# Neonatal & Pediatric Abdomen

## Chapter 25

1

## Objectives:

- Recognize different pediatric stages and best techniques to maximize patient cooperation
- Identify pediatric gastrointestinal pathologies that may require emergent surgery
- Discuss sonographic techniques used to detect different pediatric GI pathologies
- Describe symptoms related to pediatric GI pathologies
- Analyze sonographic images of the various pathologies

2

2

## Pediatric Scanning Considerations:

- Table 25.1, 25.2
- Always use warm gel
- Keep infant warm and secure
  - ✓ Wrap blankets around infant
  - ✓ Use as little gel as possible
  - ✓ Remove gel as soon as possible; it gets cold quickly
- Have them bring comfort items into exam room

3

3

## Pediatric Scanning Considerations (cont'd):

- Explain examination to parents and child
- Use age- appropriate terms
- Soft voice
- Eye contact
- Concentrate on child
- Begin exam in well-lit room
- Transducers
  -use highest frequency transducer for area imaged
  -linear, curved array, or sector

4

4

## Pediatric Scanning Considerations (cont'd):

- Take breaks:
  - ✓Give child a rest
  - ✓Let mother hold child until calm
  - ✓Feasible to allow child to lie next to mother on stretcher to continue exam
- Older child:
  - ✓Explain procedure before child undresses
  - ✓Have mother and child touch transducer and gel and be ready to "watch the movies"

5

5

## Pediatric Exam Prep:

Abdominal Ultrasound:

- 0-2 yr: NPO 4 hr
- 3-5 yr: NPO 5 hr
- 6+ yr: NPO 6 hr

Pelvic Ultrasound:

- 0-9 yr: Plenty of juice or water 30 minutes before examination and no voiding
- 10+ yr: 32 oz water 1 hour before examination. No voiding

6

6

# GI Pathology

COMMON SURGICAL CONDITIONS:

- The pediatric patient may appear in the general ultrasound lab on an emergent basis for extreme abdominal pain or vomiting with three common surgical conditions:
  - *Appendicitis*
  - *Intussusception*
  - *Hypertrophic pyloric stenosis*

7

7

# Appendicitis

❖ Most common cause of emergent surgical abdominal pain in children

❖ Mostly occurs in patients ages 5-15 years old, but may occur as young as three months old (although rare under the age of two)

❖ Male (1.7:1) prevalence

8

8

# Appendicitis (cont'd)

- Occurs when the appendiceal lumen becomes obstructed and subsequently infected
- In infants and young children, the progression of acute appendicitis to perforation is more rapid than in older children and adults, sometimes occurring within 6 to 12 hours
- Perforation of the appendix is a serious complication of appendicitis, along with peritonitis, abscess formation, and sepsis
- Right lower quadrant pain and vomiting are a common clinical presentation

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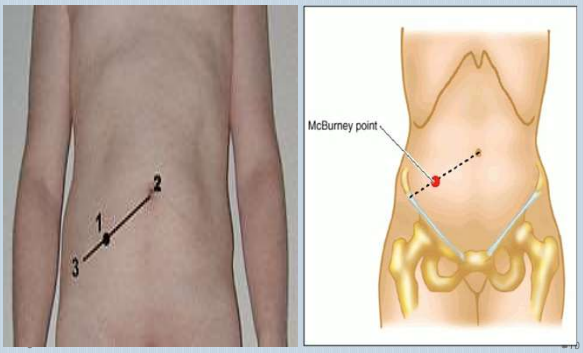
## McBurney's Point







10

## Sonographic Technique

- Gradual graded compression is slowly applied over the area of the appendix in the right flank and right lower quadrant with a linear array transducer.
- In infants and young children- frequencies of 12-17 MHz may be used, older children 5-9 MHz
- Appendix is usually seen anterior and medial to the psoas muscle and lateral to the iliac vessels

11

11

## Sonographic Technique (cont'd)

- Ask the patient to point to the place of pain with one finger
- Helpful to follow the ascending colon and cecum inferiorly to the ileocecal junction, where the appendix comes off just posteromedial (inferior) to this valve
- Normal appendix appears as a blind-ending, long, tubular structure in the longitudinal plane and as a bull's-eye in the transverse plane

12

12

## Sonographic Technique (cont'd)

- Nonvisualization may result from any of the following:
  (1) overlying bowel

  (2) retrocecal position or deep pelvic position of the appendix

  (3) overdistention or nondistention of the urinary bladder, which alters the position of the appendix and overlying bowel

