Intussusception

Intussusception

- It is an acquired invagination of the proximal bowel (intussusceptum) into the distal bowel (intussuscipiens).

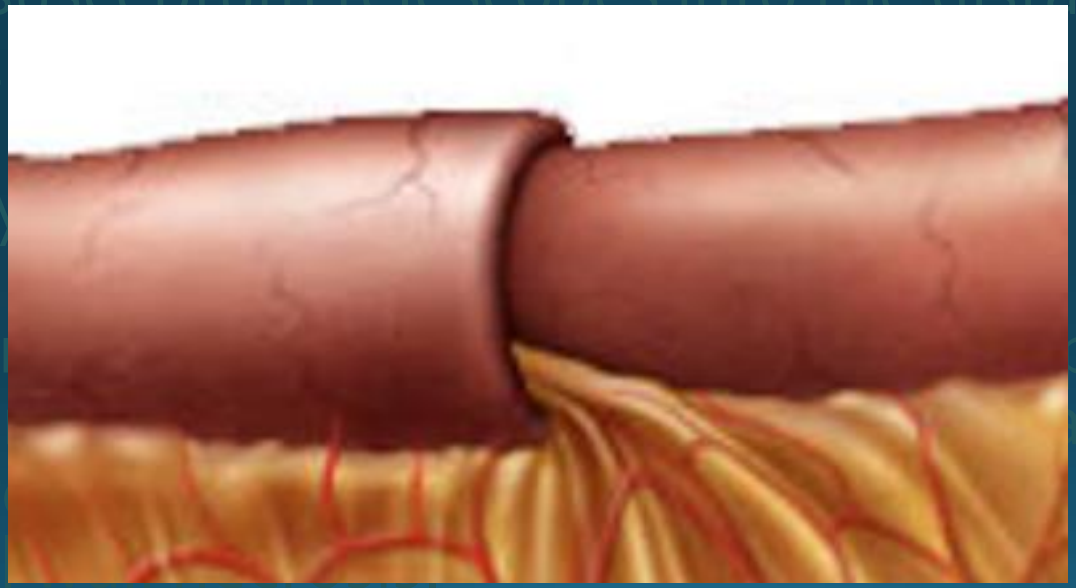
- The most frequent cause of bowel obstruction in infants and toddlers.

PATHOPHYSIOLOGY

- The intussusceptum telescopes into the distal bowel by peristaltic activity.
- There may or may not be a lead point.
- The mesentery of the proximal bowel is compressed, resulting in venous obstruction and bowel wall edema → may progress into arterial insufficiency → ischemia and bowel wall necrosis.

PATHOPHYSIOLOGY

- The intussusceptum telescopes into the distal bowel by peristaltic
- There may
- The meser pressed, resulting i ll edema → may pr ischemia and bowe



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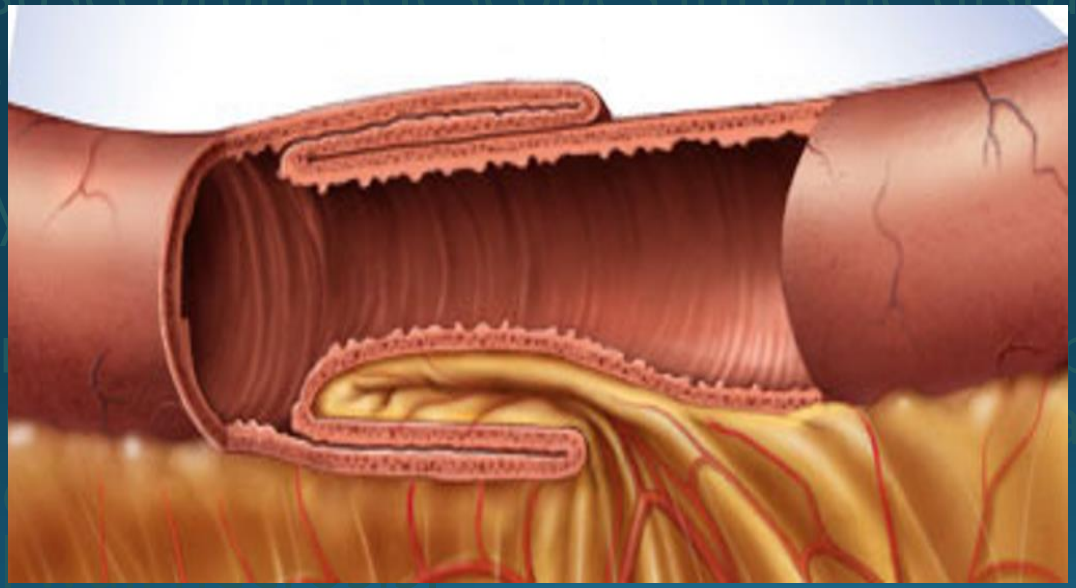


Types of Intussusception

- Primary (idiopathic) - most common
- Secondary

Primary Intussusception

- There is no lead point (the cause is generally attributed to hypertrophied Peyer patches within the bowel wall).

- Occurs frequently after a recent URTI or gastroenteritis (an etiology for the hypertrophied lymphoid tissue | adenoviruses and rotaviruses in 50% of cases).

Secondary Intussusception

- There is an identifiable lesion that serves as a lead point
- Incidence: from 1.5% - 12%
- Increases in proportion with age

Secondary Intussusception

- Lead points & associated disorders:
  - Meckel diverticulum (most common)
  - Polyps
  - Duplications
  - Appendix
  - Hemangiomas
  - Carcinoid tumors
  - Foreign bodies
  - Ectopic pancreas or gastric mucosa
  - Hamartomas from Peutz–Jeghers syndrome
  - Lipomas
  - Malignant causes (rare | ↑ with age | as lymphomas and small bowel tumors)
  - Systemic diseases (as Henoch–Schönlein purpura and cystic fibrosis)
  - Celiac disease
  - *Clostridium difficile* colitis

INCIDENCE

- Idiopathic intussusception can occur at any age.
- Most patients are well-nourished, healthy infants.
- Two-thirds are boys
- The highest incidence: in infants 4-9 months
- Uncommon < 3 months and > 3 years of age

CLINICAL PRESENTATION

- The classic presentation is an infant or a young child:
  1. With intermittent, crampy abdominal pain
  2. Associated with 'currant jelly' stools (due to bowel ischemia and mucosal sloughing)
  3. Palpable mass on PEx

→ this triad is seen in <25% of children

CLINICAL PRESENTATION

- The abdominal pain is sudden and the child may stiffen and pull the legs up to the abdomen.
- The pain can also be associated with hyperextension, writhing, breath holding and vomiting.
- The attack often ceases as suddenly as it started.
- Between attacks, the child may appear comfortable but eventually will become lethargic.

