Emergency in Pediatric Surgery and Resuscitation

Pediatric Surgical Emergencies

- Gastroschisis
- Acute Abdomen
- Hypertrophic Pyloric Stenosis
- Duodenal atresia
- Inguinal Hernia with Strangulation
- Testicular Torsion
- Congenital diaphragmatic hernia (CDH)
- Esophageal Atresia ± Tracheoesophageal Fistula
- Foreign Body Aspiration

Gastroschisis:

- Small defect below and to the right of the umbilical scar separated from the umbilical scar by a skin, through which loops of intestine herniates, the herniated structures is a very thick edematous intestine and stomach.
- **Not covered** by a membrane.
- If not treated the children will die because of the contamination, loss of heat (hypothermia), loss of fluids and electrolytes imbalance, also if not treated the herniated structures will become gangrenous and black because of obstruction of the blood flow.

- How to differentiate between Gastroschisis and ruptured Omphalocele?

a) The defect in Gastroschisis is smaller than that of Omphalocele.

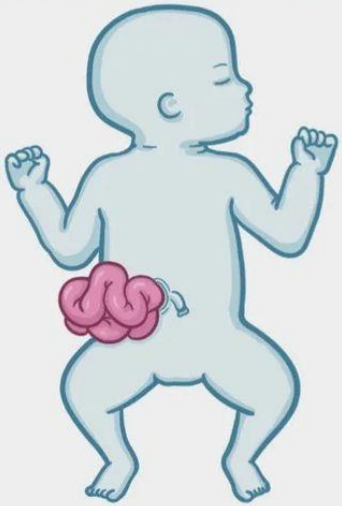
B) Gastroschisis is not covered by a membrane but Omphalocele even after rupture show the remnants of the membrane.

c) Usually the intestinal loops in Gastroschisis are much shorter and edematous than Omphalocele

OMPHALOCELE

* UMBILICAL RING DEFECT
* ABDOMINAL CONTENTS PROTRUDE INTO PERITONEAL SAC

GASTROSCHISIS



* ABDOMINAL CONTENTS SLIP OUTSIDE WITHOUT a SAC

MANAGEMENT OF GASTROSCHISIS

PRENATAL MANAGEMENT

- Diagnosis by prenatal ultrasound
- Monitoring fetal well-being
- Planned delivery at term

↓

IMMEDIATE POSTNATAL CARE

- Protect bowel with sterile bag
- NGT decompression
- IV fluids
- Antibiotic prophylaxis

↓

SURGICAL MANAGEMENT

- Primary or staged closure
- Silo placement if needed

↓

POSTOPERATIVE CARE

- Total parenteral nutrition
- Gradual initiation of enteral feeding

Discharging Umbilicus

The color of the discharge might dictate the underlying pathology and the line of treatment.

a) Bloody stained discharge with pus and the appearance of red lesion, this is called umbilical granuloma.

- This happens at the site of the cut of the umbilical cord.
- Treated by cautary or cut, with antibiotics.
- It needs to be differentiated from umbilical polyp, which represents remnants of the attachment of the omphalomesenteric duct (it is a duct that joins the terminal ilium to the umbilicus, it is an embryological remnant and it undergoes complete obliteration during the seventh week), this is treated by excision, cautary will not help.

Complications:

- Sepsis: Omphalitis abscess or septicaemia.
- Or the inflammatory process and the infective process pass deeply along the Portal vein (cavernousmalformation) this might kill the child, then we will have portal vein thrombosis, then we will have later on portal hypertension after few years here the child will be presented by hematemisis due to bleeding esophageal varices.

b) Urine (Patent Urachus):

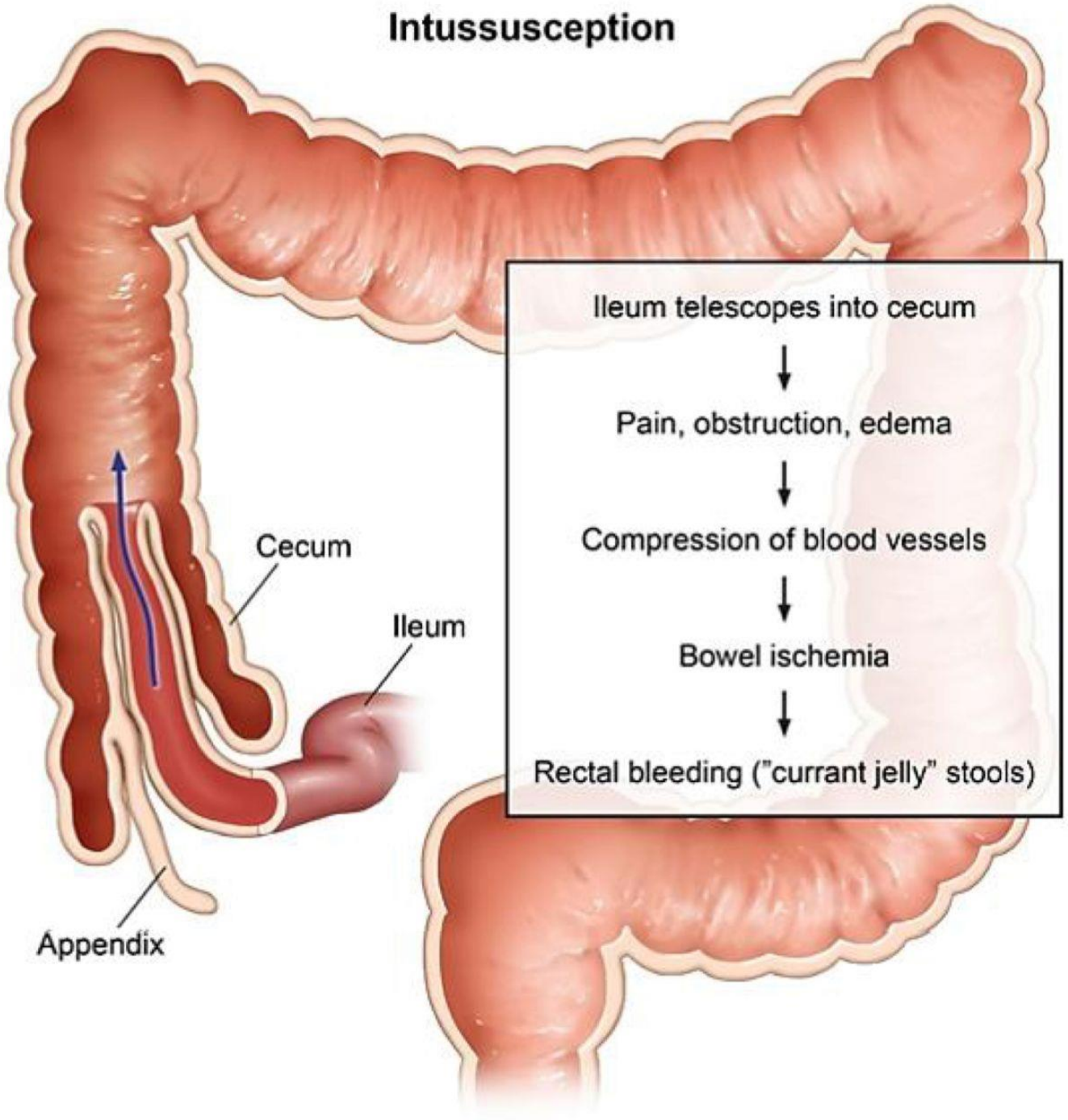
- here we will have a fistula between the urinary bladder and the umbilicus which is called Patent Urachus, this happens because the connection between the bladder and the umbilicus remained patent specially if there is bladder neck obstruction.
- **Treatment**: surgical excision of that fistula.

c) Feaces or meconium:

- because of the persistence of the omphalomesenteric duct.
- **Treatment**: Excision of the umbilicus, the duct, and the involved part of the ileum.

Acute Abdomen in Children

- 1. Intussusception: Telescoping of one bowel segment into another, usually at the ileocecal junction .
- 3months-3yrs
  - Risk Factors: Viral infections (Adenovirus), Meckel's diverticulum, Cystic fibrosis
- ➢ Primary (no lead point) : hypertrophied Peyer patches , recent URTI or gastroenteritis
- ➢ Secondary (lead point)
  - Classic Triad:
- Intermittent severe abdominal pain (child screams & pulls legs to chest)
- "Currant jelly" stools (mucus + blood)
- Sausage-shaped mass in the right upper quadrant
  - Diagnosis:
- Ultrasound: "Target sign" (concentric bowel layers)
- X-ray: Signs of obstruction, absence of air in RLQ (Dance's Sign)
  - Emergency Treatment:
- Non-operative: Air/contrast enema
- Surgical Reduction: If enema fails or perforation occurs


Intussusception
Ileum telescopes into cecum
Pain, obstruction, edema
Compression of blood vessels
Bowel ischemia
Rectal bleeding ("currant jelly" stools)
Cecum
Ileum
Appendix

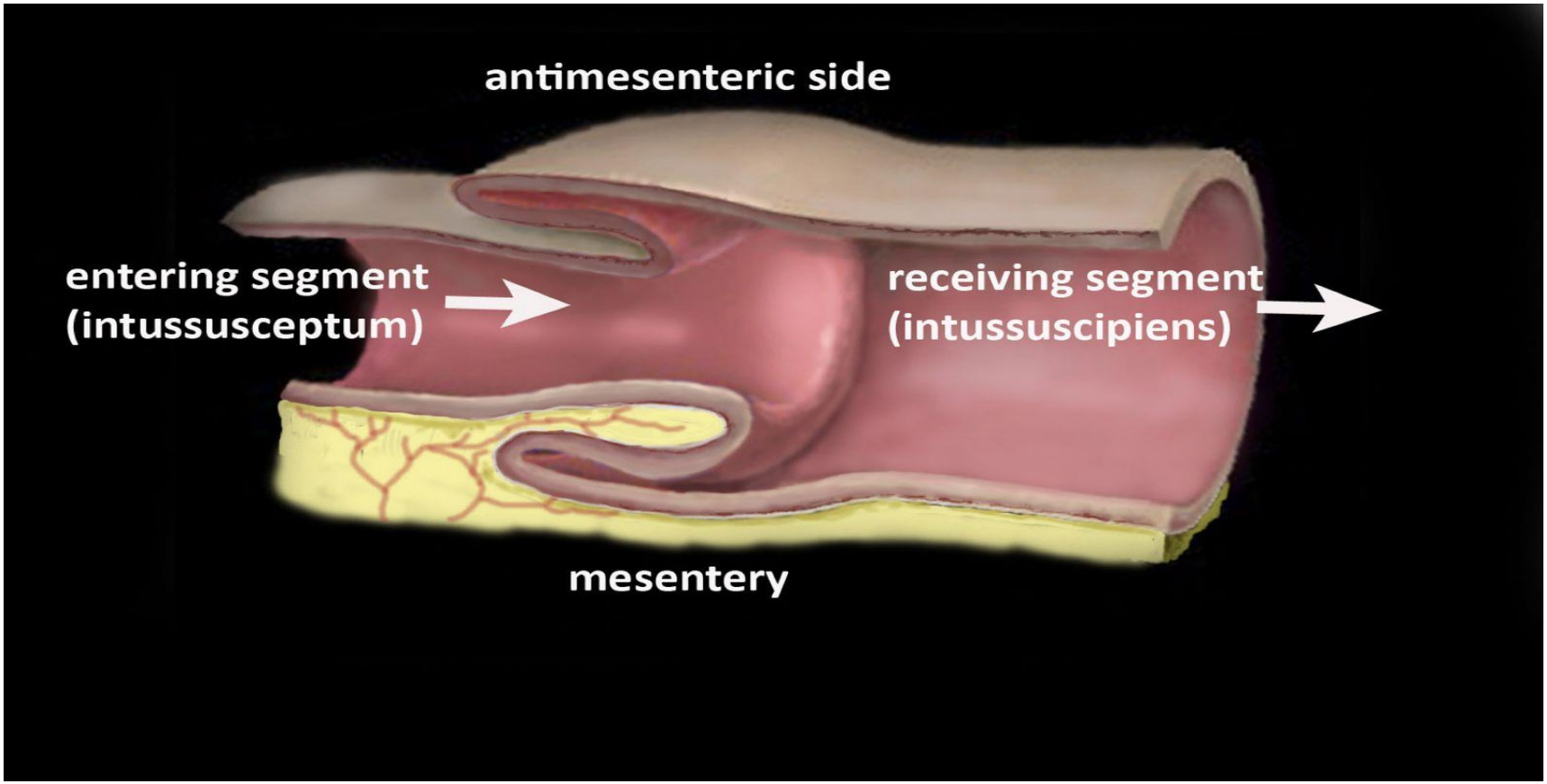

antimesenteric side
entering segment
(intussusceptum)
receiving segment
(intussuscipiens)
mesentery

FIGURE 38-3 ■ This abdominal radiograph in a patient with intussusception shows dilated loops of small bowel in the right lower quadrant and a right upper quadrant soft tissue mass density in the vicinity of the transverse colon near the hepatic flexure (arrow).

FIGURE 38-4 ■ This transverse sonographic image shows the alternating rings of low and high echogenicity due to an intussusception. This finding has been called a 'target' sign.

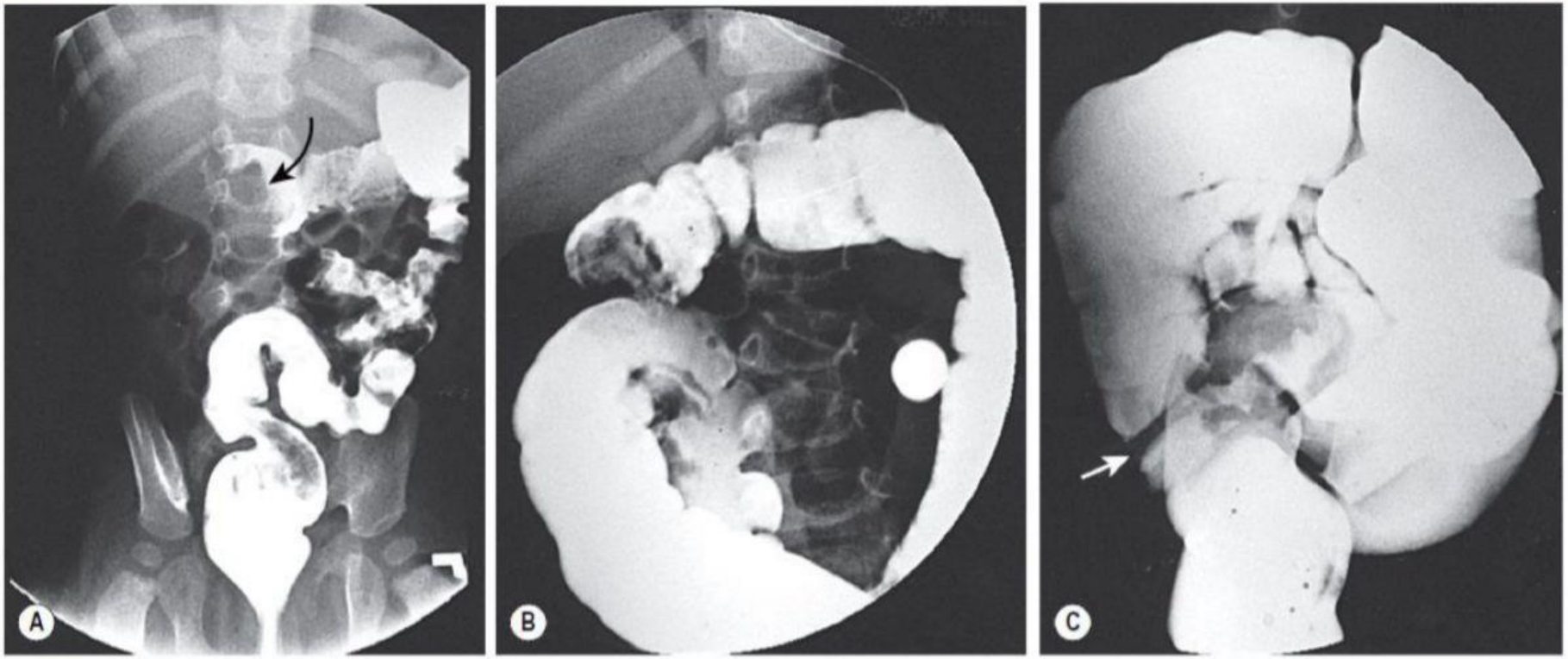


FIGURE 38-7 ■ Fluoroscopic examination using isotonic contrast for hydrostatic reduction of intussusception. **(A)** Intussusception (arrow) seen in midtransverse colon. **(B)** Reduction has occurred to the hepatic flexure. **(C)** Complete reduction with reflux of contrast medium into the terminal ileum. Note the edematous ileocecal valve (arrow).