  (4) lack of sonographer experience

13

13

## How to Scan…

- https://youtu.be/PfxxVXsQsfY?si=-XJa0lx2xl5rcl4n

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14

## Sonographic Findings

- Peristalsis is not seen in the appendix, allowing differentiation of the normal appendix and adjacent small bowel, which is similar in appearance
- Appendix may be tortuous and therefore difficult to visualize in its entirety
- Walls not thickened- maximal mural thickness should measure less than 1.7 mm
- Normal appendix compresses easily and the lumen may be empty, or filled with gas or fecal material

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## Sonographic Findings (cont'd)

- Appendix is measured from outer-to-outer wall, using the anterior-posterior (AP) maximum outer diameter (MOD).
- Measurements are best made in the plane with the most well defined wall, as acute appendicitis may present with a less defined or ragged wall
- MOD ≥ 7 mm with compression is consistent with appendicitis both in children and adults
- MOD between 6-7 mm is indeterminate and often established by each institution based on their outcomes

16

16

## Sonographic Findings (cont'd):

- May include free peritoneal fluid or a loculated fluid collection in the lower abdomen
- Mesenteric lymph nodes are another non-specific secondary finding, and sonographers should report size, number, location and hyperemia
- Confirmation of an appendicolith in a symptomatic patient is virtually diagnostic

17

17

## Normal Appendix

- https://youtu.be/VO51vgSEXuE
- https://www.youtube.com/watch?v=am_m4J9bryM&pp=ygUdIGh0dHBzOi8veW91dHUuYmUvYW1fbTRKOWJyeU0%3D

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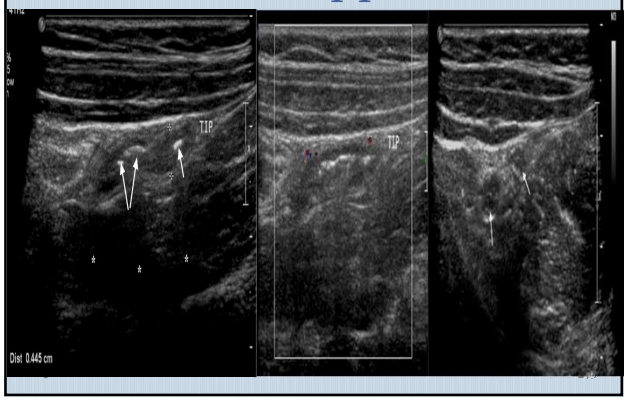
## Normal Appendix

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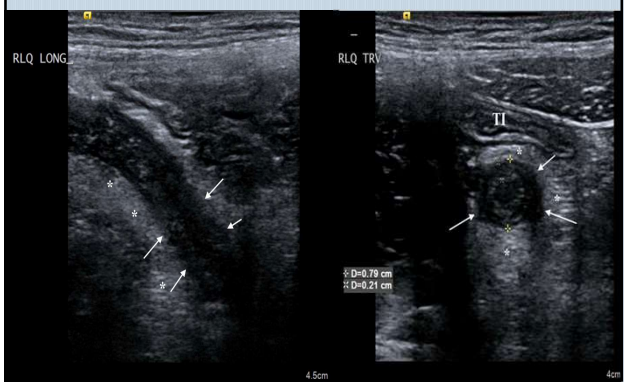
## Appendicitis

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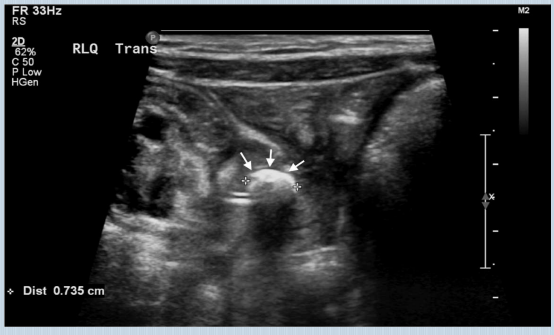
## Appendicitis/Appendicolith




21

## Appendicitis/Appendicolith

- https://youtu.be/l2aF9OYlXto
- https://youtu.be/NasAgUkEuDw?si=9ZFW2nrQlaIzSroW

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22

## Intussusception

- Most common acute abdominal disorder in early childhood
- Occurs when bowel prolapses into more distal bowel and is propelled in antegrade fashion
- Telescoping of bowel causes obstruction

