Pediatric

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Neonatal Bowel Obstruction

Concept

Bilious vomiting is!) always a surgical emergency in the newborn. Multiple possible etiologies exist, including annular pancreas, duodenal web, malrotation, jejunoileal atresia, meconium ileus, Hirschsprung's disease, infection/necrotizing enterocolitis, and metabolic abnormalities (K+, Mg++).

Always look for associated anomalies such as cystic fibrosis (meconium ileus) and trisomy 21 (duodenal atresia, malrotation).

Way Question May Be Asked?

"You are called to the neonatal intensive care unit (NICU) to evaluate a baby that has had bilious vomiting since birth. What do you want to do?"

Always look for congenital anomalies, Down's stigmata, and remember that this is a surgical emergency.

How to Answer?

History
- Maternal polyhydramnios
- Onset of bilious emesis (with every feeding)
- Delayed meconium passage
- Prematurity
- Family history

Physical Examination
- Evidence of dehydration (sunken fontanelle, skin turgor)
- Abdominal distension or scaphoid abdomen
- Any congenital anomalies (imperforate)

Diagnostic Tests
- "Babygram"—look for pattern of the gas
- "Double bubble"—duodenal atresia or malrotation with volvulus
- Dilated small bowel loops—jejunoileal atresia
- Upper gastrointestinal (UGI) series if you suspect proximal obstruction or malrotation
- Barium enema (BE) if you suspect distal obstruction

Surgical Treatment

1. Administer nothing by mouth, intravenous fluids (IVF), nasogastric tube (NGT) and correct electrolytes.
2. Determine if obstruction is proximal or distal.
3. Go to the operating room (OR) if there is any evidence of peritonitis.
4. For duodenal atresia, proceed to the OR once patient is resuscitated.
   (a) Perform duodenojejunostomy through a transverse right upper quadrant (RUQ) incision.
   (b) Obstruction is usually immediately post-ampullary.
   (c) Insert a gastrostomy tube (G-tube).
5. Malrotation (often associated with diaphragmatic hernia, abdominal wall defects, and jejunoileal atresia)
   (a) Perform counterclockwise detorsion if volvulus is present.
   (b) Take a second look if there is questionable viability.
   (c) Perform Ladd's procedure:
      - Divide the peritoneal bands crossing the duodenum (extending from the ligament of Trietz).
      - Position the duodenum and jejunum to the right of midline.
      - Position the colon to the left of midline.
      - Perform an incidental appendectomy.

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(d) Treat other anomalies if present.
(e) Cecopexy/duodenopexy is not necessary.

6. Jejunoileal atresia (the more distal the obstruction, the more abdominal distension the child will have)
   (a) Administer a BE to document normal colon.
   (b) Resect the atretic portion.
   (c) Inject saline to make sure there is no distal obstruction (web/atresia).
   (d) Perform end-to-end anastomosis.
7. Duodenal web
   (a) Perform a longitudinal duodenotomy.
   (b) Perform a partial membrane excision.
8. Meconium ileus—failure to pass meconium in <24 h with bilious emesis, abdominal distension, and perforated anus (produces obstruction from inspissated meconium secondary to pancreatic exocrine insufficiency)
   (a) Evaluate for cystic fibrosis.
   (b) Look for ground glass appearance on abdominal x-ray instead of air fluid (A/F) levels.
   (c) Administer gastrograffin enema, pancreatic enzymes by NGT, and acetylcysteine (Mucomyst) for an uncomplicated presentation.
   (d) For a complicated meconium ileus, proceed to the OR:
   Resect the nonviable bowel.
   Repair perforations.
   Drain any abscesses.
   Perform enterotomy plus an injection of acetylcysteine.

Common Curveballs

The "double bubble" seen on x-ray is malrotation and not duodenal obstruction
Scenario switches from proximal to distal obstruction
Patient has multiple atretic areas in jejunum/ileum
Patient has the appearance of total small bowel infarction
Patient has associated anomalies (only cardiac anomalies affect your decision to operate)

Clean Kills

Not identifying malrotation
Not knowing Ladd's bands or details of Ladd's procedure
Not knowing what "double bubble" means on "babygram"
Not looking for associated anomalies
Not treating bilious vomiting as a surgical emergency

Pyloric Stenosis

Concept

Pyloric stenosis is thickening of the muscle of the pylorus resulting in functional outlet obstruction. It is the most common surgical cause of emesis in infants. Etiology is unknown, but it is more common in first-born males.

Way Question May Be Asked?

