Critically Ill Children in Pediatric Surgery

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Disclosure Information
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No disclosures to report.

Objectives

• Describe surgical conditions that place patients at risk of becoming critically ill

• Identify patient populations at greatest risk of becoming critically ill

• Discuss the management of these critically ill patients, Review radiologic findings associated with these disease processes
The Pediatric Surgery Patient

- Age Spectrum: Premature infant to adolescent
- Diagnoses specific to age
- Bowel obstructions
- Congenital abnormalities must always be considered when encountering a newborn or young infant with unexplained GI symptoms

Neonatal Bowel Obstruction

1. Pyloric Stenosis
2. Malrotation with Midgut Volvulus
3. Intestinal Atresias
4. Necrotizing Enterocolitis
5. Meconium Disease
6. Hirschsprung’s Disease
7. Anorectal Malformations
1. Appendicitis
2. Intussusception
3. Incarcerated Hernia
4. Meckel's Diverticulum
5. Malrotation with Midgut Volvulus
6. Tumors

The Vomiting Infant

Hypertrophic Pyloric Stenosis
Incidence

• One of the most common surgical conditions of the infant
• Occurs 1-4:1000 live births
• 4:1 Male to Female ratio
• Risk factors: Family history, race, younger maternal age, 1st born infant, maternal feeding patternsª
• Etiology- Unknown

Presentation

• Functional gastric outlet obstruction²
• Full-term infant between the ages of 2-8 weeks
• Classic Presentation- Nonbilious vomiting which increases in amount and force as obstruction increases → projectile, hunger despite emesis
• Physical exam- well appearing

Late Presentation

• Persistent vomiting with late diagnosis results in:
  – Cachectic appearing infant with weight loss³
  – Large losses of gastric secretions causing metabolic disturbances
  – Gastritis with hematemesis
  – Palpable pyloric mass “Olive”
  – Peristaltic waves
• Lower incidence secondary to prompter diagnosis before protracted vomitingª
Differential Diagnosis

- **Gastroesophageal Reflux**
- **Milk Intolerance**
- Viral Gastroenteritis
- Malrotation with Midgut Volvulus
- Incarcerated Hernias
- Increased Intracranial Pressure
- Metabolic Disorders

Diagnosis

- Gold Standard- Ultrasound
- Diagnostic criteria:
  - Muscle thickness: ≥ 3 mm
  - Total thickness: 14 mm
  - Length of Canal: ≥ 16 mm

Diagnosis: Ultrasound
Diagnosis: KUB

Diagnosis: UGI

Pre-op Considerations

- *Not an operative emergency*
- Mainstay of therapy is resuscitation followed by surgical management
- NPO
- +/- Gastric decompression
Metabolic Disturbances

- Metabolic Disturbances:
  - Hypochloremia <100 mmol/L
  - Hypokalemia <4.5 mmol/L
- Metabolic Alkalosis
  - pH > 7.45
  - HCO₃⁻ > 30
  - BE > +3
- Jaundice
  - If sustained may turn to acidosis

Initial Resuscitation

- Usually achieved within 24 hours of presentation
- Basic metabolic panel followed by resuscitation to correct abnormalities
- Initially 10 to 20 ml/kg NSB
- IVF 1/4 - 2x Maintenance rate, IVF with KCL
- Basic Metabolic panel Q6h until normalized

Respiratory Depression

- Alkalosis-induced central respiratory depression
- △ HCO₃⁻
- Respiratory pauses & Apnea-like events
  - Tactile Stimulation
  - Supplemental Oxygen
  - Intubation
Surgical Treatment

- 1st surgical treatment by Lobker in 1898 - Unsuccessful
- Pyloromyotomy technique first introduced by Ramstedt in 1911
- Extramucosal longitudinal myotomy of the pylorus
- Open v Laparoscopic

Open Pyloromyotomy

- RUQ transverse incision/Supra-umbilical incision
- Pylorus is exteriorized through incision
- Longitudinal serosal incision in the pylorus
- Blunt dissection to divide the firm pyloric fibers
- Completed when all fibers have been divided the entire length of the incision

Laparoscopic Pyloromyotomy

- 1st laparoscopic pyloromyotomy in 1991
- Minimally invasive approach
- Typically 3 port sites
- Accomplish same results as open approach
- Studies have shown no difference in complications
Post-Op Considerations