23

23

## Intussusception

- 90% of cases includes the prolapse of the ileum into the cecum or beyond producing an ileocolic intussusception

  - usually seen in children between the ages of 6 months old and 2 years old (males 2:1 > females)

  - may present with colicky abdominal pain, vomiting, and bloody (currant jelly) stools

  - abdominal distention or a mass may also be palpable in up to 50% of patients

24

24

# Intussusception

- Sonographic Technique:
  - The patient is examined in the supine position
  - A brief survey of the entire abdomen is performed, dividing the abdomen into four quadrants, followed by an examination focusing on the bowel using a 5 to 12 MHz linear or curved array transducer
  - The bowel is followed, often starting at the cecum in the RLQ

25

25

# Sonographic Appearance

- Short axis
  - Alternating hypoechoic and hyperechoic rings surrounding an echogenic center
    - *Doughnut or target sign
- Long axis
  - Hypoechoic layers on each side of echogenic center
    - *Pseudokidney or sandwich appearance
- Color Doppler may help determine success of an air reduction enema
  - If good color flow to all areas of telescoping bowel, chances are better for a reduction

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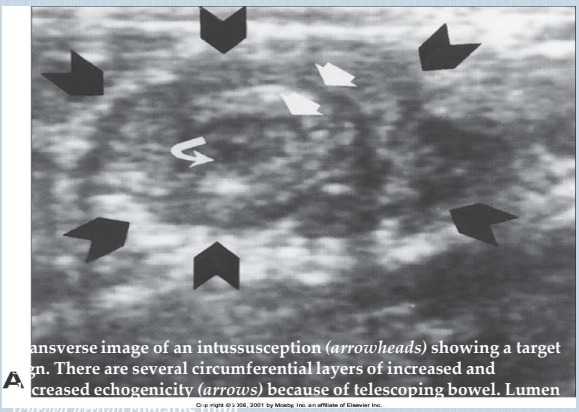

A ansverse image of an intussusception *(arrowheads)* showing a target gn. There are several circumferential layers of increased and creased echogenicity *(arrows)* because of telescoping bowel. Lumen *(curved arrow)* contains fluid.



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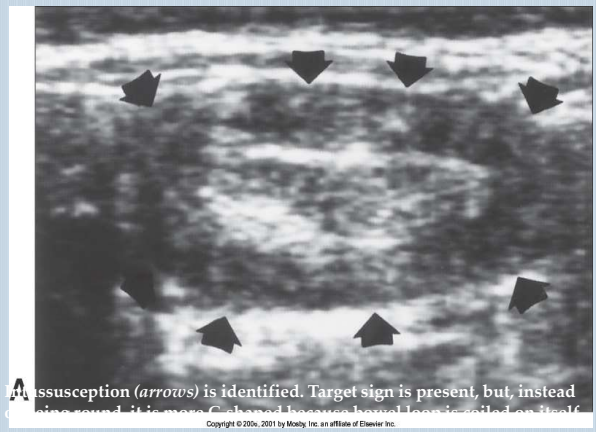


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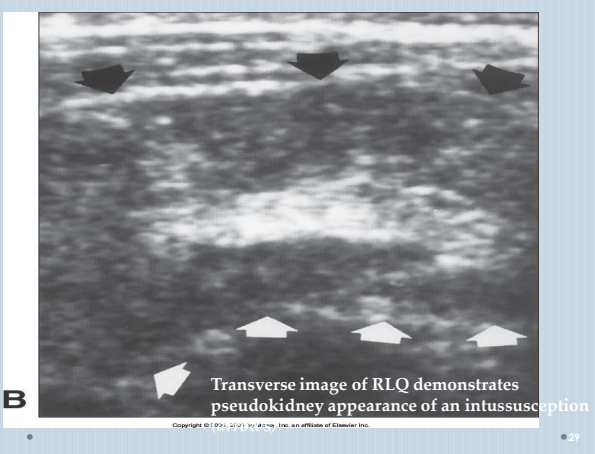


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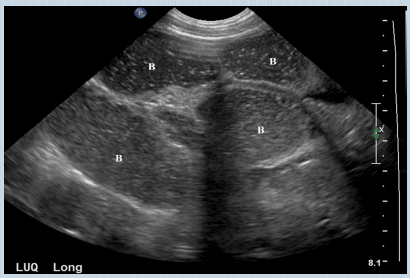
## Dilated Loops of Bowel

