, we developed a flipped classroom curriculum at the Ohio State University. This gastrointestinal emergencies curriculum is one of several topics in our overall didactic curriculum.

## Problem identification, general and targeted needs assessment:

Traditional lecture-based didactic format may not be the most effective or preferred method for emergency medicine resident education.<sup>6</sup> Previously we used a traditional lecture format in our residency curriculum, despite support in the literature for a more hands-on, “flipped classroom” approach.<sup>8,9</sup> From the perspective of resident learners, the chance to remain fully engaged through the asking of questions developed from personal experiences and also by learning from the experiences of others provides a manner of learning that makes a topic difficult to forget.<sup>5</sup>

As current literature reveals, both educators and the learners themselves benefit from an interactive and collaborative classroom, leading to the creation and implementation of this proposed curricular model at our emergency medicine residency program.<sup>10</sup> This weekly innovative small group curriculum has now replaced three hours of traditional lecture-based didactics. Since implementation, residents and educators are engaging in a new, valuable flipped classroom learning communities at The Ohio State University. Through the curriculum, we continually seek to foster self-directed learning and increased collaboration between resident learners and education faculty members. This ensures that resident time will be maximized, and learning will be more efficient and effective, positively impacting patient care and physician wellness. Currently, minimal flipped classroom curricular materials dedicated to the core content of emergency medicine exist.

## Goals of the curriculum:

This curricular innovation was developed and implemented to promote self-directed/active learning and an environment of intellectual curiosity and learner accountability. This flipped classroom curriculum is specifically designed to cover the core content of emergency medicine; this module promotes mastery of gastrointestinal emergencies. Secondary goals include: increased interaction between educators and learners, and the evaluation of resident small group teaching skills.

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## Objectives of the curriculum:

Each chapter within our curriculum has individual objectives; however, educational objectives for the curriculum and more specifically, the Gastrointestinal Emergencies Module include:

1. Resident learners will learn the core content of emergency medicine as an 18-month curriculum utilizing self-directed learning and small group discussions based on the flipped classroom model.
2. After completing the Gastrointestinal Emergencies Module, resident learners will exhibit mastery within this content area and will critically discuss the pathophysiology, diagnosis, and treatment of various pediatric and adult gastrointestinal emergencies including:
  - a. Esophageal Disorders
  - b. Stomach Disorders
  - c. Small Bowel Disorders
  - d. Splenic Disorders
  - e. Large Bowel Disorders
  - f. Liver and Peritoneal Disorders
  - g. Gallbladder and Pancreatic Disorders

## Educational Strategies:

(See curriculum chart) Please see the separate document of linked objectives and educational strategies.

**Evaluation and Feedback:** This innovative curriculum was literature based, and specifically designed to maximize active learning using the flipped classroom learning model. We overcame initial challenges and skepticism from both educators and learners to execute a successful, novel curricular model. Both resident learners and faculty educators provided an overwhelming amount of positive feedback. Additionally, a survey was administered to each resident prior to initiation of the curricular innovation, and repeated at the conclusion of the first 18-month cycle. Learners and educators were enthusiastic about the conference structure, and preferred it to the previous, lecture-based didactics. Resident learner attendance at weekly emergency medicine didactics increased, presumably as a result of our curricular innovation, likely due to increased faculty engagement, active discussions, and learner perceived value of the sessions. The curriculum will be critically evaluated and updated by education faculty members in order to ensure educational material remains current and consistent with the emergency medicine core content.

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Educational resources are available within each individual chapter of this Gastrointestinal Emergencies Curricular Module; however, a complete list of resources and educational materials are listed below.

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# DIDACTICS AND HANDS-ON CURRICULUM

Topic	Recommended Educational Strategy	Educational Content	Objectives	Learners	Timing, resources Needed (Space, Instructors, Equipment, citations of JETem pubs or other literature)	Recommended Assessment, Milestones Addressed
Esophageal Disorders	<p>-“Flipped” Classroom Discussion of Pre-reading Material, Case Discussions, and Discussion Questions</p> <p>-Encourage Participants to Share Clinical Experiences to Enhance Discussion</p> <p>-15 Minutes for Brief Topic Review and 30-45 Minutes for Case and Content Discussion</p>	<p>-Pathophysiology, Diagnosis, and Management of Pediatric and Adult Esophageal Disorders</p> <p>-Pathophysiology, Diagnosis, and Management of Adult Esophageal Disorders</p> <p>-Management of GERD in pediatric and adult patients</p> <p>-Management of variceal bleeding and the use of octreotide and antibiotics</p>	<p>By the end of this session, learners will:</p> <p>Review pathophysiology, diagnosis and treatment of pediatric esophageal disorders including congenital abnormalities and GERD.</p> <p>Review pathophysiology, diagnosis and treatment of esophageal variceal bleeding, dysphagia, and esophageal perforation.</p> <p>Discuss questions posed by residents in their pre-work assignments.</p> <p>Critically discuss the role of octreotide and antibiotic use for variceal bleeding.</p> <p>Summarize key learning points</p>	PGY-1 PGY-2 PGY-3 Medical Students Faculty	<p>Equipment: Projector and Screen Preferable (instructor can pull up web images during session). Tables and Space Promoting Small Group Discussion.</p> <p>Instructors: 2 Faculty Members or Content Experts. Pre-Determined Senior Resident Discussion Leader</p> <p>Timing: Small Group Discussions Involve No More than 15 Learners and Last 45-60 Minutes</p>	<p>Milestone: MK</p> <p>Assessment: --- Learner Preparation and Participation -Senior Resident Teaching Skills</p> <p>Evaluation: Post-test created using a purchased question bank</p>



# DIDACTICS AND HANDS-ON CURRICULUM

Topic	Recommended Educational Strategy	Educational Content	Objectives	Learners	Timing, resources Needed (Space, Instructors, Equipment, citations of JETem pubs or other literature)	Recommended Assessment, Milestones Addressed
Stomach Disorders	<p>-“Flipped” Classroom Discussion of Pre-reading Material, Case Discussions, and Discussion Questions</p> <p>-Encourage Participants to Share Clinical Experiences to Enhance Discussion</p> <p>-15 Minutes for Brief Topic Review and 30-45 Minutes for Case and Content Discussion</p>	<p>-Pathophysiology, Diagnosis, and Management of Pediatric Stomach Disorders Including Pyloric Stenosis and Foreign Body</p> <p>-Pathophysiology, Diagnosis, and Management of Adult Stomach Disorders</p> <p>-Discuss the Controversial Topic of Testing and Treating H. Pylori in ED</p> <p>-Complications Associated with Bariatric Surgery and Gastrostomy Tubes</p>	<p>By the end of this session, learners will:</p> <p>Review pathophysiology, diagnosis and treatment of pediatric stomach disorders including congenital hypertrophic pyloric stenosis, and foreign body. Review pathophysiology, diagnosis and treatment of gastritis, peptic ulcer disease, nausea and vomiting, and stomach perforation. Critically discuss the pathophysiology, diagnosis and management of complications associated with bariatric surgery, and gastrostomy tube placement. Discuss the utility of testing and treatment of helicobacter pylori in the emergency department. Discuss questions posed by residents in their pre-work assignments. Summarize key learning points</p>	PGY-1 PGY-2 PGY-3 Medical Students Faculty	<p>Equipment: Projector and Screen Preferable. Tables and Space Promoting Small Group Discussion.</p> <p>Instructors: 2 Education Faculty Members or Content Experts. Pre-Determined Senior Resident Discussion Leader</p> <p>Timing: Small Group Discussions Involve No More than 15 Learners and Last 45-60 Minutes</p>	<p>Milestone: MK</p> <p>Assessment: --- Learner Preparation and Participation -Senior Resident Teaching Skills</p> <p>Evaluation: Post-test created using a purchased question bank</p>



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Topic	Recommended Educational Strategy	Educational Content	Objectives	Learners	Timing, resources Needed (Space, Instructors, Equipment, citations of JETem pubs or other literature)	Recommended Assessment, Milestones Addressed
Small Bowel Disorders	<p>-“Flipped” Classroom Discussion of Pre-reading Material, Case Discussions, and Discussion Questions</p> <p>-Encourage Participants to Share Clinical Experiences to Enhance Discussion</p> <p>-15 Minutes for Brief Topic Review and 30-45 Minutes for Case and Content Discussion</p>	<p>-Pathophysiology, Diagnosis, and Management of Pediatric Small Bowel Disorders</p> <p>-Pathophysiology, Diagnosis, and Management of Adult Small Bowel Disorders</p> <p>-Discuss the Preferred ED Imaging for Small Bowel Disorders Based on Patient Age</p> <p>-Discuss the Various Causes of Small Bowel -Obstruction</p>	<p>By the end of this session, learners will:</p> <p>-Discuss questions posed by residents in their pre-work assignments. Encourage them to share their experiences from the clinical environment- with HIPAA and professional consideration</p> <p>-Review Basics of anatomy, physiology, vascular supply, pathology of small bowel</p> <p>-Discuss foregut, midgut, hindgut and embryology fundamentals</p> <p>-Describe the rotation of the bowel and how pediatric malrotation occurs</p> <p>-Discuss overview of differential diagnosis of small bowel disorders</p> <p>-Anatomy, physiology, blood supply, common diagnoses, rare diagnoses</p> <p>-Management decisions, Imaging options, throughput, disposition</p> <p>-Current literature</p> <p>-Imaging: What should be considered at different ages?</p>	PGY-1 PGY-2 PGY-3 Medical Students Faculty	<p>Equipment: Projector and Screen Preferable. Tables and Space Promoting Small Group Discussion.</p> <p>Instructors: 2 Education Faculty Members or Content Experts. Pre-Determined Senior Resident Discussion Leader</p> <p>Timing: Small Group Discussions Involve No More than 15 Learners and Last 45-60 Minutes</p>	<p>Milestone: MK</p> <p>Assessment: --- Learner Preparation and Participation</p> <p>-Senior Resident Teaching Skills</p> <p>Evaluation: Post-test created using a purchased question bank</p>

King A, et al. Novel Emergency Medicine Curriculum Utilizing Self-Directed Learning and the Flipped Classroom Method: Gastrointestinal Emergencies Small Group Module. JETem 2017. 2(1):C69-117. <https://doi.org/10.21980/J8MS37>





