OBJECTIVES

1. Identify patients that need referral to pediatric surgery and urgency of that referral.
2. Discuss clinical considerations in the use of diagnostic evaluation in pediatric patient with abdominal pain.
3. Identify abnormal stooling pattern in pediatric patients and discuss initial evaluation and management.
CASE STUDY #1

- 14 year old female with acute onset lower abdominal pain
- No fevers, nausea, vomiting or diarrhea
- No urinary symptoms
- Normal stooling pattern
- No ill contacts

HISTORY

- PMH: ovarian teratoma
- PSH: right oopherectomy

PHYSICAL EXAM

- General: No acute distress
- Abdomen: soft, nondistended, tender in bilateral lower quadrants, no palpable masses
**DIAGNOSTICS**

- AFP, HCG quantitative tumor antigen
- LH, FSH
- Inhibin A, Inhibin B
- CEA, CA 19-9, CA 125
- Anti mullerian hormone
OVARIAN TERATOMA, HEMORRHAGIC CYST, FOLLICULAR CYST

- Ultrasound used to determine size of mass, characteristics: solid vs cyst, blood flow to the ovaries
- MRI used to evaluate this further in complex patient as ours
- Tumor markers: normal results for our case study
- Simple cysts less than 5 cm can be watched and surveilled with US. Most are follicular cysts. Cysts with few internal septations can be observed with repeat imaging, most are hemorrhagic cysts.
- Solid components need further evaluation with surgeon
- Torsion is an emergent condition as the ovary can be salvaged

QUESTIONS

CASE STUDY #2

- 8 yr old female with 1 day abdominal pain
- Started periumbilical area, worsened with time
- Decreased appetite, no nausea or vomiting
- One loose stool
- No urinary symptoms
- No ill contacts
- In ER, pain now in RLO, low grade fever
- No PMH/PSH – otherwise healthy
PHYSICAL EXAM

• Tenderness focally in right lower quadrant
• Abdomen otherwise soft, nondistended, no masses
• No other pertinent findings on physical exam

CASE STUDY #2

• Labs:
  • WBC 16.1; 81% neutrophils
  • Electrolytes normal
PAIN VS TENDERNESS

Differential

- Female: ovarian pathology, endometriosis
- Urinary tract
- Gastrointestinal (IBD, constipation)
- Pneumonia, strep throat

APPENDICITIS

Abdominal pain caused by distended appendix, pain usually comes first in history, followed by +/- nausea, vomiting, anorexia, fever, pain is constant.
## PHYSICAL EXAM

- Obturator sign: pain with internal rotation of leg
- Rovsing sign – rebound tenderness at RLQ site after pushing and releasing LLQ
- Psoas sign – pain with raising leg against resistance
- Pain should be constant, worse with palpation/percussion to RLQ
- Distraction good technique with pediatric patient

## US FINDINGS

- Noncompressible
- Size
- Surrounding tissue
- Tenderness with exam
- Fluid collection
- Free fluid vs loculated fluid

## DIAGNOSTIC ACCURACY

- In study using maximal outer diameter of greater than or equal to 7 mm for the appendix, US compared favorably to CT
- This saves patient radiation exposure, lower cost
- If CT scan warranted, dose reduction of radiation strategies should be implemented.
- If your local imaging is not regularly doing pediatric US, clinical suspicion is high, refer
- If you are considering CT scan, refer
- Children are more sensitive to the radiation, have longer life expectancy to manifest late effect cancer
MANAGEMENT

- OR for laparoscopic appendectomy
- Preoperative considerations:
  - Hydration, antibiotics

ACUTE PERFORATED APPENDICITIS MANAGEMENT

- Antibiotic treatment with interval appendectomy 6-8 weeks later vs operation
- Limited CT scan to determine well formed abscess
- If intraabdominal abscess, abdominal pain > 3 days duration, upfront antibiotics, IR drain if possible and interval appendectomy 8 weeks later

ACUTE PERFORATED APPENDICITIS TREATMENT PROTOCOL

- Observational study of pediatric patients with suspected acute perforated appendicitis at Miami Children’s Hospital
- Less than 96 hours of symptoms, WBC >12,000, diagnostic imaging findings
- Exclusions: symptoms > 96 hours, palpable mass on exam, or well formed abscess seen on imaging
  - Zosyn, PICC, minimum 7 day course
  - Discontinuation of abx: afebrile > 48, normal WBC, absence of tenderness (fever > 100)
- 18 month study, 751 patients
STUDY DISCUSSION