CLINICAL PRESENTATION

- As the obstruction progresses:
  - Small or normal bowel movements will stop
  - Bilious emesis
  - Increasing abdominal distention

- Late signs include:
  - Passage of redcurrent jelly stools
  - Laboratory derangements (leukocytosis, and electrolyte abnormalities)

PHYSICAL EXAMINATION (early)

- Vital signs are usually normal (early in the disease course)
- During painless intervals: the child may appear comfortable and PEx may be unremarkable
- Cramping episodes usually occur every 15 to 30 minutes
- Abdominal Ex:
  - Right lower abdominal quadrant can appear flat or empty (Dance sign)
  - Sausage-shaped or curved mass (visualized &/or palpable)
  - Audible peristaltic rushes
  - On rectal Ex: bloodstained mucus or blood (a later sign)

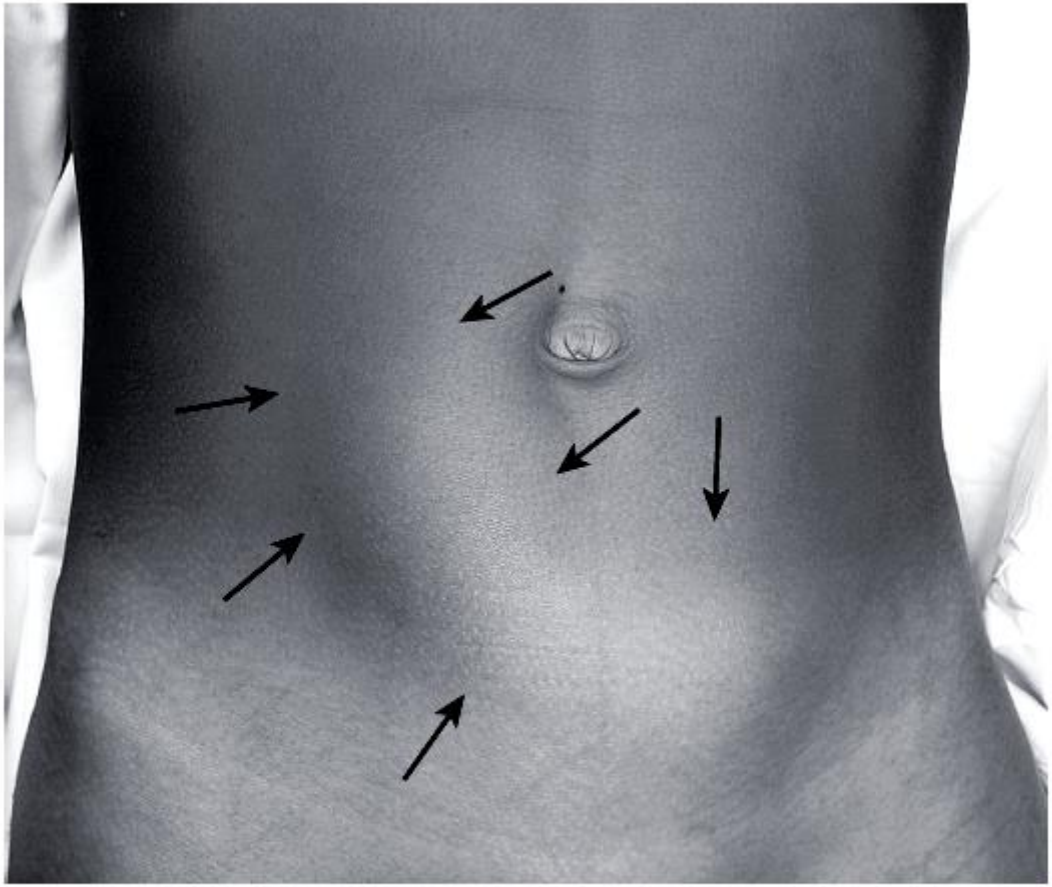


FIGURE 38-2 ■ This 10-year-old boy has a palpable sausage-shaped mass (arrows) due to an intussusception.

PHYSICAL EXAMINATION (late)

- Hypotension
- Fever
- Tachycardia
- Signs of dehydration
- Prolapse of the intussusceptum through the anus (a grave sign) [? rectal prolapse]

DIAGNOSIS

Abdominal Radiography (AXR)

- In 50% of cases, Dx can be suspected on AXR.
- AXR is not used as the sole diagnostic test.

- Suggestive findings:
  - Abdominal mass
  - Abnormal distribution of gas and fecal contents
  - Sparse large bowel gas
  - Air-fluid levels

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).

Ultrasonography (US)

- Advantages:
  - Lack of radiation exposure
  - Decreased cost
  - Ability to identify pathologic lead points
  - Can guide the therapeutic reduction of an intussusception

- Characteristic findings:
  - 'Target' or 'doughnut' lesion; in a transverse plane
  - 'Pseudokidney' sign; on longitudinal section

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 38-5 ■ Sonogram showing the 'pseudokidney' sign seen with intussusception on longitudinal section.

CT and MRI

- Neither are routinely used.
- Either may detect the pathologic causes for intussusception (as lymphoma).
- Characteristic CT finding: ‘target’ or ‘doughnut’ sign.

NONOPERATIVE MANAGEMENT

- NGT (to decompress the stomach)
- Bowel rest (NPO)
- IV fluid resuscitation
- CBC and serum electrolytes

Hydrostatic and Pneumatic Reduction

- When there are no contraindications to nonoperative reduction
- Contraindications include:
  - Intestinal perforation (free intra-abdominal air)
  - Peritonitis
  - Persistent hypotension
- Advantages (if succeeded):
  - Decreased morbidity
  - Dec. cost
  - Dec. length of hospitalization

Hydrostatic and Pneumatic Reduction

- Air or water-soluble isotonic contrast is used
- Successful reduction: **≈85%** (ranges 42% - 95%)
- The procedure is fluoroscopically monitored