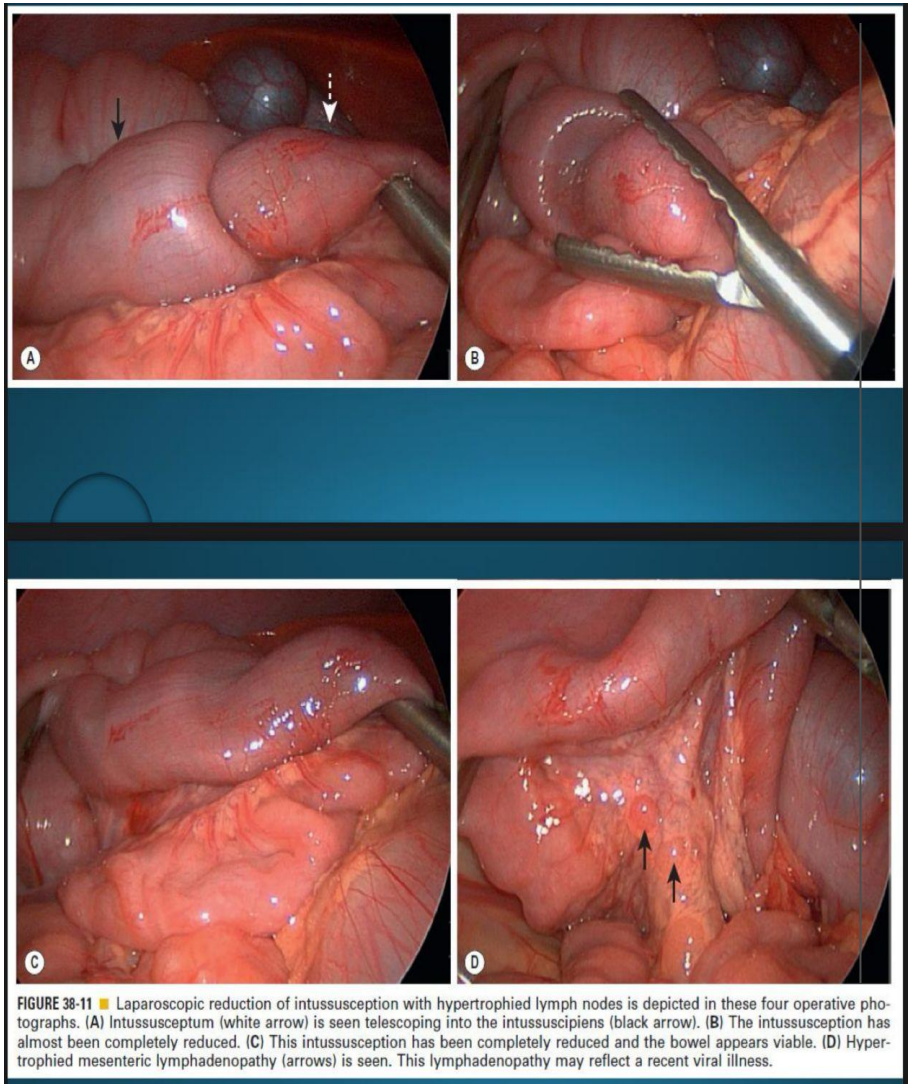


FIGURE 38-11 ■ Laparoscopic reduction of intussusception with hypertrophied lymph nodes is depicted in these four operative photographs. **(A)** Intussusceptum (white arrow) is seen telescoping into the intussuscipiens (black arrow). **(B)** The intussusception has almost been completely reduced. **(C)** This intussusception has been completely reduced and the bowel appears viable. **(D)** Hypertrophied mesenteric lymphadenopathy (arrows) is seen. This lymphadenopathy may reflect a recent viral illness.

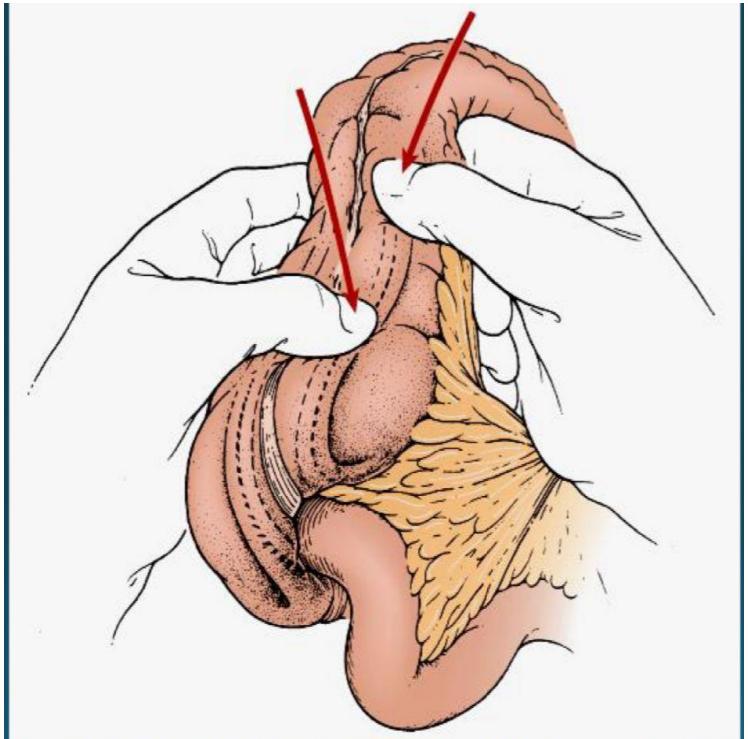
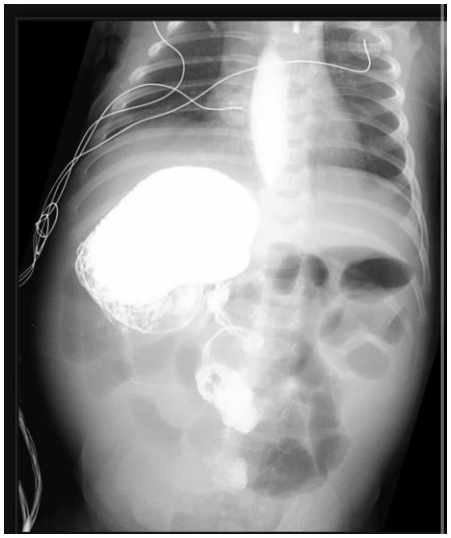


FIGURE 38-9 ■ A right lower quadrant muscle-splitting incision allows delivery of the intussusception through the incision. Gentle and continuous massage from distal to proximal usually results in reduction of the intussusception.

- 2. Malrotation with Volvulus:
  - Cause: Incomplete rotation of the intestines → Twisting around the superior mesenteric artery → Ischemia

**Cecum is fixed to the retroperitoneum by peritoneal bands running anteriorly to the second part of duodenum (Ladd's bands).



- Symptoms:

•Bilious (green) vomiting (Hallmark sign!)

•Abdominal distension & tenderness

•Peritonitis & shock if bowel necrosis occurs

- Diagnosis:

•Upper GI contrast study: "Corkscrew sign" (twisted bowel)

•Ultrasound: "Whirlpool sign" (twisting of mesenteric vessels)

- Emergency Treatment:

•IV fluids, NG decompression, broad-spectrum antibiotics

•Immediate Surgery (Ladd's Procedure) to untwist bowel & prevent recurrence

- Management: Surgery (Ladd's Procedure)

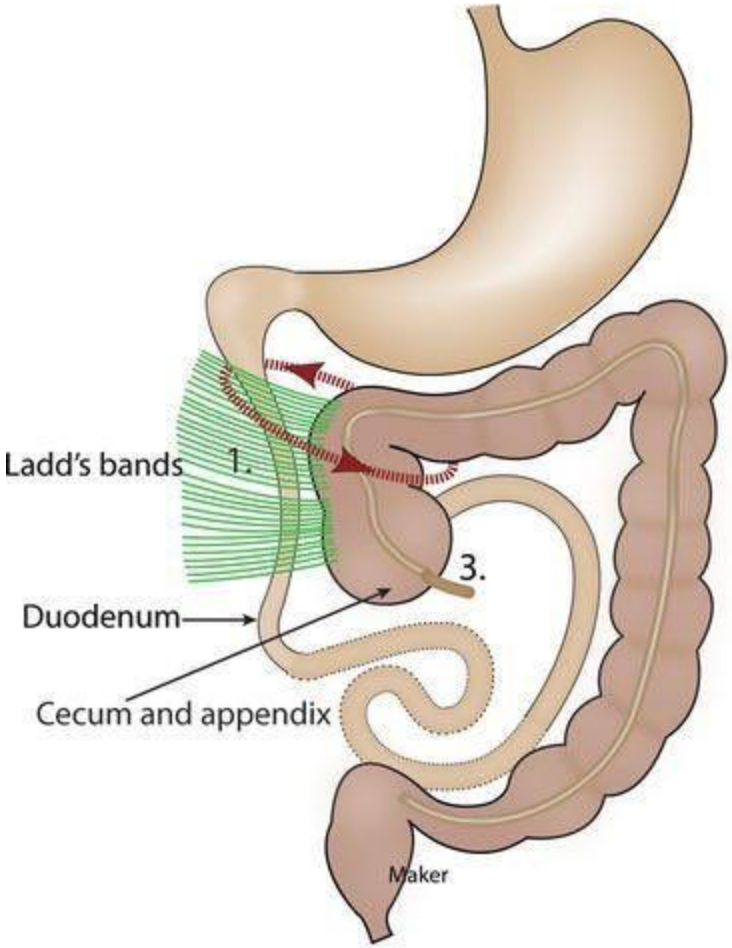
1. Division of Ladd's bands (lying across the duodenum from abnormal caecum in RUQ).

2. Widen mesenteric base (divide peritoneum overlying central mesenteric vessels).

3. Position bowel (small bowel right and large bowel left).

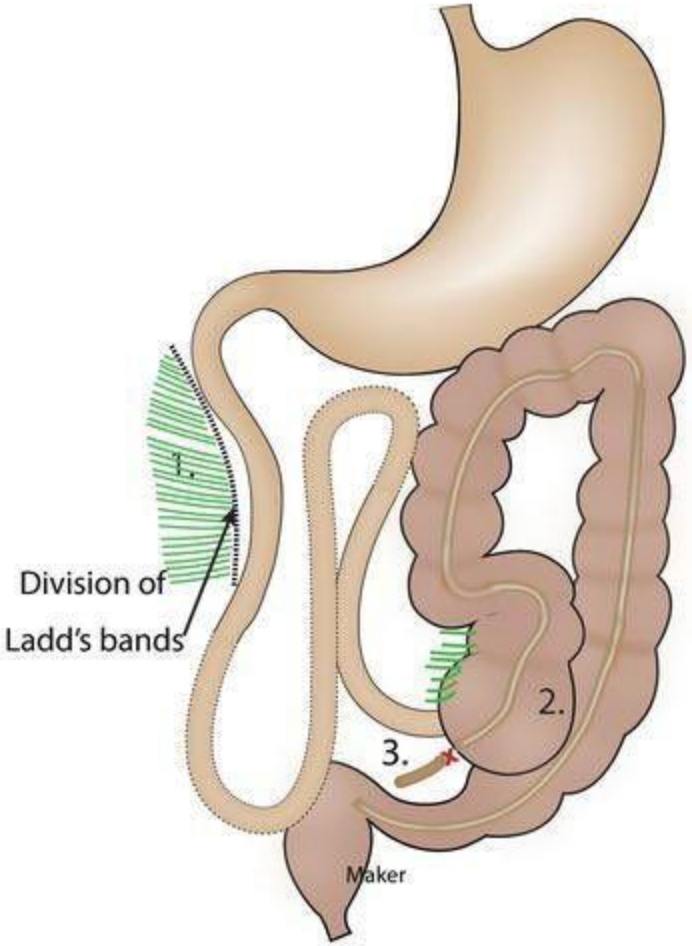
4. ± Appendectomy

Malrotation of the Midgut



Preoperative

1. Ladd's Bands causing obstruction with varying degrees of volvulus



Postop after reduction of the volvulus

1. Division of the Ladd's bands and correction of the volvulus
2. Replacement of the right colon on the left side
3. Appendectomy

3. Necrotizing Enterocolitis (NEC) –Preterm Infant Emergency

- Cause: Ischemia & bacterial invasion of the immature intestine (Common in preterm neonates)
- Risk Factors: Prematurity, Formula feeding, Perinatal hypoxia, Sepsis
- Symptoms:

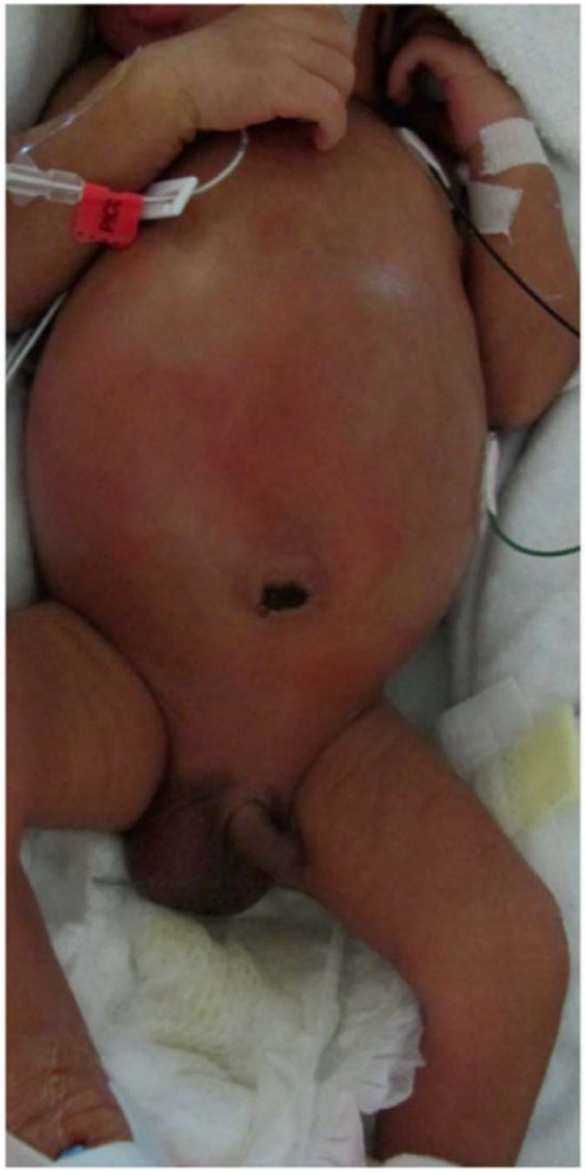
•Feeding intolerance, bloating, vomiting
•Bloody stools (Hematochezia)
•Rapid deterioration → Shock & Sepsis