"You are called to the ED to evaluate a 9-week-old infant with a history of intermittent nonbilious emesis that is now projectile vomiting. What do you want to do?" You may be given an infant with clear signs of dehydration or it may be an older child (up to 2 years old). The key is whether or not the vomiting was bilious.

How to Answer?

History
- Sex (male > female)
- Age (2–8 weeks)
- FHx Family history of pyloric stenosis
- Bilious vs. nonbilious vomiting
- Vomiting of undigested formula shortly after feeding
- Intermittent emesis progressing to projectile
- Infant is hungry between episodes of vomiting

Physical Examination
- Sunken fontanelle
- Dry mucous membranes
- Decreased skin turgor

Abdominal Examination
- Thickened pylorus or "olive" in epigastrum (need infant to be quiet and stomach empty)
- Observation of gastric peristaltic waves

Diagnostic Tests
- Full laboratory panels, especially K+ (hypokalemic, hypochloremic metabolic alkalosis)
- Ultrasound (elongated pyloric channel, thickened pyloric diameter, increased pyloric wall thickness)
- Barium UGI (elongated narrow pyloric channel—"string sign", gastric outlet obstruction)

Surgical Treatment

1. Correct electrolyte abnormalities (this is an elective surgical procedure!)
2. D51/2NS + 20 KCl
3. Pyloromyotomy (Ramstedt technique):
   Perform under general anesthesia.
   Place an NGT (especially if UGI) to avoid aspiration.
   Make a transverse epigastric or RUQ incision.
   Grasp the pylorus between two fingers.
   Make an incision with the scalpel into the serosa/muscle.
   Use the back of the scalpel handle to blunt complete pyloromyotomy.
   You should see a bulging mucosa.
   Be careful not to perforate the underlying mucosa. If it perforates, close and cover with an omental patch. Alternatively, close the myotomy, rotate the pylorus 45 degrees, and perform the pyloromyotomy again.
   Check for leak by putting a small amount of air through the NGT.
4. You can start feeding 6–12 h postoperatively with dilute milk and advance as tolerated.
5. Small episodes of emesis are not uncommon in the immediate postoperative period (can be due to gastrointestinal reflux disease, discordant peristalsis, or gastric atony). Pursue with a UGI series to check for an incomplete pyloromyotomy if it extends past postoperative day 2.

Common Curveballs

Patient has low potassium (how will you manage?)
Examiner asks when you will start feeding the child
Patient has mucosal perforation during your pyloromyotomy (now what?)
Patient has malrotation, antral web, or duodenal stenosis (scenario switch)
Pyloromyotomy is incomplete
Examiner asks you to describe paradoxic aciduria (Vomiting leads to loss of fluid with high K+, H+, and Cl^- concentrations. Volume deficit leads to aldosterone-mediated Na^+ resorption with loss of K+. The body tries to hold onto K+, leading to excretion of H^+ ions that leads to paradoxicaciduria, It is treated by replacing volume before administering K+!)
Examiner asks how to calculate the volume of fluid to be administered to the infant, given a weight in kilograms (4 cc/kg/h for the first 10 kg, 2 cc/kh/h for the second 10 kg, and 1 cc/kg/h for every kilogram after)

Clean Kills

Mistaking the diagnosis for one of the many etiologies for neonatal bowel obstruction
Not being able to describe how to resuscitate the patient preoperatively
Describing laparoscopic pyloromyotomy
Not being able to explain the hypokalemic, hypochloremic metabolic alkalosis that typically accompanies these patients

Summary

Pyloric stenosis is due to thickening of the muscle, resulting in a functional outlet obstruction that presents as projectile vomiting. It is most commonly seen in first-born males at age 2–8 weeks. On examination, the infant may have a palpable "olive" in the epigatrum. On laboratory studies, the patient will often have hypokalemic, hypochloremic, metabolic alkalosis. The treatment is correction of the electrolyte abnormalities, IVF, and pyloromyotomy.

Pediatric Inguinal Hernia

Concept

Inguinal hernia repair is the most common operation performed by pediatric surgeons. Hernias are most common in the first year of life and are more common in premature infants, in males, and on the right side. These indirect hernias are due to failure of the processus vaginalis to close during development.

Way Question May Be Asked?

"You are asked to evaluate a 3-month-old male during surgical clinic. His young mother is very nervous. The other day while she was bathing him, the infant began crying and she noticed a lump in his right groin. He was born a few weeks premature but is otherwise in good health. What do you want to do?"

The key is getting a very good history from the mother and trying to reproduce the bulge on examination.

How to Answer?

History
- Prematurity
- Sex (more common in males than females)
- Side of lump (more common on right than left)
- Timing (is the lump present all the time or does it stick out when the baby increases abdominal pressure?)