- More likely to be ruptured: younger age, pain longer than 3 days, generalized tenderness, fever over 38 degrees celsius.
- Lower complication rates, fewer abscesses, trend toward shorter LOS
- Treatment failure predictors: WBC>15,000, especially when accompanied by fecalith, symptoms >48 hours
- Other studies: prolonged fever, higher band count, imaging findings of disease spread beyond RLQ

OUR TREATMENT PROTOCOL
PERFORATED APPENDICITIS

- Ceftriaxone, flagyl once daily IV dose
- Discharge criteria: home once afebrile (<38) for 48 consecutive hours, eating, pain controlled, ambulating, no diarrhea, normalized white blood cell count

NONVISUALIZED APPENDIX

- This can present a diagnostic challenge. If you are clinically suspicious of appendicitis, refer.
- Ensure close follow up if imaging/labs reassuring – can be done with PCP
RED FLAGS

- When evaluating children with vague abdominal pain, differential is broad, few things to consider:
  - Weight loss
  - Severe vomiting
  - Chronic severe diarrhea
  - GI bleeding
  - Hematemesis
  - Family history of inflammatory bowel disease
  - Appropriate referral may be to start with pediatric GI

QUESTIONS

CASE STUDY #3

- 8 week old female
- Nonbilious vomiting after every feed for 2 weeks, increased fussiness
- Passing flatus, no bowel movement x 2 days
- Decreased urine output
PHYSICAL EXAM

LABS

- NA 135
- K 3.7
- Cl 91* (low)
- CO2 34* (high)
- BUN 13
- CREATININE 0.24*
- GLUCOSE 105*
- CALCIUM 10.8
US FINDINGS

- Size criteria – based on age, 4 mm x 14 mm (width x length)
- GI tract content not moving through pylorus
- UGI can suggest pyloric stenosis, but gold standard test is ultrasound with size criteria

DIFFERENTIAL

- Bilious vomiting – must be evaluated for malrotation immediately
- Reflux
- Classic lab findings: metabolic alkalosis

PYLORIC STENOSIS

- Thickened and elongated pylorus that acts like an obstruction
- Pylorus is smooth muscle at end of stomach
- Firstborn, more common in males
MANAGEMENT

- OR for pyloromyotomy
- Preoperative considerations: fluid resuscitation, electrolyte correction will happen with fluid resuscitation, NPO
- Study based fluid needs and LOS on chloride level at diagnosis. For chloride <97: 2 x 20m/kg NS bolus, recheck labs to expedite care, decrease cost
- Early diagnosis= less electrolyte derangement and shorter LOS

QUESTIONS

CASE STUDY #4

- 9 mos old male with abdominal pain, emesis and bloody stool
- One week prior had been to ER for poor feeding and emesis
- No PMH/PSH
LABS

- WBC 7
- HCT 31.5
- Plt 449
- Na 138
- K 4.2
- Cl 99
- CO2 22
- BUN .2
- Creat 0.2
- Glucose 90

ULTRASOUND

INTUSSUSCEPTION
DECISION MAKING

- Differential
- ileocolic vs small bowel-small bowel intussusception
- Other historical information
- Other diagnostics
- Concern for intussusception: notification of pediatric surgery team, radiologic reduction can happen elsewhere, be prepared to transfer, require IV access at our institution. Risk of perforation during exam.
- Small bowel-small bowel often resolves, does not require urgent referral
DIFFERENTIAL

- Classic presentation: age range 6 months-6 years, preceded by viral illness symptoms, crampy abdominal pain – ileocolic
- Small bowel to small bowel can happen intermittently and usually does not require surgery
- Older children, consider pathologic mass as a lead point – lymphoma

MANAGEMENT

- Fluid resuscitation
- Enema reduction – if successful, observation for recurrence
  - 74-79% success rate
- If unsuccessful, delayed repeat enema vs operative reduction
- Retrospective review over 5 year period: of the unsuccessful enema reduction group, ¾ went to surgery, ¼ had delayed repeat enema. 64% of delayed repeat enema did not need surgery.
- Bowel resection occurred more often with immediate surgery group

QUESTIONS
CASE STUDY #5

- 6 week old male
- Term, passed meconium at hour #29, after rectal stimulation
- Required suppositories and rectal stimulation for ongoing constipation
- Poor weight gain, emesis

CASE STUDY #5

- Mild distention on exam, slightly fussy, nontender
- Electrolytes unremarkable
- X-ray- first line of diagnostic evaluation after history and physical.
DIFFERENTIAL

- Distal bowel obstruction
- Rectal exam – patent anus?
- Rush of air and stool on exam...