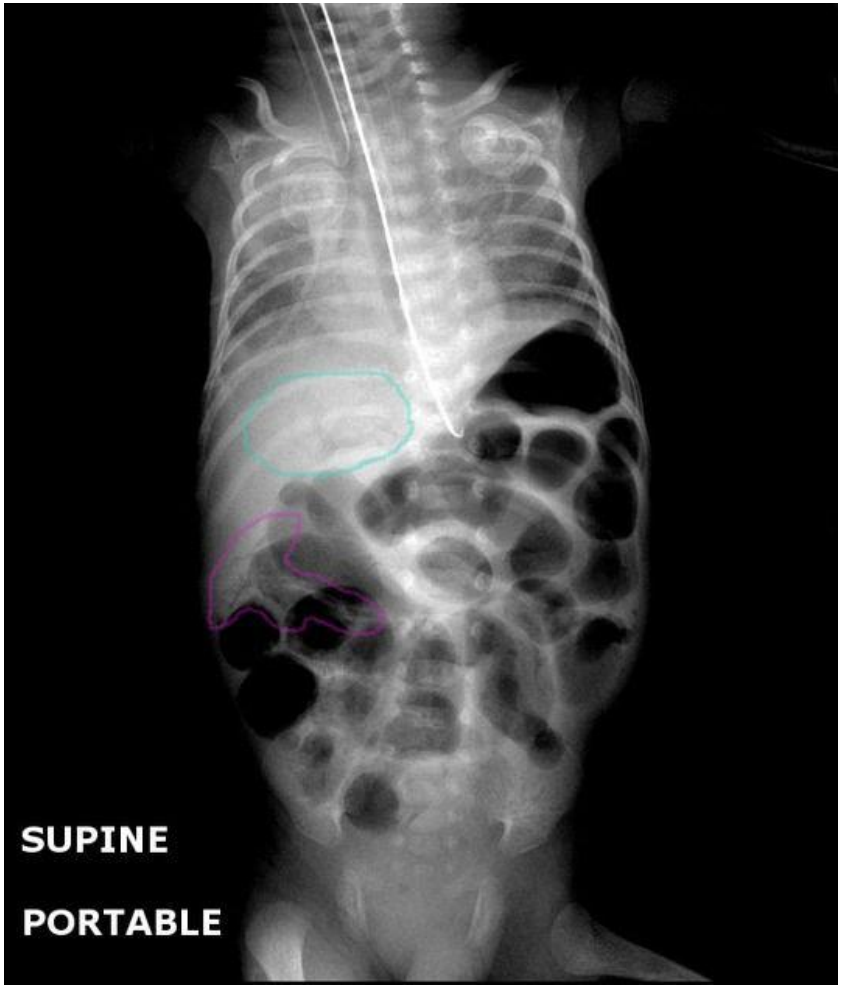
- Diagnosis:

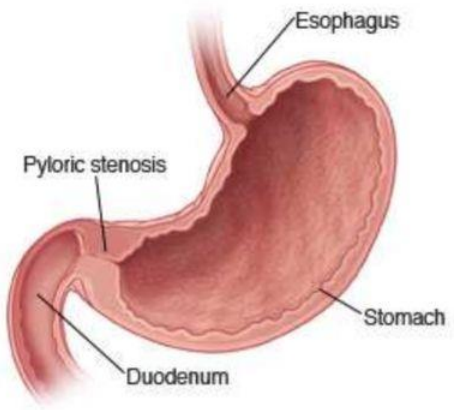
•X-ray: Pneumatosis intestinalis (Gas in bowel wall = Hallmark sign)
•Portal venous gas, dilated loops of bowel

- Emergency Treatment:

•NPO, IV fluids, IV antibiotics •Surgery if perforation occurs




SUPINE
PORTABLE



Pyloric Stenosis

4. 4. Hypertrophic Pyloric Stenosis (Projectile Vomiting in Infants) 2-8wks

- Cause: Progressive thickening of the pyloric muscle, leading to gastric outlet obstruction
- Symptoms:

•Projectile, non-bilious vomiting (after feeding)
•Palpable “olive” mass in RUQ
•Dehydration & weight loss
• Paradoxical acidosis /apnea

- Diagnosis:

•Ultrasound: “Olive sign” (Thickened pylorus muscle > 4mm, length > 16mm)
•Lab: Hypokalemic, hyperchloremic metabolic alkalosis

- Emergency Treatment:

•IV rehydration & electrolyte correction
•Definitive treatment: Pyloromyotomy

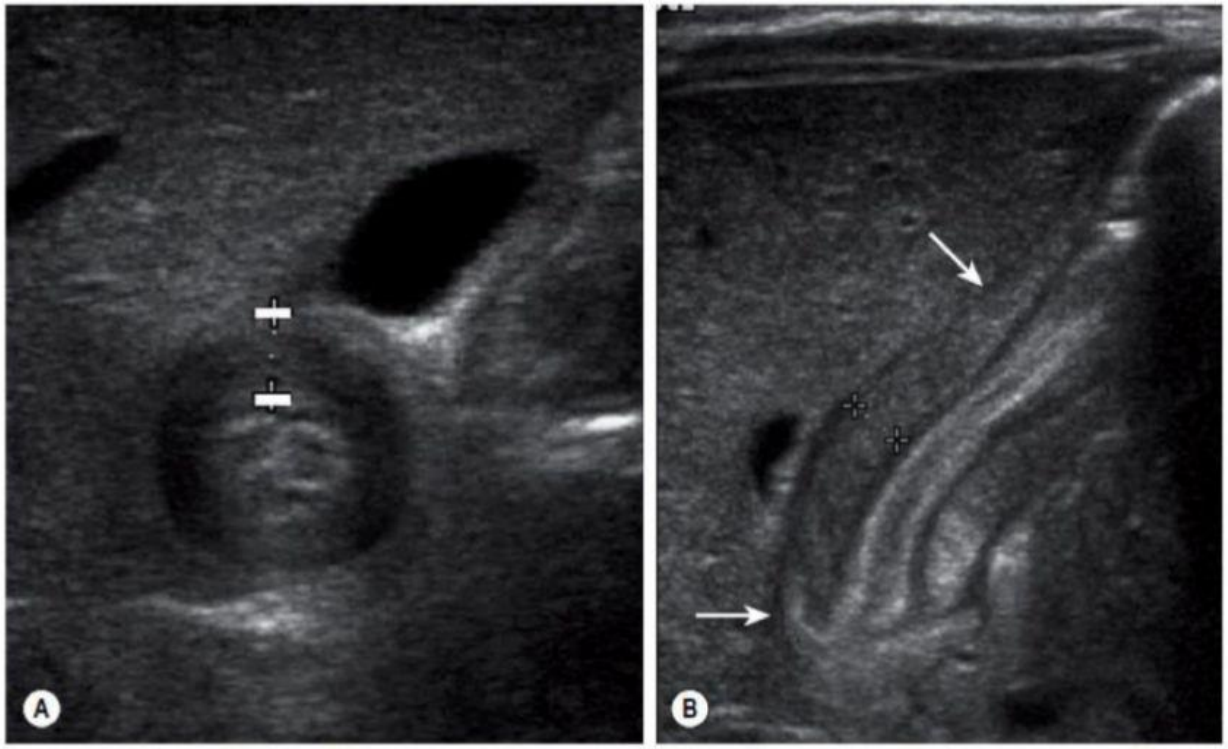
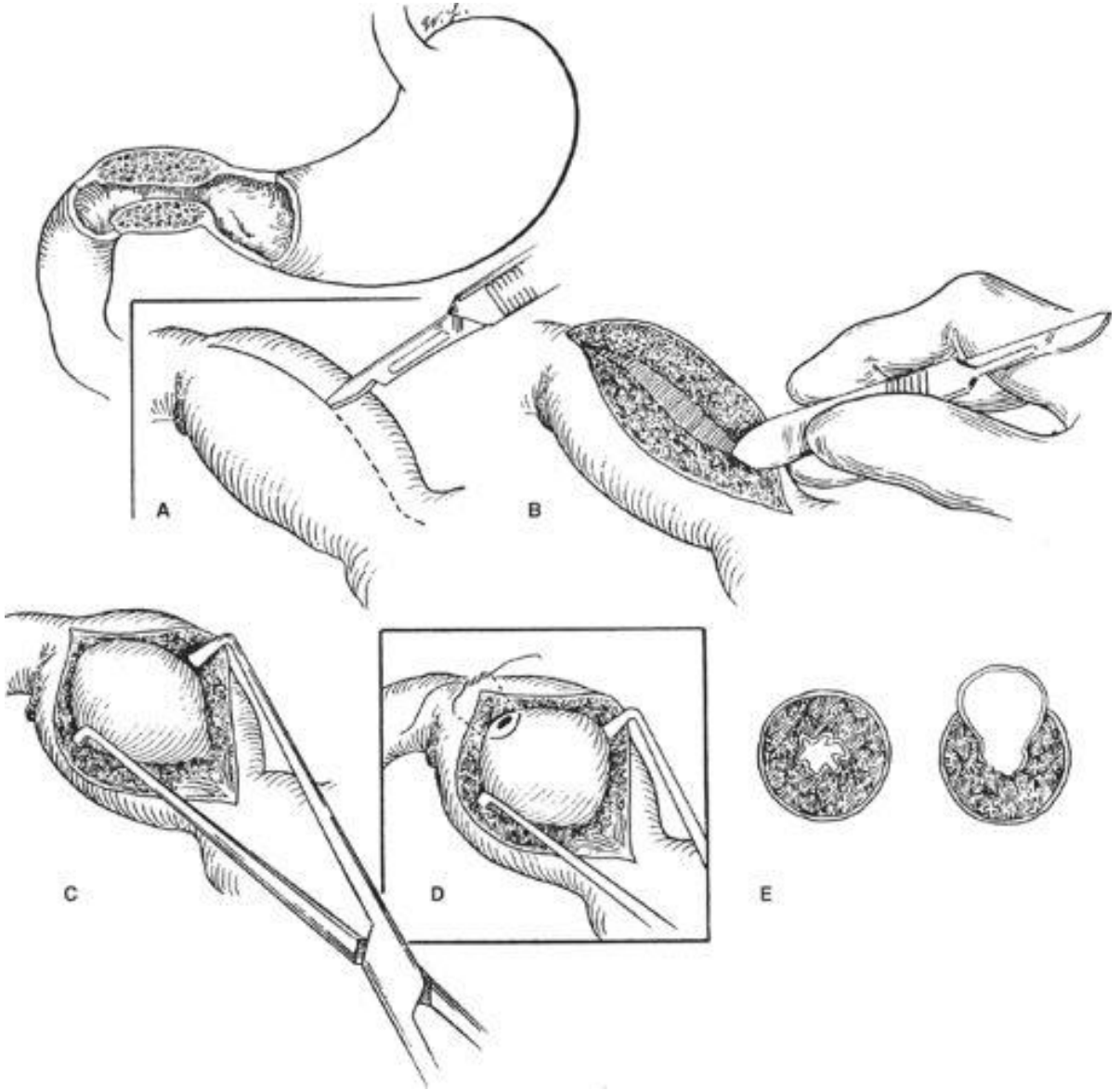
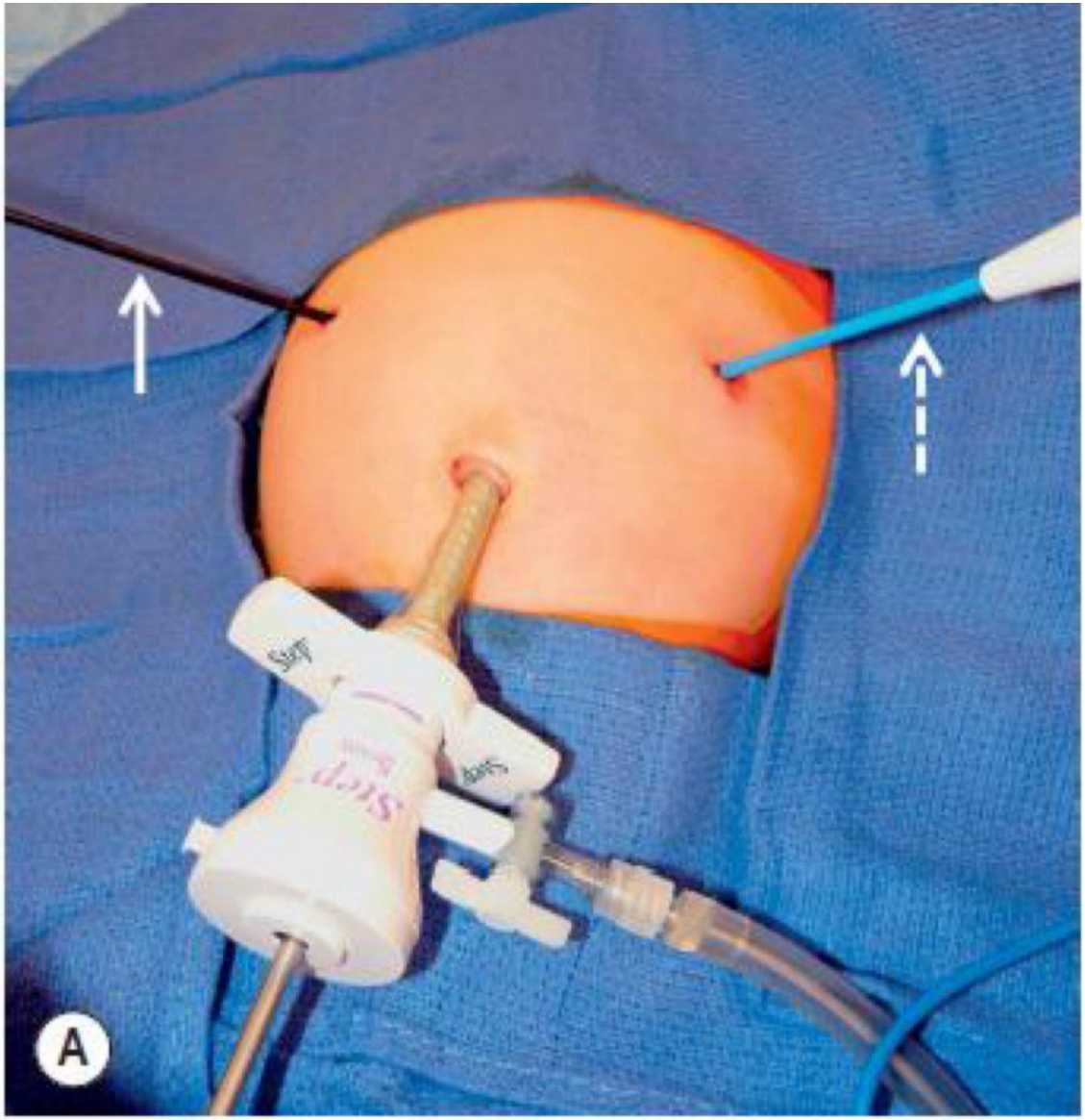


FIGURE 29-1 ■ Ultrasonography has become the standard imaging study for diagnosing pyloric stenosis and has supplanted physical examination at most institutions. The (**A**) transverse and (**B**) longitudinal views of hypertrophic pyloric stenosis are seen here. Muscle thickness greater than or equal to 4 mm on the transverse view or a length greater than or equal to 16 mm on the longitudinal view is diagnostic of pyloric stenosis. On this study, the pyloric wall thickness was 5 mm and the length (arrows) was 20 mm.