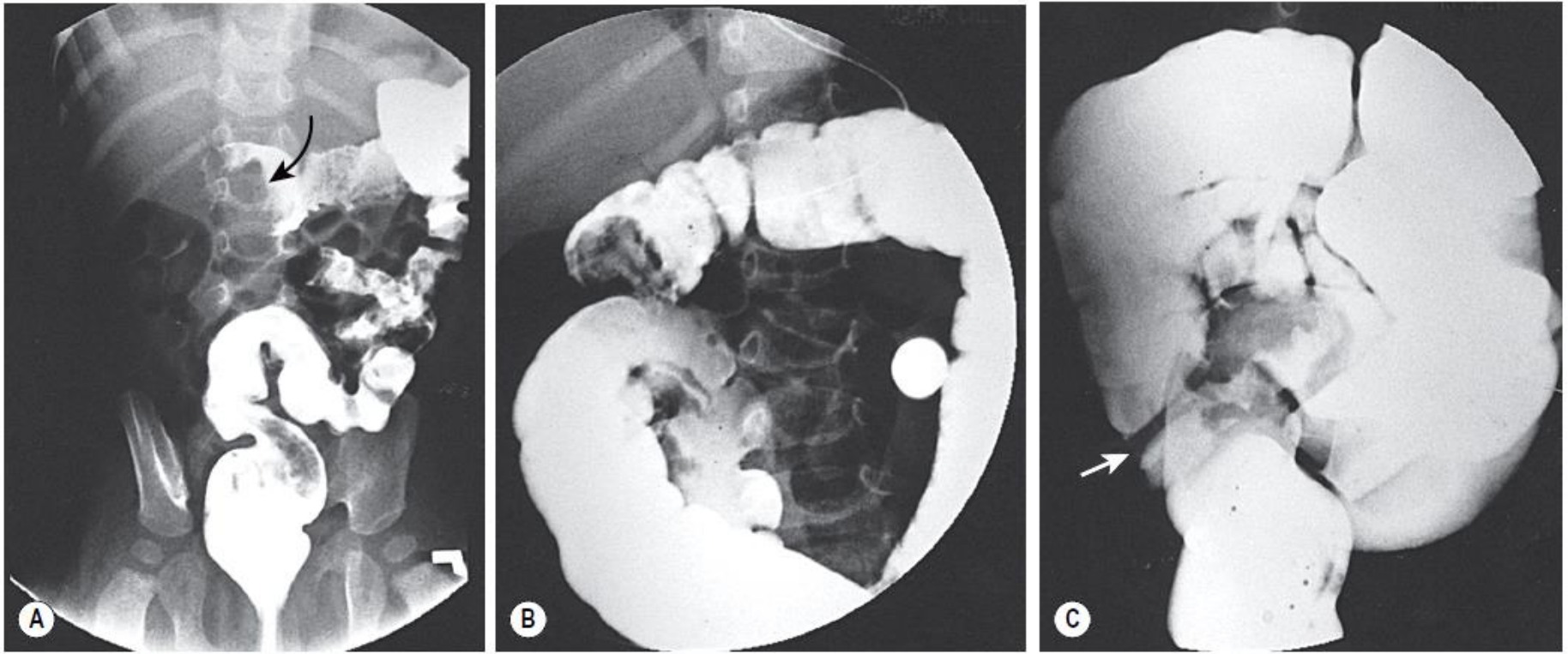


FIGURE 38-7 ■ Fluoroscopic examination using isotonic contrast for hydrostatic reduction of intussusception. (**A**) Intussusception (arrow) seen in midtransverse colon. (**B**) Reduction has occurred to the hepatic flexure. (**C**) Complete reduction with reflux of contrast medium into the terminal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

Hydrostatic and Pneumatic Reduction

- Pneumatic decompression:
  - Quicker, safer, less messy, and ↓ exposure time to radiation
  - Max. safe air pressure is:
    - 80 mmHg for younger infants
    - 110–120 mmHg for older infants
  - Drawbacks:
    - Possibility of tension pneumoperitoneum (rates of perforation 0.4-2.5%)
    - Poor visualization of lead points
    - Poor visualization of the intussusception reduction process

Hydrostatic and Pneumatic Reduction

- Rx of Tension pneumoperitoneum:
  - Immediate cessation of the procedure
  - Immediate release of pneumoperitoneum using a large gauge needle
  - Followed by immediate operative exploration

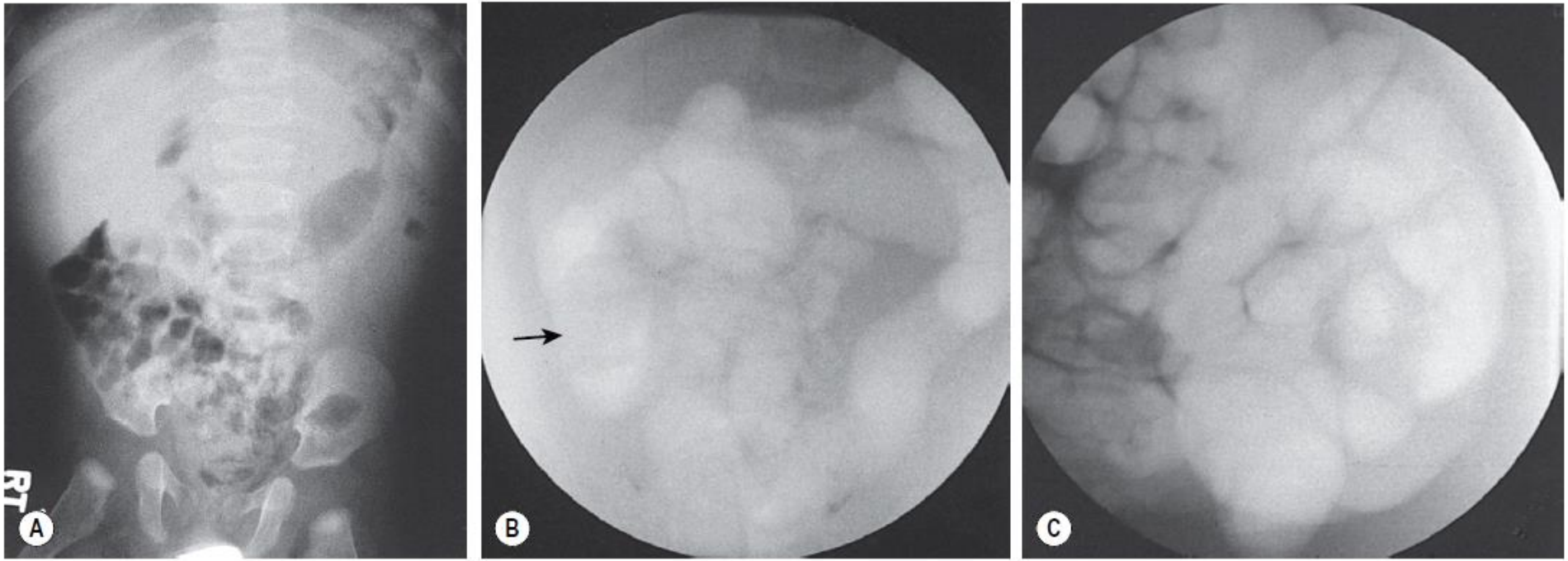


FIGURE 38-8 ■ Plain radiography and fluoroscopic examination using air for pneumatic reduction of an intussusception. **(A)** Plain radiograph showing a mass effect in the right upper quadrant. **(B)** Pneumatic reduction to the vicinity of the cecum with the intussusception still present (arrow). **(C)** Complete reduction with reflux of air into multiple loops of small intestine. (Courtesy of Charles Maxfield, MD.)

