Gastrointestinal System
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Objectives

- Identify the functions of the gastrointestinal (GI) tract
- Discuss the key elements of a systematic physical assessment of the GI tract
- Describe the etiology, pathophysiology, and clinical presentation of the most common GI disorders in the neonate
- Discuss the diagnostic evaluation and management of the most common GI disorders in the neonate

Structure and Function
GI System Structure

- Conduit from the oral cavity to the rectum and anus.
- Prone to a variety of congenital anomalies due to unique embryonic features and pattern of development.
- Anomalies may occur at any point from the mouth to the anus.

Functions of GI System

- Absorption and digestion of nutrients
- Elimination of waste products
- Maintenance of fluid and electrolyte balance
- Protection of host from toxins and pathogens

Development of GI System

<table>
<thead>
<tr>
<th>Age</th>
<th>Notable Developmental Event</th>
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<tr>
<td>10 – 14 weeks PMA</td>
<td>Fetus begins to swallow amniotic fluid. By 16 weeks PMA, the fetus swallows approximately 2-6 mL per day.</td>
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<td>24 weeks PMA</td>
<td>Lactase activity is approximately 25% of term level.</td>
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<td>25 – 30 weeks PMA</td>
<td>Gut has disorganized random contractions.</td>
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<td>28 weeks PMA</td>
<td>Esophageal sphincter is present and gut has limited digestion and absorption.</td>
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<td>30 – 32 weeks PMA</td>
<td>GI motility improves and is more organized.</td>
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<td>34 – 36 weeks PMA</td>
<td>Suck-swallow-breathe becomes well coordinated.</td>
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<td>38 – 40 weeks PMA</td>
<td>GI tract is 250 – 300 cm long with a gastric capacity of about 30 mL.</td>
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<td>4 – 6 months after birth</td>
<td>Intestinal mucosal barrier reaches functional maturity.</td>
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**Quiz: Maturation of GI Tract**

At what stage of fetal development does the GI tract begin to develop?

A. 2-4 weeks gestational age  
B. 4-8 weeks gestational age  
C. 6-10 weeks gestational age

Begins developing at 4 weeks; well defined by 8 weeks
History and Prenatal Risk Factors

- Prenatal care (known anomalies, polyhydramnios)
- Family history of GI disease or anomalies
- Cardinal signs of obstructions:
  - Persistent bile-stained emesis
  - Abdominal distention
  - Failure to pass meconium

Physical Assessment

- Inspection of oral cavity and abdomen
- Auscultation of bowel sounds
- Abdominal palpation

Common GI Disorders
Obstructions of the GI Tract: Common Associations and Early Management

- History of polyhydramnios
- Failure to pass meconium in 24 to 48 hours
- Abdominal distension
- Bilious emesis

Management:
- NPO
- Replogle to low suction
- Radiographic studies
- Surgical consultation

Obstructions of the GI Tract: Common Examples

- Pyloric stenosis
- Duodenal atresia
- Malrotation with mid-gut volvulus
- Jejunal atresia
- Hirschsprung’s disease

Stenosis vs Atresia

Stenosis
- The abnormal narrowing of a passage in the body

Atresia
- The absence or abnormal narrowing of an opening or passage in the body
Pyloric stenosis

- Narrowing of the pylorus that prevents food from emptying out of the stomach
- X-ray shows a thickened shoulder of pyloric muscle ("mushroom sign")

Duodenal atresia

- Blockage between one part of the duodenum to another
- X-ray shows air in dilated stomach and duodenum ("double bubble")

Malrotation with mid-gut volvulus

- Condition in which the intestine has become twisted as a result of malrotation of the intestine during fetal development
Jejunal atresia

- Partial or complete absence of the membrane connecting the small intestines to the abdominal wall
- X-ray shows air in dilated stomach, duodenum, and jejunum (“triple bubble”)

Hirschsprung’s disease

- Disorder in which sections of the large intestine lack nerves
- Characterized by swollen belly, vomiting, stringy/leaky stools

What is it?