A
B
C
D
E


A

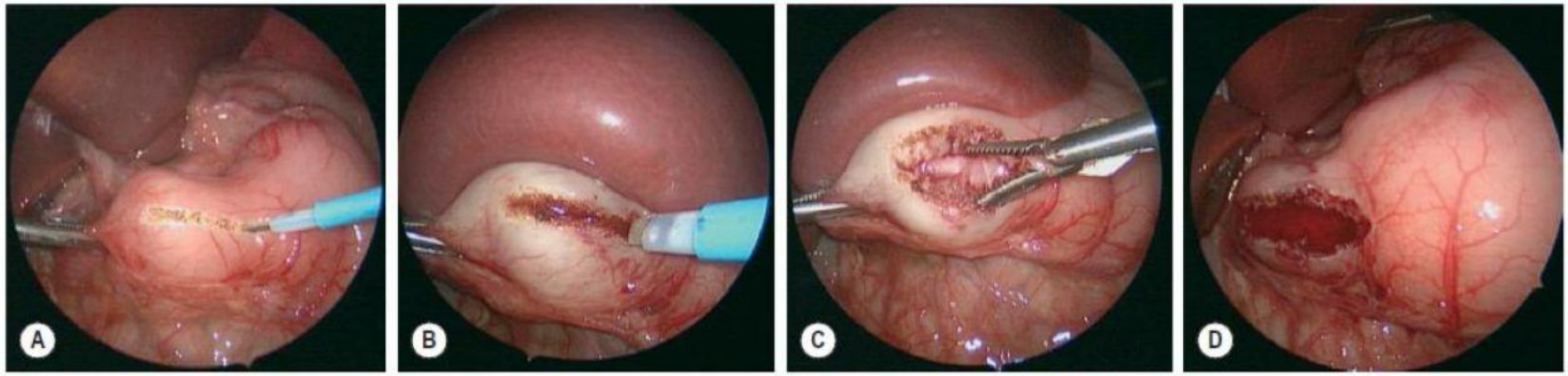
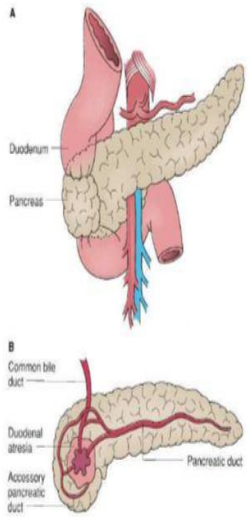
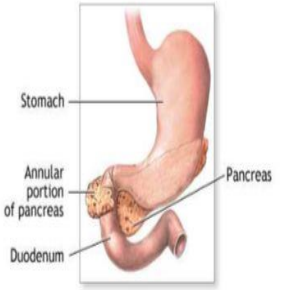
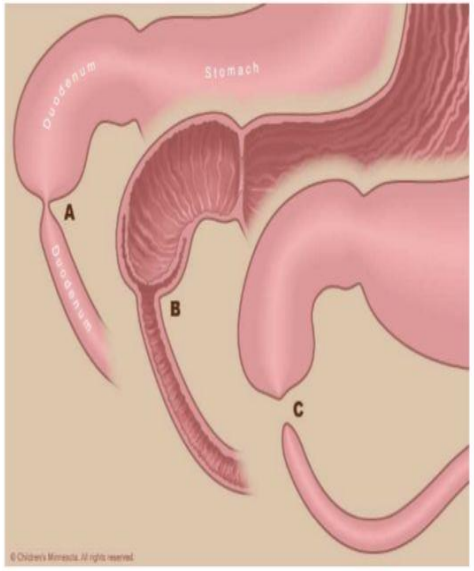


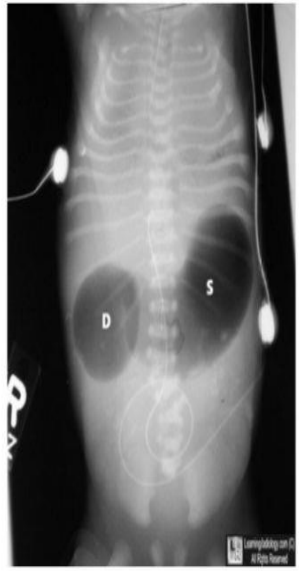
FIGURE 29-5 ■ These intraoperative photographs depict a laparoscopic pyloromyotomy. **(A)** The spatula tipped cautery is being used to incise the serosa and outer muscular layer of the hypertrophied pylorus. **(B)** The tip of the cautery is introduced into the hypertrophied muscle and twisted to break up the muscle fibers and create a space for insertion of the pyloric spreader. **(C)** The pyloric spreader is introduced into the muscle and gently opened to split the hypertrophied muscle fibers. The submucosa is visualized through the myotomy. **(D)** Air is introduced into the stomach to assess the integrity of the mucosa.





Annular Pancreas





Duodenal Atresia

Duodenal atresia vs Annular pancreas

- Duodenal Atresia: Failure of recanalization (weeks 8–10)
- Annular Pancreas: Abnormal rotation of the ventral pancreatic bud
- Clinical Presentation:

✓ Duodenal Atresia: Bilious or non-bilious vomiting (depends on atresia location) , Abdominal distension , Polyhydramnios in utero

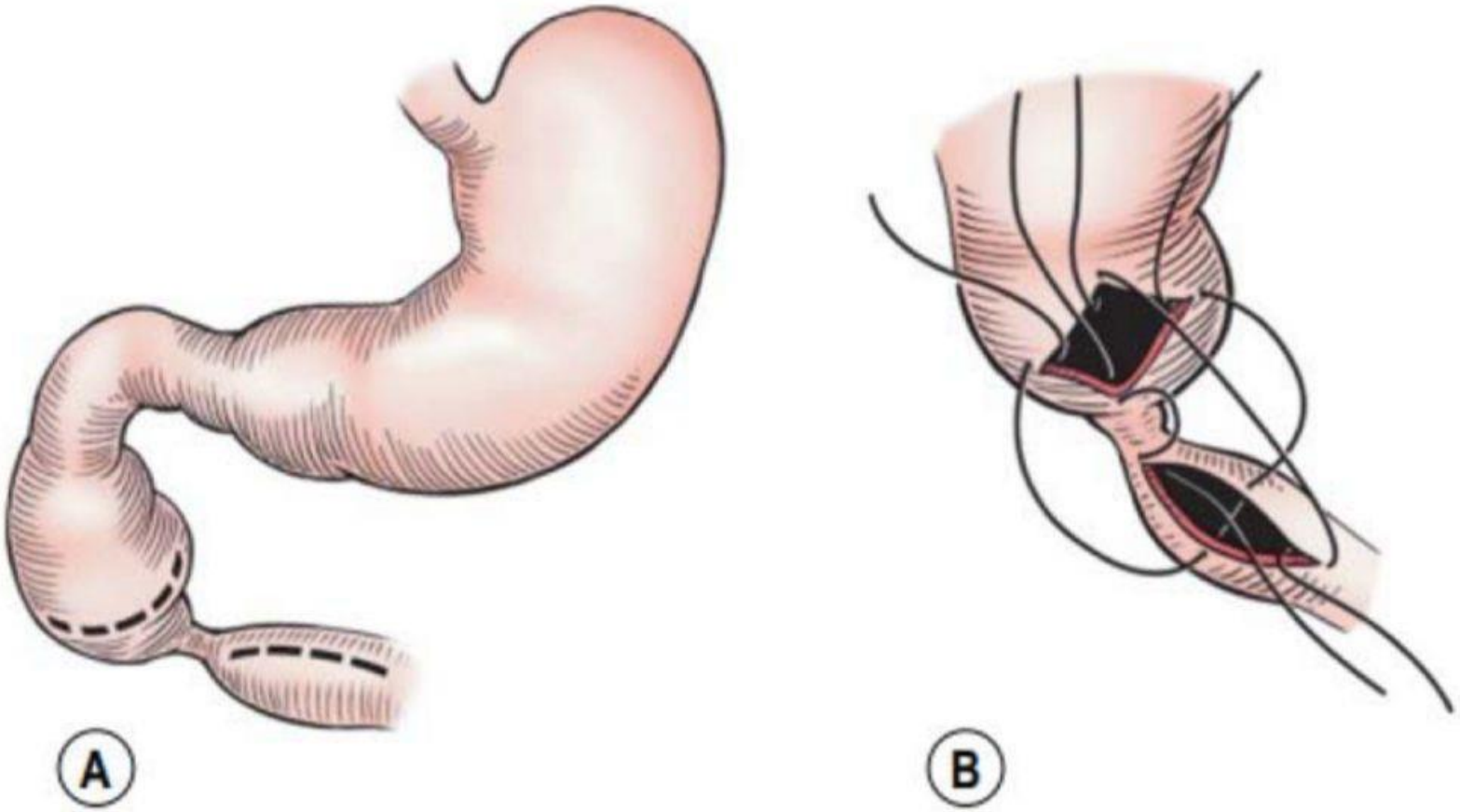
✓ Annular Pancreas: May be asymptomatic or present later in life, Similar symptoms but variable severity

- Diagnosis : - Prenatal Ultrasound: Polyhydramnios, dilated stomach
  - Postnatal X-ray: Classic “double bubble” sign
- Surgical Principles :

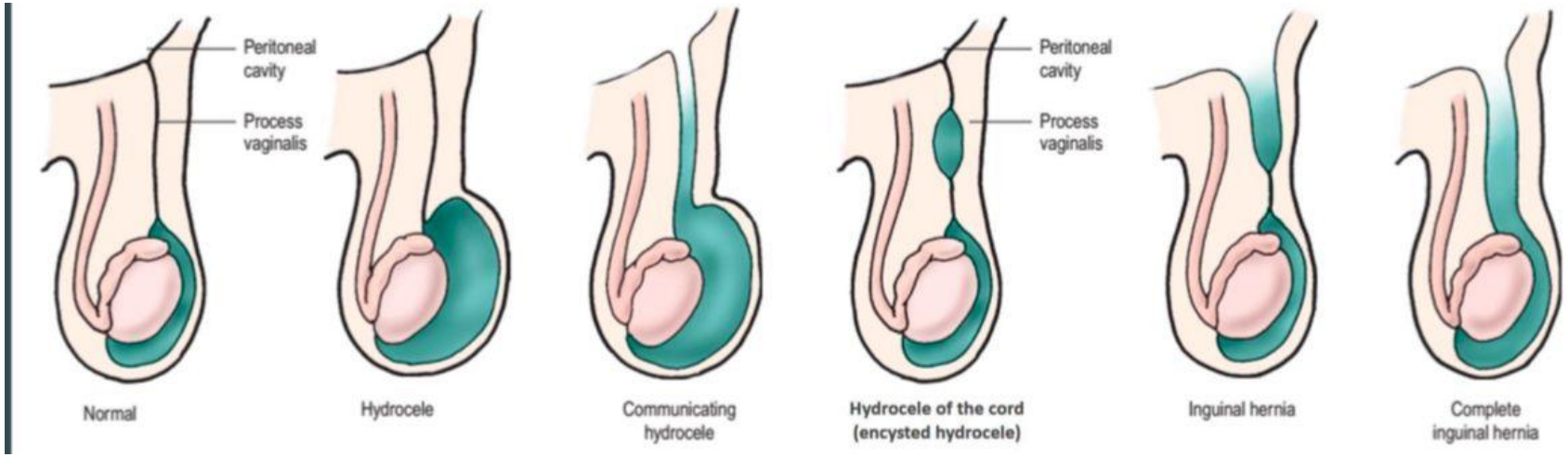
o Goals: Bypass the obstruction, preserve pancreatic integrity

o Duodenoduodenostomy (most common procedure)

o Other options: Duodenojejunostomy, gastrojejunostomy (rare)



Duodeno-duodenostomy Procedure


Peritoneal cavity
Process vaginalis
Normal
Hydrocele
Communicating hydrocele
Peritoneal cavity
Process vaginalis
Hydrocele of the cord (encysted hydrocele)
Inguinal hernia
Complete inguinal hernia

Inguinal Hernia Incarceration/strangulation

- Irreducible inguinal hernia due to trapping of bowel or omentum in the hernia sac.
- Complications:

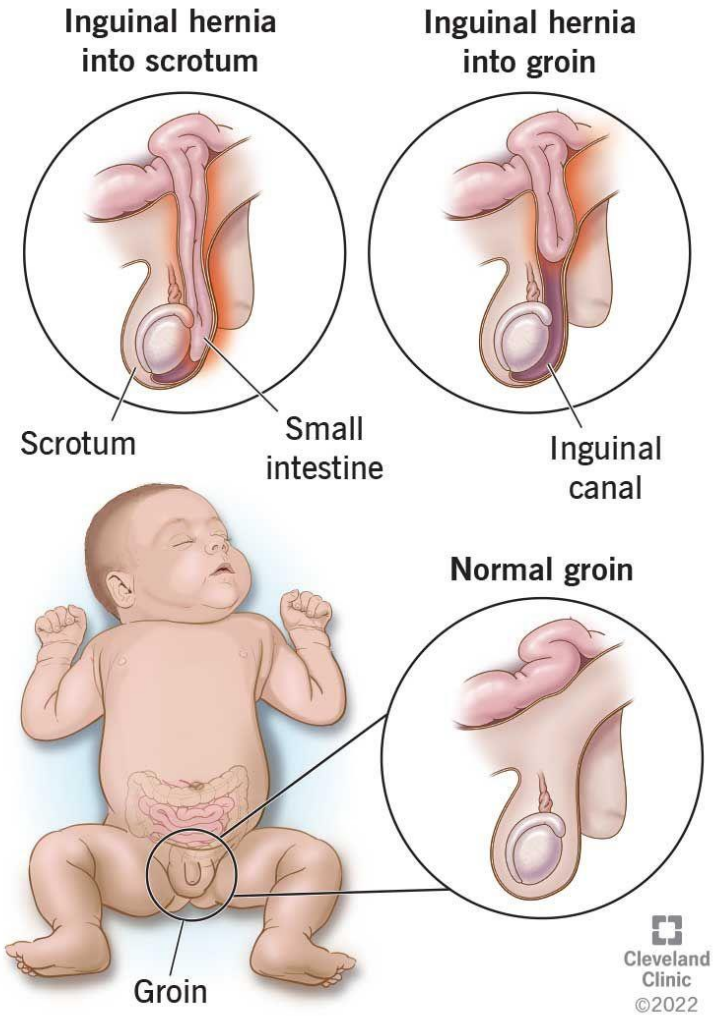
✓ Strangulation: Vascular compromise → ischemia → necrosis

✓ Bowel obstruction

(Surgical emergency if strangulation suspected!)

