Acute Abdominal Emergencies

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Disclosures

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• I do not intend to discuss any unapproved/investigative use of a commercial product/device in my presentation
Introduction

• Abdominal pain is a common complaint of children in the Emergency Department (ED)

• In 2010, the Healthcare Cost and Utilization Project (HCUP) reported that digestive disorders accounted for 1.7 million visits to the ED by pediatric patients

• Majority of patients have non-life-threatening causes
Differential diagnosis is broad!

<table>
<thead>
<tr>
<th>Less than 2 years</th>
<th>2-5 years</th>
<th>6-12 years</th>
<th>Greater than 12 years</th>
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<td><strong>More common, non-life threatening causes of abdominal pain</strong></td>
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<td>Colic</td>
<td>Constipation</td>
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<td>GERD</td>
<td>Gastroenteritis</td>
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<td>Constipation</td>
<td>UTI</td>
<td>Functional pain</td>
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<td>Gastroenteritis</td>
<td>Pneumonia</td>
<td>UTI</td>
<td>Torsion (ovarian/testicular)</td>
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<td><strong>Life threatening causes of abdominal pain</strong></td>
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<td>Malrotation/volvulus</td>
<td>Trauma</td>
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<td>Intussusception</td>
<td>Intussusception</td>
<td>Appendicitis</td>
<td>Ectopic pregnancy</td>
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<td>Trauma</td>
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<td>Megacolon from IBD</td>
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<td>Pyloric Stenosis</td>
<td>Incarcerated hernia</td>
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<tr>
<td>Incarcerated hernia</td>
<td>Meckel diverticulum</td>
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<td>Hirschsprung disease</td>
<td>Obstruction</td>
<td>Aortic Aneurysm</td>
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<td>Peritonitis</td>
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<td>Megacolon</td>
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<td>Aortic aneurysm</td>
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<td>Necrotizing enterocolitis</td>
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<td>Hepatitis</td>
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Table adapted from Fleischer and Ludwig, Textbook of Pediatric Emergency medicine
Objectives

• To review acute abdominal pain emergencies by a case based approach

• To understand the key findings, diagnostic tools and management of acute abdominal pain emergencies
Case 1
Patient BD

• BD is a 12 wo male presenting for failure to thrive
• Has not gained weight in the past month
• Head and length are normal per primary physician
• Has been spitting up since birth, over the past month started spitting up more and sometimes vomits
• Vomit is non-bilious, non-bloody
• Has no fever, no URI symptoms
• Started on ranitidine for presumed esophageal reflux, but this past week vomiting has become more forceful
Patient BD

• Birth history: full term, vaginal delivery, no complications
• PMhx: Seen by cardiology for heart murmur, thought to be benign
• PShx: circumcision
• Family hx: non-contributory
• No allergies
• Immunizations up to date
• Meds: ranitidine, vitamin D
• Social hx: lives with mom and dad, in daycare
BD examination

- Vitals within normal limits for age with exception of weight, 3%tile
- Small for age, but active, appears well hydrated
- AFOSF, normal head size for age
- HEENT unremarkable
- Heart without murmur, femoral pulses equal
- Abdomen is soft, non-tender, non-distended, no masses
- Normal skin turgor, no rashes
- GU exam with normal external male genitalia
- Neuro examination also normal
At end of examination you see this.....
Further diagnostics

• Labs:
  • Na 137
  • K 3.2
  • Cl 86
  • Bicarb 31
  • Cr 0.3
  • BUN 14
  • Glucose 90
Diagnosis??
Infantile Hypertrophic Pyloric Stenosis
Infantile Hypertrophic Pyloric Stenosis: Patient BD

• BD is a 10 wo male presenting for failure to thrive
• Has not gained weight in the past month
• Head and length are normal
• Has been spitting up since birth, over the past month started vomiting more
• Vomiting is non-bilious, non-bloody
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  • Glucose 90
Infantile Hypertrophic Pyloric Stenosis: Epidemiology

• Occurs in 2-5/1000 births per year

• Males more often affected than females (4:1 ratio)