A. Pyloric atresia
B. Malrotation with mid-gut volvulus
C. Pyloric stenosis
D. Duodenal atresia
What is it?

A. Pyloric atresia
B. Malrotation with mid-gut volvulous
C. Pyloric stenosis ("mushroom sign")
D. Duodenal atresia

Duodenal Atresia

“Double bubble” sign
What is it?

Jejunal Atresia
“Triple Bubble” sign

Quiz: You should suspect Hirschsprung’s Disease in an Infant with:

A. Acholic stools
B. Failure to pass meconium in first 48 hours
C. Projectile vomiting
D. Bilious emesis and thrombocytopenia
Quiz: You should suspect Hirschsprung’s Disease in an Infant with:

A. Acholic stools (pale or clay colored; seen with liver diseases, biliary obstruction)
B. Failure to pass meconium in first 48 hours
C. Projectile vomiting
D. Bilious emesis and thrombocytopenia

Anticipate x-rays, barium enema, and rectal biopsy

Specific Conditions: GER vs GERD

• Gastroesophageal reflux (GER) is defined as the involuntary retrograde passage of gastric contents into the esophagus with or without regurgitation or vomiting
• 70-85% of newborns have some form of reflux for first 2 months of life
• Lower esophageal sphincter relaxation responsible
• Resolves in 90-95% of infants by one year of age

Specific Conditions: GER vs GERD

• Gastroesophageal reflux disease (GERD) pathologic condition causing apnea, feeding and sleeping problems, failure to thrive, etc.
• More serious and long-lasting form of GER and may prevent an infant from feeding.
• Occurs when an infant’s lower esophageal sphincter is not fully developed
• Treatment may involve feeding changes, medicines, or surgery.
Specific Conditions: GER vs GERD

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<td>- Passage of stomach contents into the esophagus, often leading to regurgitation in otherwise healthy infants.</td>
<td>- Weight loss</td>
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<td>- Nausea associated with belching</td>
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<td>- Vomiting associated with irritability</td>
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<td>- Anorexia or feeding refusal</td>
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<td>- Flatulence</td>
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<td>- Arching of the back during feedings</td>
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<td>- Sleep disturbances</td>
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<td>- Respiratory symptoms</td>
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Specific Conditions: GERD

Quiz: You are teaching a mother to care for her baby with GER

What is the most common presentation of gastroesophageal reflux (GER)?
A. Sandifer syndrome
B. Flatulence
C. Emesis
Quiz: You are teaching a mother to care for her baby with GER

What is the most common presentation of gastroesophageal reflux (GER)?
A. Sandifier syndrome (a rare pediatric manifestation of GERD characterized by abnormal and dystonic movements of the head, neck, eyes and trunk)
B. Flatulence
C. Emesis
Emesis is the most common symptom of GER

Specific Conditions:
Spontaneous Intestinal Perforation (SIP)
- Spontaneous
- Occurs early
- Isolated
- Not NEC
- Not related to feedings (except for possibly the lack of feedings)
- May be related to early dexamethasone and possibly indomethacin exposure

Specific Conditions:
Necrotizing Enterocolitis
- A medical condition where there is inflammation and death of intestinal tissue
- The most common and serious gastrointestinal disorder amongst hospitalized preterm infants
- Most commonly seen in the ileocolic region
- Predominantly seen in premature infants between 28-32 weeks
- Exact etiology in unknown
- Gut immaturity, a change in bacterial flora, long-term antibiotic exposure, and formula cow protein increase the risk
NEC: Clinical Presentation

- Abdominal distension (70-98% of cases)
- Residuals and emesis (>70%)
- Heme positive stools
- Lethargy
- Abdominal tenderness
- A’s and B’s
- Hypoperfusion
- Hypotension
- Temperature instability

NEC Prevention

- Only sure way to prevent is to prevent prematurity
- Antenatal corticosteroids
- Feed with mother’s own milk
- Oral care with breast milk
- Use donor milk if mother’s milk unavailable
- Avoid enteral fasting
- Advance feeds by 15-35 ml/kg/day
Quiz: Which has been shown to prevent NEC?