- More common in males (9:1 ratio)
- Indirect > Direct Hernia (more common in younger patients)
- Risk Factors: Chronic cough, constipation, prematurity (in neonates), previous hernias, connective tissue disorders (Ehlers-Danlos, Marfan)

Inguinal Hernia in Babies



- Symptoms:

➢ Painful, tender groin lump that is non-reducible

➢ Nausea, vomiting (if bowel obstruction)

➢ Fever, tachycardia (if strangulated)

- Physical Exam Findings:

✓ Firm, tense, and tender inguinal swelling

✓ No cough impulse

✓ Skin changes (erythema, edema in strangulated cases)

- Initial Management:

➢ If no signs of strangulation:Attempt gentle manual reduction (Trendelenburg, analgesia, ice packs) , If successful → Elective hernia repair

➢ If strangulation suspected: DO NOT ATTEMPT REDUCTION , Prepare for emergency surgery

Testicular Torsion

- Cause: Twisting of the spermatic cord → Ischemia & necrosis
- Symptoms:

•Acute severe testicular pain (Sudden onset)

•High-riding, swollen, and tender testis

•Absent cremasteric reflex (Diagnostic clue)

- Diagnosis: Doppler Ultrasound: Absent blood flow
- Emergency Treatment:

Immediate surgical detorsion & orchiopexy required

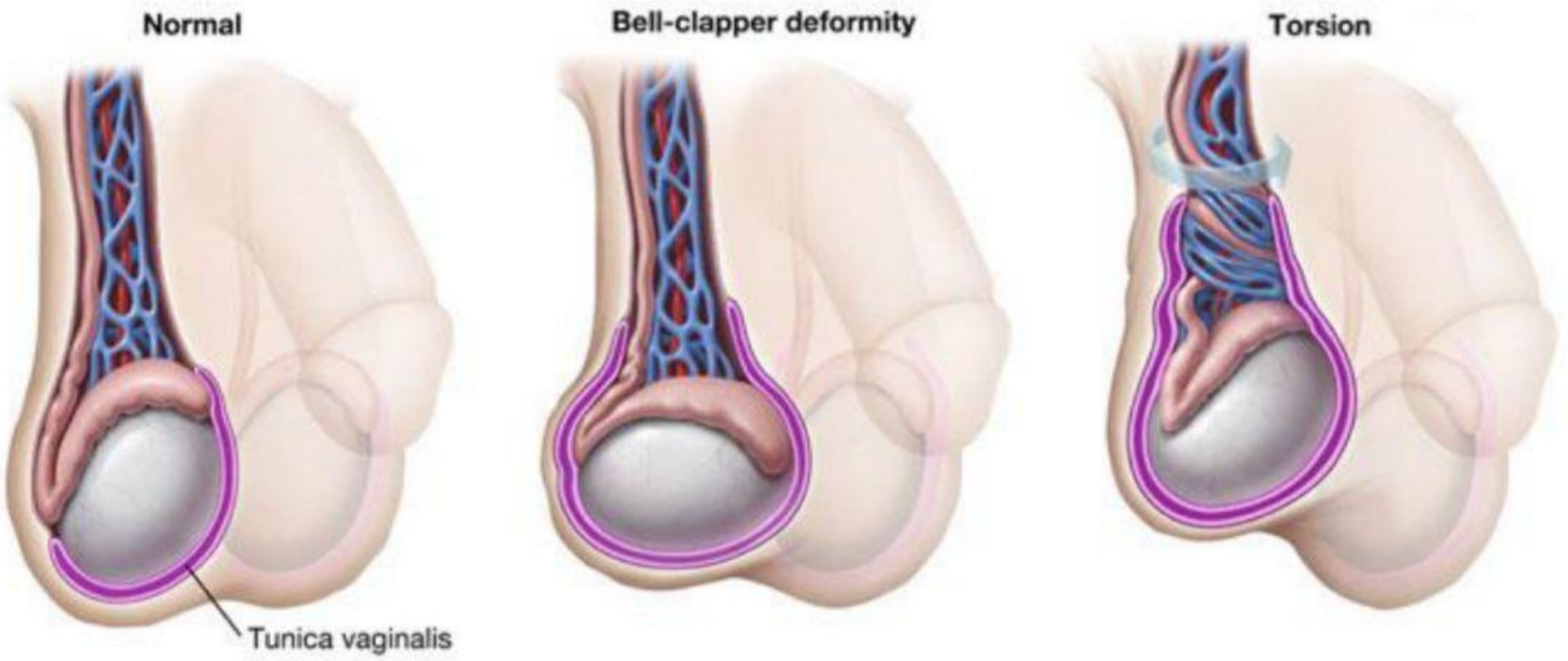
- Types:

1. Intravaginal: more common in children and adolescents, spermatic cord twists within the tunica vaginalis, ‘bell clapper’ deformity.

2. Extravaginal: occurs perinatally, spermatic cord twists proximal to the tunica vaginalis, the tunica and testis spin on the vascular pedicle.

❖ Prenatal torsion: hard, nontender scrotal mass noted at birth, with underlying dark skin, discoloration, and fixation of the skin to the mass.

❖ Postnatal torsion: an acutely inflamed scrotum with erythema and tenderness. Requires emergent exploration with detorsion and bilateral fixation. (Normal scrotum at delivery).


Normal
Bell-clapper deformity
Torsion
Tunica vaginalis

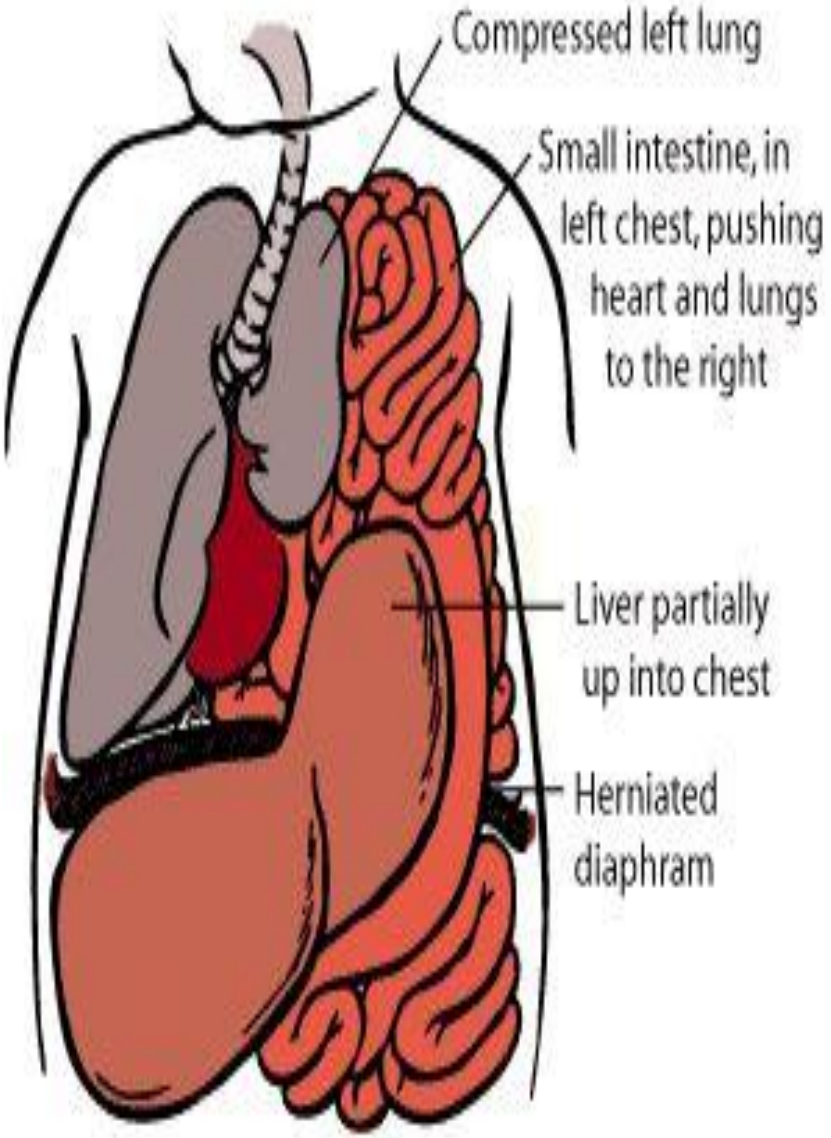
Foreign Body Aspiration

- • **Symptoms** - Sudden choking, stridor, respiratory distress
- • **Diagnosis** - X-ray, bronchoscopy
- • **Treatment** - Heimlich maneuver (older child), back blows & chest thrusts (infants), bronchoscopy

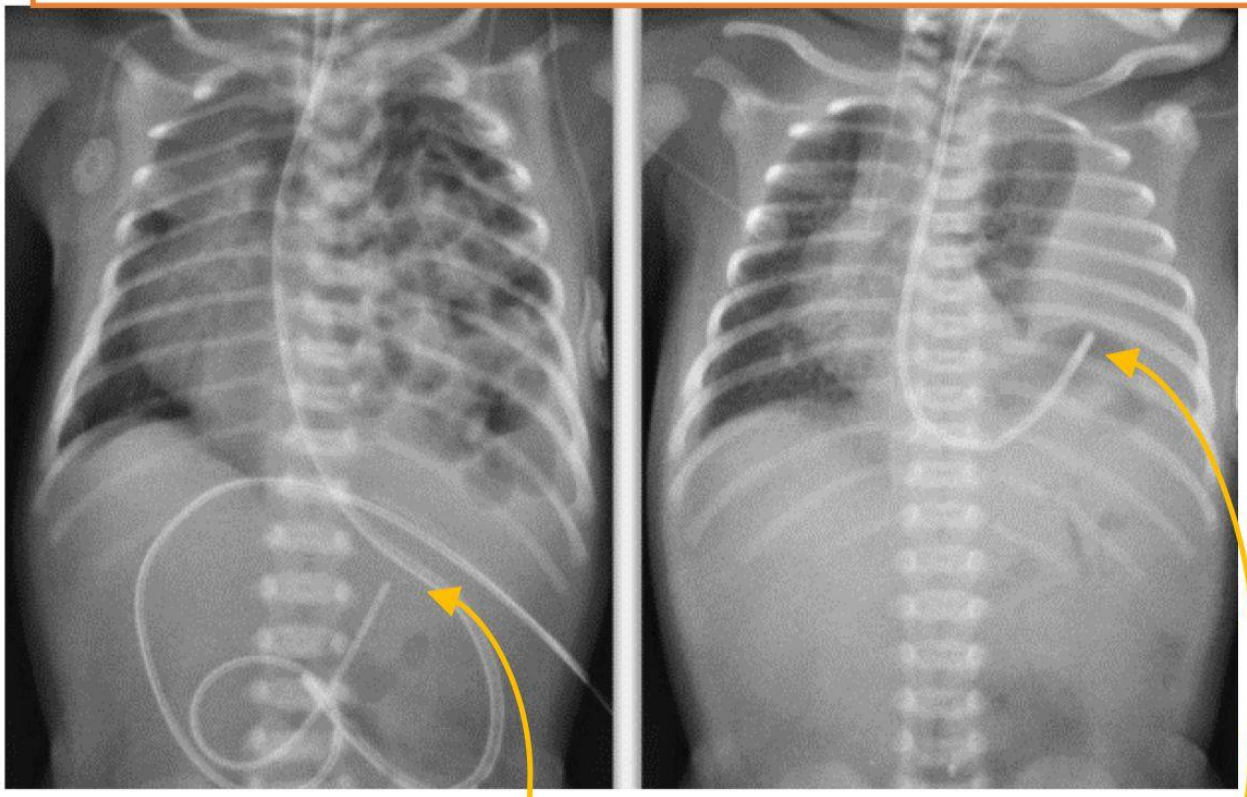
Congenital diaphragmatic hernia (CDH)

- Is a birth defect characterized by a defect in the diaphragm, allowing abdominal organs (such as the stomach, intestines, liver, and spleen) to herniate into the thoracic cavity. This can cause lung hypoplasia and pulmonary hypertension, leading to respiratory distress at birth.
- Types of CDH:

1. Bochdalek Hernia (85%) – Posterolateral defect, usually on the left side.
2. Morgagni Hernia (5–10%) – Anterior defect, more common on the right.
3. Central Diaphragmatic Hernia (rare).


Compressed left lung
Small intestine, in left chest, pushing heart and lungs to the right
Liver partially up into chest
Herniated diaphram

Chest x-ray in a neonate with CDH: bowel loops in the chest, mediastinum shifted to the right



NG tube reaching the bowel; the stomach is not herniated

CDH + NG tube only reaching the chest; stomach is herniated

Management of Congenitatal Diaphragmatic Hernia (CDH

Prenatal Management

- Diagnosis: Typically detected via fetal ultrasound
  - Polyhydramnios
  - Mediastinal shift
  - Stomach in thorax
- Fetal MRI: Assesses lungg volume and liver herniation.
- Lung-to-Head Ratlo (LHR): Predicts prognosis.
- Fetal Surgery: Fetal endoluminal tracheal occlusion (FETO) for severe cases

Postnatal Stabilization (Golden Hour Management)

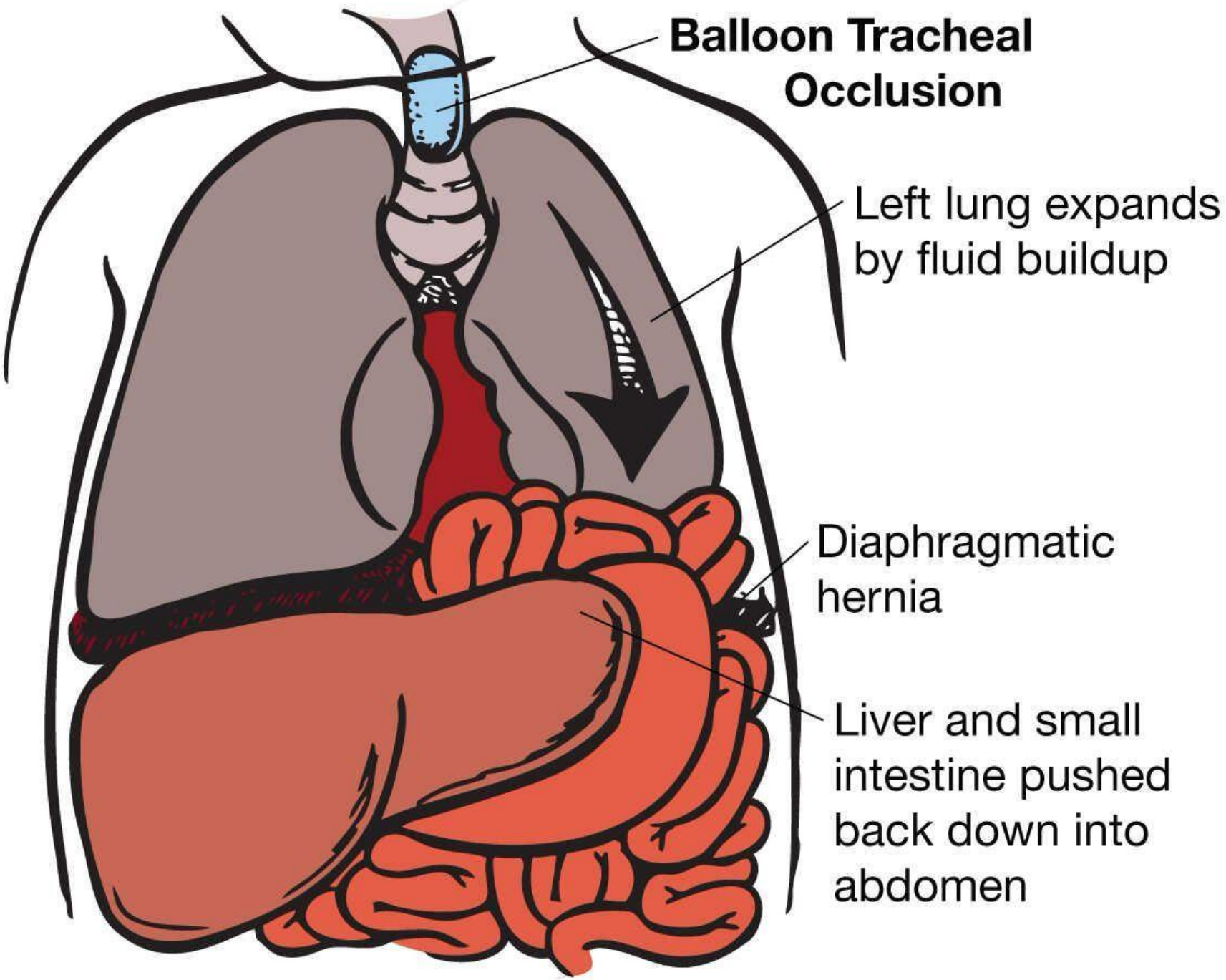
- Intubation & Ventilation: Avoid bag-mask ventilation (prevents gastric insufflation)
- Gastric Decompression: NG tube to prevent distension
- Permissive Hypercapnia & Gentle Ventilation
- Pulmonary Hypertension Management:
  a. Inhaled nitric-oside (INO)
  b. Extracorporeal Membrane Oygenaion (ECMO) in severe