• 30-40% are first born children
  • 1.5 fold increased risk if first born AND male

• Presents between 3-5 weeks, rarely after 12 weeks
Infantile Hypertrophic Pyloric Stenosis: Anatomy and physiology

Pyloric channel widens and thickens, then fills with redundant mucosa

Picture obtained from: http://www.mayoclinic.org/diseases-conditions/pyloric-stenosis/home/ovc-20163855
Infantile Hypertrophic Pyloric Stenosis: Risk factors

• Environmental
  • Maternal smoking during pregnancy
  • Bottle feeding

• Genetic factors

• Macrolide antibiotics
Infantile Hypertrophic Pyloric Stenosis: Differential diagnosis

• Must distinguish between malrotation with mid-gut volvulus!!!!
  • Usually ill appearing with bilious emesis
  • True surgical emergency

• Other diagnoses
  • GERD
  • Adrenal crisis
  • Milk protein intolerance
Infantile Hypertrophic Pyloric Stenosis: Presentation

• Classic: “The Hungry Vomiter”
  • Non-bilious vomiting occurs at the end of a feeding
  • Infant appears hungry after vomiting and attempts to feed
  • Vomiting becomes more predominant, projectile over time

• Atypical:
  • Failure to thrive presentation
  • Reflux presentation
  • Septic presentation
Infantile Hypertrophic Pyloric Stenosis: Physical examination

• Can vary from well appearing to ill appearing

• Abdomen generally soft, nondistended
  • If patient relaxed, an “olive mass” may be palpated in epigastrium
  • May also see prominent gastric peristaltic waves

• Normal genitalia
  • Must evaluate for ambiguous genitalia in a vomiting infant!!
  • Vomiting can occur with congenital adrenal hyperplasia

• If symptoms prolonged →
  • “Old man” appearance with loose hanging skin secondary to absence of subcutaneous tissue
Infantile Hypertrophic Pyloric Stenosis: The "Olive" Mass

- Firm mass at lateral edge of the rectus abdominis muscle in the right upper quadrant
  - Best felt after immediately after vomiting

- In 1970s, it was seen in 87% of patients but decreased to 49% by 1980s (Macdessi 1993); now ranges 53-74% in detection
  - Due to earlier detection
  - Increased diagnostic advances with ultrasound

- If present, pathognomonic of disease with 99% sensitivity
Infantile Hypertrophic Pyloric Stenosis: Diagnostic Imaging with Ultrasound

• Gold standard

• Pyloric stenosis = \( \pi \)
  • Diagnostic criteria
    • > 3mm pyloric muscle thickness
    • > 14mm pyloric muscle length

• Stomach should be emptied of gastric contents
  • Fluid filled duodenal bulb and gastric antrum can cause false positive readings
Infantile Hypertrophic Pyloric Stenosis: Diagnostic Imaging with Upper GI

• Used if physical exam/US are non-diagnostic

• Classic signs:
  • String sign
  • Double track sign
  • Beak sign

• Cons:
  • Involves radiation
  • May take longer
  • Normal peristalsis or pylorospasm may be mistaken for IHPS

A special thank you to Dr. Susan Kost for her images
Infantile Hypertrophic Pyloric Stenosis: Laboratory data

• May be initially normal!
  • One study demonstrated up to 88% of patients with normal electrolytes

• As symptoms progress there is loss of gastric hydrochloric acid
  • Results in: **Hypochloremic, metabolic alkalosis**
  • Over time can also develop hypokalemia

• Important to know their electrolytes
  • Metabolic alkalosis can lead to apnea, especially intraoperatively
Infantile Hypertrophic Pyloric Stenosis: Definitive Treatment

• Electrolytes need to be corrected prior to repair due to risk of apnea

• Surgical correction with pyloromyotomy

• Majority of patients do well, no further surgical interventions are usually needed
Infantile Hypertrophic Pyloric Stenosis: Follow up to BD