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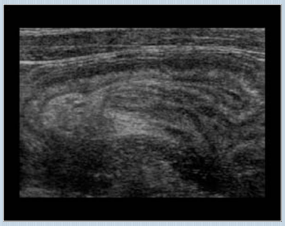
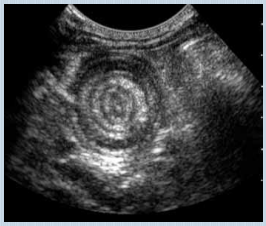
# Intussusception Sonographic Images

- Long

Trans





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31

# Sonographic Appearance (cont'd)

- Sonographic Findings:
  - The sonolucent ring is believed to represent the edematous infolded loop of the intussusceptum, whereas the echogenic central area represents its compressed mucosa
  - Other concentric rings are present resulting from visualization of additional bowel wall layers within the intussusception

32

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# Intussusception

- https://youtu.be/rRO_b7yZMsU?si=2-W57XgiboyVHsHv

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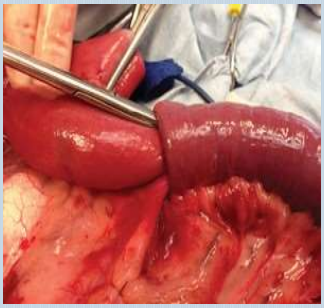
# Intussusception



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# Hypertrophic Pyloric Stenosis (HPS)

- Pyloric canal located between the stomach and duodenum
- Pyloric muscle can become hypertrophied, resulting in significantly delayed gastric emptying
- Hypertrophy of the circular muscle of the pylorus is an acquired condition that narrows the pyloric canal
- Pyloric canal itself is not intrinsically stenotic or narrowed but functions as if it were due to the abnormally thickened surrounding muscle

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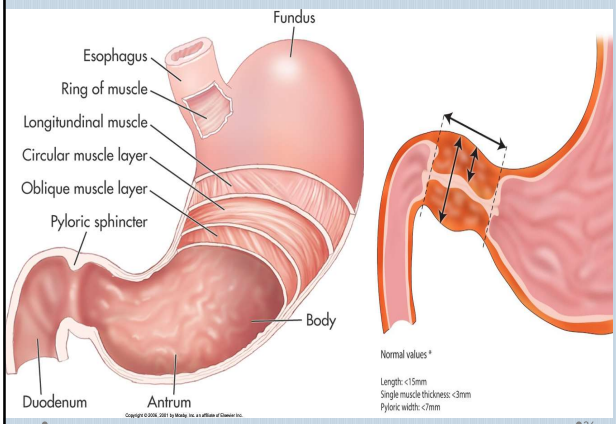


36

## HPS (cont'd)

- Presents most commonly in male infants
  -between 3 and 12 weeks (peak @ 4 wks)

*Bile-free emesis in an otherwise healthy infant is the most frequent clinical presentation
- projectile vomiting

- As pyloric muscle thickens and elongates, stomach outlet obstruction increases and vomiting is more constant and projectile

37

37

## HPS (cont'd)

- Dehydration and weight loss may occur
- Peristaltic waves and reverse peristaltic waves crossing upper abdomen may be observed during or after feeding
- Stomach attempts to force its contents through the abnormal canal resulting in projectile vomiting

*Sonography is the imaging method of choice

38

38

## Contrast Radiography

- Upper GI exam necessary to assess for other potential causes of vomiting such as:
  - Gastrointestinal reflux
  - Antral web
  - Pylorospasm
  - Hiatal hernia
  - Malrotation of bowel

39

39

## Sonographic Technique

- Preliminary survey of abdomen is performed first to exclude abnormalities
  - Hydronephrosis
  - Adrenal hemorrhage
- 5- to 12- MHz linear array transducer

40

40

## Sonographic Technique (cont'd)

Longitudinal images

- Place transducer transversely across RUQ just below xiphoid process
- Rotated obliquely until pyloric muscle is visualized in its long axis

41

41

## Sonographic Technique (cont'd)

- If stomach is empty and HPS is not apparent, oral feeding is given
  - Glucose water
  - Pedialyte
- Overly distended stomach can displace pyloric muscle posteriorly, making visualization virtually impossible