Hydrostatic and Pneumatic Reduction

- Results of nonoperative reduction:
  - Unsuccessful: perform a second attempt after 30 min to 24 hours
  - Successful: the patient should..
    - Be admitted for observation
    - Receive a short period of bowel rest
    - Be given intravenous fluids

OPERATIVE MANAGEMENT

Open Approach

- **Indications**:
  - When nonoperative reduction is unsuccessful or incomplete
  - For signs of peritonitis
  - Presence of a lead point
  - Radiographic evidence of pneumoperitoneum

Open Approach

- **Preoperative preparation:**
  - Broad-spectrum antibiotics
  - IV fluid resuscitation
  - Insertion of a urinary catheter (to monitor urine output)
  - NG tube for gastric decompression

Open Approach

- **Procedure**:
  - Right lower abdominal incision
  - Leading edge of the intussusceptum is gently manipulated back toward its normal position in the terminal ileum
  - Excessive force or pulling is avoided (to prevent injury or perforation)
  - Incidental appendectomy is often performed
  - Questionable ischemic bowel can be warmed with saline-soaked pads and re-evaluated.
  - +/- Resection and bowel anastomosis or diversion:
    - Inability to manually reduce the intussusception
    - The finding of ischemic bowel
    - Identification of a lead point

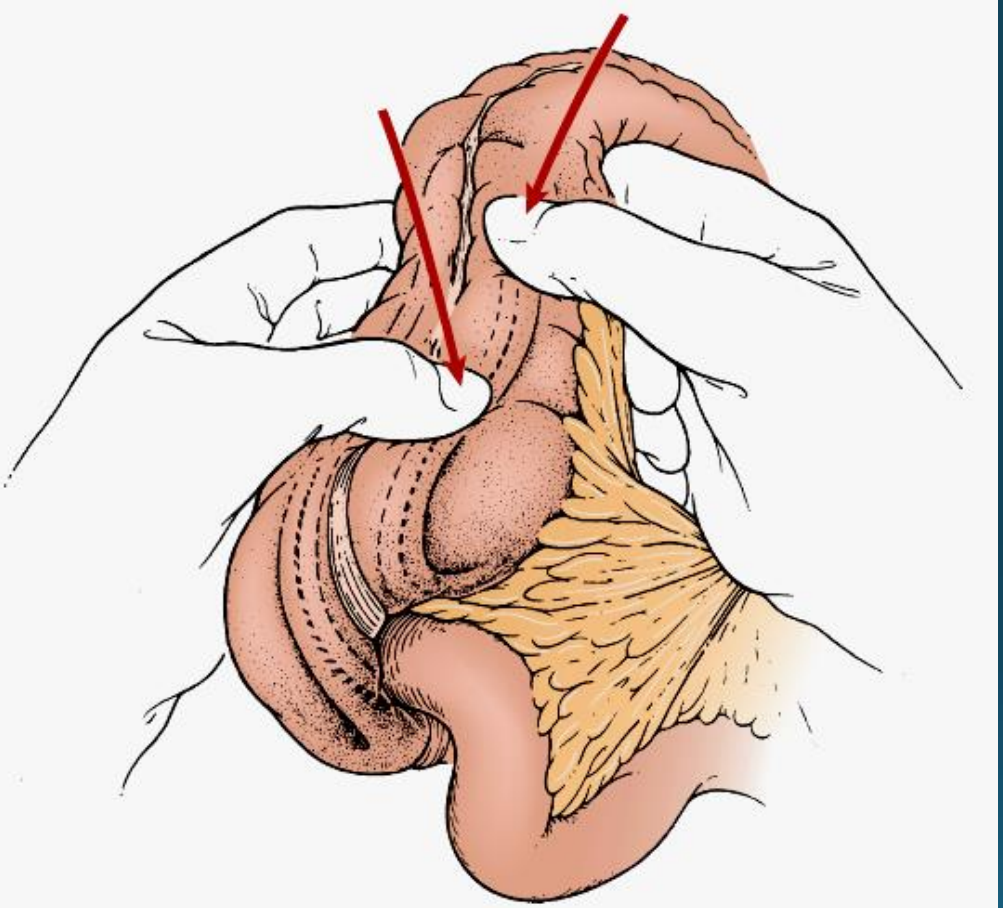


FIGURE 38-9 ■ A right lower quadrant muscle-splitting incision allows delivery of the intussusception through the incision. Gentle and continuous massage from distal to proximal usually results in reduction of the intussusception.

Laparoscopic Approach

- Recently, ↑ success rate
- Conversion rates as low as 5.4%
- Contraindications to laparoscopy:
  - Peritonitis
  - Hemodynamic instability
  - Severe bowel distension (precludes adequate visualization)