• Had surgery on hospital day 3 → took 2 days to correct electrolytes

• Now thriving, gaining weight well, no further issues
Case 2
Patient GS

- GS is a 20 month old male presenting with lethargy
- Woke up well this morning, but throughout the day is more somnolent
- In the morning had long periods of crying, parents unsure why
- Had one episode of vomiting, non-bilious, non-bloody
- Has no fever, no URI symptoms but was sick one week prior with gastroenteritis
- Last bowel movement was this morning, and was normal
- Parents think his belly might hurt because he hunches over with crying
Patient GS

• Birth history: full term, vaginal delivery, no complications
• PMhx: asthma
• PShx: circumcision
• Family hx: non-contributory
• No allergies
• Immunizations up to date
• Meds: none
• Social hx: lives with mom, dad and brother; in daycare
GS examination

- Vitals within normal limits for age
- Awake, playful, nontoxic, responds appropriately
- AFOSF, normal head size for age
- HEENT unremarkable
- Heart without murmur
- Abdomen is soft, non-tender, non-distended, no masses
- Normal skin turgor, no rashes
- GU exam with normal external male genitalia
- Neuro examination also normal
GS examination

- At the end of the exam, he becomes extremely fussy, difficult to console
- Drawing legs up to his abdomen
- Responds appropriately despite being fussy
- Episode lasted 10 minutes, afterwards is extremely quiet but still interactive
Further diagnostics
Diagnosis??
Intussusception
Intussusception: Patient GS

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Intussusception: GS examination

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• Drawing legs up to his abdomen
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• Episode lasted 10 minutes, afterwards is extremely quiet but still interactive
Intussusception: Further diagnostics
Intussusception: Anatomy and Pathology

- Occurs when one segment of bowel invaginates into a more distal segment
  - Often described as a “telescoping”

- Most common in the ileocolic area where the terminal ileum prolapses through the ileocecval valve

Picture from http://www.chop.edu/conditions-diseases/intussusception
Intussusception: Epidemiology

• Occurs in 2-4 patients/1000/year

• Most often occurs in children 2 months to 2 years
  • Approximately 60% occur in children under 1 year of age
    • 80-90% are younger than 2 years of age

• Slight male predominance with a 3:2 ratio
Intussusception: Causes

• Most cases (~75%) are idiopathic
  • Most common cause for children between 3 months and 2 years of age

• Viral illnesses, specifically adenovirus may be associated

• Lead points
  • More common in children younger than 3 months or older than 2 years
    • Meckel’s diverticulum, polyp, tumor
    • Small bowel wall hematoma in Henoch Schonlein Purpura (HSP)
    • Thickened stool seen with CF patients
    • Inflammation and stricture formation seen in Crohn’s disease
Intussusception: Differential

• Dependent upon presenting symptoms/exam findings:
  • Lethargy
    • Trauma
    • Sepsis
    • Metabolic
    • Ingestion
  
• Rectal bleeding and vomiting
  • Meckel diverticulum
  • Infectious colitis
  • Malrotation with volvulus
Intussusception:
Initial presentation - “Colicky abdominal pain”

- Intermittent episodes of severe, crampy and progressive abdominal pain with inconsolable crying and drawing of their legs towards the abdomen

- Occurs in 15-20 minute intervals

- In between episodes, child is normal and free of pain

- Classic triad of pain, currant jelly stools and palpable mass only seen in 15% of patients
Intussusception: Physical examination

• General appearance can range depending on timing of their pain
  • Can be normal, fussy or even lethargic

• Sausage shaped abdominal mass in the right upper quadrant

• Occult blood with
  • Currant jelly stools

[Image obtained from: https://clinicalgate.com/intussusception/2016s-clinical-image/]

[Image obtained from: https://kchemimage.wordpress.com/answers-for-january-2016]
Intussusception: Medical imaging

• Plain radiographs:
  • Most will have a normal bowel gas pattern as they are highly variable based on duration of symptoms
  • If symptoms are present for 6-12 hours, complete a flat and upright film looking for:
    • Decreased gas and/or stool in the cecum
    • Air fluid levels
    • Soft tissue mass
Intussusception: Medical imaging