- Remain NPO for approximately 6 hours post-op
- Post-pyloromyotomy feeding regimens
- Recent studies support ad lib feeds
- Metabolic derangement pre-op affect post-op feeding tolerance
- Acetaminophen for pain
- Outcomes

Malrotation/Midgut Volvulus

Incidence

- Occurs 1:6000 live births
- 1% of the total population
- 2:1 Male to Female ratio
- Intestinal rotation and fixation is an orderly sequence of embryologic events in early fetal development
- Disruption of these steps leads to rotational anomalies
Normal Rotation & Fixation

Nonrotation

Midgut Volvulus: Presentation

- Incidence of volvulus:
  - Presents during the first week in 50%, in the first month in 75%, in the first year in 15%, small amount later in life
- Cardinal sign is bilious emesis
- B/C of devastating outcomes, volvulus is presumed diagnosis until proven otherwise
- Surgical Emergency!!
Presentation

• Symptoms vary with progression of volvulus
  – Acute onset bilious emesis
  – Scaphoid abdomen ➔ increasing abdominal distention
  – Abdominal tenderness
• Late signs:
  – Abdominal wall erythema
  – Hematemesis
  – Melena

• Laboratory findings:
  – Leukocytosis v Leukopenia
  – Hyperkalemia
  – Thrombocytosis
  – Metabolic Acidosis
• Mesenteric vascular compromise ➔ peritonitis ➔ sepsis ➔ shock ➔ death

Diagnosis: UGI

• Upper GI (UGI):
  – Gold Standard
  – Evaluate position of the duodenojejunal junction
  
  Normal ➔

• Abnormal Findings:
  – Duodenojejunal junction to the right of the spine
  – Obstruction of the duodenum
  – “Coil Spring”, “Corkscrew”, or “Beak” appearance of the obstructed proximal jejunum
Diagnosis: KUB

- Plain Abdominal Radiograph (2 View):
  - Nonspecific
  - “Double Bubble” Sign
  - Gasless abdomen
  - OR ENTIRELY NORMAL

Diagnosis: Ultrasound “UGI”

- Ultrasound Vessel orientation
  SMV anterior R of SMA
  Malrotation: SMV L of SMA

- Ultrasound Vessel orientation
  SMV anterior R of SMA
  Malrotation: SMV L of SMA
  “Swirl” or “Whirlpool” Sign
Pre-Op Considerations

- Early diagnosis is imperative
- Aggressive resuscitation with electrolyte correction
- NGT decompression
- IV broad-spectrum antibiotics (Gram +, Gram -, and Anaerobic Flora)
- IMMEDIATE SURGICAL INTERVENTION

Ladd’s Procedure

- 6 Key Elements in Operative Correction of Malrotation:
  1. Entry into abdominal cavity and evisceration
  2. Counterclockwise detorsion of bowel
  3. Division of Ladd’s cecal bands
  4. Broadening small bowel mesentery
  5. Incidental appendectomy
  6. Placement of small bowel along the right lateral gutter and large colon along the left lateral gutter
Intra-Op Considerations

• Necrotic or ischemic bowel may involve isolated segments or entire midgut
• Limited resection and second-look operation in 24-48 hours
• Abdominal compartment syndrome may necessitate temporary closure (silo, patch)
**Entire Midgut Loss**

- Occasionally complete infarction of the midgut, resulting in entire midgut loss
- Ethical issues remain controversial
- Abdominal closure and comfort care
- Long-term TPN & eventual intestinal and multivisceral transplantation

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**Post-Op Considerations**

- Continued resuscitation to correct hypovolemia, metabolic acidosis
- NGT decompression until return of bowel function
- +/- Antibiotics
- Respiratory support
- Pain management

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**Special Populations:**

**Adhesive Bowel Obstruction in Infants, Children & Adolescents**

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Adhesive Bowel Obstructions

- Most common cause of bowel obstruction
- Occurs in 1-6% of children
- Rate depends on initial type of operation
- Conservative vs Operative management still controversial in this age group

Special Populations:
Patients with Intellectual Disabilities

- Challenges include:
  - Can have extensive PMHx & PSHx- Multiple abdominal surgeries
  - Nonverbal patients- difficult to ascertain history
  - Sometimes difficult physical exam secondary to body habitus, scoliosis
  - Pain is difficult to assess
  - Often present late in course of illness
  - Radiographic imaging difficult to interpret

Intellectual Disability
Collaborative Care

- ICU Collaboration
- Multidisciplinary Team Care
- Complex, Multisystem dysfunction

References