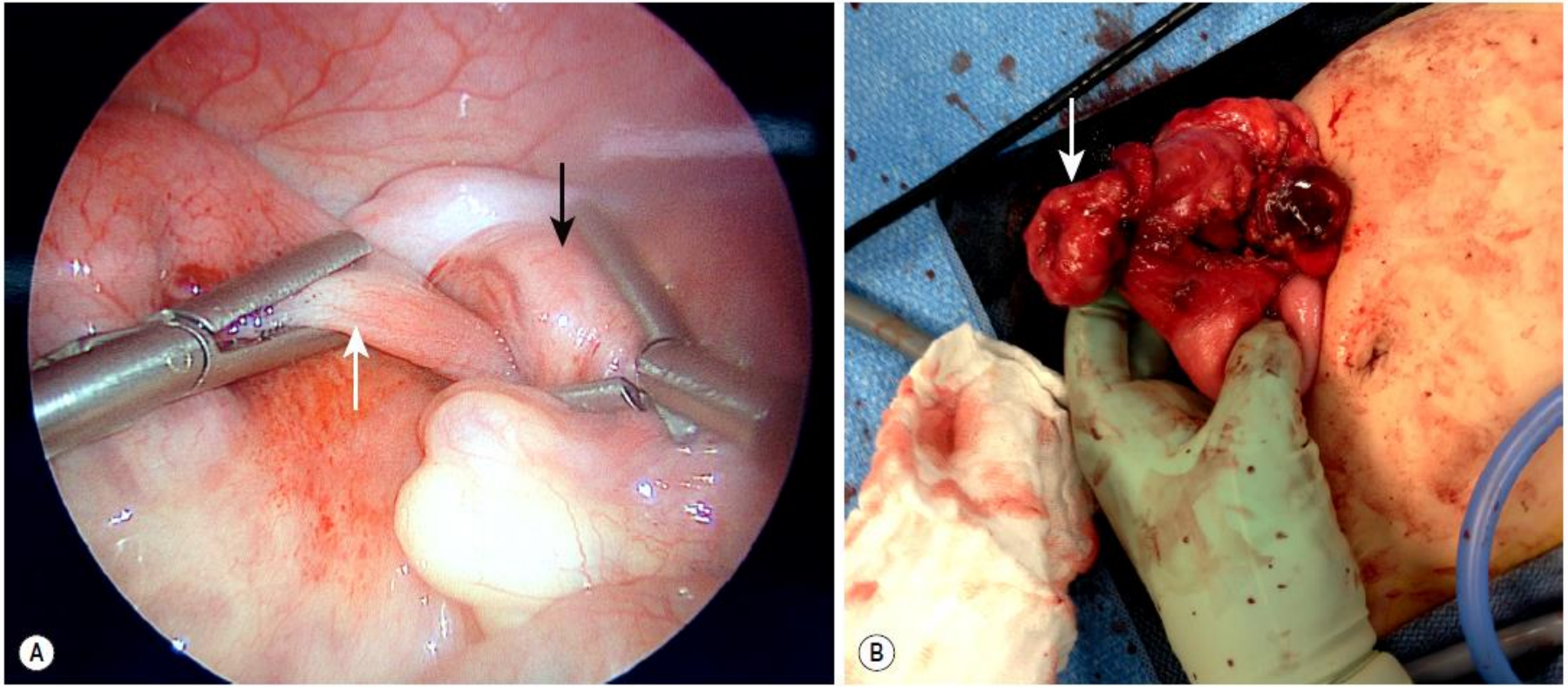
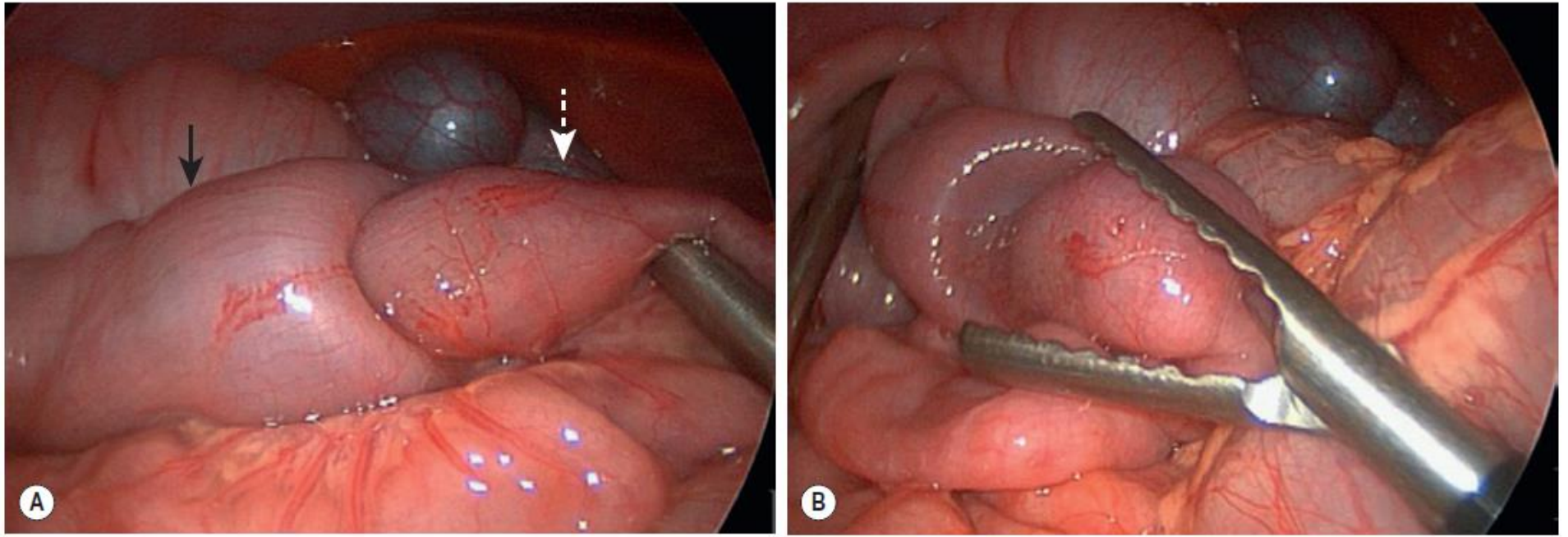


FIGURE 38-10 ■ **(A)** This laparoscopic photograph shows an incompletely reduced intussusception with the intussusceptum (white arrow) telescoping into the intussuscipiens (black arrow). **(B)** A pathologic lead point due to a Burkitt lymphoma was found requiring conversion to open.

Laparoscopic Approach

- **Procedure**:
  - The use of three abdominal ports.
  - Applying gentle pressure distal to the intussusceptum using atraumatic graspers.
  - Traction is usually required proximal to the intussuscipiens to complete the reduction.
  - If resection is required → can be accomplished by exteriorizing the bowel through the umbilical incision.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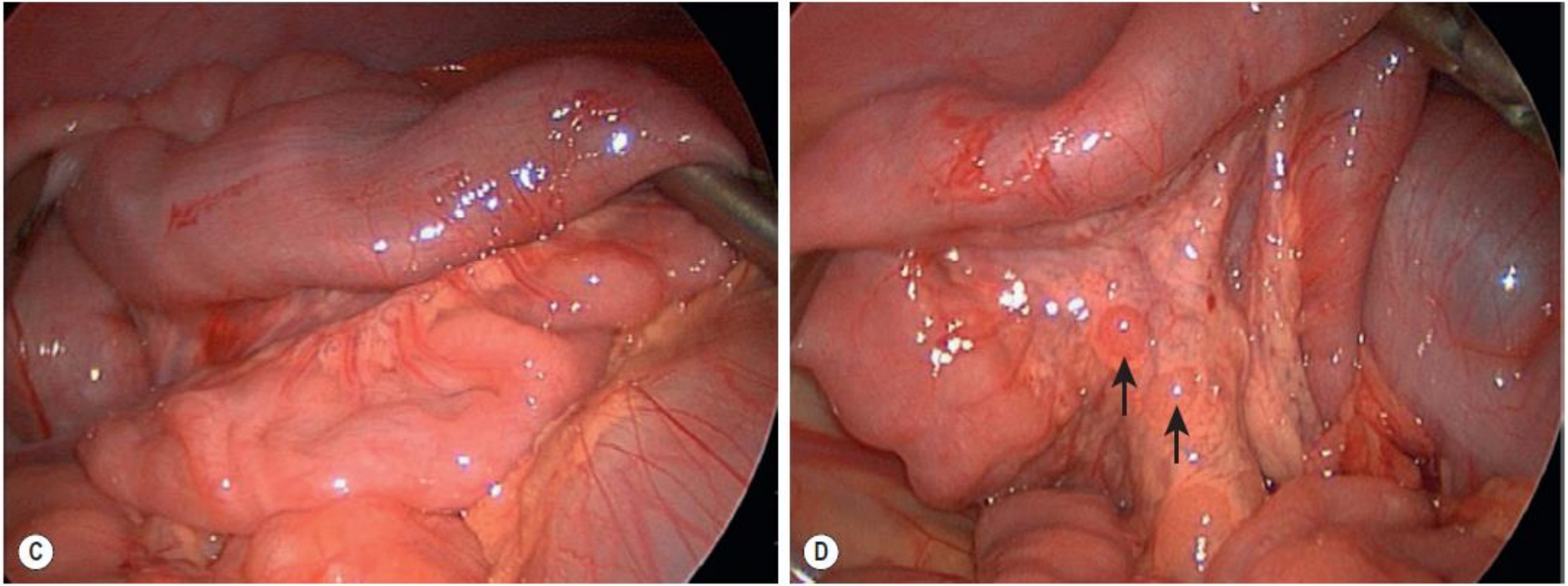


FIGURE 38-11 ■ Laparoscopic reduction of intussusception with hypertrophied lymph nodes is depicted in these four operative photographs. **(A)** Intussusceptum (white arrow) is seen telescoping into the intussuscipiens (black arrow). **(B)** The intussusception has almost been completely reduced. **(C)** 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.