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Topic	Recommended Educational Strategy	Educational Content	Objectives	Learners	Timing, resources Needed (Space, Instructors, Equipment, citations of JETem pubs or other literature)	Recommended Assessment, Milestones Addressed
			<ul style="list-style-type: none"><li>-Review pathophysiology, diagnosis and treatment of pediatric small bowel disorders including congenital abnormalities, obstruction, and inflammatory bowel disease.</li><li>-Critically discuss the role of imaging and surgical intervention for pediatric and adult small bowel obstruction</li><li>-Summarize key learning points of causes of small bowel obstruction</li></ul>			



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Topic	Recommended Educational Strategy	Educational Content	Objectives	Learners	Timing, resources Needed (Space, Instructors, Equipment, citations of JETem pubs or other literature)	Recommended Assessment, Milestones Addressed
Spleen Disorders	<p>-“Flipped” Classroom Discussion of Pre-reading Material, Case Discussions, and Discussion Questions</p> <p>-Encourage Participants to Share Clinical Experiences to Enhance Discussion</p> <p>-15 Minutes for Brief Topic Review and 30-45 Minutes for Case and Content Discussion</p>	<p>-Pathophysiology, Diagnosis, and Management of Pediatric Splenic Disorders</p> <p>-Pathophysiology, Diagnosis, and Management of Adult Splenic Disorders</p> <p>-Asplenia, Splenic Sequestration</p> <p>-Grades of Splenic Injury and Associated Diagnosis and Management</p>	<p>By the end of this session, learners will:</p> <p>-Review pathophysiology, diagnosis and treatment of asplenia and hypersplenism.</p> <p>-Review pathophysiology, diagnosis and treatment of splenic trauma, grades of injury and operative vs. non-operative management.</p> <p>-Discuss questions posed by residents in their pre-work assignments.</p> <p>-Critically discuss the role of splenic preservation and the role for antibiotic prophylaxis after splenectomy..</p>	PGY-1 PGY-2 PGY-3 Medical Students Faculty	<p>Equipment: Projector and Screen Preferable. Tables and Space Promoting Small Group Discussion.</p> <p>Instructors: 2 Education Faculty Members or Content Experts. Pre-Determined Senior Resident Discussion Leader</p> <p>Timing: Small Group Discussions Involve No More than 15 Learners and Last 45-60 Minutes</p>	<p>Milestone: MK</p> <p>Assessment: --- Learner Preparation and Participation</p> <p>-Senior Resident Teaching Skills</p> <p>Evaluation: Post-test created using a purchased question bank</p>



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Topic	Recommended Educational Strategy	Educational Content	Objectives	Learners	Timing, resources Needed (Space, Instructors, Equipment, citations of JETem pubs or other literature)	Recommended Assessment, Milestones Addressed
Large Bowel, Rectal, and Anal Disorders (Part 1)	<p>-“Flipped” Classroom Discussion of Pre-reading Material, Case Discussions, and Discussion Questions</p> <p>-Encourage Participants to Share Clinical Experiences to Enhance Discussion</p> <p>-15 Minutes for Brief Topic Review and 30-45 Minutes for Case and Content Discussion</p>	<p>-Pathophysiology, Diagnosis, and Management of Pediatric Large Bowel Disorders: Intussusception, Hirschsprung, Necrotizing Enterocolitis</p> <p>-Pathophysiology, Diagnosis, and Management of Adult Large Bowel Disorders: Inflammatory Bowel Diseases, Volvulus, Diverticulitis</p> <p>-Implications of C. Diff Colitis</p> <p>-Diagnosis and Management of Perianal and Perirectal Abscesses</p>	<p>By the end of this session, learners will:</p> <p>-Review pathophysiology, diagnosis and treatment of pediatric large bowel, rectal and anal disorders including inflammatory bowel disease, diverticulitis and colitis.</p> <p>-Review pathophysiology, diagnosis and treatment of pediatric large bowel, rectal and anal disease including.</p> <p>-Discuss questions posed by residents in their pre-work assignments.</p> <p>-Critically discuss the role of abdominal CT in the diagnosis of large bowel disorders.</p> <p>-Summarize key learning points</p>	PGY-1 PGY-2 PGY-3 Medical Students Faculty	<p>Equipment: Projector and Screen Preferable. Tables and Space Promoting Small Group Discussion.</p> <p>Instructors: 2 Education Faculty Members or Content Experts. Pre-Determined Senior Resident Discussion Leader</p> <p>Timing: Small Group Discussions Involve No More than 15 Learners and Last 45-60 Minutes</p>	<p>Milestone: MK</p> <p>Assessment: --- Learner Preparation and Participation -Senior Resident Teaching Skills</p> <p>Evaluation: Post-test created using a purchased question bank</p>



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Topic	Recommended Educational Strategy	Educational Content	Objectives	Learners	Timing, resources Needed (Space, Instructors, Equipment, citations of JETem pubs or other literature)	Recommended Assessment, Milestones Addressed
Large Bowel, Rectal, and Anal Disorders (Part 2)	<p>-“Flipped” Classroom Discussion of Pre-reading Material, Case Discussions, and Discussion Questions</p> <p>-Encourage Participants to Share Clinical Experiences to Enhance Discussion</p> <p>-15 Minutes for Brief Topic Review and 30-45 Minutes for Case and Content Discussion</p>	<p>-Pathophysiology, Diagnosis, and Management of Pediatric Large Bowel Disorders: Intussusception, Hirschsprung, Necrotizing Enterocolitis</p> <p>-Pathophysiology, Diagnosis, and Management of Adult Large Bowel Disorders: Inflammatory Bowel Diseases, Volvulus, Diverticulitis</p> <p>-Implications of C. Diff Colitis</p> <p>-Diagnosis and Management of Perianal and Perirectal Abscesses</p>	<p>By the end of this session, learners will:</p> <p>-Review pathophysiology, diagnosis and treatment of pediatric large bowel, rectal and anal disorders including necrotizing enterocolitis, intussusception and perianal abscess.</p> <p>-Discuss questions posed by residents in their pre-work assignments.</p> <p>-Critically discuss the role of surgical consultation in large bowel, rectal and anal disorders.</p> <p>-Summarize key learning points</p>	PGY-1 PGY-2 PGY-3 Medical Students Faculty	<p>Equipment: Projector and Screen Preferable. Tables and Space Promoting Small Group Discussion.</p> <p>Instructors: 2 Education Faculty Members or Content Experts. Pre-Determined Senior Resident Discussion Leader</p> <p>Timing: Small Group Discussions Involve No More than 15 Learners and Last 45-60 Minutes</p>	<p>Milestone: MK</p> <p>Assessment: --- Learner Preparation and Participation -Senior Resident Teaching Skills</p> <p>Evaluation: Post-test created using a purchased question bank</p>



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Topic	Recommended Educational Strategy	Educational Content	Objectives	Learners	Timing, resources Needed (Space, Instructors, Equipment, citations of JETem pubs or other literature)	Recommended Assessment, Milestones Addressed
Liver and Peritoneal Disorders	<p>-“Flipped” Classroom Discussion of Pre-reading Material, Case Discussions, and Discussion Questions</p> <p>-Encourage Participants to Share Clinical Experiences to Enhance Discussion</p> <p>-15 Minutes for Brief Topic Review and 30-45 Minutes for Case and Content Discussion</p>	<p>-Pathophysiology, Diagnosis, and Management of Pediatric Liver and Peritoneal Disorders</p> <p>-Pathophysiology, Diagnosis, and Management of Adult Liver and Peritoneal Disorders</p> <p>-Cirrhosis and its Complications</p> <p>-Spontaneous Bacterial Peritonitis</p> <p>-Hepatorenal Syndrome</p> <p>-Diagnosis and Management of Various Types of Hernias</p>	<p>By the end of this session, learners will:</p> <p>-Review pathophysiology, diagnosis and treatment of hepatitis and cirrhosis.</p> <p>-Review pathophysiology, diagnosis and treatment of complications of cirrhosis such as ascites, SBP and hepatorenal syndrome.</p> <p>-Discuss questions posed by residents in their pre-work assignments.</p> <p>-Critically discuss the role of paracentesis and diuretics for the treatment of ascites.</p> <p>-Summarize key learning points</p>	PGY-1 PGY-2 PGY-3 Medical Students Faculty	<p>Equipment: Projector and Screen Preferable. Tables and Space Promoting Small Group Discussion.</p> <p>Instructors: 2 Education Faculty Members or Content Experts. Pre-Determined Senior Resident Discussion Leader</p> <p>Timing: Small Group Discussions Involve No More than 15 Learners and Last 45-60 Minutes</p>	<p>Milestone: MK</p> <p>Assessment: --- Learner Preparation and Participation</p> <p>-Senior Resident Teaching Skills</p> <p>Evaluation: Post-test created using a purchased question bank</p>





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Topic	Recommended Educational Strategy	Educational Content	Objectives	Learners	Timing, resources Needed (Space, Instructors, Equipment, citations of JETem pubs or other literature)	Recommended Assessment, Milestones Addressed
Gallbladder and Pancreas Disorders	<p>-“Flipped” Classroom Discussion of Pre-reading Material, Case Discussions, and Discussion Questions</p> <p>-Encourage Participants to Share Clinical Experiences to Enhance Discussion</p> <p>-15 Minutes for Brief Topic Review and 30-45 Minutes for Case and Content Discussion</p>	<p>-Pathophysiology, Diagnosis, and Management of Pediatric Gallbladder and Pancreas Disorders</p> <p>-Pathophysiology, Diagnosis, and Management of Adult Gallbladder and Pancreas Disorders</p> <p>-Various pancreatitis severity scores and utility of imaging</p> <p>-Biliary Atresia</p>	<p>By the end of this session, learners will:</p> <p>-Review pathophysiology, diagnosis and treatment of gallbladder diseases</p> <p>-Review pathophysiology, diagnosis and treatment of acute pancreatic diseases</p> <p>-Discuss questions posed by residents in their pre-work assignments.</p> <p>-Evaluate the role of imaging modalities for the evaluation of gallbladder and pancreatic diseases.</p> <p>-Summarize key learning points</p>	PGY-1 PGY-2 PGY-3 Medical Students Faculty	<p>Equipment: Projector and Screen Preferable. Tables and Space Promoting Small Group Discussion.</p> <p>Instructors: 2 Education Faculty Members or Content Experts. Pre-Determined Senior Resident Discussion Leader</p> <p>Timing: Small Group Discussions Involve No More than 15 Learners and Last 45-60 Minutes</p>	<p>Milestone: MK</p> <p>Assessment: --- Learner Preparation and Participation -Senior Resident Teaching Skills</p> <p>Evaluation: Post-test created using a purchased question bank</p>



## Appendix A: Esophageal Disorders

Authors: Andrew King, MD, FACEP; Jillian McGrath, MD; and Jennifer Mitzman, MD

### Faculty Objectives for Small Group Discussion

1. Review pathophysiology, diagnosis and treatment of pediatric esophageal disorders including congenital abnormalities and gastroesophageal reflux disease (GERD).
2. Review pathophysiology, diagnosis and treatment of esophageal variceal bleeding, dysphagia, and esophageal perforation.
3. Discuss questions posed by residents in their pre-work assignments.
4. Critically discuss the role of octreotide and antibiotic use for variceal bleeding.
5. Summarize key learning points.