42

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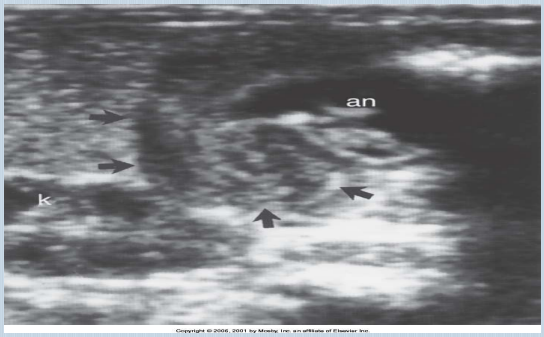




**Fluid-distended antrum *(an)* has pushed elongated pyloric muscle *(arrows)* posteriorly, not allowing accurate measurement of length of pyloric canal**

43

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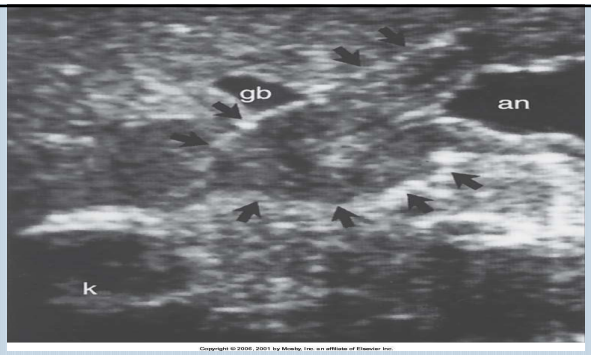




**Transverse image of RUQ using liver as a window in a 5-week-old boy with hypertrophic pyloric stenosis shows a longitudinal view of an elongated thickened pyloric muscle *(arrows)*. Antrum *(an)* is filled with fluid. The gallbladder *(gb)* is anterior to the pyloric muscle, whereas the right kidney *(k)* is posterior and lateral**

44

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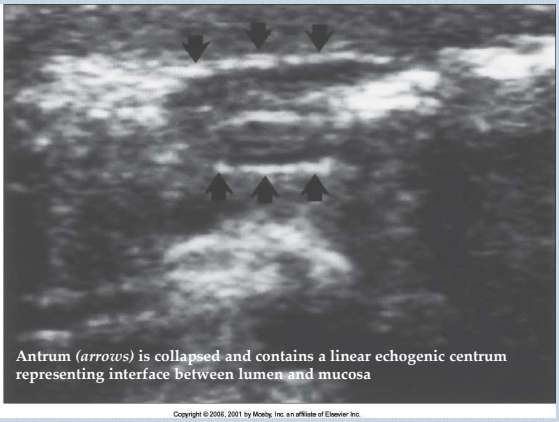


**Antrum *(arrows)* is collapsed and contains a linear echogenic centrum representing interface between lumen and mucosa**



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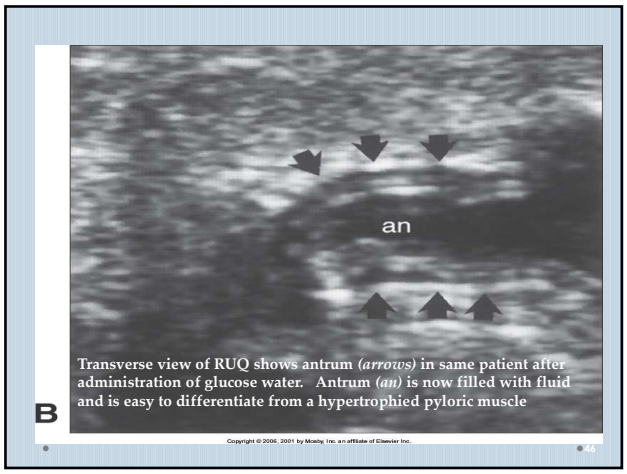


46

## Sonographic Technique (cont'd)

Transverse images

- Obtained from right coronal plane
- Gallbladder is initially identified
- Angle medially until bull's-eye appearance is seen

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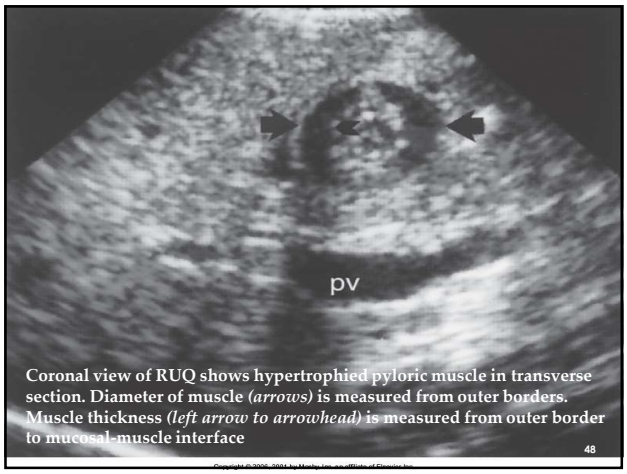


