Pediatric Grand Rounds

Vomiting in the Newborn

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August 7th, 2017
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Vomiting in the Newborn

Workup and Evaluation of Bilious Emesis
2 day old with bilious emesis

• A healthy 2 day old infant presents with a 12 hour history of bilious vomiting, lethargy and decreased urine output. His last bowel movement was blood tinged.

• The parents called the pediatrician who immediately told them to go to the pediatric ER.
2 day old with bilious emesis

PE: Temp 98
HR 170, BP 70/42, RR 38, Sat 99% RA
General appearance listless
Good breath sounds bilaterally
Abdomen: soft, non-tender, and non-distended.

• What is your differential diagnosis?

• How would you work up this patient?
Newborn intestinal obstruction

- Often presents with bilious emesis
- **May or may not present with abdominal distension**

**MALROTATION WITH MIDGUT VOLVULUS IS A SURGICAL EMERGENCY**

- Key is to differentiate proximal from distal obstructions
First test: AXR

- "Lots of loops" = DISTAL OBSTRUCTION
  
  DDx: Hirschsprung’s disease, jejuno-ileal atresia, meconium ileus, meconium plug, imperforate anus, MALROTATION

- "Not a lot of loops" = PROXIMAL OBSTRUCTION
  
  DD: MALROTATION, duodenal atresia/ stenosis, proximal jejunal atresia, pyloric atresia
Proximal Obstructions

• Malrotation with midgut volvulus until proven otherwise.

• NPO, IVF, NGT

• UGI series with water soluble contrast can be given through NGT
Proximal Obstructions

- Corkscrew duodenum, bird’s beak = midgut volvulus

- Normal UGI looking for a duodenum to cross midline right to left and anterior reflection on lateral films with the Ligament of Treitz located to the left of midline at the level of the gastric antrum
Pearls: Malrotation

**ABSOLUTE SURGICAL EMERGENCY**

- Birds beak on UGI= **midgut volvulus**
- Detorse counterclockwise- “turn back the hands of time”
- Ladds procedure- appendectomy
Malrotation

- Structural anomaly of the GI tract resulting from improper sequence of events in embryologic development of the GI tract

- Predispose the bowel to twist around its mesentery resulting in the potential for a midgut volvulus
Normal Bowel Embryology

4th and 8th week of gestation

- Duodenal intestinal loop comes out into the yolk sac
- It twists 90 degrees counterclockwise
8-10th week of gestation

• The primary loop of intestine returns to the abdomen with an additional 180 degrees of counterclockwise rotation

• Cecal loop rotates 180 degrees

• Total of 270 degrees
Normal Bowel Embryology

- The proximal portion of the bowel is fixed to the retroperitoneum early in gestation at the ligament of Treitz whereas fixation of the colon is gradual completed closer to term

- Ileocecval valve in right lower quadrant
- Ligament of Treitz in the left upper quadrant.
Normal Bowel Embryology

- Prearterial
- Postarterial
- Superior mesenteric artery
- Ligament of Treitz
- Cecum

180°

90°
Malrotation

• Occurs in 1:500 live births

• Traditionally considered primarily a disease of infancy

• Prevalence of malrotation in children over 1 year of age and adults is higher than traditionally thought often is a form of incomplete form of malrotation (21% and 48% respectively of 170 patients of all ages in one study)
Malrotation

• No race predilection

• Male:female is 3:2

• Associated anomalies are found in up to 60% of patients:
  – Duodenal atresia
  – Duodenal webs
  – Jejunal atresia
  – Mesenteric cysts
  – CDH (100%)
  – Omphaloceles
  – Gastrochisis
  – Prune Belly
  – VACTERL
  – Meckel’s diverticulum
  – Biliary Atresia
Malrotation Pathophysiology

• Impaired rotational process as it returns from outside the abdominal cavity to the abdominal cavity

• Results in non-rotation, partial rotation, or combination
Malrotation Pathophysiology

- Abnormal fixation of the cecum to the right abdomen, obstruction of duodenum by bands of peritoneum called Ladd’s bands to the right abdominal wall
Malrotation Pathophysiology

- Ladd’s bands cross the duodenum and can cause extrinsic compression and obstruction of the duodenum.
Malrotation Pathophysiology

- Narrow and long base of mesentery which predisposes bowel to twist

- Volvulus when it does occur is around the superior mesenteric artery axis (ischemia from duodenum to the splenic flexure)
Malrotation

Volvulus
Malrotation

- 60% volvulus cases occur in the first month of life

- 75% by 1 year of age

- Volvulus occurs in 70% of neonatal malrotation cases

- Morbidity: short-gut, TPN, SBO, recurrent volvulus

- Mortality: 3-9%
Malrotation

Symptoms:

• Sudden onset of bilious emesis in a previously healthy, growing infant

• Crampy abdominal pain

• Melena
Malrotation

Sudden onset of bilious emesis in a previously healthy, growing infant
Malrotation

Symptoms:

On Exam:

• Proximal bowel obstruction can result in a scaphoid abdomen as the distal colon empties
• Complete obstruction rapidly progresses to ischemia and a firm, distended abdomen, peritonitis
• Metabolic acidosis
Malrotation

Radiologic Diagnosis:

• AXR
  – Abnormal placement of duodenum by NGT
  – Double bubble in this situation is due to obstruction of duodenum

• Of note can also be completely normal
Malrotation

Volvulus:
Believe it or Not . . .
Malrotation

Radiologic Diagnosis:

• **Gold standard is an upper GI study with water soluble contrast**

• Looking for duodenum to the cross the midline and normal anterior reflection

• Ultrasound can be used but is not a Substitution for an UGI (on u/s looking for the orientation of the SMA/SMV & Whirlpool sign)
Malrotation
Malrotation

Volvulus:

- Misplaced duodenum with corkscrew appearance
- Duodenal obstruction
Volvulus
Malrotation

Radiologic Diagnosis:
Malrotation

Barium Enema
• Often used as an adjunct study when looking to see where the cecum lies

CT scan
• Normally incidentally found or a malrotation variant
Management for Malrotation

• Volvulus is a surgical emergency, delay in untwisting bowel can lead to ischemic necrosis

Ladd Procedure:
• Divide Ladd (peritoneal) bands which obstruct duodenum, separate the duodenum and jejunum to the right side of the abdomen and colon to the left (why we do an appendectomy as it’s no long in it’s expected place)
Ladd’s Procedure
Management for Malrotation

• Minimize future volvulus by widening the mesentery
Volvulus

- Malrotation most common condition resulting in midgut volvulus
- Can have volvulus with normal rotation
  - Omphalomesenteric remnant
  - Internal hernia
  - Duplication
  - Adhesive small bowel obstruction
Postoperative Complications & Management

• Bowel function quickly recovers in 1-5 days varying if there was volvulus and bowel involvement
• Short bowel syndrome, TPN dependence
• SBO – 4%
• Recurrent Volvulus - <1 %
What is this?
Normal?
Normal?
Laparoscopic Ladd’s Procedure

• Often done in older children or adults

• First was done in 1995

• Only preformed in the absence of bowel ischemia and volvulus though been reported to be safe and effective

• Patients with asymptomatic malrotation or incidentally found malrotation

• May have a higher rate of recurrence due to less adhesions
Surgical Management of Incidental and Atypical Malrotation Variants

• Surgery is controversial

• Cannot tell width of mesentery and risk of volvulus on imaging

• Volvulus is rare and persistent symptoms after a Ladd procedure were more common in the variant group

• Patients with malrotation variants were less likely to have volvulus or internal hernias though higher rates of post-operative complications

• Most recommend laparoscopy for assessment of width of mesentery in asymptomatic malrotation patients regardless of the age and presenting symptoms
Prospective audit of all neonates admitted to a regional pediatric hospital over 2 yrs in Leeds, England

Only infants with bilious vomiting not OGT/NGT aspirates

63 patients included with median gestational age of 40 weeks (31-42 wks)

Mean age at presentation 26 hrs

38% (24/63) had a surgical cause (Hirschsprung’s n=9), small bowel atresia n=5, intestinal malrotation n=4, colonic atresia n=1, meconium ileus n=3, meconium plug n=1, milk inspissation n=1

All 24 infants were well at a median age of 14 months

Bilious emesis should be evaluated for intestinal obstruction until proven otherwise

62% of cases were not from intestinal obstruction

- 6 year retrospective audit
- 61 infants
- 34.4% had surgical pathology
- 65.6% of patient did not have a surgical cause
Drewett M1, Johal N1, Keys C1, J Hall N1,2, Burge D3
The burden of excluding malrotation in term neonates with bile stained vomiting.

- Retrospective review
- Term neonates (>37 weeks, <28 days)
- 166 infants
- 9% (14) had malrotation confirmed by UGI and laparotomy
- Increased awareness can result in increased referrals

** Bilious emesis should be evaluated in the clinical context of the infant or children’s presenting story and symptoms unless other causes for symptoms have been confirmed.
Final Review of Vomiting Differential Diagnosis

Age Based:

• **Premature infants** (NEC, Incarcerated Hernia, Malrotation, GERD)

• **Neonate** (Malrotation, Incarcerated Hernia, GERD, Pyloric Stenosis (nonbilious), Milk Protein Allergy)

• **Older infants** (Intussusception, Foreign Body Ingestion, Trauma, Poisoning, Incarcerated Hernia, Malrotation)

• **Older Children** (Trauma, Foreign Body, Poisoning, Appendicitis, PUD, Constipation, Gastroenteritis, UTI, PID, Ectopic Pregnancy, Malrotation)
Signs of intestinal perforation with peritonitis such as abdominal distension with a rigid, painful abdomen; hematemesis; hematochezia; and/or shock?

No

Other clinical findings suggesting malrotation?:
- Infants (<1 year of age): Bilius or nonbilius emesis, abdominal distension, or acute duodenal obstruction
- Older patients: Acute presentation as above (less common) or chronic, intermittent abdominal pain with vomiting (bilius or nonbilius)

No

Evaluate for other etiology of abdominal complaints*

Yes

Perform two view plain radiograph of the abdomen

Perforation present?

No

Limited upper gastrointestinal series with oral contrast

Definitive findings of malrotation?
- Misplaced duodenum
- Corkscrew duodenum
- Duodenal obstruction with beaking suggesting volvulus
- Duodenal obstruction with distal air

No

Consultation with a pediatric radiologist and pediatric surgeon to determine if additional imaging or diagnostic laparoscopy is needed

Yes

Intestinal malrotation

Emergency consultation with a pediatric surgeon
Bibliography/Literature/Resources:

- **Drewett M1, Johal N1, Keys C1, J Hall N1,2, Burge D3**
  The burden of excluding malrotation in term neonates with bile stained vomiting.
- https://www.hawaii.edu/medicine/pediatrics/pemxray/v2c08.html July 2, 2017
Questions