### Case Studies

**Case 1:** A 4-year-old male presents with his parents to the emergency department after refusing to eat dinner. Parents report that when asked why he did not want to eat, the child stated that he was full because he “ate money” during naptime. They have not noted any respiratory distress. There has been no vomiting or drooling. Child refused both solids and liquids at home and is refusing oral intake in the emergency department.

### Question Prompts

1. What is the most appropriate diagnostic evaluation for this child?
  - a. Plain film acute abdominal series including lateral chest x-ray.
2. Describe the management algorithm for this child’s presentation.
  - a. Coins located in the stomach or in the distal gastrointestinal (GI) tract can be managed expectantly as an outpatient.
  - b. If asymptomatic with an ingestion time of less than 24 hours, coins in the esophagus can be managed expectantly as an inpatient.
  - c. If symptomatic or the ingestion time exceeds 24 hours, the coin should be removed from the esophagus in an urgent or emergent manner.
  - d. If the coin is located in the proximal esophagus, consider removal even if asymptomatic as the risk of aspiration is increased while the risk of spontaneous passage is decreased.
3. Would management change if the ingestion was a button battery?
  - a. Button batteries in the esophagus require emergent removal regardless of the timeframe or presence of symptoms. This is a true emergency because button batteries can begin to cause mucosal damage in as little as 1-2 hours and can result in erosion through the esophagus.



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**Case 2:** A 3-month-old male presents with vomiting after every feed. His family states that he is extremely fussy towards the end of his feeds and especially when vomiting. He is otherwise a fairly happy, healthy baby. Parents do notice that the child has “spells” where he is extremely cranky and inconsolable. During these spells, it appears as if he is uncomfortable. Their pediatrician sent them for a stomach ultrasound a few weeks ago and told them it was normal. They have switched to a gentle formula without noticing a change.

## Question Prompts

1. Describe the pathophysiology of this child’s diagnosis.
  - a. The pathophysiology of gastroesophageal reflux disease (GERD) involves relaxation of the lower esophageal sphincter, allowing stomach contents to pass into the esophagus and the oropharynx. This normal physiologic process becomes pathologic when the acidic nature of the stomach contents causes irritation to the esophageal mucosa and other tissues it contacts such as teeth and bronchial tissue.
2. What treatment recommendations should be given to the parents?
  - a. Lifestyle and Feeding modifications are the first line treatment; these include: keeping the infant completely upright or prone during and after feeding, reducing feeding volume while increasing frequency, a maternal restriction diet that eliminates milk and egg, changing to a hydrolyzed protein or amino acid–based formula, thickening feeds, and decreasing smoke exposure.

**Case 3:** A 56-year old female presents to the emergency department in extremis after family reports profuse, gross hematemesis. She appears pale, chronically ill, and uncomfortable. She continues to vomit gross blood while in the emergency department. Family is unclear on her exact medical history but state that she is an alcoholic. Patient is unable to provide any additional history but moans when her epigastrium is palpated.

## Question Prompts

1. List potential sources of this patient’s GI bleeding and describe their pathophysiology.
  - a. Esophageal Varices: Portal hypertension, most commonly from cirrhosis, causes swelling and increased pressure of esophageal veins as the blood takes the path of least resistance into general circulation. The increased pressure can cause these varices to spontaneously bleed.
  - b. Gastritis: Diffuse irritation of the gastric mucosa can cause spontaneous bleeding. This irritation is commonly caused by local irritant effects and increased acid secretion from substances such as alcohol, salicylates, and NSAIDs.
  - c. Mallory-Weiss Syndrome: Bleeding comes from a longitudinal partial thickness tear of the esophageal mucosa, most commonly caused by vomiting.
  - d. Peptic Ulcer Disease: Ulcers in the gastric mucosa can spontaneously bleed and are the most common cause of upper GI bleed in the US. The most common causes are *H. pylori* infection and chronic NSAID use.



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2. What diagnostic studies are required for this patient?
  - a. Complete blood count (CBC), Electrolytes (Chem-7), liver function tests (LFTs), Prothrombin Time (PT)-INR, PTT, Type and Cross.
  - b. NG tube placement can help confirm the presence of blood in the upper GI tract and determine if bleeding is active; however, false negatives are common.
  - c. Esophagogastroduodenoscopy (EGD) is the ultimate diagnostic test of choice.
3. What is the appropriate management and disposition plan for this patient?
  - a. Consider intubation for airway protection.
  - b. Fluid and Blood product resuscitation.
  - c. IV PPI (generally pantoprazole), octreotide, ceftriaxone.
  - d. Emergent EGD and ICU Admission.
  - e. Prophylactic antibiotic use in patients with cirrhosis and upper GI bleeding significantly reduced bacterial infections and all-cause mortality/morbidity.
  - f. Use of octreotide and other somatostatin analogues showed limited benefit, saving only one half unit of blood per patient.
  - g. PPI medications decrease risk of re-bleeding in upper GI bleeding.

## Recommended Reading:

Mendelson M. Esophageal emergencies. In: Tintinalli JE, Stapczynski J, Ma O, Yealy DM, Meckler GD, Cline DM, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 8<sup>th</sup> ed. New York, NY: McGraw-Hill; 2015:508-513.

Yardeni D, et al. Severe esophageal damage due to button battery ingestion: can it be prevented? *Pediatr Surg Int*. 2004;2(7) 496-501. doi: 10.1007/s00383-004-1223-6

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**\*\*Consider additional EBM resources and FOAMed**

## Key Learning Points:

1. Prophylactic antibiotic use in patients with cirrhosis and upper GI bleeding significantly reduced bacterial infections and all-cause mortality/morbidity.
2. Use of octreotide and other somatostatin analogues showed limited benefit, saving only one half unit of blood per patient.
3. PPI medications decrease risk of re-bleeding in upper GI bleeding.
4. High degree of suspicion for esophageal foreign body necessary in children. Signs and symptoms can be vague and include refusal or inability to eat, vomiting, gagging, stridor, neck or throat pain, and drooling.
5. Button batteries lodged in the esophagus represents a true emergency requiring prompt removal due to high risk of mucosal injury and necrosis.
6. Consider diet and lifestyle modifications in children with GERD prior to medications.
7. Maintain high degree of suspicion for Boerhaave's syndrome in patients with chest pain and history of vomiting.



## Appendix B: Stomach Disorders

Author: Andrew King, MD, FACEP

### Faculty Objectives for Small Group Discussion

1. Review pathophysiology, diagnosis and treatment of pediatric stomach disorders including congenital hypertrophic pyloric stenosis and foreign body.
2. Review pathophysiology, diagnosis and treatment of gastritis, peptic ulcer disease, nausea and vomiting, and stomach perforation.
3. Critically discuss the pathophysiology, diagnosis and management of complications associated with bariatric surgery, and gastrostomy tube placement.
4. Discuss the utility of testing and treatment of helicobacter pylori in the emergency department.
5. Discuss questions posed by residents in their pre-work assignments.
6. Summarize key learning points

### Case Studies

A 2-week-old male presents to the emergency department for evaluation of vomiting, lethargy, and jaundice. The parents state that the child was born full term with no complications at birth. Child is breast fed and has been eating vigorously, but soon after eating he has multiple episodes of projectile vomiting. This is the parents' first child and they are very concerned. The also state that he appears more yellow than he did at birth. He has also become more lethargic in the past few days with little interaction.

### Question Prompts

1. What is the most appropriate diagnostic evaluation for this child?
  - a. Abdominal Ultrasound, LFTs, Chemistry, Urinalysis.
2. Describe the management algorithm for this child's presentation.
  - a. If toxic, the patient, who is presenting with pyloric stenosis, requires aggressive rehydration with particular attention paid to electrolyte abnormalities along with surgical evaluation.
  - b. If mildly dehydrated or not tolerating PO, the patient can be admitted for gentle hydration and urgent surgical intervention.
  - c. If well appearing, tolerating PO, and has close follow up, the patient can be discharged with plans for outpatient surgical intervention.
3. Consider a differential diagnosis for a child presenting with these complaints.
  - a. Pyloric stenosis, mal-rotation, volvulus, necrotizing enterocolitis, biliary atresia, dehydration, sepsis, bacteremia, UTI, meningitis, inborn errors of metabolism, hypoglycemia, non-accidental trauma, intracranial hemorrhage.



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**Case 2:** A 62-year-old female presents to the emergency department for evaluation of severe epigastric abdominal pain with associated nausea and vomiting. Pain has gotten progressively worse in the past few weeks and is exacerbated by certain foods. She has tried multiple medications at home but has had little relief. She drinks alcohol socially and enjoys a few cups of coffee throughout the day. She has been on naproxen for 3 years due to worsening arthritis in her knees. At this time, she does not report hematemesis. On physical examination, she has epigastric tenderness and a positive guaiac.