RECURRENT INTUSSUSCEPTION

- With **nonoperative** intervention: **10–15%**
  (1/3 within 24 hrs | majority within 6 months)
- After **open operative** reduction or resection: recurrences are **less likely**
- After **laparoscopic reduction**: recurrence rate is **up to 10%**
- Recurrent intussusception tend to be seen earlier (parents are more aware)

POSTOPERATIVE INTUSSUSCEPTION

- A rare clinical entity..
  - often occurs in the initial 10 days postop.
  - 3-10% of cases of postoperative bowel obstruction

- Has been described after:
  - Ileocolic intussusception reduction and resection
  - Retroperitoneal dissections
  - Long intra-abdominal procedures
  - Ladd procedure
  - Extra-abdominal operations

POSTOPERATIVE INTUSSUSCEPTION

- Dx:
  high index of suspicion + ultrasound

- Rx:
  operative reduction (mostly without resection)

HYPERTROPHIC PYLORIC STENOSIS

HYPERTROPHIC PYLORIC STENOSIS (HPS)

- One of the most common surgical conditions of the newborn.
- M:F = 4 : 1
- Risk factors:
  - Family history
  - Male gender
  - Younger maternal age
  - Being a first-born infant
  - Maternal feeding patterns
- Premature infants are diagnosed with HPS later than term or post-term infants.

Etiology

Unknown (multifactorial with environmental influences)

- Genetic factors
  - race discrepancies
  - increased frequency in males
  - birth order (first-born infants with a positive family history)
- Environmental factors
  - method of feeding (breast vs formula)
  - seasonal variability
  - exposure to erythromycin
  - transpyloric feeding in premature infants
- Other factors
  - excessive substance P
  - decreased neurotrophins
  - deficient nitric oxide synthase
  - gastrin hypersecretion

Diagnosis

- Classic presentation:
  - nonbilious, projectile vomiting
  - full-term neonate
  - 2-8 weeks old

Diagnosis

- Initially, the emesis is infrequent (appear to be gastroesophageal reflux disease)

→ after short period, the emesis occurs with every feeding and becomes forceful (projectile)

- The contents of the emesis are usually the recent feedings (signs of gastritis are not uncommon ('coffee-ground' emesis))

Diagnosis

- PEx:
  - Early: the neonate usually appears well
  - Later: dehydration, somnolence
  - Visible peristaltic waves (in the mid to left upper abdomen)
  - Pylorus may be palpable "olive sign" (70–90% of patients)

  Profound dehydration (rarely seen today due to early Dx and proper fluid management)

Diagnosis

- Labs:
  - Hypochloremic
  - Hypokalemic
  - Metabolic alkalosis

  seen in most patients

[? paradoxical aciduria]

Diagnosis

- Ultrasound:
  - Standard technique for diagnosing HPS
  - Muscle thickness ≥ 4 mm (or > 3mm if <30 days of age)
  - Pyloric channel length ≥ 16 mm

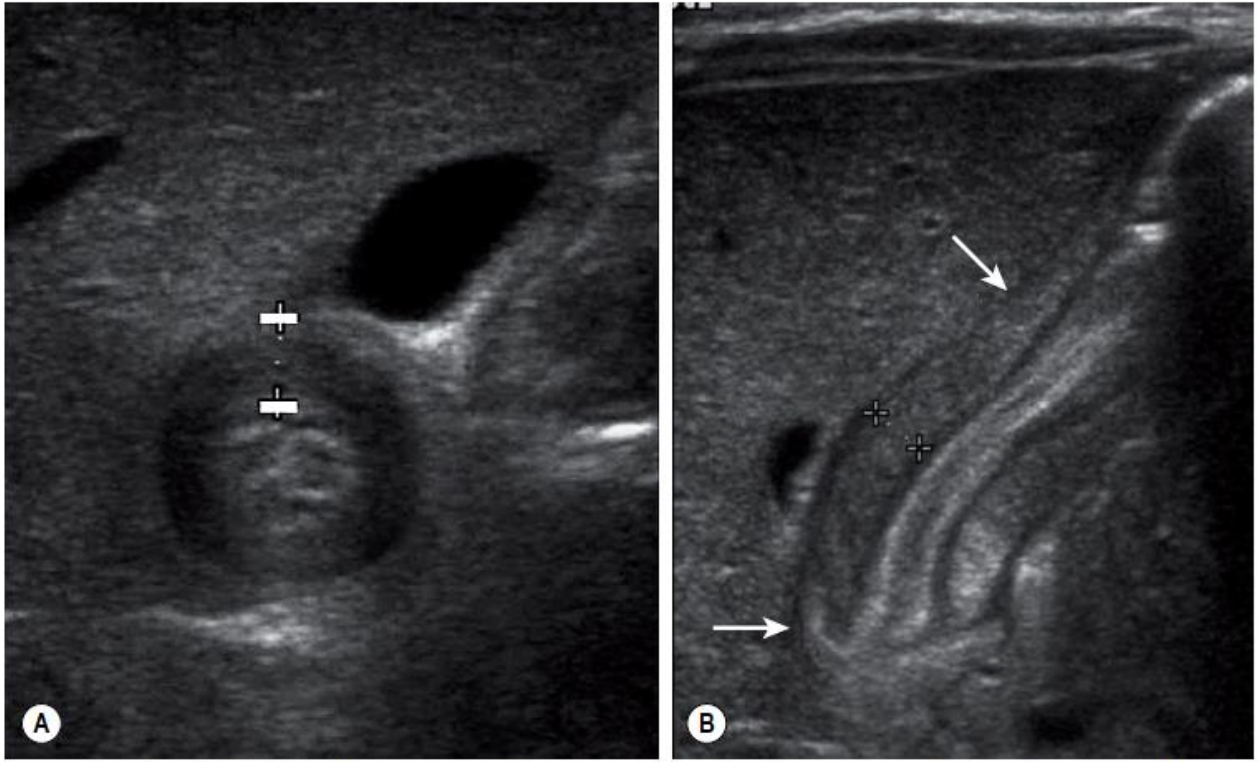


FIGURE 29-1 ■ Ultrasonography has become the standard imaging study for diagnosing pyloric stenosis and has supplanted physical examination at most institutions. The (**A**) transverse and (**B**) longitudinal views of hypertrophic pyloric stenosis are seen here. Muscle thickness greater than or equal 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.