Physical Examination
- Examine for inguinal mass or asymmetry
- Palpate cord for thickness (silk glove sign)

Diagnostic Tests
- Ultrasound if the examination is inconclusive

Surgical Treatment

Perform open inguinal hernia repair with high ligation of the hernia sac with an absorbable suture.

Common Curveballs

Patient has bilateral hernias (always check for this)

Patient has injury to the vas deferens (can be repaired with 8-0 monofilament absorbable suture at the time of injury

Clean Kills

Waiting to repair the hernia (this can lead to incarceration or strangulation)

Not identifying the hernia

Attempting to put mesh in an infant/child or not knowing the proper technique for repair in a child

Confusing a hydrocele for a hernia

Tracheoesophageal fistula

Concept

Tracheoesophageal fistula (TEF) is a common cause of respiratory distress in infants. Several variants exist:

A. Esophageal atresia and distal TEF (most common)

B. Atresia without fistula

C. H-type TEF

D. Atresia with proximal and distal TEF

Approximately 50 % of infants will have other congenital defects (VACTERL—vertebral, anorectal, cardiovascular, TEF, renal, limb) and you need to rule these in/out prior to operation.

Way Question May Be Asked?

"You are called to the NICU to evaluate a newborn who is small for his gestational age. He had an episode of choking and desaturation with his first two feedings. What do you want to do?" You should consider TEF in any newborn with respiratory distress. Key to this condition is that the problems are associated with feeding. Most TEFs should be identified pre-term by ultrasound.

How to Answer?

History
- Earliest clinical sign is excessive salivation
- Maternal polyhydramnios
- Respiratory distress with first feeding (choking, coughing, regurgitation)
- Desaturation with nippling

Physical Examination
- Cannot place NGT
- Small for gestational age
- Scaphoid abdomen (if atresia without TEF)
- Imperforated anus or limb abnormalities
- Cardiac examination

Diagnostic Tests
- "Babygram"(air in the GI tract rules out atresia without TEF; rule out duodenal atresia, vertebral anomalies)
- 0.5 cc barium down NGT (blunt pouch)
- Preoperative echocardiogram to rule out cardiac anomalies (affects anesthesia management)
- Renal ultrasound before or after repair
- Chromosomal analysis

Surgical Treatment

1. Place NGT in pouch (to prevent aspiration pneumonitis).
2. Elevate head of bed (to prevent aspiration pneumonitis).
3. Adminster antibiotics if pneumonia.
4. Administer IVF.
5. Proceed to the OR in the first 24–48 h for repair:
   (a) Use an extrapleural approach through a right thoracotomy.
   (b) Divide the fistula.
   (c) Close the trachea.
   (d) Perform end-to-end esophageal anastomosis.
   (e) Use gastrotomy for early postoperative feeding.
   (f) Leave a drain next to the esophageal anastomosis.
   (g) An alternative is gastrotomy only: Create a spit fistula in the neck and delay repair until the patient is 1 year old (colon interposition is usually performed in cases of atresia without TEF).

Common Curveballs

Patient has postoperative complications:
Leak (13–16 %: if a drain is left, 95 % will close spontaneously; you can also use a pleural or pericardial patch with or without an intercostal muscle flap)
Stricture (up to 80 %: use balloon dilatation; if it fails, patient may require resection and reanastamosis)
Recurrent fistula (3–14 %: due to leak and inflammation and erosion through previous repair site; can also use a flap)
Reflux (30–70 %: treat medically)
You enter the pleura during an extrapleural approach
Patient has associated anomalies (Down syndrome, valvular defect, etc.)
You are not able to perform primary end-to-end anastomosis because of a long "gap"
Patient presents with an H-type fistula (repeated episodes of pneumonia in infancy)
Patient has an associated imperforate anus (scenario switch)

Clean Kills

Not making the diagnosis
Not knowing the most common type/how to repair most common type
Not ruling other associated anomalies preoperatively (especially cardiac!)
Not trying to place NGT (alternatively, continuing to try to advance when meet resistance)
Not placing G-tube at operation

Summary

Tracheoesophageal fistulas come in several variants, the most common being esophageal atresia with a distal TEF. Approximately 50 % of infants with a TEF have other associated congenital defects that must be ruled out prior to surgery. The most common presenting symptoms are excessive salivation and respiratory distress with the first feeding. An NGT is unable to be placed on physical examination. X-ray can help narrow down the type of atresia/TEF. The exact surgical technique depends on the type of fistula, but a G-tube for early feeding should be placed. The overall survival rate is 85–95 %.