## Question Prompts

1. Describe the pathophysiology of this diagnosis.
  - a. Peptic Ulcer Disease (PUD) and Gastritis both occur as a consequence of stomach mucosa exposure to the hydrochloric acid and pepsin produced to aid in digestion. *H. pylori* produces multiple compounds which are thought to interfere with the mucus gel, exposing the mucosa to the acidic environment. Non-steroidal anti-inflammatory drugs (NSAIDs) interfere with prostaglandin production which decreases mucus and bicarb production, again exposing the mucosa to the acidic environment.
2. What are the various causes of this diagnosis?
  - a. *H. Pylori*, NSAIDs, alcohol, caffeine, steroid use, severe illness.
3. Describe the diagnosis and treatment of this disorder.
  - a. Pt's without alarm symptoms (age >55, weight loss, anemia, jaundice, early satiety, persistent vomiting, dysphagia, abdominal mass, anorexia) can be treated empirically with H2 blockers and PPIs and referred for EGD for definitive diagnosis of PUD and *H. Pylori*. If desired or diagnosed by serum or breath testing, *H. pylori* is generally treated with the classic triple therapy of proton pump inhibitor (PPI), clarithromycin, and either amoxicillin or metronidazole. Also key to treating PUD and/or gastritis is the elimination of potentially causative agents such as NSAIDs, alcohol, and caffeine.
  - b. If alarm symptoms are present, the patient should be admitted for urgent endoscopy.

**Case 3:** A 43-year old female presents to the emergency department critically ill. The patient is found to have a temperature of 103° F and a heart rate of 134. She appears short of breath and has an altered mental status. She has difficulty answering questions; however, she is accompanied by her husband who completes the history. Her husband reports that she is 2 weeks status post gastric bypass surgery and she has been vomiting and declining since returning home. Abdominal examination is relatively unremarkable and the operative site appears normal.

## Question Prompts

1. List potential causes of this patient's overall condition.
  - a. Anastomotic leak, intraabdominal abscess, perforated marginal ulcer, obstruction, pancreatitis, pneumonia, urinary tract infection, wound infection.
2. When in this patient's emergency department course should a consultant be notified?
  - a. As soon as possible due to high concern for anastomotic leak.



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3. What diagnostic studies are required for this patient?
  - a. CT Abdomen and Pelvis with PO and IV Contrast, Blood Cultures, complete blood count (CBC), electrolytes (Chem-7), liver function tests (LFTs), Lipase, Urinalysis, Chest X-ray, Blood Gas, Lactate, Ammonia.
4. What is the appropriate management and disposition plan for this patient?
  - a. Consider intubation for airway protection.
  - b. Aggressive fluid resuscitation and antibiotics (covering intraabdominal pathogens: gram negative, anaerobes).
  - c. Admission to the ICU.

## Recommended Reading:

Hooker E. Complications of general surgical procedures. In: Tintinalli JE, Stapczynski J, Ma O, Yealy DM, Meckler GD, Cline DM, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 8<sup>th</sup> ed. New York, NY: McGraw-Hill; 2015:567-574, Table 87.4.

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Poirier RF. Complications of bariatric surgery. In: Adams JG, Barton ED, Collings JL, DeBlieux PM, Gisondi MA, Nadel ES, eds. *Adams' Emergency Medicine Clinical Essentials*. 2<sup>nd</sup> ed. Philadelphia, PA: Elsevier Saunders; 2013:390-396.

Fox S. Pyloric stenosis. Pediatric EM Morsels. <http://pedemmorsels.com/pyloric-stenosis/>. Published November 22, 2013. Accessed October 18, 2016.

## **\*\*Consider additional EBM resources and FOAMed**





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## Key Learning Points:

1. Have a high index of suspicion for pyloric stenosis in a young infant with lethargy, jaundice, and projectile vomiting.
2. Aggressive acid reduction with H2 blockers and PPI medications decrease risk of re-bleeding in peptic ulcer disease and gastritis.
3. Alcohol, NSAIDs, caffeine, and *H. pylori* are significant risk factors for peptic ulcer disease.
4. Numerous complications can result from bariatric surgery, and prompt surgical consultation and CT imaging is paramount.
5. Maintain high degree of suspicion for perforated ulcer in patients with severe abdominal pain with peritoneal signs.
6. Nausea and vomiting can be caused by a myriad of things from drugs to cancer and many classes of medications exist to treat intractable nausea and vomiting.



## Appendix C: Small Bowel Disorders

Author: David Bahner, MD, RDMS

### Faculty Objectives for Small Group Discussion

1. Discuss questions posed by residents in their pre-work assignments. Encourage them to share their experiences from the clinical environment, with HIPAA and professional consideration.
2. Review Basics of anatomy, physiology, vascular supply, pathology of small bowel.
  - a. Duodenum
  - b. Jejunum
  - c. Ileum
  - d. Digestion
  - e. Celiac, superior mesenteric artery (SMA), inferior mesenteric artery (IMA)
3. Discuss foregut, midgut, hindgut and embryology fundamentals.
4. Describe the rotation of the bowel and how pediatric malrotation occurs.
5. Discuss overview of differential diagnosis of small bowel disorders.
  - a. Anatomy, physiology, blood supply, common diagnoses, rare diagnoses
  - b. Management decisions, imaging options, throughput, disposition
  - c. Current literature
6. Imaging: What should be considered at different ages?
  - a. X-ray
  - b. Computed Tomography (CT)
  - c. MRI
  - d. Ultrasound Comprehensive
  - e. Ultrasound Point of Care
7. Review pathophysiology, diagnosis and treatment of pediatric small bowel disorders including congenital abnormalities, obstruction, and inflammatory bowel disease.
8. Critically discuss the role of imaging and surgical intervention for pediatric and adult small bowel obstruction.
9. Summarize key learning points of causes of small bowel obstruction.
  - a. Adhesions
  - b. Cancer
  - c. Hernia
  - d. Congenital--Midgut volvulus, malrotation

### Case Studies

**Case 1:** A 65-year-old male smoker states he has had some weight loss and complains of aching abdominal pain in his epigastrium. He states the pain comes on around 9 o'clock for the past few nights and last hours. He comes in tonight because he has been vomiting green bile and can't keep anything down. His blood pressure is 150/100 and heart rate is 90 and regular with PVCs. He looks uncomfortable and in pain. He has a



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soft abdomen with voluntary guarding but without rebound. There is no stool in the rectal vault, but material on glove is guaiac positive for occult blood.

## Question Prompts

1. What diagnostic work up is recommended?
  - a. CT Abdomen Angiogram, complete blood count (CBC), electrolytes (Chemistry-7), liver function tests (LFTs), Lipase, Lactate, Type and Cross, coagulation studies.
2. What service should be consulted?
  - a. General Surgery, possibly Vascular Surgery or Interventional Radiology based on imaging results and local management practices for ischemic bowel.
3. What choices for imaging should be considered to work up these cases?
  - a. For a toxic patient, abdominal x-ray can be utilized to quickly diagnose free air from intestinal perforation. However, this test does not directly demonstrate mesenteric ischemia and it is not sufficiently sensitive to rule out perforation if negative. CT abdomen with IV and PO contrast is a good diagnostic test in situations where there are multiple different abdominal etiologies on the differential because it will show ischemic changes in the bowel. It may not, however, directly demonstrate a partial occlusion in the vasculature that is not yet causing ischemic changes in the bowel tissue. CT Abdomen Angiogram directly examines the vasculature and is the most sensitive test for mesenteric ischemia routinely available in the Emergency Department.

**Case 2:** A 64-year-old male presents with his wife to the emergency department after vomiting and complaining of abdominal pain. He is unable to eat and is refusing oral intake in the emergency department. He looks ill and is retching. When asked, he admits to pain occurring in his “stomach” and places his hands over the umbilicus. He has vitals of BP: 105/50, HR: 116, T: 99.5° F and RR: 22. He has a laparotomy scar that he states was from a stab wound when he was a teenager. His abdominal exam is tender to palpation of his mid and left upper quadrant. His rectal exam has no stool and the guaiac was negative.

## Question Prompts

1. What is the most appropriate diagnostic evaluation for this patient?
  - a. CT Abdomen and Pelvis with oral and IV contrast vs Acute Abdominal Series X-rays, CBC, Chem-7, LFTs, Lactate.
2. Describe the management algorithm for this patient’s presentation.
  - a. Non-toxic patients can be managed conservatively with fluid resuscitation and bowel rest. Patients that are significantly distended and uncomfortable may feel symptomatic relief with NG placement, but NG placement has not been shown to improve outcomes. If, however, there are any signs of closed-loop obstruction, bowel necrosis, and/or cecal volvulus clinically or on imaging, the patient requires emergent surgery.
3. What would prompt you to order a CT scan rather than a plain film?



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- a. If there is any concern for bowel necrosis, the patient requires a CT scan to evaluate the severity of the obstruction. If there is high concern for obstruction with normal x-rays, this patient may also benefit from a CT scan because it is more sensitive than plain film for bowel obstruction (which has approximately 80% sensitivity). Finally, if the differential is broad, CT scan allows for evaluation of multiple other etiologies of abdominal pain.

**Case 3:** A 15-month-old male presents with vomiting and bloody bowel movements His family states that he is extremely lethargic and has intermittent vomiting. On physical exam there is a palpable mass in the right lower quadrant.

### Question Prompts

1. Describe the pathophysiology of this child's diagnosis.
  - a. One segment of intestines telescopes into an adjacent segment. The resultant inflammation and edema can result in decreased blood flow. This ultimately can result in bowel ischemia and potentially perforation. Classically there is thought to be a lead point which allows the telescoping to occur. Lymphoid hyperplasia, Meckel's diverticulum, and intestinal polyps can all act as lead points.
2. What treatment recommendations should be given to the parents for treatment?
  - a. Treatment options include air contrast enema vs surgical reduction. The enema is less invasive and also acts as a diagnostic tool, but does carry the risk of intestinal perforation.
3. What are the next steps in management?
  - a. The first step in management should focus on fluid resuscitation. Prompt surgical evaluation should be obtained even if the patient is to undergo an air contrast enema in case it is unsuccessful or the procedure results in a complication.
4. Is there a role for ultrasound in this patient's care?
  - a. Ultrasound can be used to evaluate for intussusception with a very high degree of accuracy (sensitivity ranges 85%-100% in studies, specificity 89%-97%). The benefit of using this minimally invasive diagnostic modality must be weighed against the risk of delaying definitive treatment with air contrast enema. If US is negative and suspicion remains high, an air enema can be performed for further evaluation.