A. Transpyloric feedings
B. Maternal breast milk feedings
C. Formula feedings
D. Donor breast milk feedings

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Quiz: Your patient with necrotizing enterocolitis has gone to the operating room for exploratory laparotomy and resection. You anticipate that the area of bowel that is most likely affected is the:

A. Jejunum, ileum and colon
B. The ileocecal valve
C. The duodenum
D. Descending colon
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The site of transition between the small and large bowel, the ileocecal valve is the most common area of the bowel affected by NEC.

Specific Conditions:
Short Gut Syndrome
- A malabsorption disorder caused by a lack of functional small intestine
- Most cases are due to the surgical removal of a large portion of the small intestine
- Primary symptom is diarrhea
- Can result in dehydration, malnutrition, and weight loss
- Other symptoms may include bloating, heartburn, feeling tired, lactose intolerance, and foul-smelling stool
- Treatment may include a specific diet, medications, or surgery
Quiz:
Short bowel syndrome puts neonates at increased risk for which of the following deficiencies?

A. Vitamins A, D, E, and K deficiencies
B. Vitamin B complex and vitamin K deficiencies
C. Vitamin C, B complex and vitamin D deficiencies

Vitamins A, D, E, and K are fat-soluble vitamins that are absorbed in the ileum.
Abdominal Wall Defects:
Omphalocele vs Gastrochisis

Specific Conditions:
Omphalocele

- Birth defect in which the infant’s intestine or other abdominal organs (e.g. liver, spleen) protrude through a hole in the belly button area and are covered with a membrane.
- Caused by malrotation of the bowels while returning to the abdomen during development.
- Associated with other birth defects (i.e. chromosomal abnormalities, congenital diaphragmatic hernia, and heart & kidney defects)
- Primary surgical repair in small cases; staged repair using sewn mesh in large cases
**Specific Conditions:**

**Omphalocele**

- Birth defect in which the baby's intestines extend outside of the body through a hole next to the umbilicus.
- Size of the defect is variable, and other organs including the stomach and liver may also occur outside the baby's body.
- Complications may include feeding problems, prematurity, intestinal atresia, and intrauterine growth retardation.
- Cause is typically unknown; high incidence with exposure to methamphetamine use.
- Requires surgical treatment to return the exposed intestines to the abdominal cavity and close the hole in the abdomen.
- Silo bag for staged repair to allow abdominal cavity to accommodate intestines over a period of time.

**Specific Conditions:**

**Gastrochisis**

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Specific Conditions:
Gastroschisis

Quiz: Which GI defect has the highest association with other anomalies?

A. Omphalocele
B. Gastroschisis
C. Malrotation
D. Ileal atresia

Quiz: Which GI defect has the highest association with other anomalies?

A. Omphalocele (≥60%)
B. Gastroschisis
C. Malrotation
D. Ileal atresia
Quiz: How do an omphalocele and gastroschisis differ?

A. Omphalocele is the herniation of some or all the abdominal contents into a sac at the umbilicus
B. Gastroschisis is the herniation of all the abdominal contents into a sac at the umbilicus
C. Omphalocele is the herniation of the small bowel into a sac outside the abdomen

Specific Conditions:
Esophageal Atresia
- Disorder of the digestive system in which the esophagus does not develop properly.
- Most often associated with tracheoesophageal fistula (an abnormal connection between the esophagus and the trachea).
- Associated with polyhydramnios, as fetus is unable to swallow amniotic fluid before birth.
- Detected after birth when the baby first tries to feed, or when a feeding tube cannot pass down into the stomach.
- Surgery is needed to reconnect the two ends of the esophagus so that the baby can breathe and feed properly.
Specific Conditions:
Esophageal Atresia

Quiz: Soon after birth, a term newborn infant presents with increased oral secretions and mild respiratory distress. Which of the following is the most likely problem?

A. Persistent pulmonary hypertension of the newborn
B. Pneumonia
C. Esophageal atresia

Anticipate NPO, reposition to LCS, and x-ray to confirm.
Quiz:
What type of TEF/EA is the most common?

A. EA without TEF
B. EA with distal TEF
C. EA with proximal TEF
D. TEF without EA

Quiz:
What type of TEF/EA is the most common?

A. EA without TEF (8%)
B. EA with distal TEF (87%)
C. EA with proximal TEF (1%)
D. TEF without EA (4%)

References