48

## Measurements

- Can be made in both short and long axis planes
  - Individual muscle wall thickness
  - Total diameter
  - Length of pyloric canal

49

49

## Measurements (cont'd)

- Thickness
  - Measured from periphery of hypoechoic muscle to its junction with the echogenic central canal
- Diameter
  - Measured between peripheral margins of hypoechoic muscle layer
- Length
  - Measured from proximal to distal extremes of echogenic central canal

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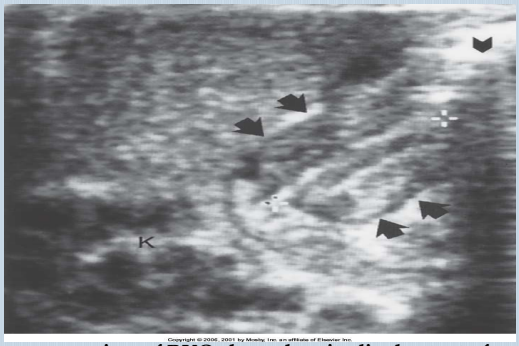


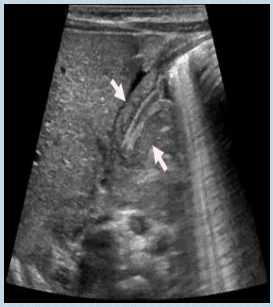

**Transverse view of RUQ shows longitudinal extent of hypertrophied pyloric muscle *(arrows)*. Calipers measure length of pyloric muscle, which is 20 mm.**

51

51

## Normal Pylorus

Long



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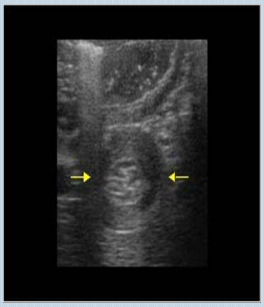


52

52

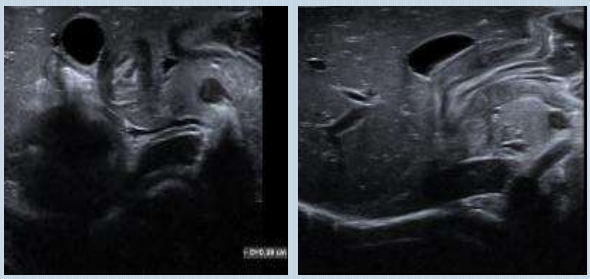
## Sonographic Diagnosis of HPS

- Depends on following findings:
  - Visualization of hypertrophied pyloric muscle with a canal measuring greater than 15-16 mm
  - Individual pyloric muscle wall thickness greater than or equal to 3.0 mm
  - Pyloric diameter of 10 mm or greater
  - Additional significant finding:
    - Presence of active antegrade and reverse gastric peristalsis

53

53

## HPS



**Positive HPS "bagel" or "donut" sign. A,** Short-axis view of the hypertrophied pyloric muscle, measuring 3.9 mm demonstrating the *bagel* or *donut* sign. The muscle thickness is measured from the outer border to the mucosal-muscle interface. **B,** Long-axis view in the same 3-week-old neonate.

54

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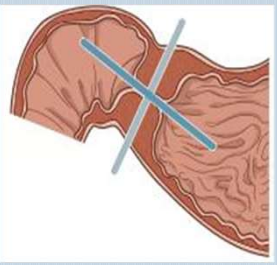
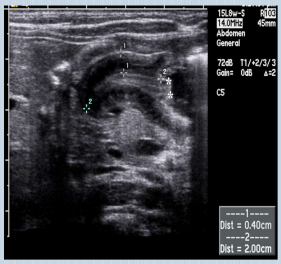
# HPS (cont'd)






If the muscle is thickened and elongated, the mucosa extends into the antrum, and this appearance has been called the "cervix" sign

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# HPS (cont'd)

- https://youtu.be/_hvzmgbTDxI?si=rr8JM49CXvoYd46m

56

56

# REVIEW

Webinar on Pediatric GI Pathologies

https://youtu.be/6QDx5TFbyLQ?si=JdD8gBnbvHVMxZXx

57

57