**Case 4:** A 6-week-old present with intractable vomiting that has turned green. Vitals demonstrate a pulse of 120, BP of 64/30, RR 28, T 99.4° F. The patient appears ill and his abdomen is distended. A plain film demonstrates a loop of distended bowel overlying the liver. (Instructors, we recommend you google an image to show your students.)

### Question Prompts

1. What should be considered in the differential diagnosis of this presentation?
  - a. Malrotation with midgut volvulus, necrotizing enterocolitis, incarcerated hernia, pyloric stenosis, and non-accidental trauma.



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2. What is the emergency department work up of this patient?
  - a. Upper GI Series with oral contrast, CBC, Chemistry, LFTs, Lactate, Blood Culture.
3. Does this warrant emergent surgical evaluation and why?
  - a. Volvulus can cut off blood supply to the entire midgut, resulting in a large area of bowel loss, shock, and death. The mesentery twists and fails to rotate as an embryo, resulting in restricting the blood supply.

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**\*\*Consider additional EBM resources and FOAMed**



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## Key Learning Points:

1. Small bowel has key anatomy of duodenum, jejunum, and ileum arising from the foregut and midgut embryologically.
2. Normal and abnormal fluid flow inside the small bowel lumen is a function of physiology, obstruction, genetics, inflammation or infection.
3. GI obstruction has different etiologies for children and adults. Adhesions are the most common cause of obstruction in adults.
4. Intussusception is the most common cause of intestinal obstruction in children between 3 months and 6 years of age.
5. Vast majority of cases of malrotation present within first month of life.
6. Small bowel obstruction occurs because of adhesions as the major cause. A virgin abdomen and new malignancy had a 10% incidence as cause for SBO.
7. Mesenteric ischemia can be chronic or acute and will present with pain out of proportion to physical exam.



## Appendix D: Spleen Disorders

Author: David Bahner, MD, RDMS

### Faculty Objectives for Small Group Discussion

1. Review pathophysiology, diagnosis and treatment of asplenia and hypersplenism.
2. Review pathophysiology, diagnosis and treatment of splenic trauma, grades of injury and operative vs. non-operative management.
3. Discuss questions posed by residents in their pre-work assignments.
4. Critically discuss the role of splenic preservation and the role for antibiotic prophylaxis after splenectomy.

### Case Studies

**Case 1:** A 19-year female college student presents with sore throat and fatigue. Her vitals are P of 96, BP of 112/65, T of 100.2°, RR of 18. She also complains of difficulty swallowing, fever, and poor appetite. On heart exam there are no murmurs; abdomen is soft with positive bowel sounds and there is a spleen tip detected below the left costal margin. She has an exudative pharyngitis with erythema and edema to the tonsillar pillars with an associated tender lymphadenopathy.

### Question Prompts

1. What diagnostic tests are indicated?
  - a. Rapid Strep, Monospot, complete blood count (CBC), liver function tests (LFTs)
2. What are the treatment plan and discharge instructions?
  - a. Because there are no signs of severe disease such as hemolytic anemia, neurological complications, or airway obstruction, mononucleosis can be managed symptomatically with over-the-counter medications. Steroids have been shown to increase the risk of complications.
3. What information should you include in your discharge instructions?
  - a. The patient should be told to avoid all contact sports for at least 3 weeks after the onset of symptoms and ideally should only return to contact sports after receiving a physical exam which demonstrates a normalization in the size of her spleen. She should also be told to return if she develops increasing confusion, severe headaches, abdominal pain, or yellowing of the sclera.

**Case 2:** A sickle cell patient who has had many visits for acute pain crises related to his disease presents with a fever and tachycardia, and a sepsis alert is called. The nurse starts two lines, draws labs, and sends cultures.



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## Question Prompts:

1. What are the possible causative organisms for infection?
  - a. Asplenic patients are at risk for infections from encapsulated organisms such as Hemophilus influenza, Streptococcus pneumoniae, Neisseria meningitidis, Group B streptococcus, Klebsiella pneumoniae, and Salmonella typhi.
2. What antibiotics would you choose to treat this patient?
  - a. Vancomycin plus ceftriaxone or cefotaxime.
3. In the future, what precautions should this patient receive before getting invasive procedures or dental work?
  - a. Prophylactic oral antibiotic, such as penicillin, appropriate vaccinations.

**Case 3:** A 30-year-old snowboarder presents after a fall with shoulder and rib pain and is found to have a hemoglobin of 9 g/dL on triage labs. The patient has a blood pressure of 100/60 and a heart rate of 110. He has voluntary guarding and rebound tenderness on abdominal examination of his left side.

## Question Prompts

1. What is the diagnostic algorithm for this patient?
  - a. Trauma Activation (if available), advanced trauma life support (ATLS) evaluation, chest x-ray, and pelvic x-ray.
2. After securing IVs, starting fluids and ordering blood, what is the next test of choice?
  - a. Focused assessment with sonography in trauma (FAST) scan +/- CT scan of the abdomen and pelvis with IV contrast.
3. How would you select imaging to manage this case?
  - a. If this patient is clinically stable, he should undergo CT evaluation to fully interrogate and characterize his injury. If, however, he is unstable, he should undergo bedside FAST exam to evaluate for intra-abdominal free fluid, which in the setting of trauma, is presumed to be blood. If the FAST is positive for free fluid, the unstable patient should be taken to the OR for surgical management. If, however, the FAST exam is negative for free fluid, clinicians should continue to look for other causes to his instability.
4. What are the various grades of organ injury?
  - a. Grades I-V
5. Which grades need operative intervention?
  - a. In general Grades IV and V require operative intervention. Lower grade injuries can generally be observed or treated via vascular and interventional radiology (VIR) embolization. Treatment, however, is highly variable based on the entire clinical picture and individual trauma surgeon preferences.





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**Case 4:** A 34-year-old female with a past medical history of Sickle Cell SC Disease presents with a rash that is non-blanching and arranged along the dorsal side of both feet. On physical exam, she is also noted to be tachycardic and her abdomen has significant tenderness in the left rib cage along with splenomegaly. Her platelets are 12,000, and her Hemoglobin is 4 g/dL.

## Question Prompts

1. What is the emergency to consider in the differential?
  - a. This patient likely has splenic sequestration. Although it can be a consequence of portal hypertension and cancer, this pathology is most often seen as a side effect of sickle cell diseases. In Sickle Cell SS disease, this is most often seen in childhood prior to chronic sickling causing auto-splenectomy. However in variants of Sickle Cell such as SC disease, this can be seen in adults. Microvascular sickling within the spleen prevents adequate outflow, resulting in engorgement of the spleen with previously circulating red cells and platelets.
2. What are treatment options?
  - a. This patient requires aggressive fluid rehydration. In discussion with hematology, this patient may also require simple PRBC transfusion or exchange transfusion. Because this does predispose the patient to another episode of sequestration, many patients will ultimately undergo elective splenectomy, after resolution of the acute episode.
3. From what specific etiologies can platelets be low?
  - a. TTP (Thrombotic thrombocytopenic purpura), DIC (disseminated intravascular coagulation), ITP (idiopathic thrombocytopenic purpura), leukemia, HIT (heparin-induced thrombocytopenia), Sepsis, Hepatic Failure, HUS (hemolytic uremic syndrome).

## Recommended Reading:

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## **\*\*Consider additional EBM resources and FOAMed**

## Key Learning Points

1. Splenomegaly is common after EBV infection and precautions should be made to avoid injury as it projects beyond the costal margin.
2. Splenic trauma is a common cause of abdominal pain and bleeding and can be diagnosed with ultrasound if free fluid is present or CT for lower grades of injury.



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3. The spleen produces antibodies in its white pulp and removes encapsulated bacteria.
4. The spleen is a repository for red blood cells and breaks down senescent red blood cells.
5. The spleen can be enlarged due to cancer, portal hypertension and infections.
6. Accessory spleens can be found in 10% of population.
7. Functional asplenia can occur after splenectomy, congenital abnormalities, and sickle cell anemia and auto-splenectomy.



## Appendix E: Large Bowel, Rectal and Anal Disorders (Part 1)

Author: Howard Werman, MD

### Faculty Objectives for Small Group Discussion

1. Review pathophysiology, diagnosis and treatment of pediatric large bowel, rectal and anal disorders including inflammatory bowel disease, diverticulitis and colitis.
2. Review pathophysiology, diagnosis and treatment of pediatric large bowel, rectal and anal diseases.
3. Discuss questions posed by residents in their pre-work assignments.
4. Critically discuss the role of abdominal CT in the diagnosis of large bowel disorders.
5. Summarize key learning points.

### Case Studies

**Case 1:** A 55-year-old male presents to the Emergency Department with two days of left lower quadrant pain without associated chills, nausea or vomiting. The patient reports a one-day history of fevers and anorexia. The patient does note a history of repeated episodes of abdominal bloating and discomfort. There is no family history of abdominal disorders. There is no reported history of rectal bleeding, diarrhea or constipation.

### Question Prompts

1. What is the differential diagnosis for this patient's presentation?
  - a. Diverticulitis, viral gastroenteritis, diverticulosis, hernia, colitis, renal stone, appendicitis, obstruction, c. difficile.
2. What diagnostic modality is most appropriate for this patient? What other diagnostic options are available?
  - a. If there is high concern for complicated diverticulitis, meaning formation of an abscess or perforation, CT can be performed, but in an otherwise well- appearing patient, the diagnosis can be made and treated clinically.
3. Describe the treatment plan for this patient.
  - a. Outpatient oral antibiotics, typically ciprofloxacin and metronidazole, along with symptom control. Amoxicillin-clavulanate can also be considered as a monotherapy depending on patient allergy profile.
  - b. If the patient appears clinically ill, or has complicated diverticulitis, the patient should be admitted for intravenous antibiotics and surgical consultation.

**Case 2:** A 70-year-old female presents with five days of profuse watery diarrhea. There is some associated abdominal cramping but no associated nausea, vomiting, fever or chills. She has a past history of atrial fibrillation which is rate controlled, type II diabetes and hypertension. Her history is remarkable for a recent



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hospitalization for a skin infection one month ago treated with clindamycin. She denies recent foreign travel, exposure to other sick contacts.