Surgical Repair (Diaphragmatic Hernia Closure)

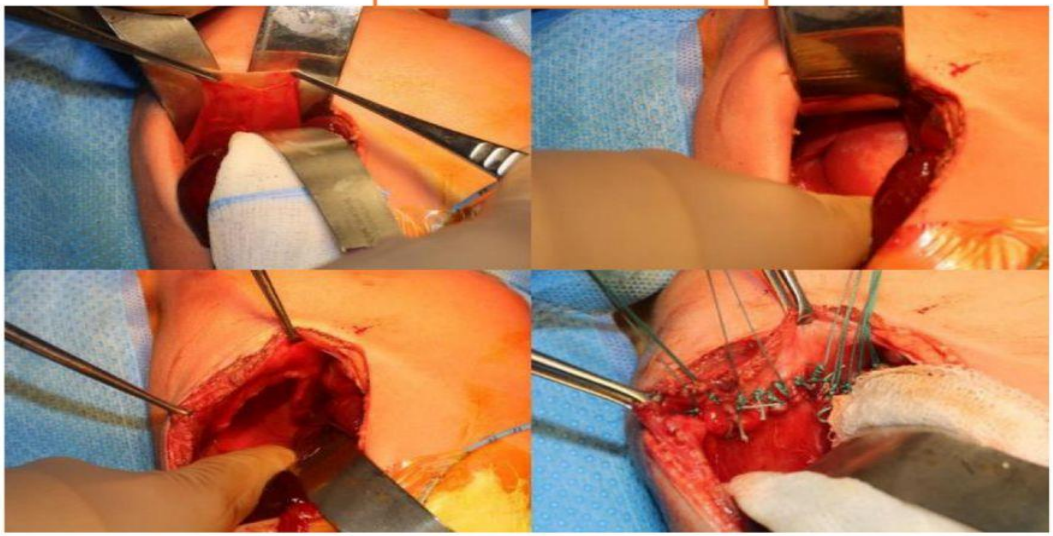
- Timing: After stabilization (usually within 43–72 hours)
- Approach:
  - Open Repair (Subcostal or Thoracic approach)
  - Laparoscopic/Thoracoscopic Repair (select-casees)
- Steps: 1. Reduce herniated organs.
  2. Close diaphragmatic defect (primary or patch for large defects)
  3. Assess lung expansion and remove any adhesions

Postoperative Care

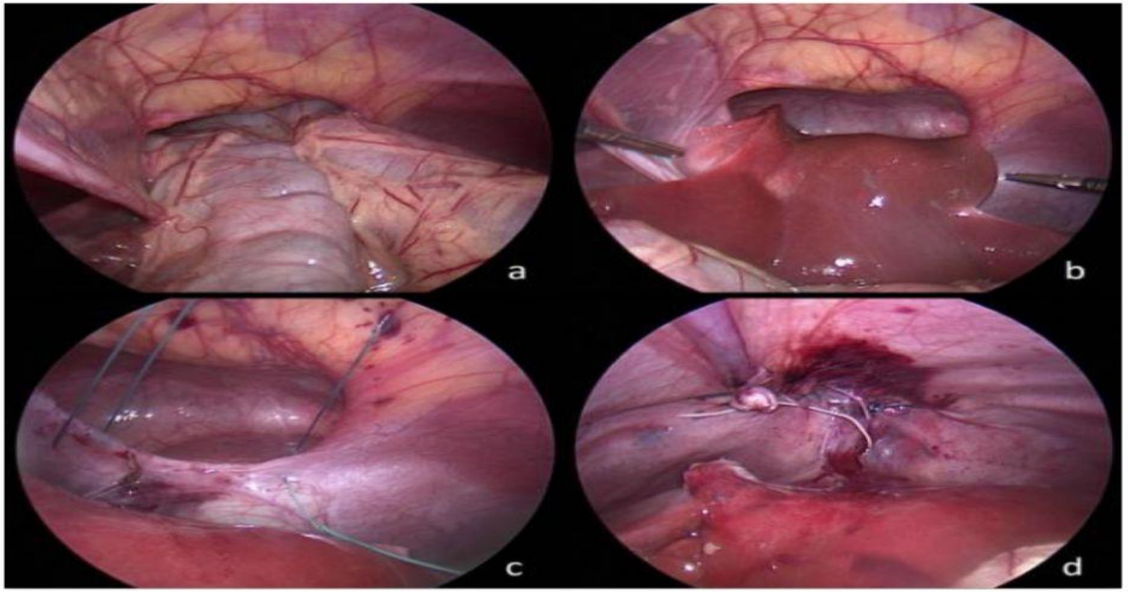
- Ventilation Weaning: Gradual extubation
- Nutritional Support: NG feeds: then orn al feeding
- Monitor for: Pulmonary hypertension: GERD, recurrencence

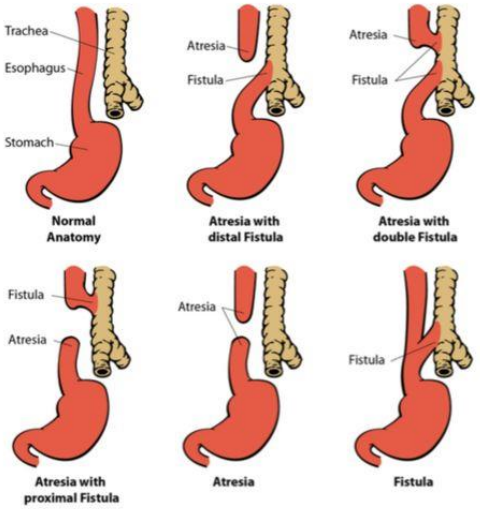

Balloon Tracheal Occlusion
Left lung expands by fluid buildup
Diaphragmatic hernia
Liver and small intestine pushed back down into abdomen

Open CDH repair

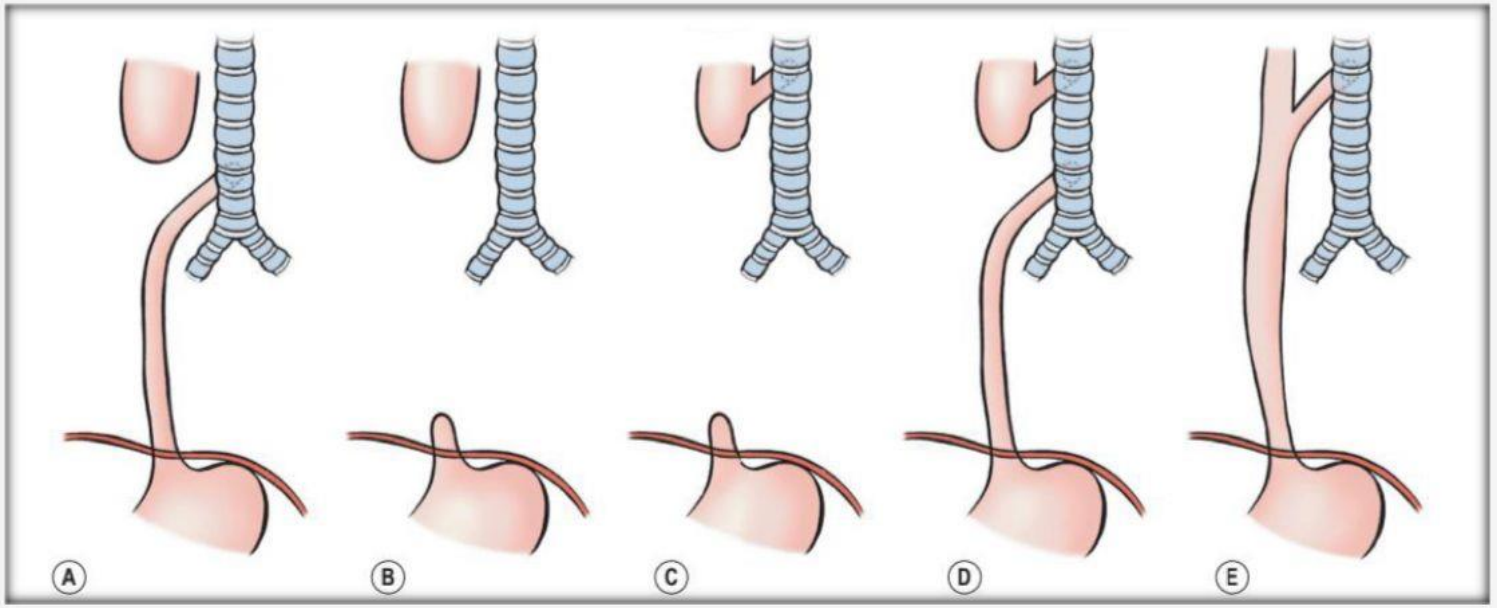


Minimally invasive surgery





Oesophageal Atresia



85% 7% 2% <1% 4%

- Associated anomalies: (Isolated EA in 50% of cases) Syndromic EA (50%): VACTERL and CHARGE
- Diagnosis:

1. Antenatal: polyhydramnios, absent/small stomach bubble (both are nonspecific)

2. Postnatal: excessive salivation, coiled feeding tube on CXR, +/- contrast study

- Management:

- **Preoperative preparation:**

a. Continuous suctioning tube in the upper esophagus.

b. Head-up position or on the side.

c. Gentle low-pressure ventilation if baby is in respiratory distress.

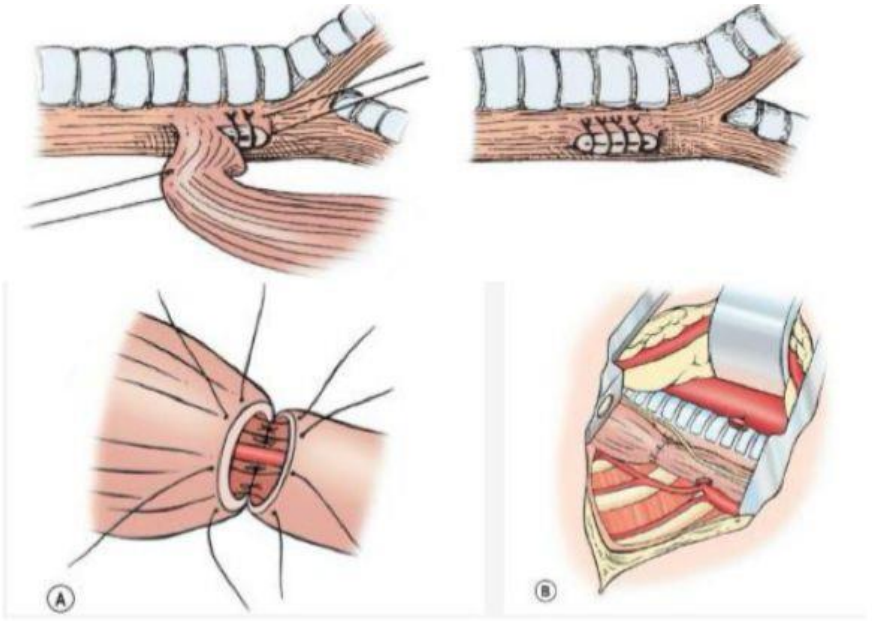
***Preoperative workup: ECG (to rule out cardiac and aortic arch anomalies), renal ultrasound, and spine radiographs.

- **Operative repair** depends on the gap between esophageal ends:

a. < 2vertebrae → primary anastomosis

b. 2-6 vertebrae → gastrostomy + delayed primary anastomosis

c. >6 vertebrae → gastrostomy + esophagostomy + esophageal replacement later on



Main principle of surgery: to remove the fistula and anastomose the two ends of the esophagus.

Note that the proximal part of the esophagus is dilated due to saliva collection.

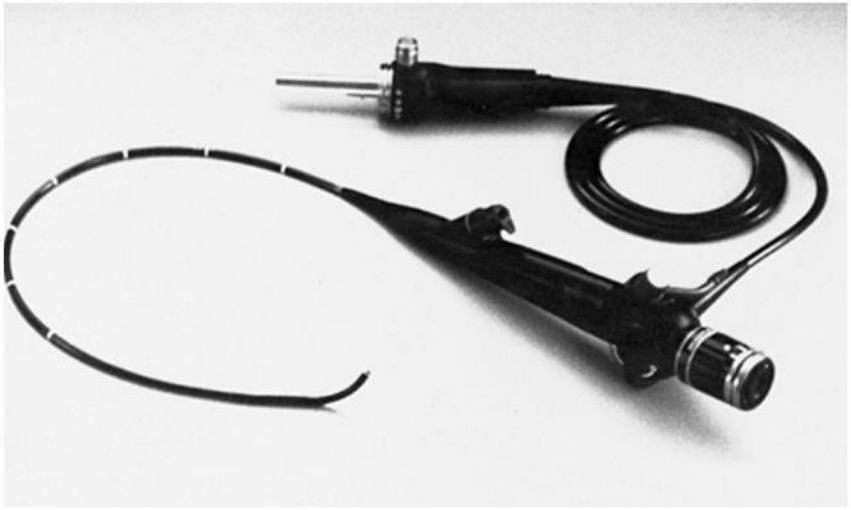
COMPLICATIONS

- Anastomotic Leaks (3.5-17%)
- Anastomotic Stricture (17-60%)
- Recurrent Tracheoesophageal Fistula (3-15%)
- Tracheomalacia
- Disordered Peristalsis → GERD → ?! Esophageal Cancer
- Vocal Cord Dysfunction
- Respiratory Morbidity
- Thoracotomy-Related Morbidity

Foreign Body Aspiration

- ❖ Common Aspirated Foreign Bodies
- ✓ Organic: Peanuts, seeds, popcorn, hot dogs
- ✓ Inorganic: Small toys, coins, beads, pen caps
- ✓ Sharp Objects: Pins, needles, bones
- ❖ History: Sudden choking episode while eating or playing
- ❖ Physical Exam: • Diminished breath sounds • Wheezing (often unilateral)
  - Stridor (if upper airway obstruction)
- ❖ Imaging:
- CXR (Inspiratory & Expiratory Films): Air trapping, mediastinal shift
- Lateral Neck X-ray: Useful for upper airway objects
- CT Scan: If unclear
- Bronchoscopy (Gold Standard): Diagnostic & therapeutic
- ❖ Management
- Rigid bronchoscopy = gold standard (OR procedure)
- Performed under general anesthesia
- Remove object with forceps or suction

FLEXIBLE FIBEROPTIC VS RIGID METAL



FLEXIBLE FIBEROPTIC BRONCHOSCOPE

RIGID METAL BRONCHOSCOPE

IMAGE SOURCE: CLINICALGATE.COM | KARLSTORZ.COM

BRONCHOSCOPY DIAGRAM

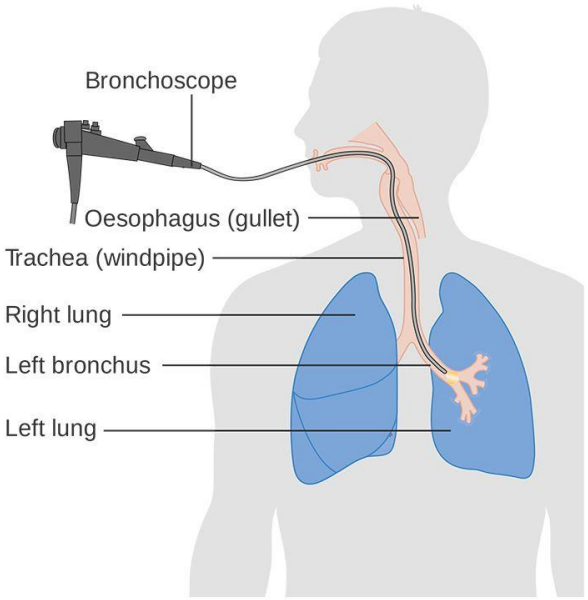


IMAGE SOURCE: WIKIPEDIA.COM

TRACHEA AND BRONCHIOLES

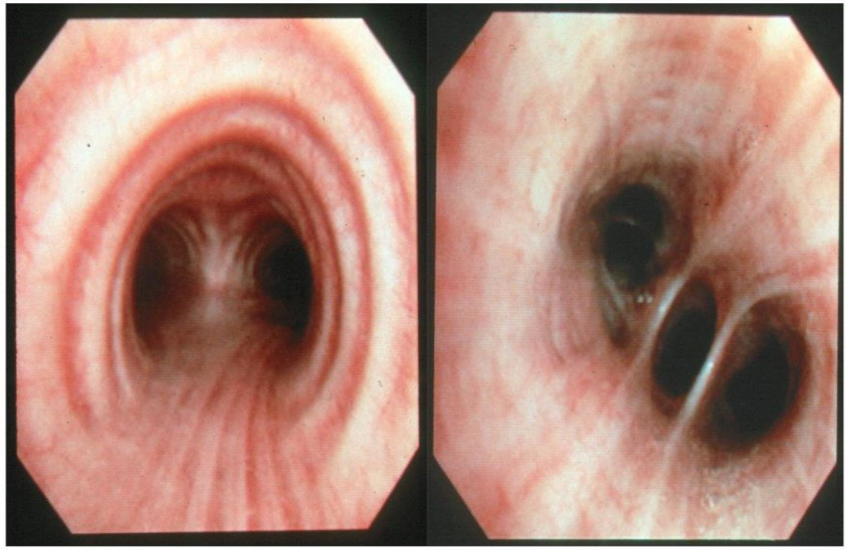


IMAGE SOURCE: COUGHDOC.COM

FOREIGN OBJECTS ON BRONCHOSCOPY

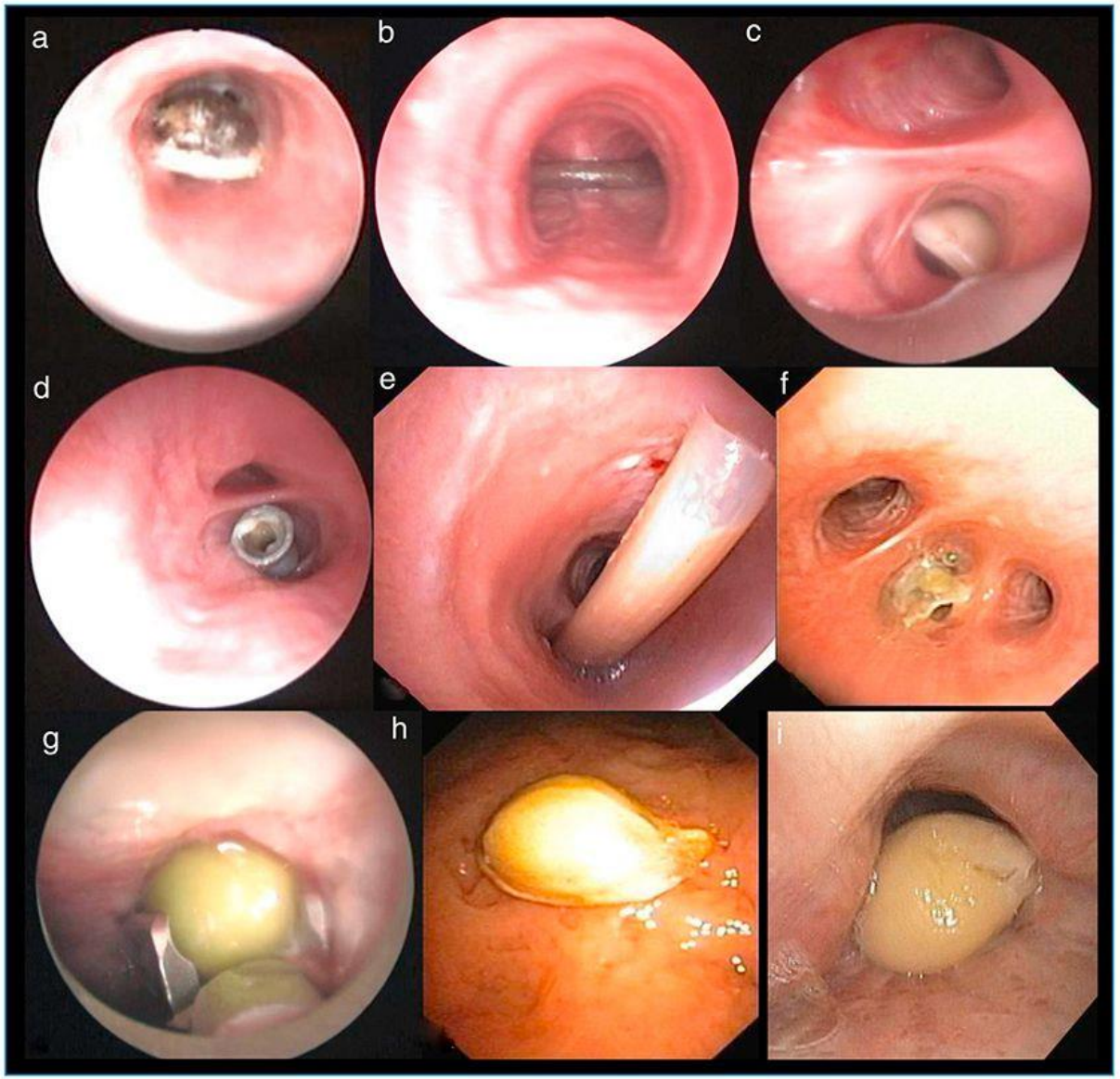
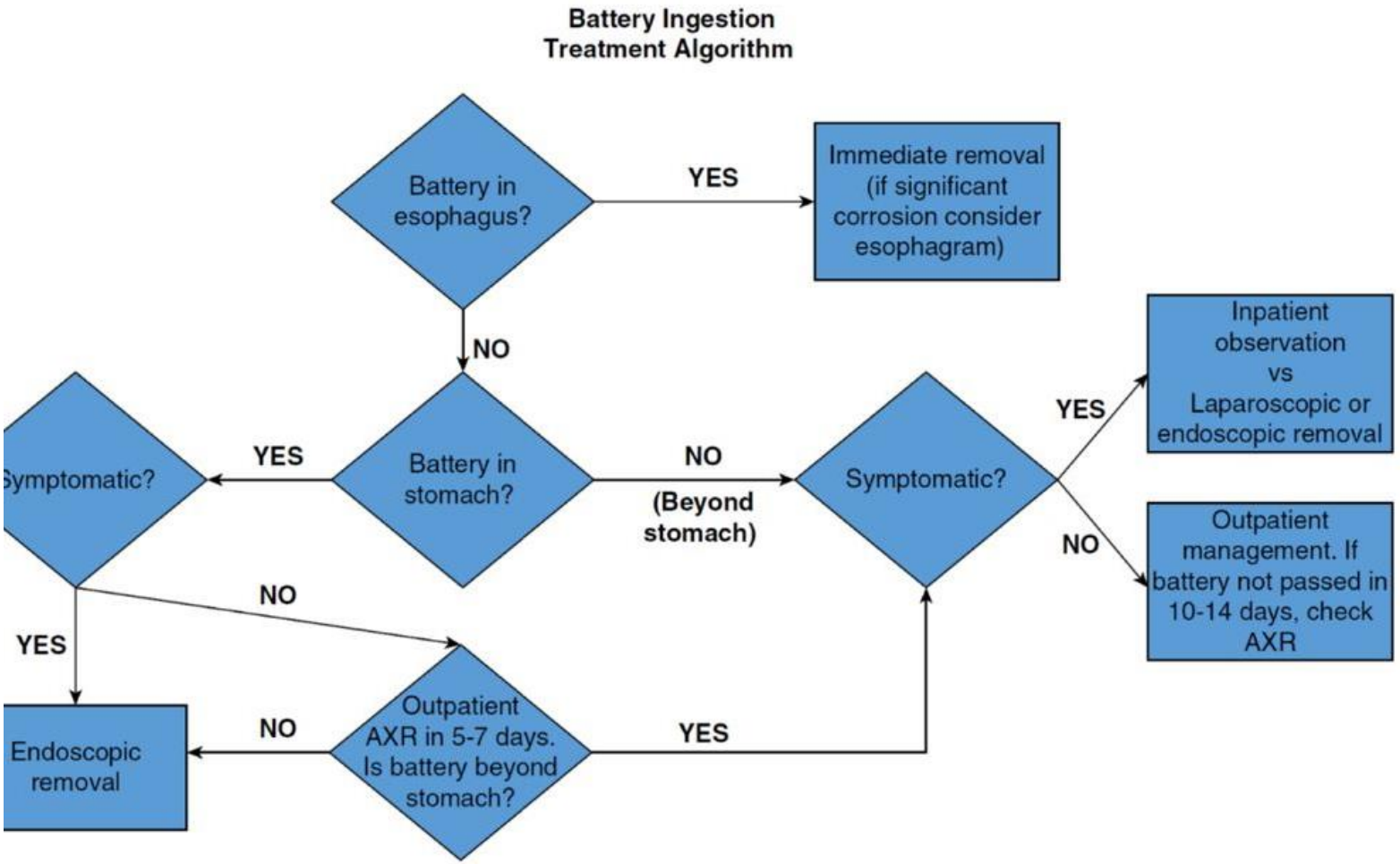


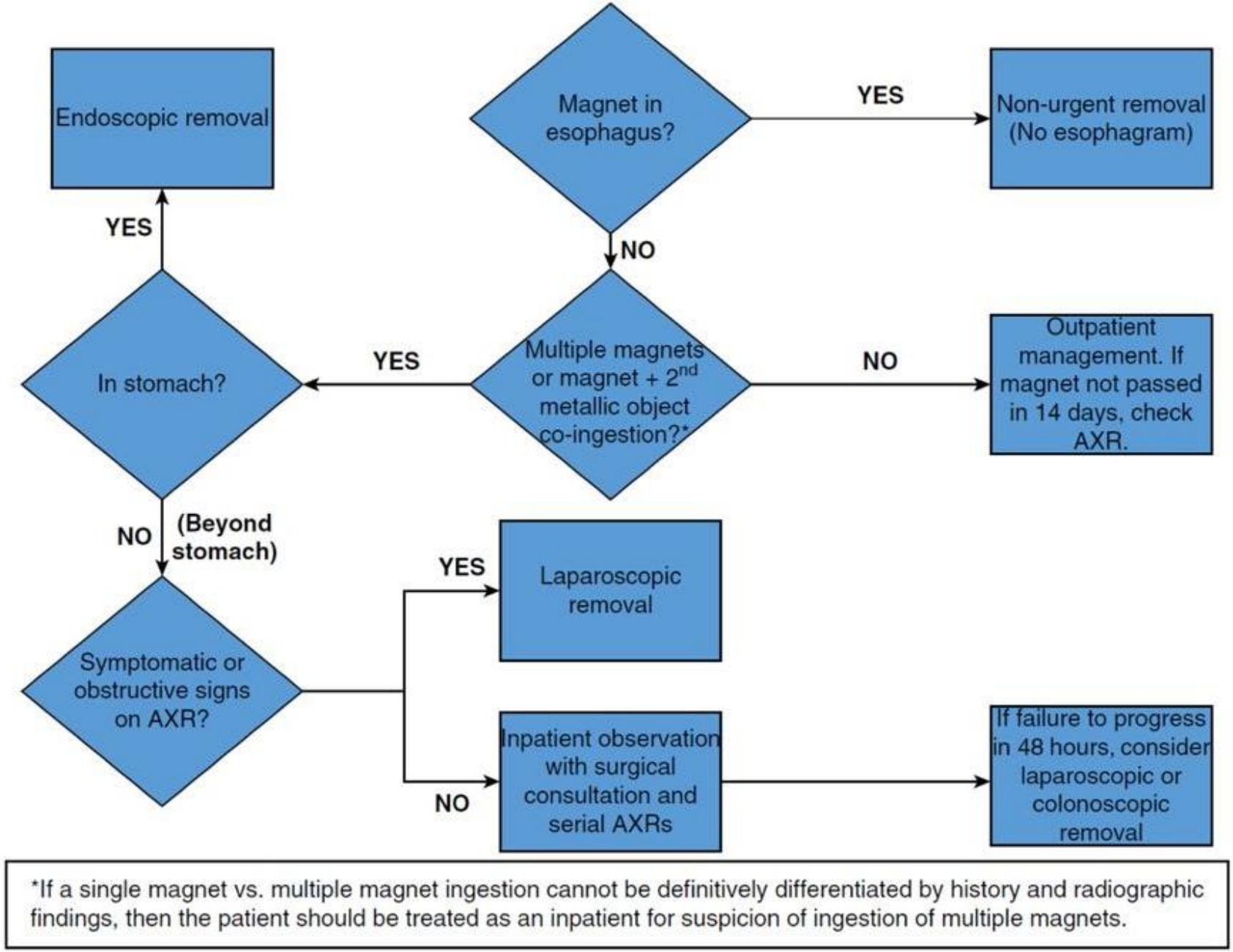
IMAGE SOURCE: JOURNALPULMONOLOGY.ORG


Battery Ingestion
Treatment Algorithm
Battery in esophagus?
YES
Immediate removal (if significant corrosion consider esophagram)
NO
Battery in stomach?
YES
Symptomatic?
NO
(Beyond stomach)
Symptomatic?
YES
Inpatient observation vs Laparoscopic or endoscopic removal
NO
Outpatient management. If battery not passed in 10-14 days, check AXR
YES
NO
Outpatient AXR in 5-7 days. Is battery beyond stomach?
NO
Endoscopic removal
YES

Lithium battery was removed

→ 1 week later, respiratory distress → bronchoscopy: tracheoesophageal fistula

double contour rim (button battery)



Management algorithm for ingested magnets

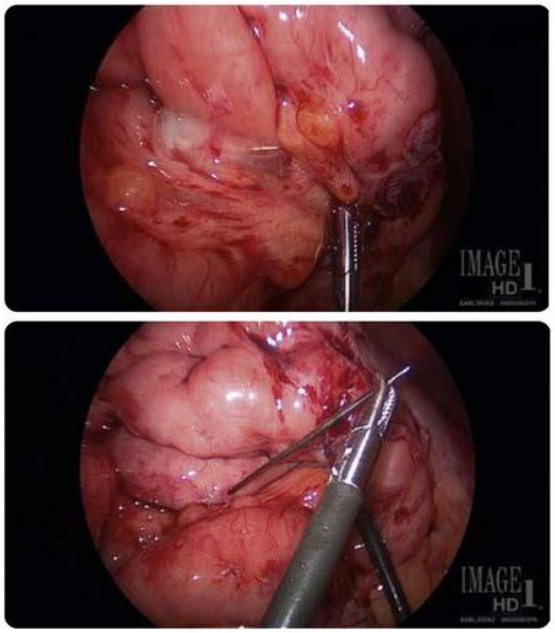
two small magnets ➔ exploratory laparotomy ➔ in two separate bowel lumens causing the bowel obstruction and fistulization

Table 22.8 Timing of endoscopy in foreign body ingestion

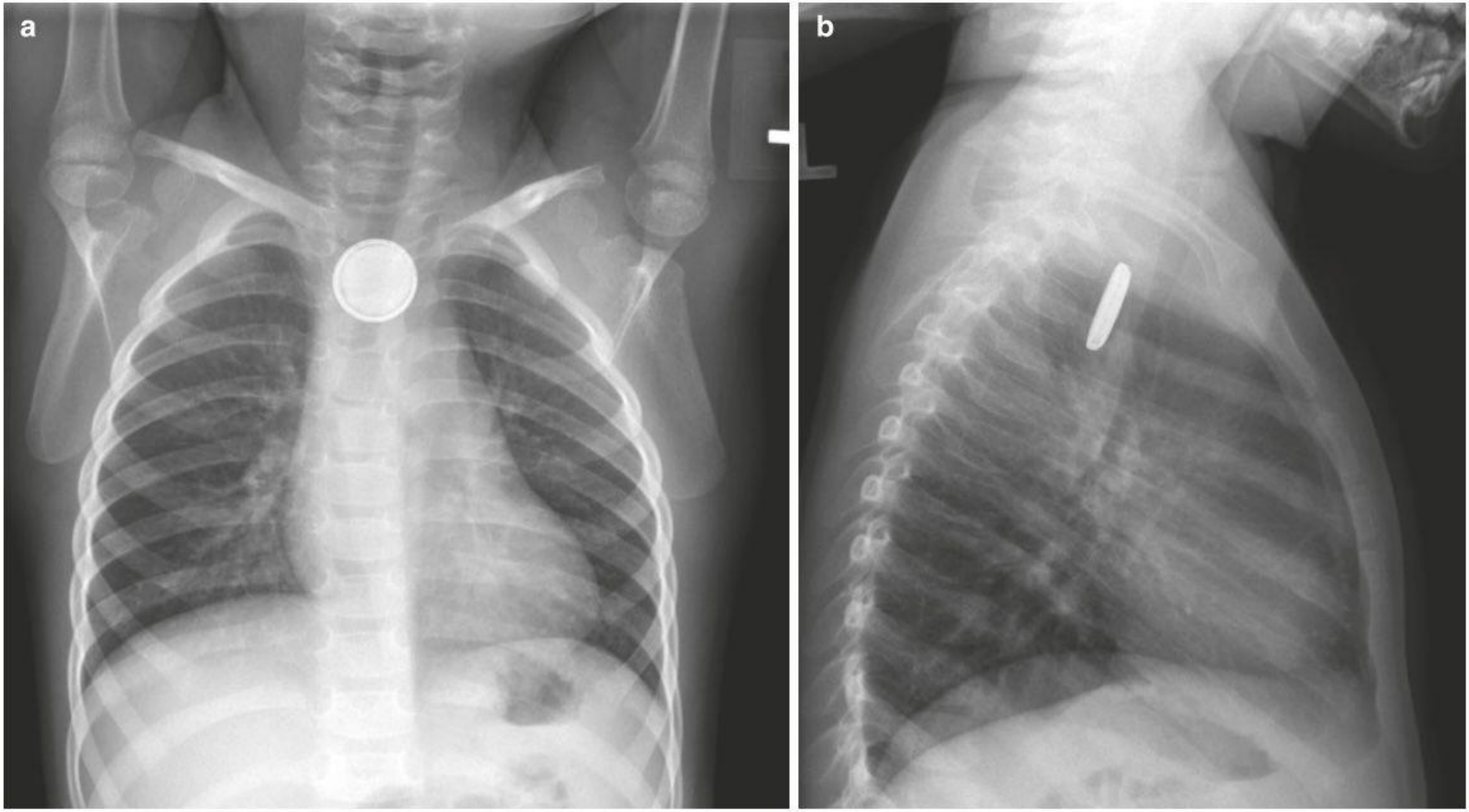
Type	Location	Symptoms	Timing
Button battery	Esophagus	Yes or no	Emergency
	Gastric/SB	Yes	Emergency
		No	Urgent (if age < 5 and BB ≥ 20 mm)
			Elective (if not moving)
Magnets	Esophagus	Yes	Emergency (if not handling secretions)
		No	Urgent
	Gastric/SB	Yes	Emergency
		No	Urgent
Sharp object	Esophagus	Yes	Emergency (if not handling secretions)
		No	Urgent
	Gastric/SB	Yes	Emergency (if signs of perforation, with surgery)
		No	Urgent
Food impaction	Esophagus	Yes	Emergency (if not handling secretions)
		No	Urgent
Coin	Esophagus	Yes	Emergency (if not handling secretions)
		No	Urgent
	Gastric/SB	Yes	Urgent
		No	Elective
Long object (> 4 cm)	Esophagus	Yes or no	Urgent
	Gastric/SB	Yes or no	Urgent
Absorptive object	Esophagus	Yes	Emergency (if not handling secretions)
		No	Urgent
	Gastric/SB	Yes or no	Urgent

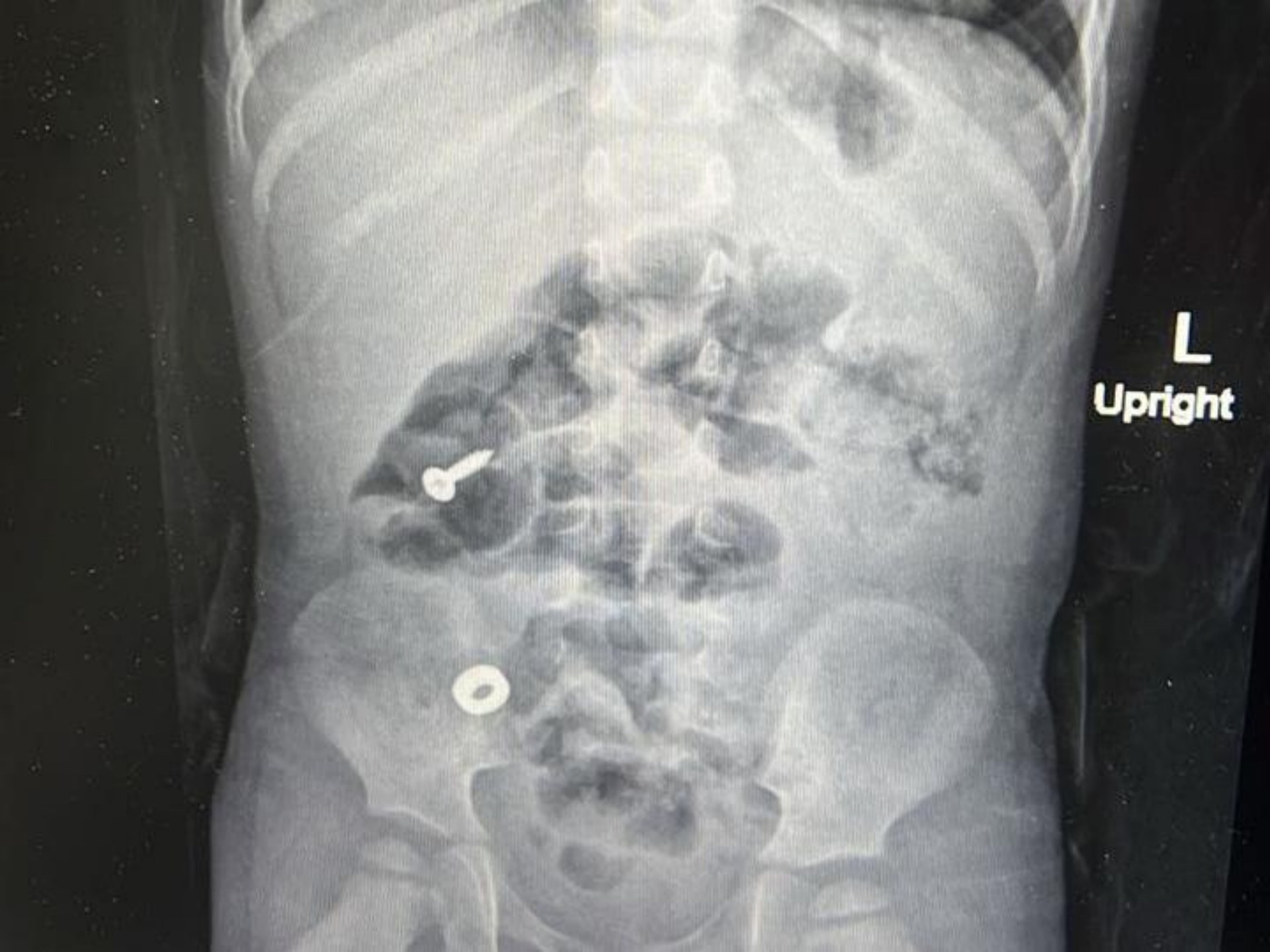
From Kramer et al. [3], with permission

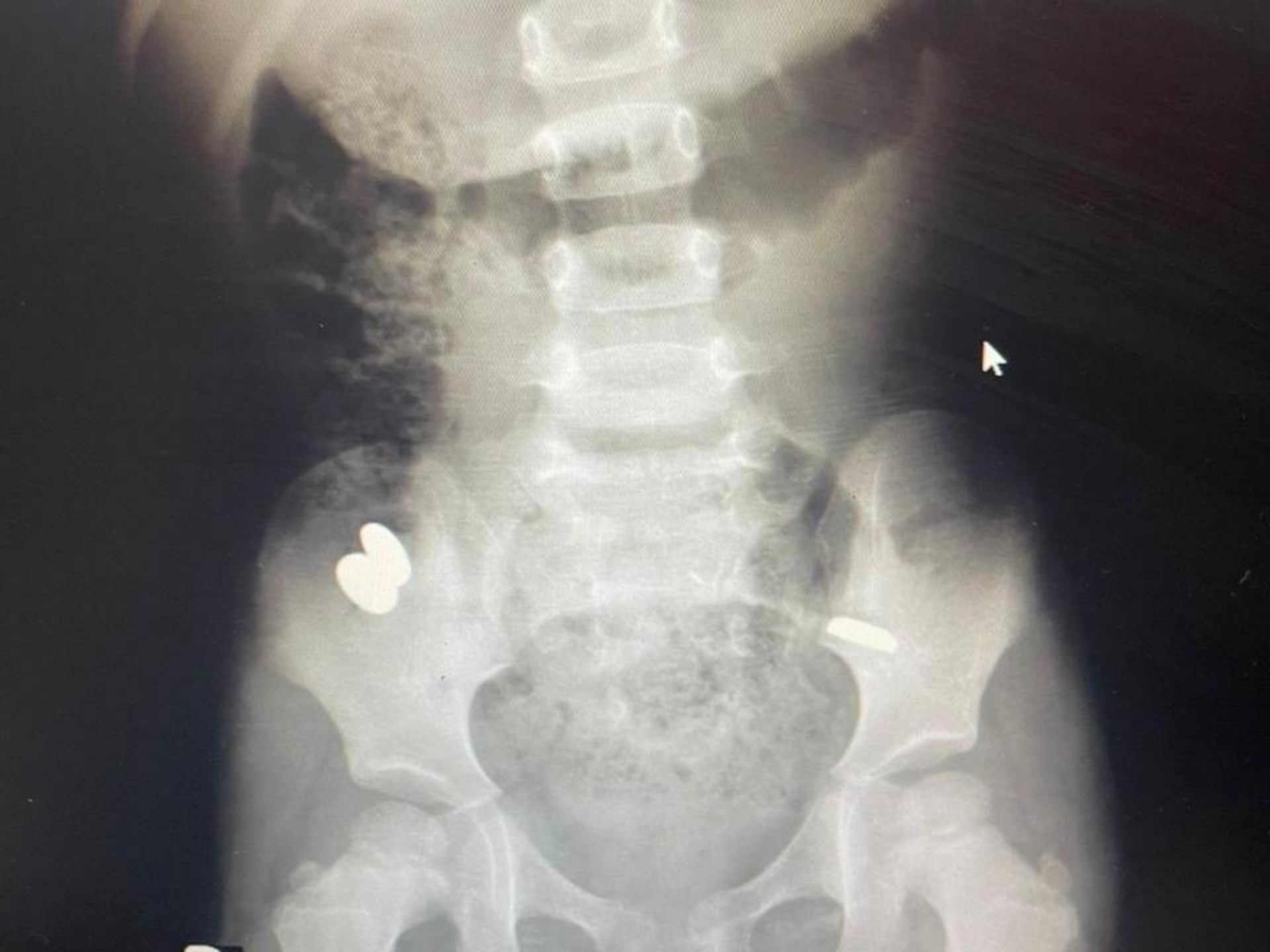
BB Button battery, *SB* Small bowel. Emergency = Move to endoscopy as quickly as possible, < 2 h Urgent = Endoscopy within 24 h after appropriate *nil* per os (NPO) period. Elective = Endoscopy after appropriate NPO period at next available time



sewing needle was ingested ➔ diagnostic laparoscopy ➔ penetrated the proximal jejunum ➔ extracted


a
b


L
Upright



Neonatal Fluid Management

Type of fluid (dextrose 10%)

Daily Fluid Requirements by Postnatal Age:

Postnatal Age (Days)	Fluid Requirement (mL/kg/day)
Day 1	60–80 mL/kg
Day 2	80–100 mL/kg
Day 3	100–120 mL/kg
Day 4–6	120–150 mL/kg
Day 7+	150–180 mL/kg

Calculation Example:

For a neonate weighing 3 kg on Day 3:

- **Fluid Requirement:**

3 kg × 100 mL/kg/day = 300 mL/day

Thank You! ❤