DECISION MAKING

- Infants should pass first meconium in first 24 hours of life
- Stooling patterns in infancy can vary widely
- Refer to pediatric surgery, we often will order contrast enema
- Keep child stooling until they can be seen – glycerin suppositories

CASE STUDY #5

- Suction rectal biopsy
- Path: Suction rectal biopsy:
  - Ganglion cells (presence/absence): ABSENT; No ganglion cells present.
  - Nerve Trunk Hypertrophy (presence/absence): PRESENT
  - Calretinin Stain Result: NEGATIVE
HIRSCHSPRUNGS

- Aganglionic intestine can only contract
- Peristalsis requires contraction and relaxation to have bowel movement

MANAGEMENT

- Rectal irrigations with warm saline, 20 ml/kg with soft red rubber tube
- Parents can be taught to do at home
- Surgical intervention – colostomy – 2 stage procedure
- Pull through as 1 stage to remove aganglionic bowel

LONG TERM CONSIDERATIONS

- Enterocolitis
- Bowel management
QUESTION 1: WHAT IS THE DEFINITION OF FUNCTIONAL CONSTIPATION?

- Rome III diagnostic criteria
- In the absence of pathology, 2 or more of the following for child <4 years of developmental age for at least 1 month
  - less than or = 2 defecations a week
  - 1 episode of incontinence per week
  - History of excessive stool retention
  - History of painful or hard BM
  - Presence of large fecal mass in rectum
  - History of large diameter stools
  - Accompanying symptoms may include irritability, decreased appetite, and/or early satiety, which may disappear immediately following passage of a large stool
**ROME III DIAGNOSTIC CRITERIA FOR FUNCTIONAL CONSTIPATION**

- For children with developmental age > 4 with insufficient criteria for IBS, have to have criteria fulfilled at least once per week for at least 2 months before diagnosis:
  - less than or = 2 defecations a week
  - 1 episode of incontinence per week
  - History of retentive posturing or excessive volitional stool retention
  - History of painful or hard BM
  - Presence of large fecal mass in the rectum
  - History of large diameter stool

**ALARM SIGNS AND SYMPTOMS**

- Constipation starting early < 1 month of age
- Delayed passage of meconium > 48 hours of life
- Family history of Hirschsprung disease
- Failure to thrive
- Bilious vomiting
- Severe abdominal distention
- Abnormal position of anus/perianal fistula
- Decreased lower extremity strength/tone/reflex
- REFERRAL

**HISTORY**

- Key to guide your evaluation
- Onset, precipitating factors, passage of meconium
- Family history
- Psychosocial history
- Growth curve
- Toilet training history
PHYSICAL EXAM

- General health
- Abdominal exam
- Perianal exam
- DRE – if you suspect HD, not needed if you suspect functional constipation
- X-ray: not needed to diagnose functional constipation

MEDICATIONS

<table>
<thead>
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<th>Medication</th>
<th>Dosage</th>
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<tbody>
<tr>
<td>Osmotic laxatives:</td>
<td></td>
</tr>
<tr>
<td>Lactulose</td>
<td>0.2-2 g/kg once or twice daily</td>
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<tr>
<td>PEG 3350</td>
<td>Maintenance 0.2-0.8 g/kg/day</td>
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<tr>
<td>MOM</td>
<td>Age dependent: 0.4-4.8 g/kg/day</td>
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<tr>
<td>Stimulant laxative</td>
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<tr>
<td>Bisacodyl</td>
<td>5-50 mg/day</td>
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<tr>
<td>Senna</td>
<td>2.5-20 mg/day</td>
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<tr>
<td>Rectal laxative</td>
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<tr>
<td>Bisacodyl</td>
<td>5-50 mg/day</td>
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<tr>
<td>NaCl</td>
<td>6 mg/kg once or twice daily</td>
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<tr>
<td>Mineral oil</td>
<td>30-150 ml once daily</td>
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</tbody>
</table>
QUESTIONS

PEDIATRIC SURGERY RESOURCES

- OHSU and Legacy
  - 503.494.4799
  - 503.413.4300

- APSNA – American Pediatric Surgical Nurses Association, Inc.
  - Apsna.org – access to patient education handouts in English and Spanish
  - Email: mckeej@ohsu.edu

REFERENCES

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