## Question Prompts

1. What are the major pathophysiologic causes of diarrhea?
  - a. Osmotic Diarrhea: Large solutes or carbohydrates in the diet that are difficult to break down or absorb osmotically drive fluid intra-luminally.
  - b. Secretory Diarrhea: typically toxins from bacteria or due to iatrogenic causes, triggers the small bowel to secrete more fluid into the lumen.
  - c. Inflammatory: Inflammatory changes to the endothelium causes exudative movement of fluid and blood into the lumen.
2. What are the major clinical considerations in this patient? What specific management strategies should you consider?
  - a. Electrolyte imbalance and significant dehydration are always considerations in large volume diarrhea. With high suspicion for c. diff infection, we would want to avoid anti-motility agents such as Imodium, since this is theorized to cause toxic mega-colon because there is no forward movement of gas and liquids.
3. When do you decide to initiate treatment in patients with diarrhea who are seen in the Emergency Department?
  - a. Patients with a good history and physical consistent with c. diff should empirically be started on antibiotics in the Emergency Department. However, there is little good evidence for the use of antibiotics in the setting of otherwise uncomplicated infectious diarrhea.
4. What is the role of stool cultures and other laboratory testing in patients with diarrhea?
  - a. Stool cultures can be used to confirm diagnosis and aid outpatient or inpatient providers in the continued direction of care for a patient, but are rarely available in the emergency department. Chemistries and complete blood count can be helpful to assess for dehydration and complications of specific causes of infectious diarrhea such as Hemolytic Uremic Syndrome.

**Case 3:** A 22-year-old male presents to the Emergency Department with crampy abdominal pain and bloody diarrhea. He has had approximately 3-6 bowel movements daily. The patient notes that this has been going on for the past 2 weeks and that it worsened after taking ibuprofen for fever and joint aches that have been a problem over the past year. The patient does report a 10 pound weight loss over the course of this illness. He does recall previous 'attacks' with abdominal cramping and diarrhea. He denies recent foreign travel, drinking well water or any recent infections. The patient's family history is significant for stroke and Crohn's disease.

## Question Prompts

1. List potential sources of this patient's GI bleeding and describe his pathophysiology.



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- a. Peptic Ulcer: non-steroidal anti-inflammatory drugs (NSAIDs) reduce production of prostaglandins which help in protective mucus production exposing the mucosa to the acidic environment of the stomach.
  - b. Crohn's Disease/Ulcerative Colitis: Autoimmune mediated inflammation of the GI tract, causes exudative loss of fluid and blood into the lumen.
  - c. Hemorrhagic diarrhea: Typically shigella and E. coli can produce toxins which cause vascular damage to the colon and result in bloody diarrhea.
2. What diagnostic studies are required for this patient?
    - a. Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are nonspecific markers of inflammation which can easily be obtained from the Emergency Department. These tests however are non-diagnostic. As the patient is febrile, they would likely also benefit from a computed tomography (CT) scan of the abdomen to ensure there is no abscess formation. Ultimately, the patient requires a colonoscopy with biopsy to confirm Inflammatory Bowel Disease and differentiate between Crohn's disease and Ulcerative Colitis.
  3. What is the likely diagnosis? What complications may be associated with this disease?
    - a. This patient likely has Inflammatory Bowel Disease, but at this time it is unclear if he has Crohn's Disease or Ulcerative Colitis.
  4. What is the appropriate management and disposition plan for this patient?
    - a. This patient likely requires admission for definitive diagnosis and initiation of treatment. In the ED, he requires a CT scan to rule out abscess and perforation and initiation of symptom control.

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**\*\*Consider additional EBM resources and FOAMed**

## Key Learning Points:

1. Imaging may not be necessary in patients with obvious findings of diverticulitis.
2. Right sided diverticulitis is more common in patients of Asian origin and its findings can mimic acute appendicitis.
3. *Clostridium difficile* colitis can occur up to 12 weeks after the discontinuation of antibiotic therapy.
4. Virtually all antibiotics can lead to *C. difficile* colitis; the most common are clindamycin, fluoroquinolones, cephalosporins and penicillins.
5. Toxic megacolon is a life-threatening complication of ulcerative colitis and less commonly, Crohn's colitis and *C. difficile* colitis.
6. Extra-intestinal manifestations are common in inflammatory bowel disease and may pre-date gastrointestinal symptoms as the initial manifestation.



## Appendix F: Large Bowel, Rectal and Anal Disorders (Part 2)

Author: Howard Werman, MD

### Faculty Objectives for Small Group Discussion

1. Review pathophysiology, diagnosis and treatment of pediatric and adult large bowel, rectal and anal disorders.
2. Discuss questions posed by residents in their pre-work assignments.
3. Critically discuss the role of surgical consultation in large bowel, rectal and anal disorders.
4. Summarize key learning points

### Case Studies

**Case 1:** A 35-year old female presents to the Emergency Department with three days of rectal pain. She reports pain with sitting and defecation. Occasional rectal bleeding is noted. There is no fever or chills. She notes particular pain at the anal verge and believes that she can palpate a painful swelling.

#### Question Prompts

1. What is the differential diagnosis for this patient's presentation?
  - a. External Hemorrhoid, Internal hemorrhoid, thrombosed hemorrhoid, perirectal abscess, anal fissure.
2. What underlying conditions and/or disease states are likely to predispose to these conditions?
  - a. Pregnancy, advanced age, chronic constipation, straining, prolonged sitting, anticoagulation.
3. Describe the treatment plan for this patient including appropriate consultation.
  - a. For her external hemorrhoid, this patient can be treated with steroid cream, sitz baths, and other conservative measures. She can be referred as an outpatient to general or colorectal surgery for discussion of surgical management of her hemorrhoids.

**Case 2:** A 2-year-old male child presents with his mother to the Emergency Department with a chief complaint of rectal bleeding. This has been associated with periods where the child appears uncomfortable with periods of crying and bringing his knees and hips into a flexed position. His appetite is diminished but he has no vomiting. He has been lethargic at times. The child has an unremarkable birth history and has received all of his immunizations. There are no ill contacts.

#### Question Prompts



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1. Describe the differential diagnosis of rectal bleeding in a child. What are the common causes and life-threatening conditions based on patient age?
  - a. Infant: Necrotizing enterocolitis (NEC), milk protein allergy, Meckel's diverticulum, mal-rotation with volvulus, viral gastroenteritis, vascular malformation, non-accidental trauma.
  - b. Toddler: Intussusception, Meckel's diverticulum, viral gastroenteritis, non-accidental trauma, hemolytic-uremic syndrome, Henoch–Schönlein purpura, mal-rotation with volvulus.
  - c. Older Child: Infectious gastroenteritis, inflammatory bowel disease, Henoch–Schönlein purpura, hemorrhoids, non-accidental trauma.
2. Describe the differential diagnosis of intestinal obstruction in children. What are the common causes and life-threatening conditions based on patient age?
  - a. Newborn: Duodenal atresia, mal-rotation with volvulus, Hirschsprung's, incarcerated hernia, necrotizing enterocolitis.
  - b. Infant: mal-rotation with volvulus, incarcerated hernia, pyloric stenosis.
  - c. Toddler: Intussusception, incarcerated hernia, constipation.
3. What is the major diagnostic study used in a 2-year old with crampy abdominal pain and rectal bleeding? What other conditions would be diagnosed using this modality?
  - a. In non-toxic patients, ultrasound is the most commonly used imaging modality to diagnose intussusception. Ultrasound can also be used to diagnose pyloric stenosis, testicular torsion, appendicitis, hernias, and gall bladder pathology.
4. What is the primary treatment modality used in this condition? When should surgery be consulted to care for this child?
  - a. Air contrast enema is the treatment of choice for intussusception. This can also be diagnostic if ultrasound is unavailable. Surgery should be aware of the patient prior to the procedure as there is a risk of perforation, which would require surgical intervention. Furthermore, if the air enema is unsuccessful in reducing the intussusception, surgery will be required to manually reduce the bowel. Surgery should also be consulted if the patient is toxic-appearing and there is high degree of suspicion for bowel death or perforation.

**Case 3:** A one-week old female infant is brought to the Emergency Department by her parents who explain that the child has been feeding poorly and is lethargic and irritable. The parents believe that the infant's abdomen appears to be distended. The child has been vomiting over the past 24 hours and appears to be jaundiced. The child was born at 35 weeks gestation.

## Question Prompts

1. List potential causes of abdominal pain in the newborn infant.
  - a. Necrotizing enterocolitis, mal-rotation with volvulus, Hirschsprung's enterocolitis, non-accidental trauma.
2. What diagnostic studies are appropriate for this patient?
  - a. This patient requires plain x-rays of the abdomen including lateral views.
3. What is the likely diagnosis? What complications may be associated with this disease?





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- a. Necrotizing enterocolitis can result in sepsis and bowel death.
4. What is the appropriate management for this patient?
  - a. Surgical consultation, fluid resuscitation, broad spectrum antibiotics, NG decompression.

## Recommended Reading:

Lochhead A, Jamjoom R, Ratnapalan S. Intussusception in children presenting to the emergency department. *Clin Pediatr (Phila)*. 2013;52(11):1029-1033. doi: 10.1177/0009922813506255

Thompson AM, Bizzarro JM. Necrotizing enterocolitis in newborns: pathogenesis, prevention and management. *Drugs*. 2008;68(9):1227-1238.

Reid SM. Gastrointestinal bleeding in infants and children. In: Tintinalli JE, Stapczynski J, Ma O, Yealy DM, Meckler GD, Cline DM, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 8<sup>th</sup> ed. New York, NY: McGraw-Hill; 2015:864-870.

Fleischman RJ. Acute abdominal pain in infants and children. In: Tintinalli JE, Stapczynski J, Ma O, Yealy DM, Meckler GD, Cline DM, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 8<sup>th</sup> ed. New York, NY: McGraw-Hill; 2015:857-863.