• Plain radiographs warnings:
  • Air-fluid levels are NOT a sensitive or specific finding for intussusception
  • Air in the sigmoid colon may be mistaken for air/stool in the cecum
  • Soft tissue masses are only present in 50-60% of true positives

• What are they good for??
  • Evaluation of free air prior to contrast enema reduction
    • Absolute contraindication to reduction is free air, therefore plain radiograph is needed prior to reduction
Intussusception: Medical imaging

• Ultrasound:
  • Test of choice with sensitivity of 98-100%
    • False positives include bowel wall thickening, stool
  • Classic image finding is a “target sign” or “bull’s eye”
  • Better to detect pathologic lead points
Intussusception: Treatment

• Non-operative reduction
  • Reserved for stable patients and no evidence of perforation

• Surgical treatment
  • Reserved for ill or unstable patients with evidence of perforation or non-operative reduction is not successful
Intussusception: Non-operative reduction

• Can be successful in up to 70-95% of cases
  • High rate of success in patients with idiopathic intussusception

• Uses hydrostatic (saline or contrast) or pneumatic pressure (air) via enemas

• Perforation can occur in up to 3% of patients, therefore surgery should be involved prior to reduction
  • Risk factors for perforation include:
    • Age less than 6 months
    • Long duration of symptoms
    • Evidence of bowel obstruction

• Recurrence rate of 10% after successful reduction
Intussusception: Follow up to case GS
Case 3
Patient EH

- EH is an 11 yo female with abdominal pain
- Pain started 1 day prior
- Described as a 10/10 at its worst
- Generalized but also in the RLQ
- Sick one week prior with vomiting/diarrhea but this resolved after 48 hours
- One episode of vomiting today
- No diarrhea, cannot remember last time she stooled
- Had “mild” fever today, but family cannot remember the number
Patient EH

• PMhx: none
• PShx: none
• No allergies
• No medications
• Immunizations are up to date
• Has not started menses
• Lives with mom, dad, sister
Patient EH

• Seen one day prior in the ED for similar pain
  • US of abdomen did not visualize the appendix
  • US of pelvis
    • Right ovary greater in size than left ovary
    • Arterial and venous flow present within the right and left ovary

• Was seen by surgical resident
  • Low suspicion for appendicitis, no further work up recommended

• Case discussed with gynecology
  • Did not feel case was consistent with torsion, advised follow up in 1-2 months for repeat US

• Her pain improved, tolerated PO and discharged
EH Examination

• Vitals:
  • Temp 36.7, HR 105, RR 20, 99%RA, 132/74
• Lungs clear bilaterally
• HR 105, no murmurs
• Mild right lower quadrant tenderness, no rebound, no guarding
• Otherwise well appearing
• Stated the pain is “coming/go ing” and felt like it was coming back
• Asking to eat
EH diagnostics

• Ultrasound unable to visualize appendix and right ovary in its entirety due to bowel gas and stool
• Right ovary appears larger than the left
• Normal flow to both ovaries
Patient EH diagnostics
Diagnosis?

Ovarian Torsion
Ovarian Torsion: Patient EH

- EH is an 11 yo female with abdominal pain
- Pain started 1 day prior
- Described as a 10/10 at its worst
- Generalized but also in the RLQ
- Sick one week prior with vomiting/diarrhea but this resolved after 48 hours
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Ovarian Torsion: Patient EH Examination

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  - Temp 36.7, HR 105, RR 20, 99%RA, 132/74
- Lungs clear bilaterally
- HR 105, no murmurs
- Mild RLQ tenderness, no rebound, no guarding
- Otherwise well appearing
- Told me pain is “coming/go ing” and felt like it was coming back
- Asking to eat
Ovarian Torsion: Patient EH diagnostics

• Ultrasound unable to visualize appendix and right ovary in its entirety due to bowel gas and stool
• Right ovary appears larger than the left
• Normal flow to both ovaries
Ovarian Torsion: Patient EH diagnostics
Ovarian Torsion

Complete or partial rotation of the ovary on its ligamentous supports therefore impeding its blood supply.
Ovarian Torsion: Relevant Anatomy
Ovarian Torsion: Pathophysiology

Picture obtained from:
https://www.researchgate.net/publication/269934990_Multimodality_imaging_in_adnexal_torsion
Ovarian Torsion: Risk factors

• Occurs in 4.9 per 100,000 patients in patients less than 20 years of age

• Children usually have normal ovaries
  • Theorized that their longer utero-ovarian ligament puts them at risk, but not proven

• Late adolescents and young adults usually have cysts or neoplasm as risk factor
  • If mass or cyst >5cm in diameter there is increased risk of torsion

• Right side more likely to be affected than the left
  • Due to the elongated utero-ovarian ligament
  • Left side is protected by the sigmoid colon
Ovarian Torsion: Clinical recognition

• Often difficult to make the diagnosis due to vague symptoms

• Most common symptom in all age groups
  • ABDOMINAL PAIN

• Other symptoms
  • Vomiting
    • Nausea is not as specific of a symptom
  • Fever
    • Usually a later symptom
    • Often associated with necrosis of ovary
Mean duration from emergency department admission to first incision site was greater in pre-menarchal group compared with post-menarchal group.

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<th>Pre Menarchal</th>
<th>SYMPTOM</th>
<th>Post Menarchal</th>
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<tr>
<td>Diffuse</td>
<td>ABDOMINAL PAIN</td>
<td>Right lower quadrant</td>
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<tr>
<td>Higher Rates</td>
<td>FEVER</td>
<td>Lower Rates</td>
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<tr>
<td>Higher Rates</td>
<td>RESTLESSNESS</td>
<td>Lower Rates</td>
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<tr>
<td>Higher Rates</td>
<td>PALPABLE MASS</td>
<td>Lower Rates</td>
</tr>
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Ovarian Torsion: Medical Imaging

• Ultrasound is test of choice
  • Findings can include
    • Unilaterally enlarged, rounded ovary due to edema from compromised vascular flow
    • Diminished blood flow
      • Normal blood flow DOES NOT torsion exclude due to dual blood supply, but ABNORMAL blood supply is highly suggestive
    • Small peripheral follicles resembling a “string of pearls” due to edema
    • Ovary anteriorly displaced (usually lateral to the uterus)
Ovarian Torsion: Treatment

• Surgical EMERGENCY
  • Salvage of ovary is time dependent
    • But unknown how long after symptoms occur will the ovary become unsalvageable

• Types of surgical interventions include
  • Oophorectomy
  • Detorsion of ovary with conservation
    • With or without oophoropexy
Ovarian Torsion: EH Follow up

- Ultrasound of pelvis
  - Right ovary again measures larger in size than the left ovary
  - Normal appearance of the left ovary
Ovarian Torsion: EH follow up

- After US pain worsened, required morphine

- MRI completed

- Surgery consulted → taken to OR
  - Had 540 degree torsion but without signs of ischemia
Ovarian Torsion: EH Follow up

• Discharged following day

• 1 months later follow up with OBGYN
  • Doing well, no issues

• Follow up US
  • Decreased in size of the right ovary and lost the central echogenicity and peripheral follicles but right still slightly larger than the left
Summary

• Differential diagnosis for abdominal pain is broad, best broken down into age and severity

• Pyloric stenosis can occur in well looking infants, always consider in patients presenting with concerns for GERD or failure to thrive

• Intussusception can occur with absence of abdominal pain complaint, always include this on differential for patients presenting with lethargy

• Ovarian torsion can occur at any age therefore have heightened awareness for females with abdominal pain and vomiting
General References


• Mark I Neuman, MD, MPH. Causes of acute abdominal pain in children and adolescents. Up to date. Apr 12, 2016.

Pyloric Stenosis References

Pyloric Stenosis References

- Smoking picture: https://www.whatisepigenetics.com/maternal-smoking-epigenetically-harms-child-development/
- Olive: https://www.delallo.com/explore/olives-antipasti/#
Intussusception References


Intussusception References


Ovarian Torsion References

- Marc R Lauber, M. Ovarian and fallopian tube torsion. Up to date. Jun 01, 2017