Diagnosis

- Upper GI series:
  - If US findings are equivocal
  - "String sign"
  - "Double track" sign

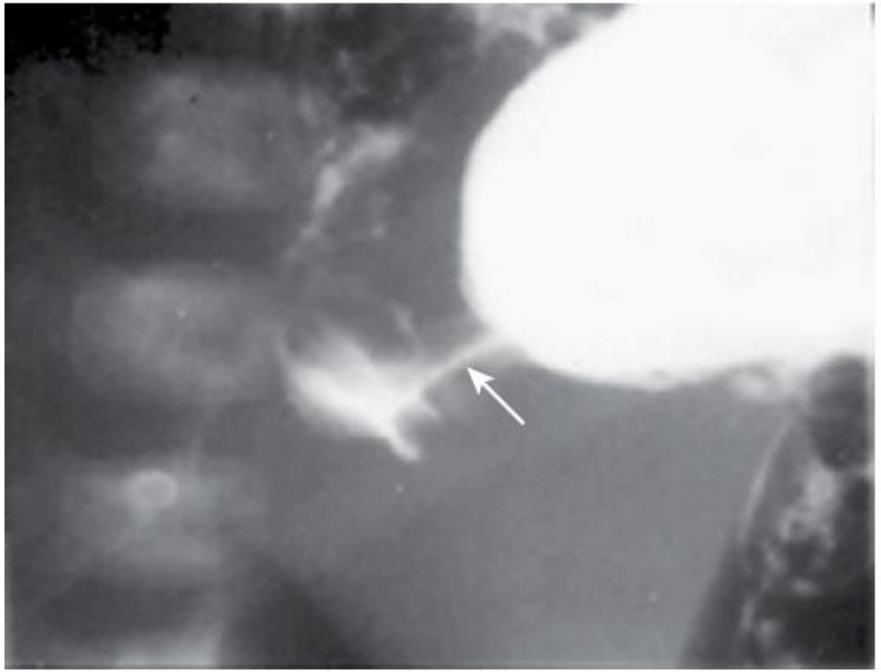


FIGURE 29-2 ■ At some hospitals outside of urban centers, ultrasound technicians and radiologists proficient in performing an ultrasound study for pyloric stenosis are not available. Also, in some instances, an ultrasound study can be equivocal. An upper gastrointestinal series can be helpful in making the diagnosis of pyloric stenosis or confirming an equivocal ultrasound study. In this upper gastrointestinal study, note the 'string sign' indicating a markedly diminished pyloric channel (arrow) and subsequent gastric outlet obstruction. It is important to evacuate the contrast material after this study to reduce the risk of aspiration and pulmonary complications.

DDx for nonbilious vomiting

- Medical causes:
  - Gastroesophageal reflux
  - Gastroenteritis
  - Increased intracranial pressure
  - Metabolic disorders

- Anatomic causes:
  - Antral web
  - Foregut duplication cyst
  - Gastric tumors
  - A tumor causing extrinsic gastric compression

Treatment

- HPS is **NOT** a surgical emergency

- IV fluid resuscitation is the initial priority (and correction of electrolyte abnormalities)
- Feedings should be withheld (+/- gastric decompression for extreme cases)
- Surgical correction "Pyloromyotomy"

- Other reported modalities (require long periods, and often not effective):
  - medical treatment with atropine
  - pyloric dilation

Treatment

Inadequate preop. resuscitation
→ persistent metabolic alkalosis
→ decreased respiratory drive
→ can lead to postoperative apnea

The Open Approach

- Incision options:
  - Right upper quadrant transverse incision (used most commonly)
  - Omega-shaped incision around the superior portion of the umbilicus followed by incising the linea alba cephalad

- Pylorus is exteriorized through the incision
- Longitudinal serosal incision is made in the pylorus
- Blunt dissection to divide the firm pyloric fibers until the pyloric submucosal layer is seen, and mucosa bulges out
- Abdominal incision is then closed in layers

The Open Approach

- If perforation is large or in the middle of the myotomy..

→myotomy should be closed

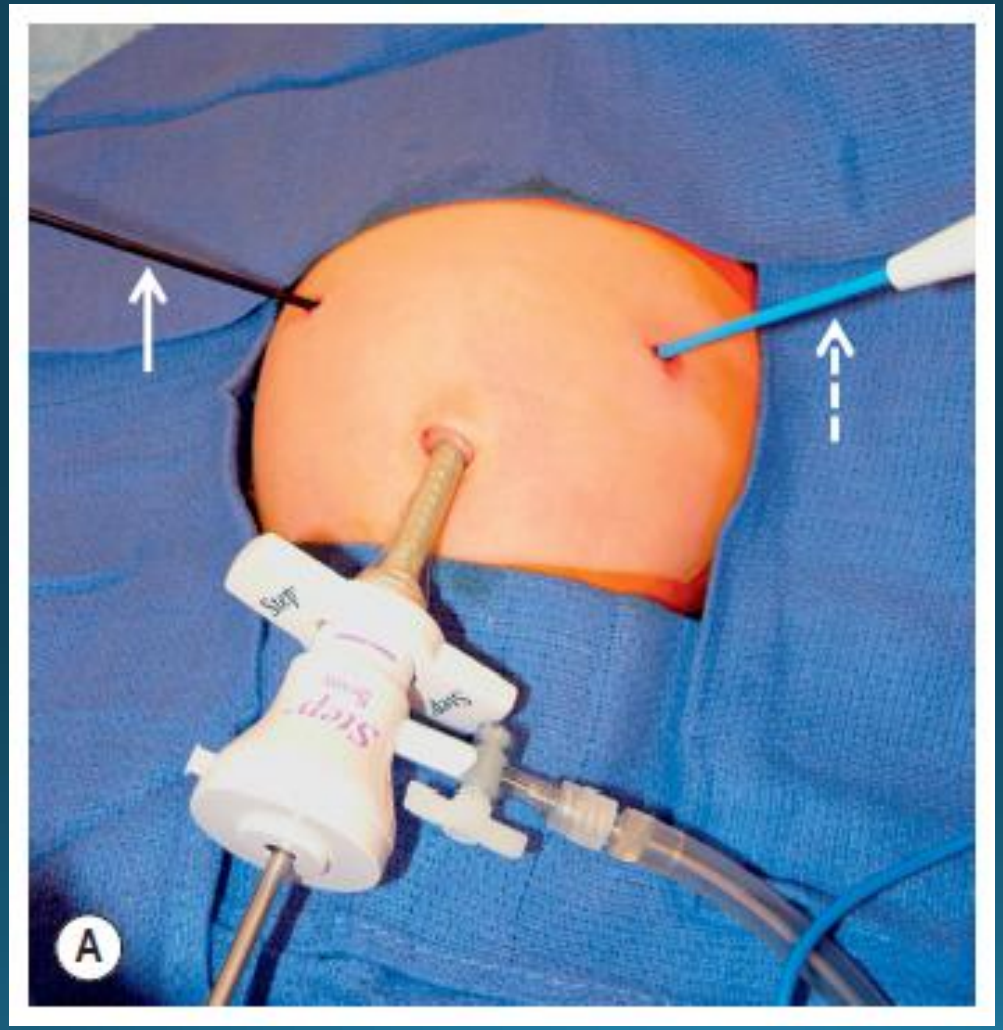
→a new myotomy made 90–180° from the original one

→feedings should be held for 24 hours postop. and then restarted

The Laparoscopic Operation

- Recent randomized prospective trials have not shown any difference in complication rates between open and laparoscopic operations.

- Technique:
  - Entering the abdomen through an umbilical incision
  - Abdomen is then insufflated
  - 3 ports for the lens and two instruments are introduced
  - A longitudinal pyloromyotomy is made
  - Mucosal integrity is checked
  - Pneumoperitoneum is evacuated after the instruments are removed
  - The umbilicus & other incisions are closed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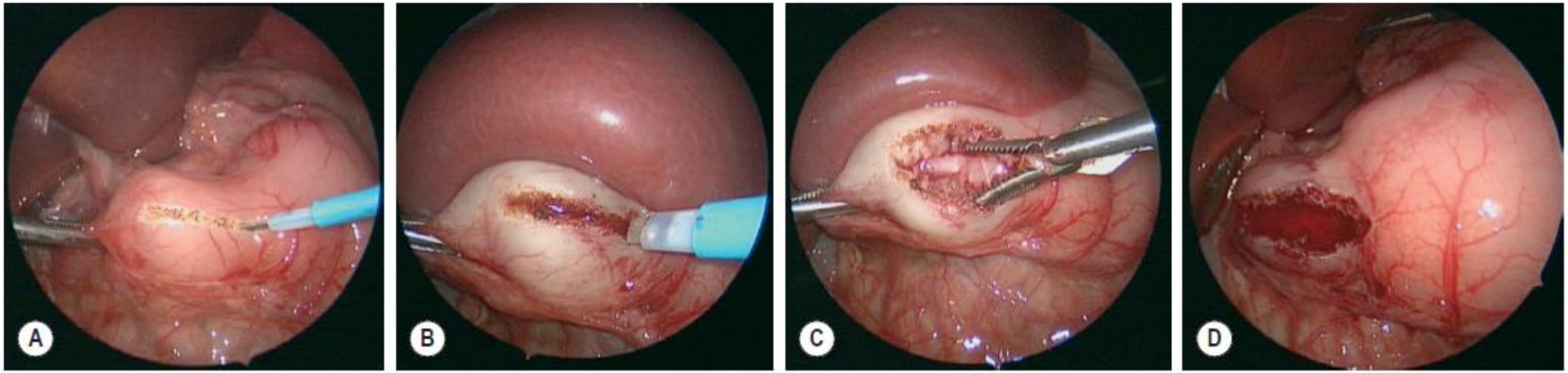

FIGURE 29-5 ■ These intraoperative photographs depict a laparoscopic pyloromyotomy. (**A**) The spatula tipped cautery is being used to incise the serosa and outer muscular layer of the hypertrophied pylorus. (**B**) The tip of the cautery is introduced into the hypertrophied muscle and twisted to break 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.

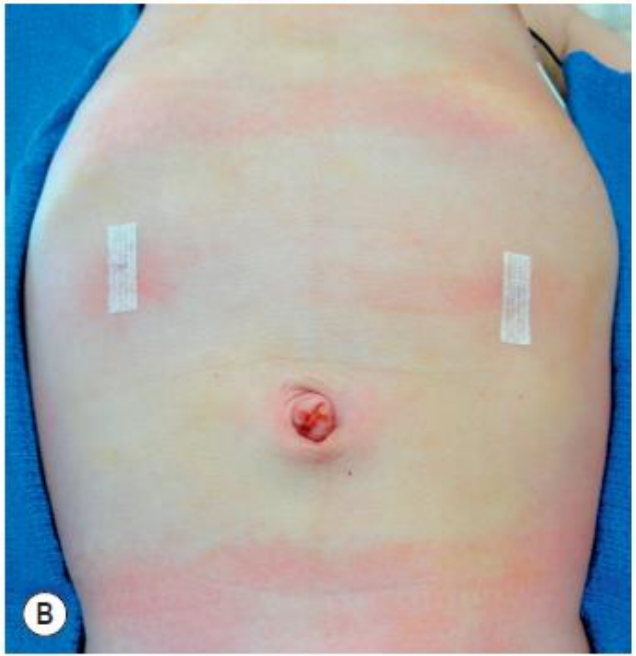

FIGURE 29-4 ■ Laparoscopic pyloromyotomy has become a common approach for pyloric stenosis in infants. In the USA, the sheathed arthrotomy knife is no longer available. Therefore, other techniques are now utilized. (**A**) The atraumatic grasper that is holding the duodenum is seen on the patient's right (solid arrow). In the patient's left upper abdomen, a spatula tipped cautery (dotted arrow) has been introduced to incise the serosa of the stomach . The 5 mm cannula has been placed in the umbilicus through which an angled telescope is introduced for visualization. (**B**) The stab incisions have been closed with steri-strips.

FIGURE 29-3 ■ These two children underwent open pyloromyotomy through a right upper quadrant transverse incision. Over time, the cosmetic appearance of their incision is not as attractive as that seen after the laparoscopic operation.

Postoperative Care

- Similar for both open and lap. approaches
- Ad libitum feedings in the early postoperative period (faster time to full feeding and earlier discharge)
- Pain is usually controlled with acetaminophen
- There are no data to support the use of prophylactic perioperative antibiotics (pyloromyotomy is a clean procedure)
- Most infants are ready for discharge on the first postoperative day

Complications

- Major complications include:
  - mucosal perforation (1-2%)
  - wound infection (1-2%)
  - incisional hernia (1%)
  - postoperative emesis (common | occur in most infants)
  - prolonged postoperative emesis (less common | 2-26% | due to GER or incomplete myotomy)
  - duodenal injury

Outcomes

- In the past, mortality rate was up to 50%
- Today, mortality rate is **nearly zero**;
  - improvement in neonatal resuscitation
  - improvement in neonatal anesthesia
  - improvement in surgical techniques
- Morbidity: overall complication rate between 1–2%

THANK YOU!

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