## **\*\*Consider additional EBM resources and FOAMed**

## Key Learning Points:

1. Necrotizing enterocolitis in full term infants is commonly associated with other abnormalities (congenital heart disease, seizures, hypoglycemia, etc.).
2. The diagnosis of NEC is based on non-specific clinical findings, abdominal tenderness, guaiac positive stools and the characteristic radiographs showing pneumatosis intestinalis (bubbles of gas in small bowel intestinal wall).
3. Complications of NEC include infectious complications (peritonitis, sepsis), DIC and respiratory failure.
4. Intussusception is the most common cause of abdominal pain in a child under two years; intussusception may present as lethargy and altered level of consciousness in an infant, often confused with sepsis.
5. Ultrasound can be used to diagnose intussusception with the finding of a "target sign" being pathognomonic. Ultrasound can also guide therapeutic interventions.
6. Surgical indications for intussusception include: acute illness, perforation, unsuccessful non-operative intervention, known lead point and small bowel intussusception.
7. Simple perianal abscesses can be drained locally; complex perianal abscesses (ischioanal, intersphincteric and supralelevator) should be drained in the OR.
8. Antibiotics are required for: immunosuppressed, valvular heart disease, diabetics and those with extensive cellulitis.



## Appendix G: Liver and Peritoneal Disorders

Author: Daniel Martin, MD

### Faculty Objectives for Small Group Discussion

1. Review pathophysiology, diagnosis and treatment of hepatitis and cirrhosis.
2. Review pathophysiology, diagnosis and treatment of complications of cirrhosis such as ascites, SBP and hepatorenal syndrome.
3. Discuss questions posed by residents in their pre-work assignments.
4. Critically discuss the role of paracentesis and diuretics for the treatment of ascites.
5. Summarize key learning points

### Case Studies

**Case 1:** A 30-year-old female presents with fatigue, nausea and anorexia for about 3 weeks. There is no blood in her vomit or her stool. She is homeless and has a history of IVDA and sharing needles. She moved here from San Francisco 2 weeks ago. She has diffuse abdominal pain but more in the RUQ and her skin and sclera show a yellow hue.

### Question Prompts

1. What diagnostic tests should be ordered?
  - a. Complete blood count (CBC), Electrolytes (Chem 7), Liver function tests (LFTs), Lipase, Hepatitis Panel, Blood Cultures, Coagulation studies, right upper quadrant ultrasound, HIV test, Acetaminophen level.
2. What are indications to admit this patient?
  - a. Lack of response to supportive care, bilirubin > 20, PT > 1.5 times normal, hypoglycemia, low albumin, poor outpatient follow up, GI bleeding, obstructive biliary pathology, or fevers. Concern for hepatitis C.
3. How should a nurse be treated if she is a needle stick victim while starting an IV in this patient?
  - a. The nurse should undergo basic wound care and wash out the injury vigorously with soap and water. If the nurse has positive hepatitis B titers, she does not require any further intervention in regards to hepatitis prophylaxis. If the nurse is a known non-responder to the Hepatitis B vaccine and the patient tests positive for an active Hepatitis B infection, she should receive 2 doses of Hepatitis B Immunoglobulin separated by 1 month. If the nurse is an intermediate responder to the vaccine or has not completed a full vaccine regimen and the patient tests positive for Hepatitis B, she should receive 1 dose of Hepatitis B Immunoglobulin and complete a course of Hepatitis B vaccinations. There is no specific post exposure prophylaxis for Hepatitis C. Regardless, the patient should be referred to Employee Health Services for continued testing and monitoring in the setting of this high



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risk exposure. The nurse should also be offered HIV prophylaxis and the patient should be tested.

4. Are there any treatment recommendations besides supportive therapy for this patient?
  - a. For Chronic hepatitis B and C, there are antiviral treatment options including Interferon, direct acting antivirals, and nucleoside analogs. These regimens however are rarely started by Emergency Physicians. In addition, for advanced liver failure, transplant is a potential treatment option.

**Case 2:** A 50-year-old male comes to the ED with increasing confusion. He has been vomiting on occasion but has had no trauma or any medical history except for hypertension for which he is on an ace inhibitor. A former girlfriend brings him in when she noticed he made no sense on the phone; he seemed confused when she visited him. She found him to be disheveled and unkempt and he had lost his job 6 months earlier due to “drinking too much.” On exam, his heart rate is 110 and his systolic BP is 90 mm-Hg and his temperature is 100.0° F. He knows his name but not his location nor the day or the month. He seems shaky and his abdomen seems distended and diffusely tender with minimal rebound but no focal tenderness.

## Question Prompts

1. Explain what labs and imaging you might order and your rationale for this?
  - a. CBC, Chem 7, LFT, Lipase, Hepatitis Panel, Blood Cultures, Coags, right upper quadrant ultrasound, HIV test, Acetaminophen level, fluid gram stain, fluid culture, fluid cell count, ammonia, CT head.
  - b. The patient requires a broad work up to identify the cause of his liver failure. With fever and abdominal distention, he requires a diagnostic paracentesis to rule out spontaneous bacterial peritonitis. The patient could potentially undergo a CT scan of the abdomen, but if his history and physical exam are localizing to hepatic dysfunction, an ultrasound is more sensitive to detecting biliary pathology.
2. Review the physical exam findings of cirrhosis and hepatic encephalopathy.
  - a. Cirrhosis: ascites, jaundice, spider angiomas, gynecomastia, splenomegaly, caput medusae.
  - b. Hepatic Encephalopathy: impaired cognition, impaired memory, asterixis, hyperreflexia, bradykinesia, sleep disturbances.
3. Explain the safest way to perform a paracentesis and how much fluid can be safely removed.
  - a. The safest way to perform a paracentesis is under direct ultrasound guidance. Large volumes up to 10 liters can be safely removed, but if more than 5 liters are taken off, the patient requires colloid replacement, usually in the form of albumin to minimize large fluid shifts.
4. Explain the pathophysiology of spontaneous bacterial peritonitis (SBP) and rationale for antibiotic therapy.
  - a. Although not fully understood, it is believed that SBP is caused by translocation of the bacteria from the GI tract into the peritoneal fluid. Portal hypertension decreases gut motility and increases bowel edema, which allow for the translocation of enteric organisms.



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Because these patients are immunocompromised, and SBP can proceed to bacteremia and sepsis, early antibiotic therapy is indicated.

5. Know the most common precipitants of hepatic encephalopathy.
  - a. Medication non-compliance, GI Bleeding, infection, SBP, worsening hepatic failure.

**Case 3:** A 60-year old male has longstanding alcohol-related cirrhosis and recently completed a course of ceftriaxone for SBP. Now he still feels weak with fatigue, and although his abdominal pain has improved he was sent in from his physician's office because his serum creatinine has increased from 1.8 to 4.0 in 2 weeks. He was not exposed to contrast during his recent admission and he denies drinking alcohol. He has noted increased swelling to his legs and some increased confusion.

## Question Prompts

4. Explain the pathophysiology of hepatorenal syndrome.
  - a. Portal hypertension causes arterial vasodilation, particularly in the splanchnic circulation. This results in an overall decreased systemic vascular resistance. In an attempt to increase blood flow, renal vessels constrict and increase vascular resistance. This combination of systemic decreased resistance and increased resistance at the renal vessels results in decreased overall flow to the kidneys, which causes decreased renal function overall.
5. What is the most appropriate therapy in the ED and what additional treatments should be considered?
  - a. If the patient appears intravascularly dry, fluid can improve renal function. Acutely ill patients requiring ICU level care can be treated with norepinephrine and albumin. As an inpatient, a trans-jugular intrahepatic portosystemic shunt (TIPS) procedure can improve hepatorenal syndrome and, of course, treatment of the underlying liver failure can improve renal function.
6. What is the prognosis of hepatorenal syndrome?
  - a. The presence of hepatorenal syndrome is a very poor prognostic indicator.

## Recommended Reading:

O'Mara SR, Gobreyes K. Hepatic disorders. In: Tintinalli JE, Stapczynski J, Ma O, Yealy DM, Meckler GD, Cline DM, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 8<sup>th</sup> ed. New York, NY: McGraw-Hill; 2015:525-531.

Oyama LC. Disorders of the liver and biliary tract. In: Marx JA, Hockberger RA, Walls RM, Biros MS, Danzl DF, Gausche-Hill M, et al. eds. *Rosen's Emergency Medicine Concepts and Clinical Practice*. 8<sup>th</sup> ed. Philadelphia, PA: Elsevier Saunders; 2014:1186-1204.

Iqbal K, Klevens RM, Kainer MA, Baumgartner J, Gerard K, Poissant T, et al. Epidemiology of acute hepatitis B in the US from population-based surveillance, 2006-2011. *Clin Infect Dis*. 2015;61(4):584-592. doi: 10.1093/cid/civ332

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Dever JB, Sheikh MY. Review article: spontaneous bacterial peritonitis - bacteriology, treatment, risk factors and prevention. *Aliment Pharmacol Ther*. 2015;41(11):1116-1131.

Barsuk JH, Cohen ER, Vozenilik JA, O'Conner LM, McGaghie WC, Wayne DB. Simulation-based education with mastery learning improves paracentesis skills. *J Grad Med Educ*. 2012;4(1):23-27.

Braupera, L, Gines P. Hepatorenal syndrome: the last piece of the puzzle or not yet? *Hepatology*. 2015;62(2):352-354. doi: 10.1002/hep.27829

## Key Learning Points:

1. An aspartate aminotransferase:alanine aminotransferase (AST:ALT) ratio > 2 is common with alcohol because alcohol stimulates AST production. AST can be from other organs whereas ALT is specific for hepatocytes. In viral hepatitis ALT is usually greater than AST and both are more than 10 times normal. Bilirubin is elevated and direct and indirect are equally elevated. Elevation of the Prothrombin time (PT) or International Normalized Ratio (INR) suggests a more complicated course.
2. Acute hepatitis A or B infection can be diagnosed with IgM for A and HBsAg and HBcAg antibody for B. HBsAb is the best indicator of immunity.
3. For complicated hepatitis B (INR > 1.5, long course, bilirubin > 10) consider treatment with a nucleoside/tide inhibitor.
4. Even in the setting of prolonged INR or low platelets, US guided taps are safe with a very low risk of bleeding (*Dig Liver Dis*, 2005; 37:946-951).
5. SBP is diagnosed when neutrophils are greater than 250 in ascetic fluid.
6. In hepatic encephalopathy, bacteria produce ammonia from metabolism of gut proteins, the ammonia is absorbed, but not converted in the liver to urea. Blood ammonia levels do not correlate well with encephalopathy severity. Always think of GI bleeding and infection as precipitating causes. Lactulose is metabolized to lactate and traps ammonium in the stool whereas Neomycin reduces colonic bacteria that make ammonia.
7. Increase in creatinine defines hepatorenal syndrome (by 0.3 or more within 48 hours, 50% higher than baseline within 7 days or a rise to greater than 1.5.)
8. Regarding treatment of hepatorenal syndrome, always consider volume to treat volume depletion but in the ICU consider albumen + norepinephrine or consider vasopressin as well. If not in the ICU consider other medications.



## Appendix H: Gallbladder and Pancreas Disorders

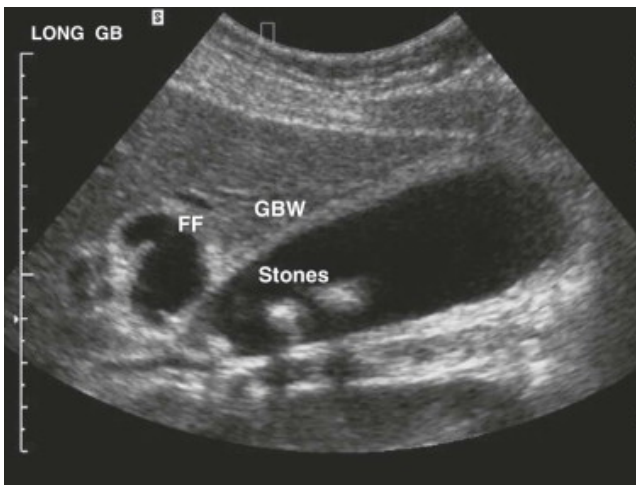
Author: Ashish Panchal, MD, RDMS

### Faculty Objectives for Small Group Discussion

1. Review pathophysiology, diagnosis and treatment of gallbladder diseases.
2. Review pathophysiology, diagnosis and treatment of acute pancreatic diseases.
3. Discuss questions posed by residents in their pre-work assignments.
4. Evaluate the role of imaging modalities for the evaluation of gallbladder and pancreatic diseases.
5. Summarize key learning points.

### Case Studies

**Case 1:** A 35-year-old female presents with intermittent right upper quadrant (RUQ) pain after meals. She has no significant past medical history and follows with her physician. She reports she had a meal 1 hour prior to arrival and now has consistent pain. Patient has had no fevers and has been tolerating fluid by mouth. On examination, she appears stated age, has a high body mass index (BMI), and is sitting in bed uncomfortable. She has RUQ tenderness with no peritoneal signs.



<http://carrolltondiagnostic.com/physicians.html>

### Question Prompts

1. Define the different risk factors which increase her risk for possible cholelithiasis
  - a. Female sex, Obesity.
  - b. Other risk factors which may not apply to this patient are age > 40 years, pregnancy, diabetes mellitus, and positive family history.
2. Generate a differential diagnosis for this patient's abdominal pain.



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- a. Cholecystitis, Choledocholithiasis, biliary colic, duodenal ulcer, pancreatitis, hepatitis, cholangitis.
3. What is the most appropriate diagnostic evaluation for this patient?
  - a. Complete blood count (CBC), electrolytes (chem-7), liver function tests (LFTs), Lipase, RUQ ultrasound
4. What are the sonographic findings for cholecystitis?
  - a. Thickened wall of the gallbladder, pericholecystic fluid, sonographic Murphy's sign.

**Case 2:** A 65-year-old female with a history of diabetes mellitus type II and hypertension presents with RUQ abdominal pain. She was transferred from an outside hospital for possible cholangitis.

## Question Prompts

1. Describe the pathophysiology of this patient's diagnosis.
  - a. Classically, the common bile duct is obstructed and bacteria are therefore able to cause infection within the biliary tree.
2. Compare and contrast the presentations of cholecystitis to cholangitis.
  - a. Both pathologies can present with RUQ pain and fever. However patients with cholangitis are typically more toxic appearing. Furthermore, jaundice is common in cholangitis and rare in cholecystitis. AMS and hypotension are also more common in cholangitis.
3. Consider other complications this patient may be facing?
  - a. Choledocholithiasis, Emphysematous Cholecystitis, Perforation, Bacteremia.

**Case 3:** A 42-year-old female with a past medical history of alcohol abuse presents with epigastric abdominal pain. She reports that she has been vomiting over the last 2 days. Vital signs reveal a febrile, tachycardic patient with normal blood pressure. Exam is positive for significant epigastric pain with no peritoneal signs.

## Question Prompts

1. With the acuity of this patient's presentation, what is the possible differential diagnosis?
  - a. Pancreatitis, pancreatic abscess, perforated peptic ulcer, cholecystitis, cholangitis.
2. What diagnostic studies are required for this patient?
  - a. CBC, Chem-7, LFTs, Lipase, ultrasound vs CT scan if necrosis or abscess is suspected.
3. What is the appropriate management and disposition plan for this patient? Are there any ways to estimate the risk of mortality from their disease process?
  - a. Fluids and symptom control are the mainstays or treatment for pancreatitis. Ranson's criteria can be used to assess for severity and risk of mortality, but requires 48 hours from presentation to fully calculate. This febrile patient should be admitted for continued monitoring; if she is persistently showing signs of systemic infection, she requires imaging, antibiotics, and possible surgical intervention. In afebrile cases, if the pain can be controlled, the patient can tolerate PO, and there are no significant lab abnormalities, the patient can be considered for outpatient treatment.



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**Case 4:** A 2-week-old Asian American female presents with her parents for evaluation of jaundice and abnormal stools. They state that the child has been previously healthy and was born full term with no complications. The child has been eating well. Stools are described as gray and white in color. On examination, hepatomegaly and jaundice are noted. Labs show conjugated hyperbilirubinemia.

## Question Prompts

1. What is the likely cause of this child's presentation?
  - a. Biliary atresia, which results from the failure of the biliary tree to properly develop. This results in the backup of bile, liver failure, and potentially death.
2. Describe the further emergency department management of this child?
  - a. Fluid resuscitation as needed, LFTs, CBC, Chem-7, RUQ ultrasound, and surgical consultation.
3. If left untreated, what will the child develop and what will be the ultimate outcome?
  - a. Liver failure, cirrhosis, and ultimately death.

## Recommended Reading:

Cappell MS. Acute pancreatitis: etiology, clinical presentation, diagnosis, and therapy. *Med Clin North Am.* 2008;92(4):889-923. doi: 10.1016/j.mcna.2008.04.013

Spence SC, Teichgraeber D, Chandrasekhar C. Emergent right upper quadrant sonography. *J Ultrasound Med.* 2009;28(4):479-496.

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Besinger B, Stehman SR. Pancreatitis and cholecystitis. In: Tintinalli JE, Stapczynski J, Ma O, Yealy DM, Meckler GD, Cline DM, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide.* 8<sup>th</sup> ed. New York, NY: McGraw-Hill; 2015:517-524.

Hardasmalani MD. Liver disease and gallbladder. In: Schafermeyer R, Tenenbein M, Macias CG, Sharieff GQ, Yamamoto LG, eds. *Strange and Schafermeyer's Pediatric Emergency Medicine.* 4<sup>th</sup> ed. New York, NY: McGraw-Hill; 2015:421-425.

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King A, et al. Novel Emergency Medicine Curriculum Utilizing Self-Directed Learning and the Flipped Classroom Method: Gastrointestinal Emergencies Small Group Module. *JETem* 2017. 2(1):C69-117. <https://doi.org/10.21980/J8MS37>







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**\*\*Consider additional EBM resources and FOAMed**

## Key Learning Points:

1. Prompt 1
  - a. Risk Factors for cholelithiasis: estrogen use, age, pregnancy, female (2-3X higher than men), obesity and rapid weight loss.
  - b. Consider differential diagnosis to include: gastroesophageal reflux disease (GERD), gastritis, peptic ulcer disease (PUD), biliary colic, cholecystitis, pancreatitis, cholangitis (unlikely), choledocholithiasis (unlikely).
  - c. CBC, CMP, LFT's, lipase; discuss RUQ ultrasound vs CT sensitivity for stones vs cholecystitis. (CT sensitivity/specificity = 95%/96% vs US sensitivity/specificity = 94%/78%).
  - d. RUQ US findings include thickened GB wall, pericholecystic fluid, sonographic Murphy sign.
2. Prompt 2
  - a. Cholangitis is biliary obstruction with infected biliary tract.
  - b. Acute cholecystitis is rarely jaundiced and is less toxic than cholangitis. The cystic duct is usually blocked in cholecystitis, and the hepatic and common bile ducts are patent and free of inflammation/infection. The hallmark of acute cholangitis is Charcot's triad: fever (95%), RUQ pain (90%) and jaundice (85%). Reynolds pentad adds hypotension and AMS suggestive of gramnegative sepsis (15%).
  - c. Choledocholithiasis, Emphysematous Cholecystitis, cholangitis, perforation.
3. Prompt 3
  - a. Cholecystitis, cholangitis (if yellow), pancreatitis with complications, perforation.
  - b. Labs as noted with lipase/amylase. Make sure learners describe why you may or may not need amylase.
  - c. Discuss whether further imaging is necessary in order to make disposition planning decisions (disposition home if pain controlled and tolerating oral food or liquid by mouth (POs) versus need for bowel rest, nothing by mouth (NPO) and admission). Anyone with complicating factors requires admission. Discuss Ransom's Criteria (i.e. white blood count (WBC) > 16, Age >55, Glucose > 200, aspartate aminotransferase (AST) > 250, LDH > 350 at admission).
4. Prompt 4
  - a. Biliary atresia is a serious cause of conjugated hyperbilirubinemia.
  - b. Requires surgical consultation and likely additional imaging.
  - c. Life threatening – can result in cirrhosis, liver failure, and death



# FLIPPED CLASSROOM SMALL GROUP EVALUATION FORM

Topic:

Date:

Learner	Below Expectations	Meets Expectations	Exceeds Expectations

Comments:

Supervised by: