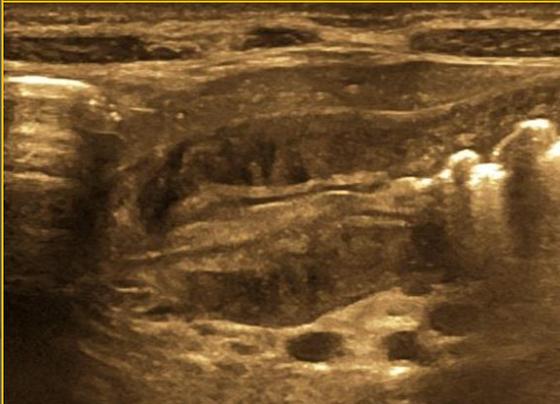
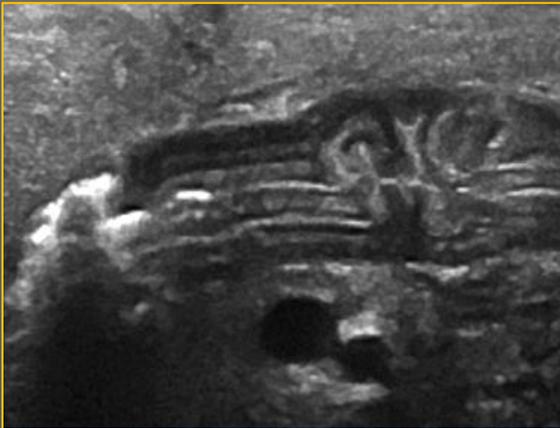


A Sonographic walk-through:

Infantile Hypertrophic Pyloric Stenosis



Tara K. Cielma, RDMS, RDCS, RVT, RT(S)
Anjum N. Bandarkar, MD,
Adebunmi O. Adeyiga, MD,

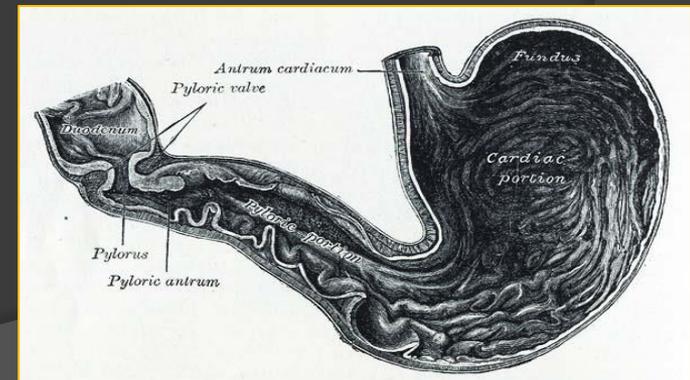
Diagnostic Imaging and Radiology,
Children's National Health System,
Washington, D.C.,

Objectives

- ① Review sonographic anatomy of normal and abnormal pylorus
- ② Illustrate technical approach to pyloric ultrasound
- ③ Describe tips & tricks to minimize equivocal exams

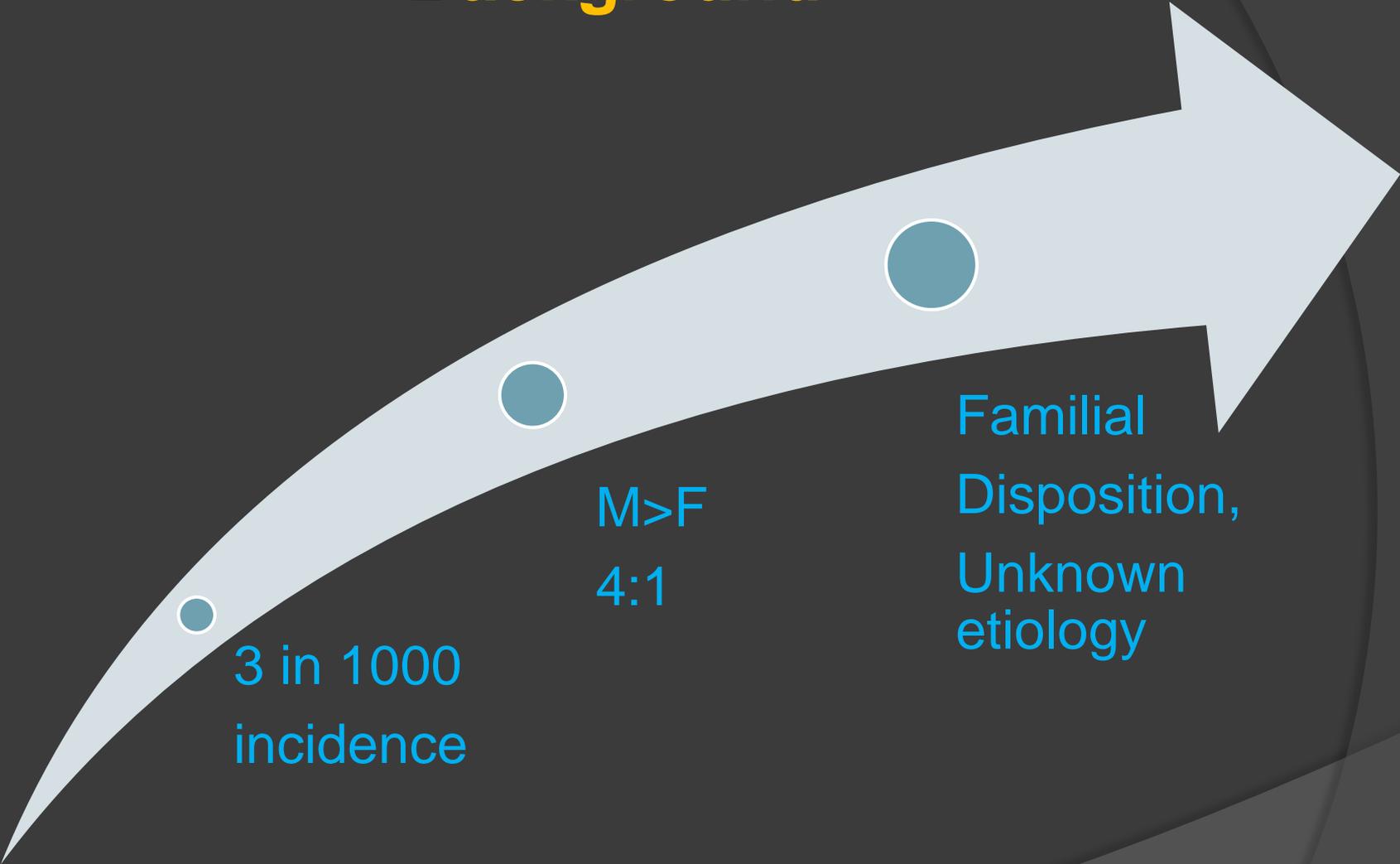
Introduction

- Infantile hypertrophic pyloric stenosis (IHPS) is a common condition affecting young infants, in which the antropyloric portion of the stomach becomes abnormally thickened and manifests as obstruction to gastric emptying.
- Not present at birth, but mechanical obstruction typically develops in the first 2-12 weeks of life.
- Most common condition requiring surgery in infants.
- Treatment: Surgical pyloromyotomy.



Drawing of pylorus specimen

Background



3 in 1000
incidence

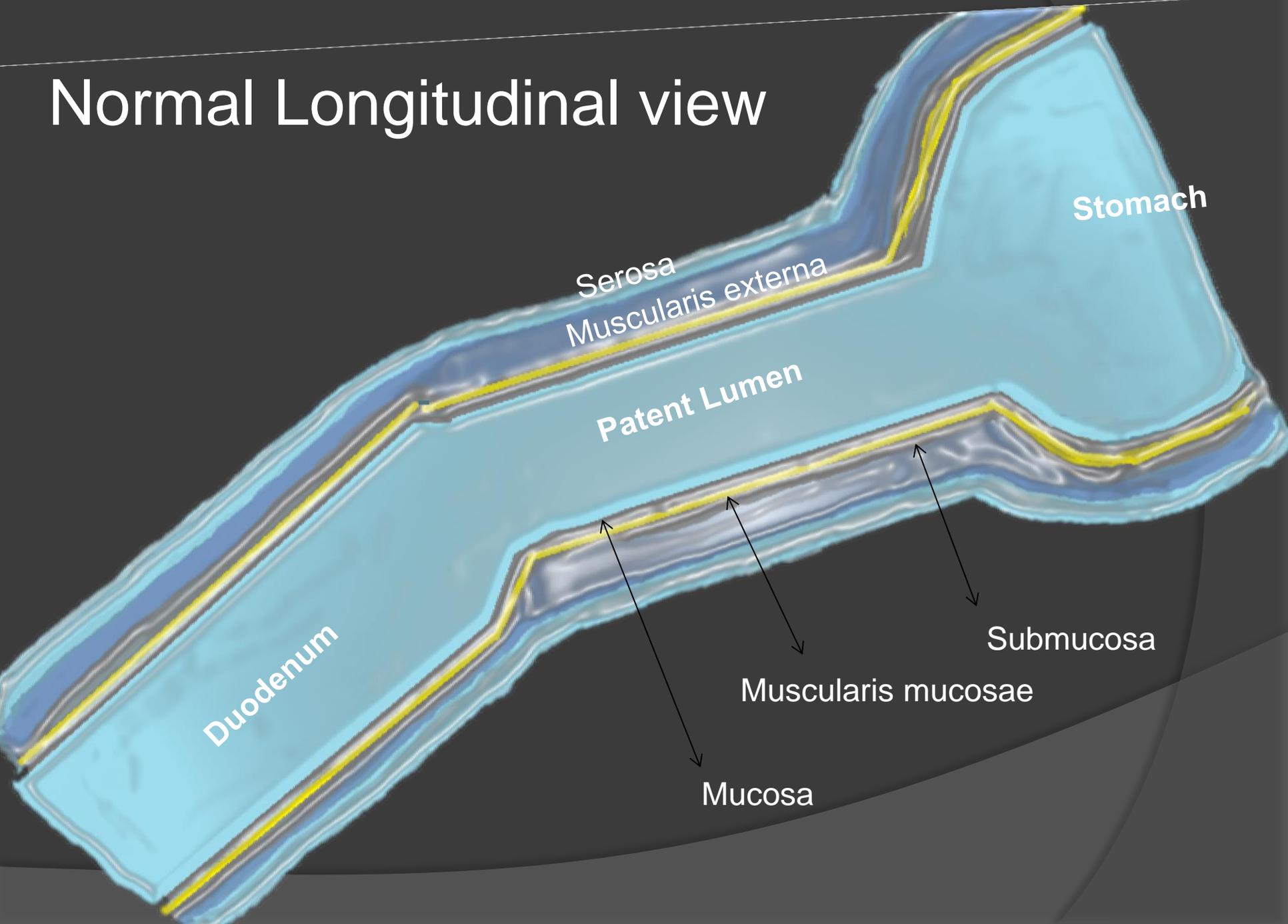
M>F
4:1

Familial
Disposition,
Unknown
etiology

Clinical Presentation

- The infant presents with a recent onset of forceful **nonbilious** vomiting, typically described as “**projectile**.”
- Initially intermittent, the frequency of emesis increases with time. Vomitus may be stained with blood due to rupture of small capillaries in gastric mucosa.
- Dehydration and weight loss are often present. Occasionally, indirect hyperbilirubinemia may be seen.
- **Hypochloremic metabolic alkalosis** is the characteristic biochemical abnormality because vomiting of gastric contents leads to depletion of sodium, potassium and hydrochloric acid.

Normal Longitudinal view



Stomach

Serosa
Muscularis externa

Patent Lumen

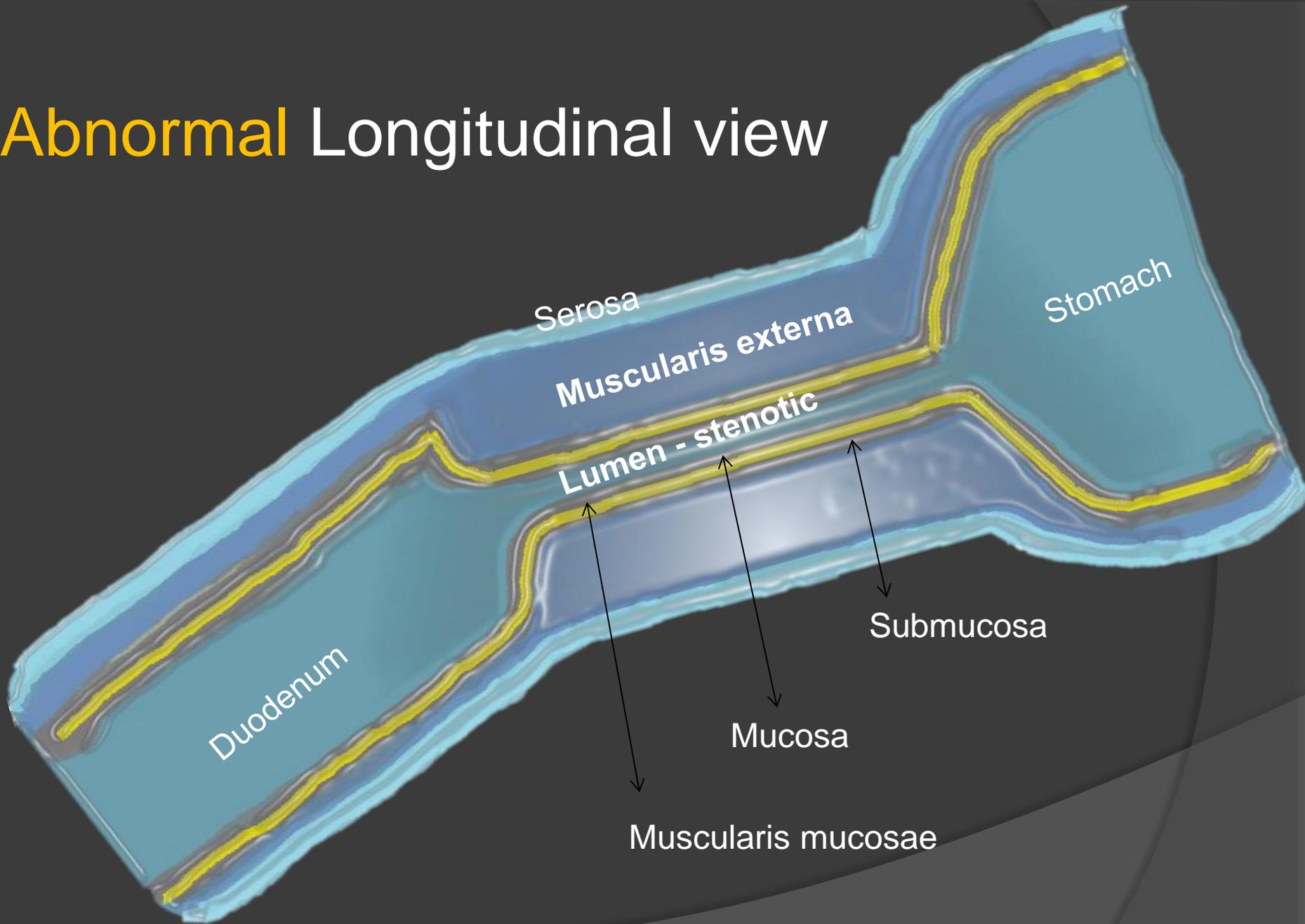
Duodenum

Submucosa

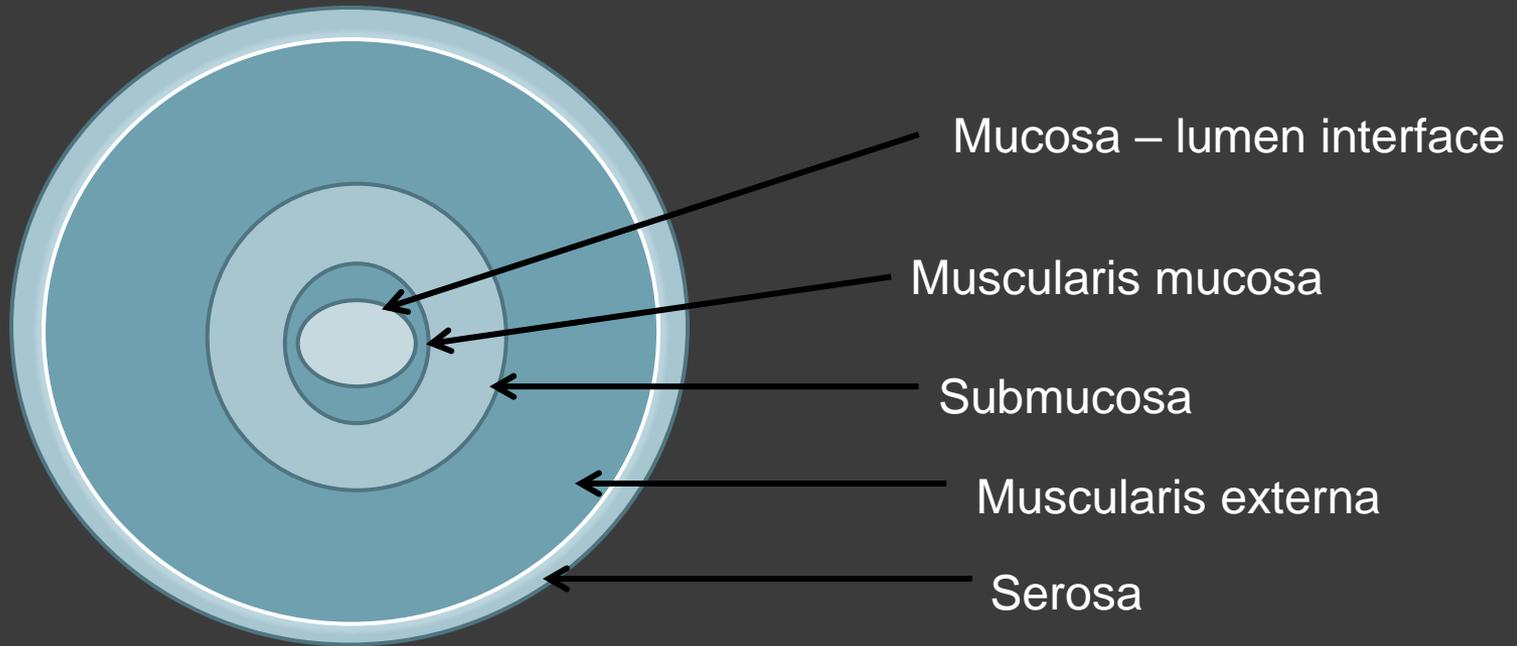
Muscularis mucosae

Mucosa

Abnormal Longitudinal view

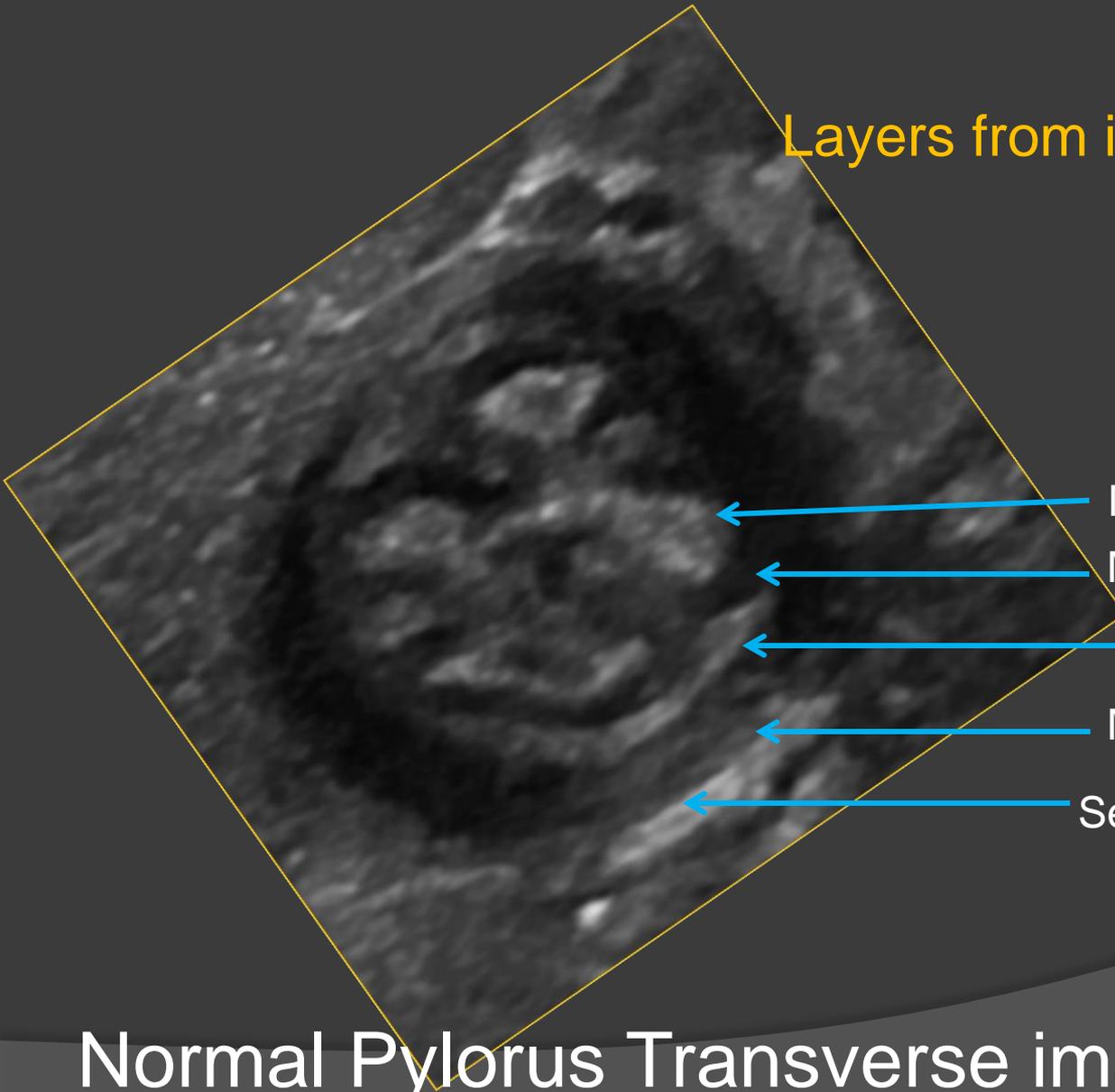


Abnormal Transverse view



Zonal Anatomy of Pylorus

Layers from innermost to outermost



Mucosa- echogenic

Muscularis mucosa- hypoechoic

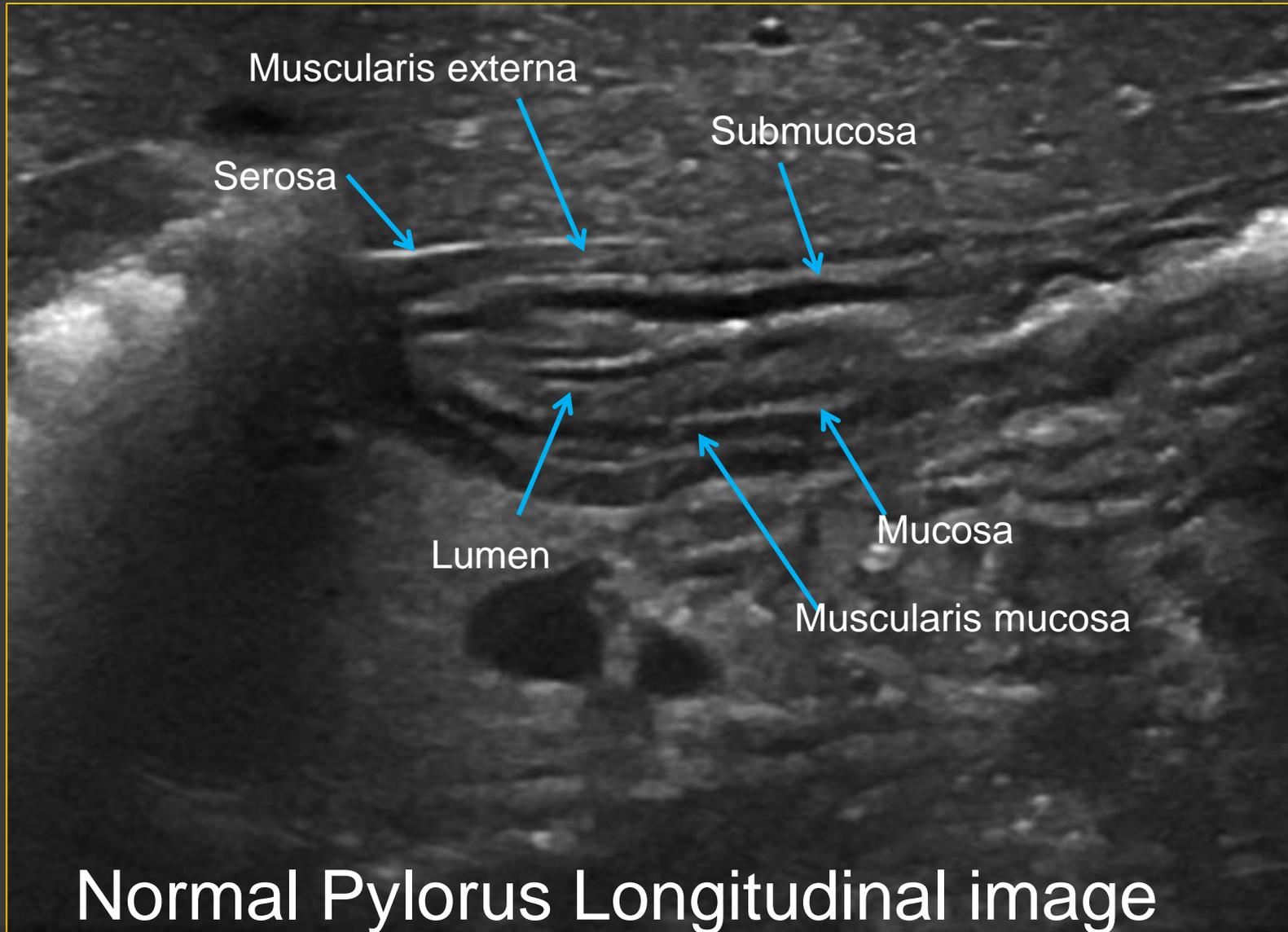
Submucosa- echogenic

Muscularis externa- hypoechoic

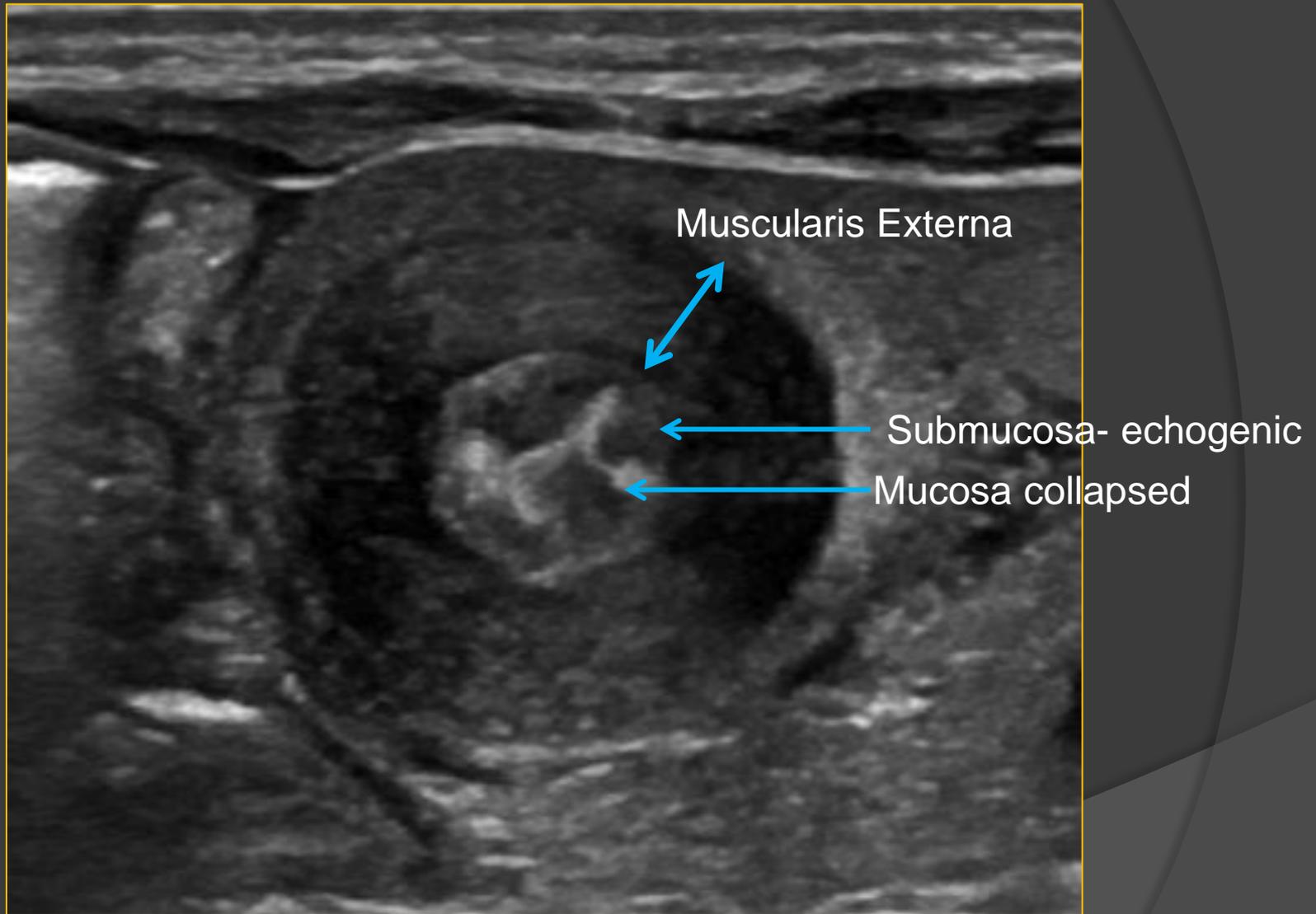
Serosa- echogenic

Normal Pylorus Transverse image

Zonal Anatomy of Pylorus

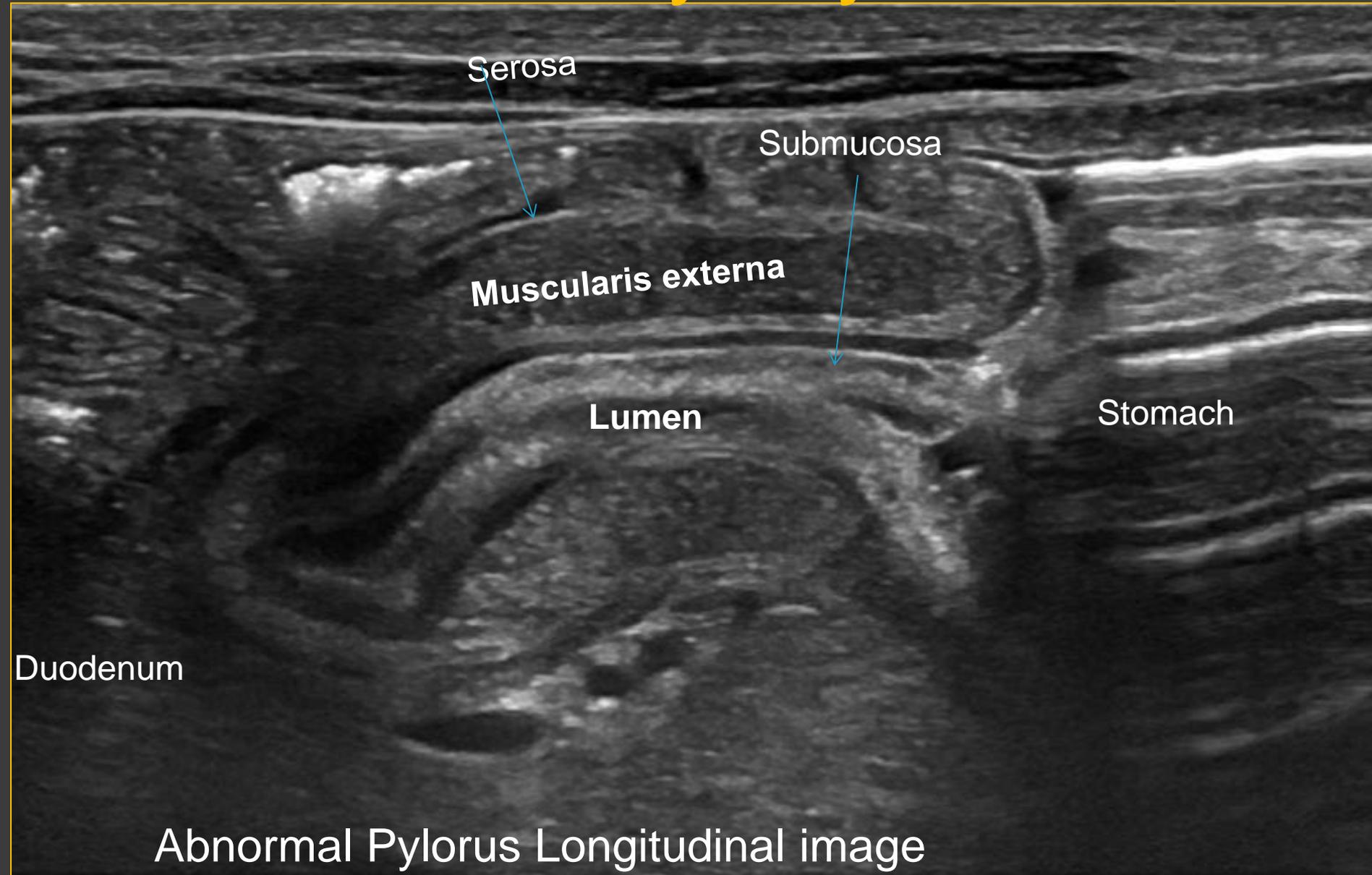


Zonal Anatomy of Pylorus



Abnormal Pylorus Transverse image

Zonal Anatomy of Pylorus



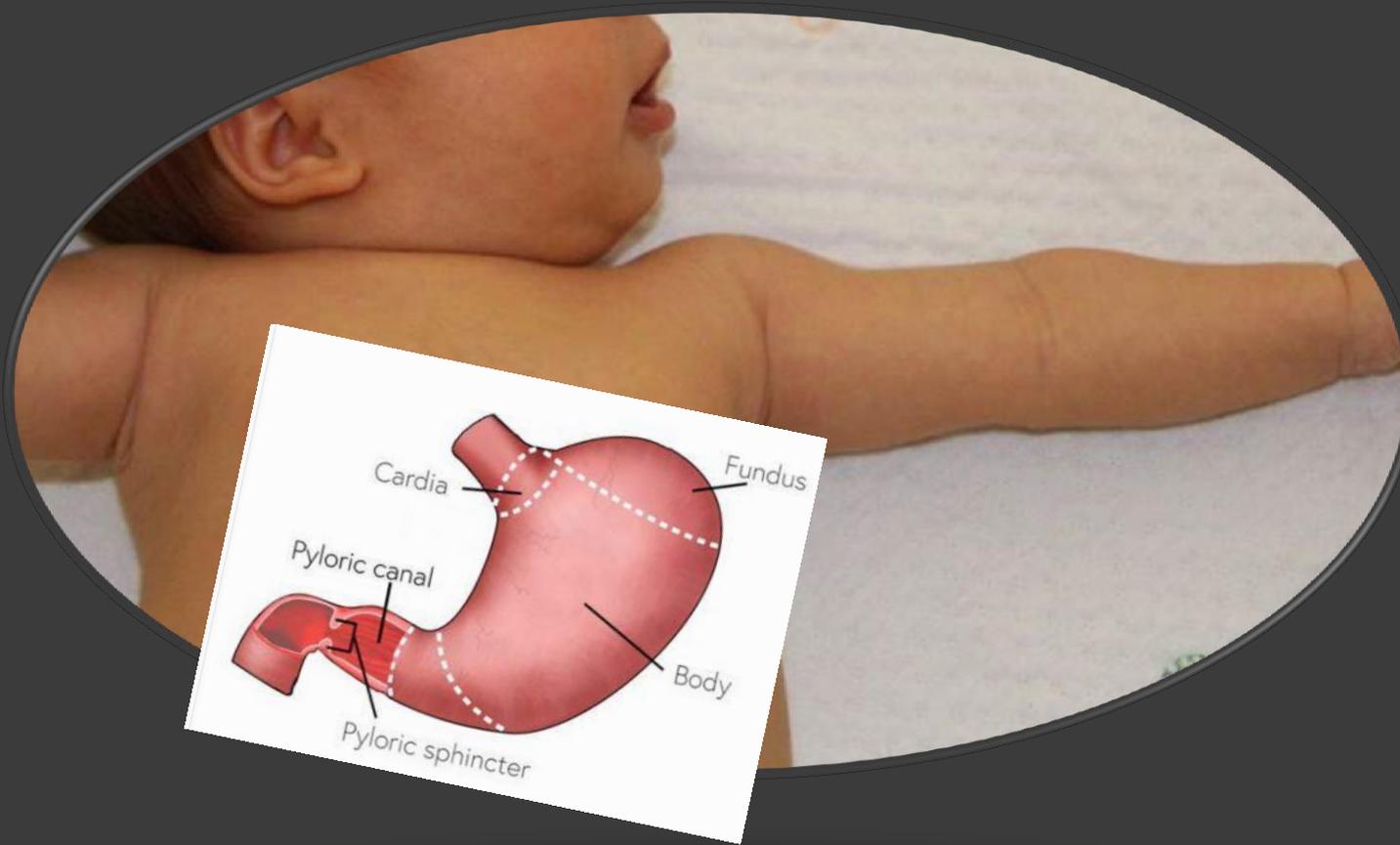
Abnormal Pylorus Longitudinal image

Sonographic Technique for Pylorus US

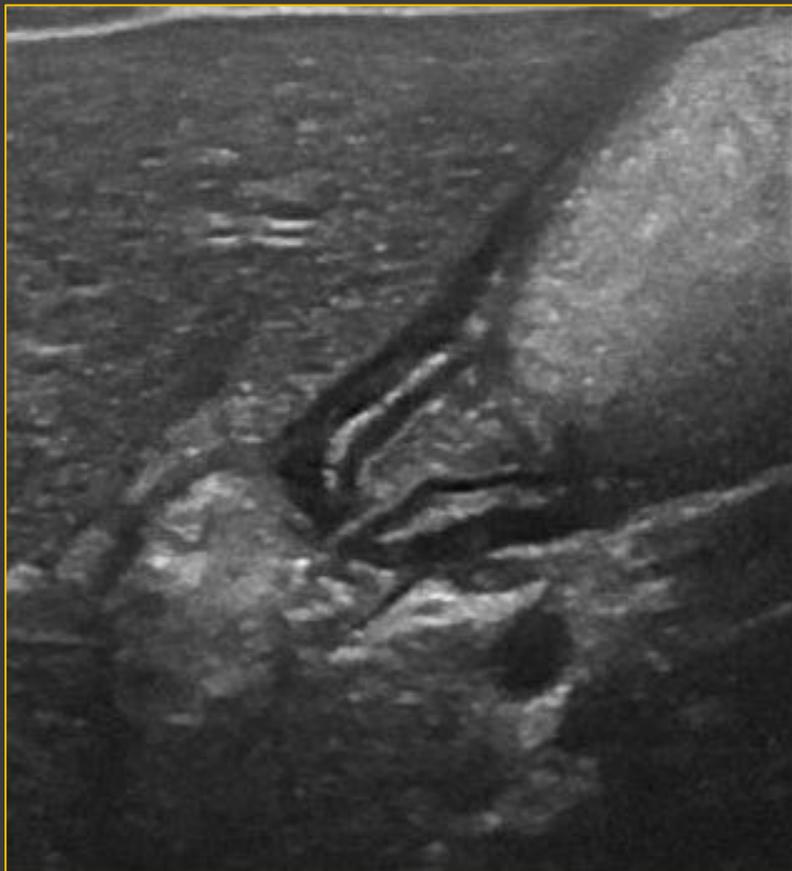


High frequency linear transducer must be used for optimal evaluation of pyloric anatomy.

- Supine position, or
- Right posterior oblique



Diagnostic Criteria: Normal

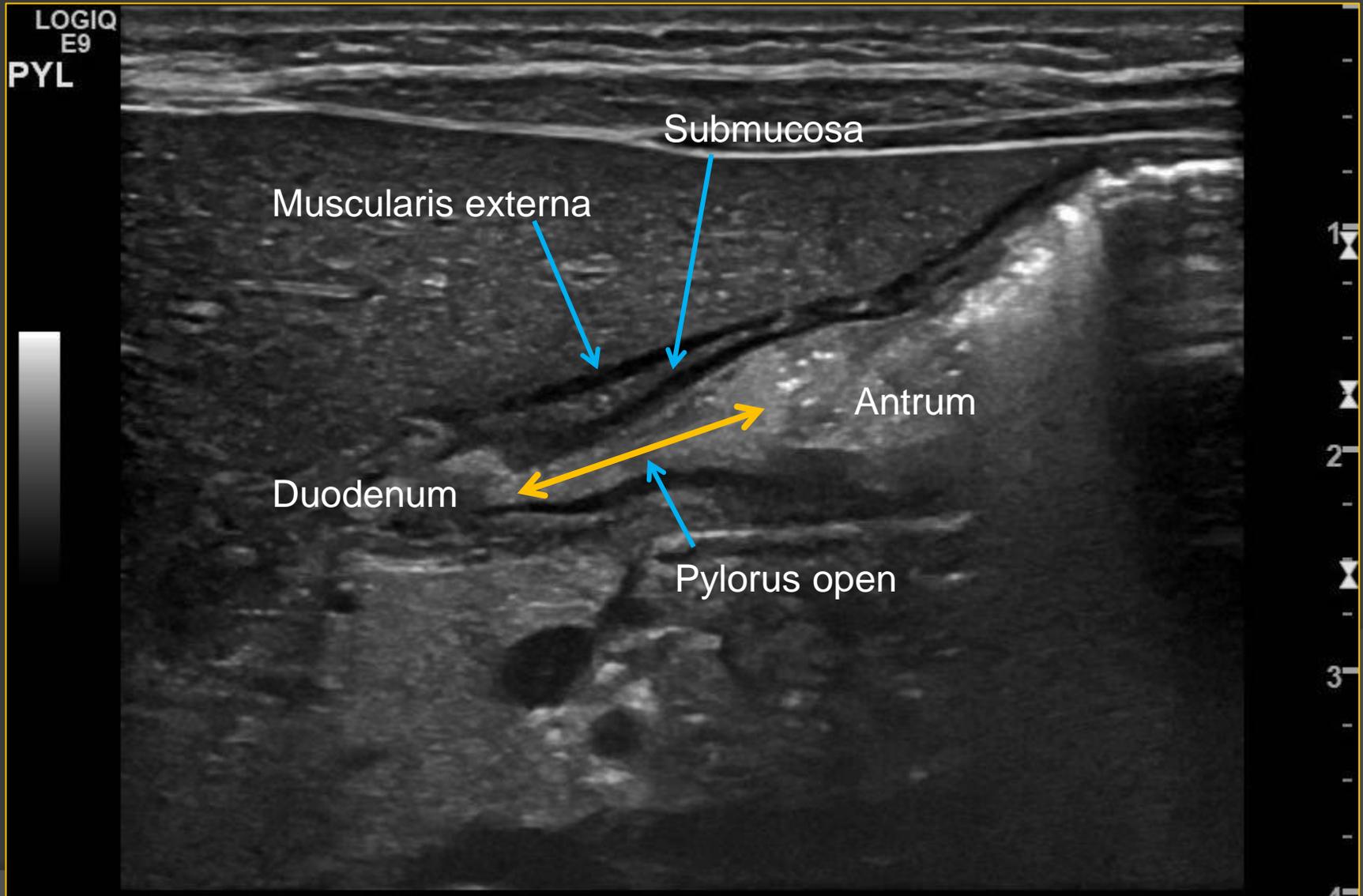


Normal pyloric muscle:
- Measures <3mm thick

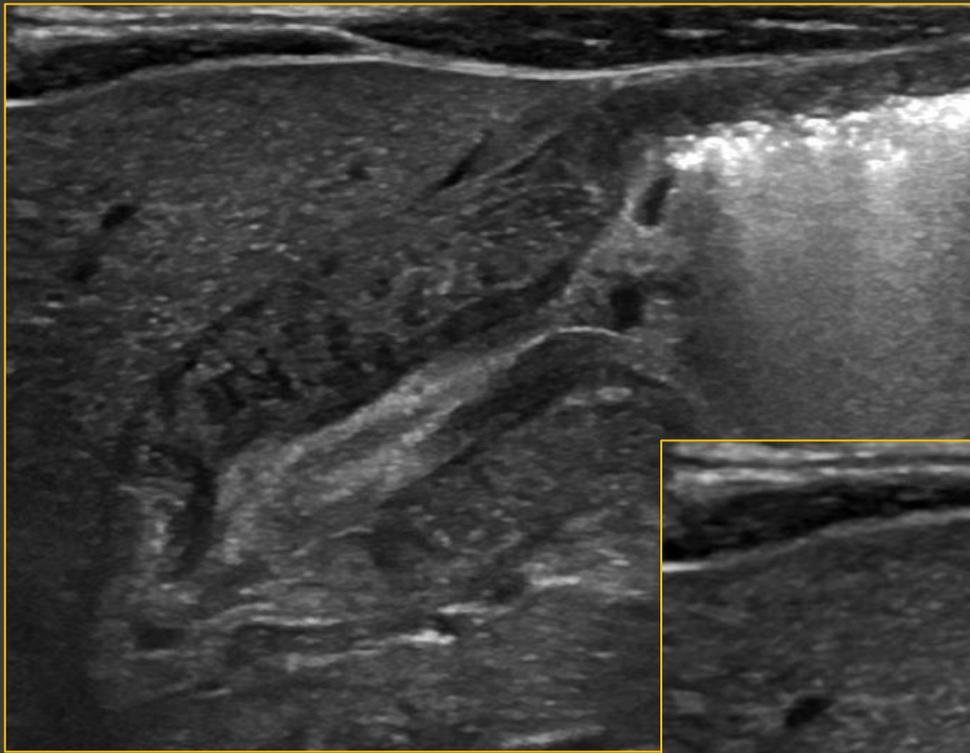
Normal pyloric channel:
- 11 to 14 mm in length



Normal Pylorus US

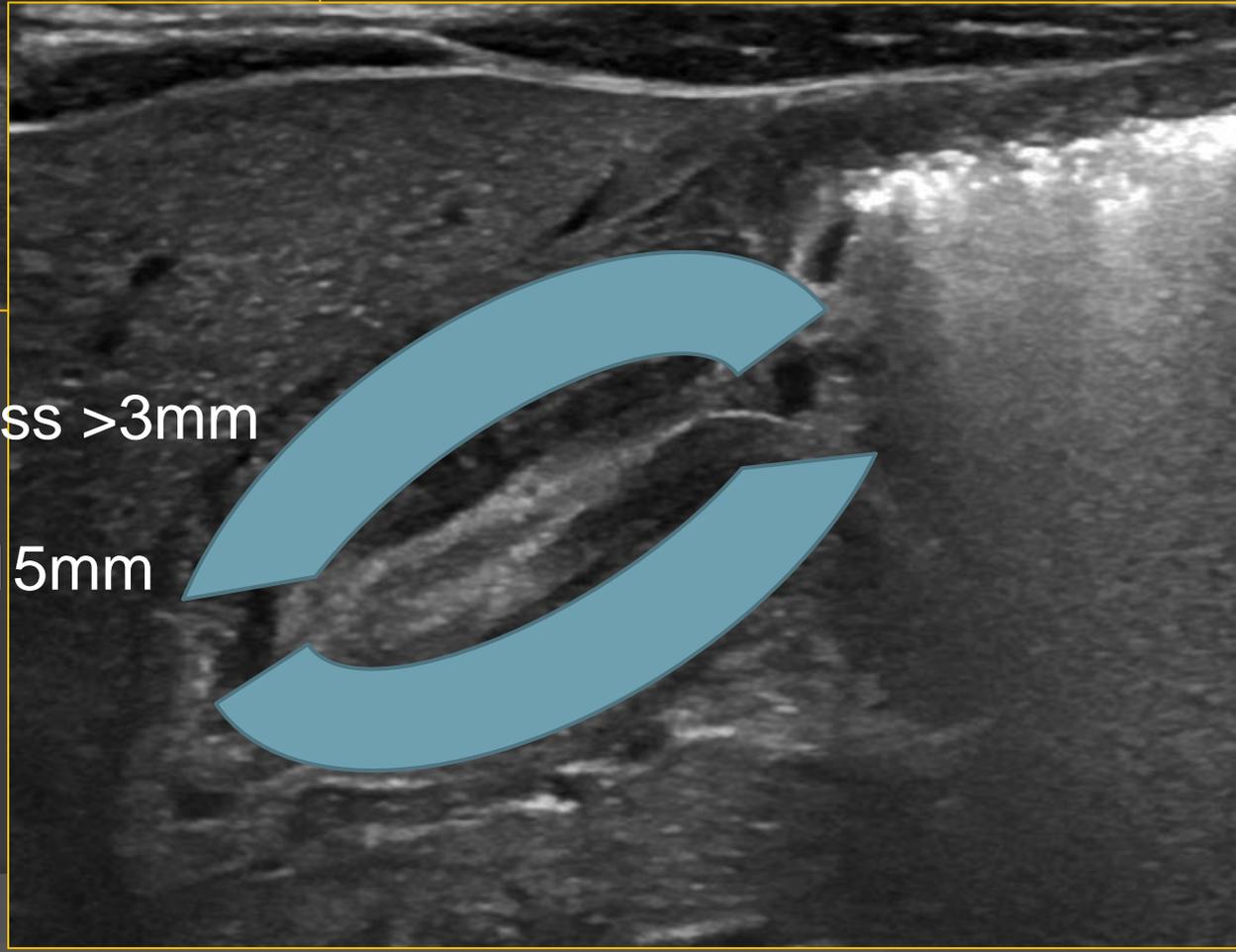


Diagnostic Criteria:
Abnormal



Pyloric muscle thickness $>3\text{mm}$

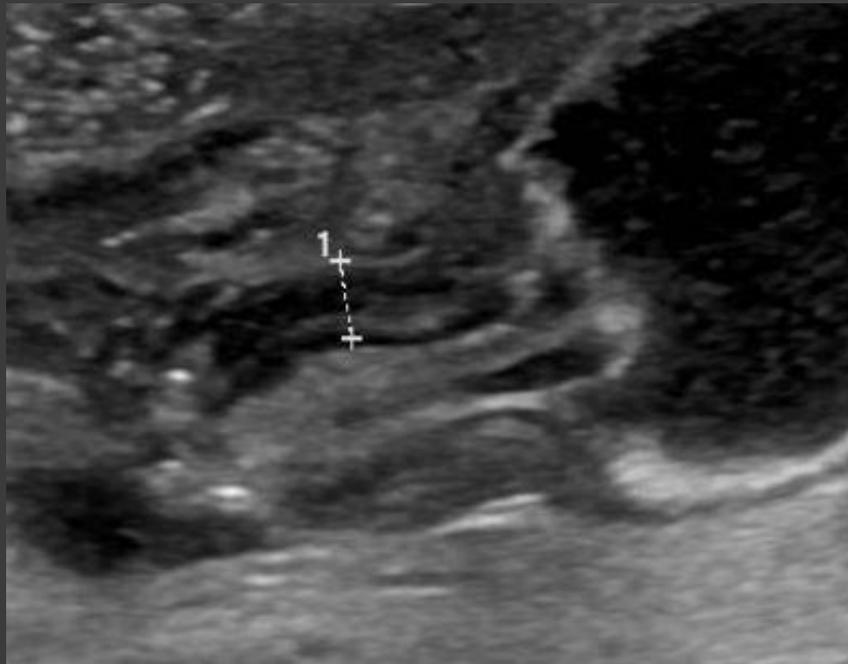
Pyloric canal length $>15\text{mm}$



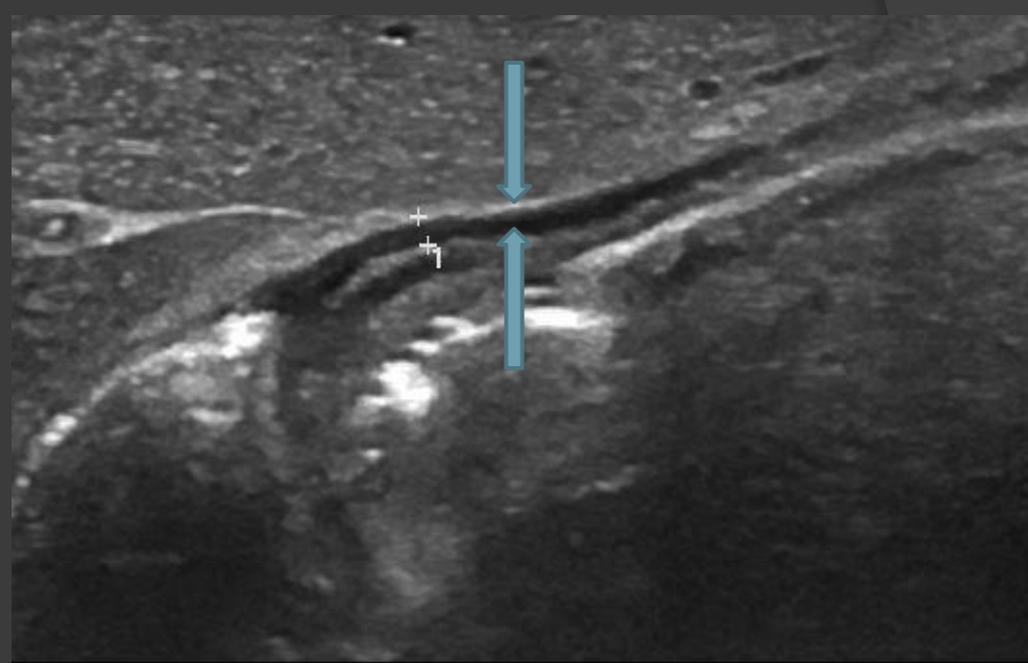
How to measure pylorus muscle: Long axis

Incorrect, overmeasured

Correctly measured



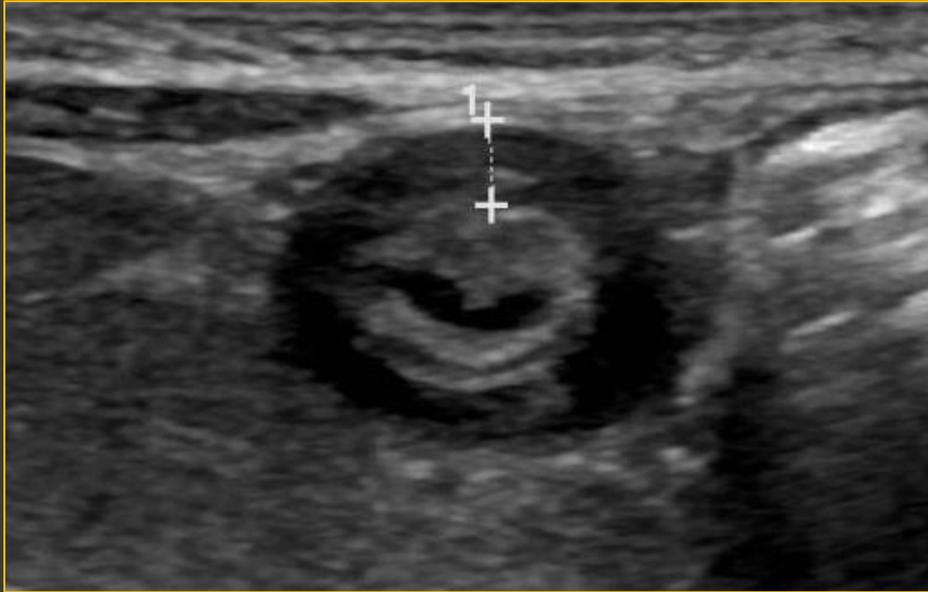
0.31 cm



0.16 cm



How to measure pylorus muscle: Short axis



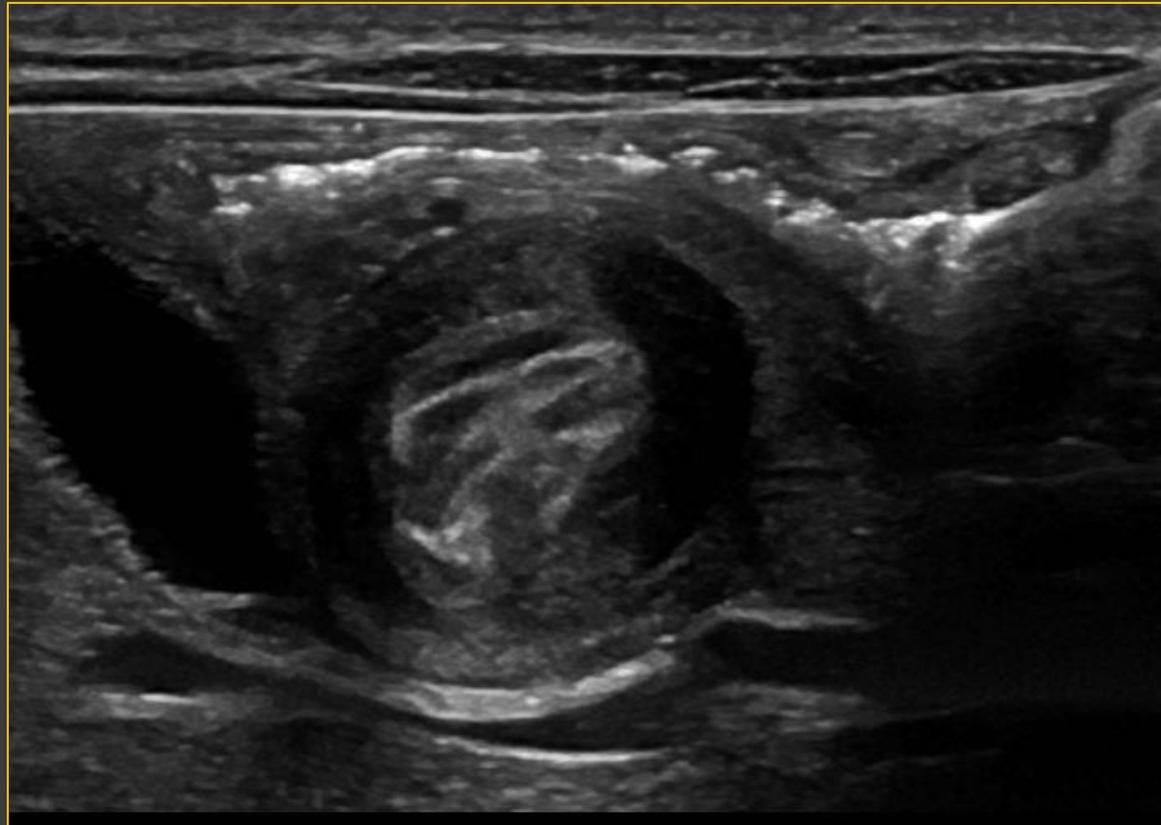
0.27 cm



1 L 0.13 cm

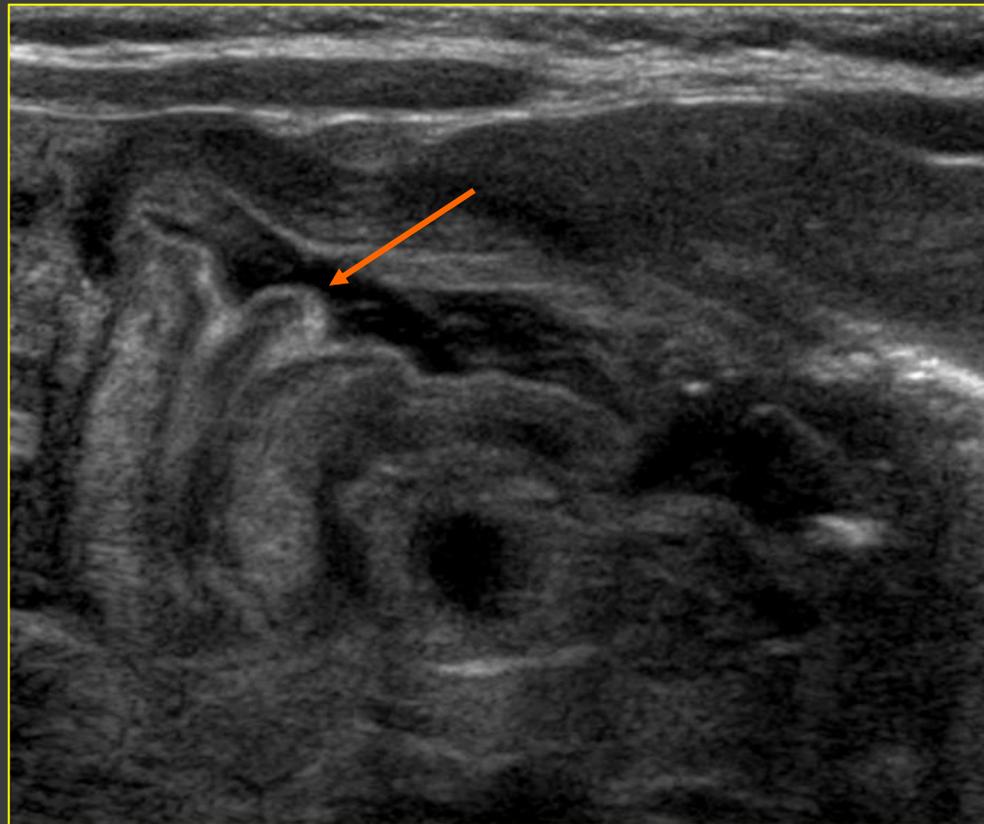
Sonographic Signs of Pyloric Stenosis:

Target sign – Peripheral ring of hypertrophied hypoechoic muscle surrounding central echogenic mucosa, resembling a doughnut.



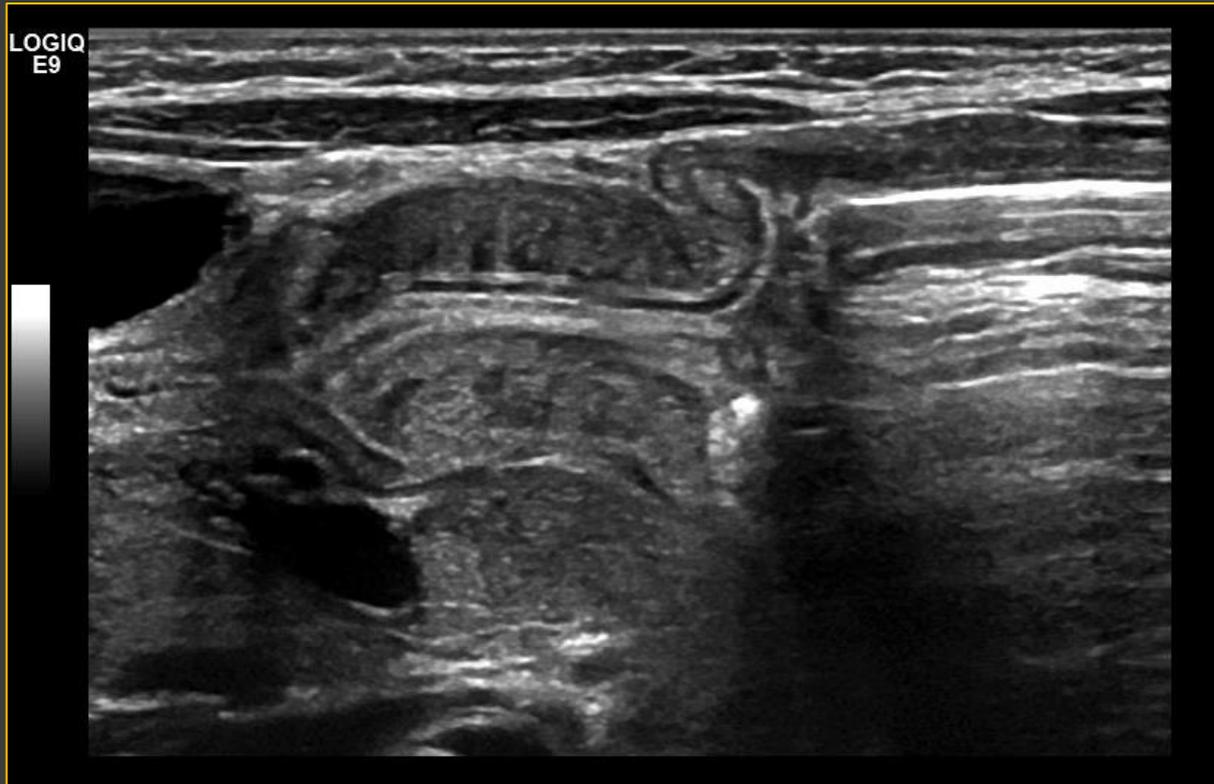
Sonographic Signs of Pyloric Stenosis:

Antral nipple sign – redundant pyloric mucosa protruding into the gastric antrum (orange arrow)



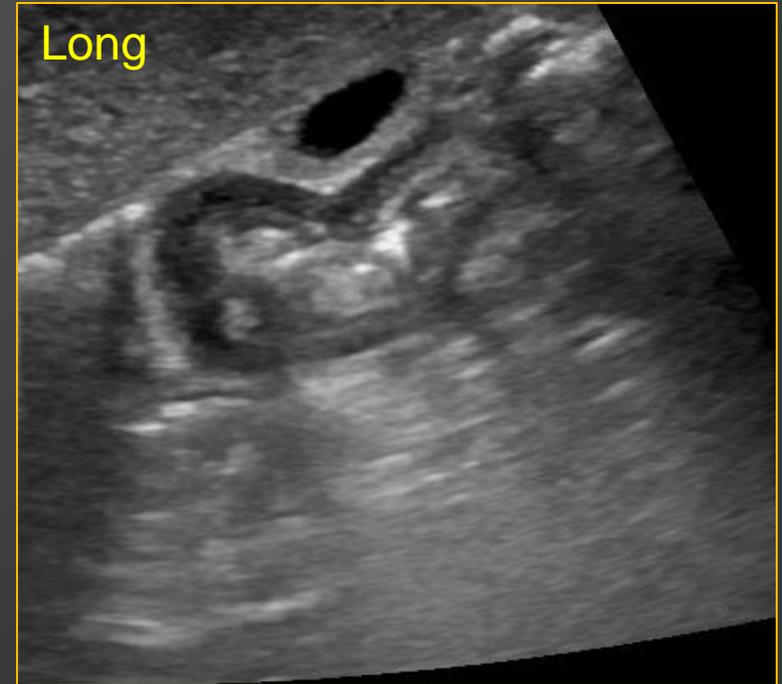
Sonographic Signs of Pyloric Stenosis:

Cervix sign - Extension of hypertrophied pyloric muscle into the antrum and elongated pyloric channel form an image that resembles a cervix

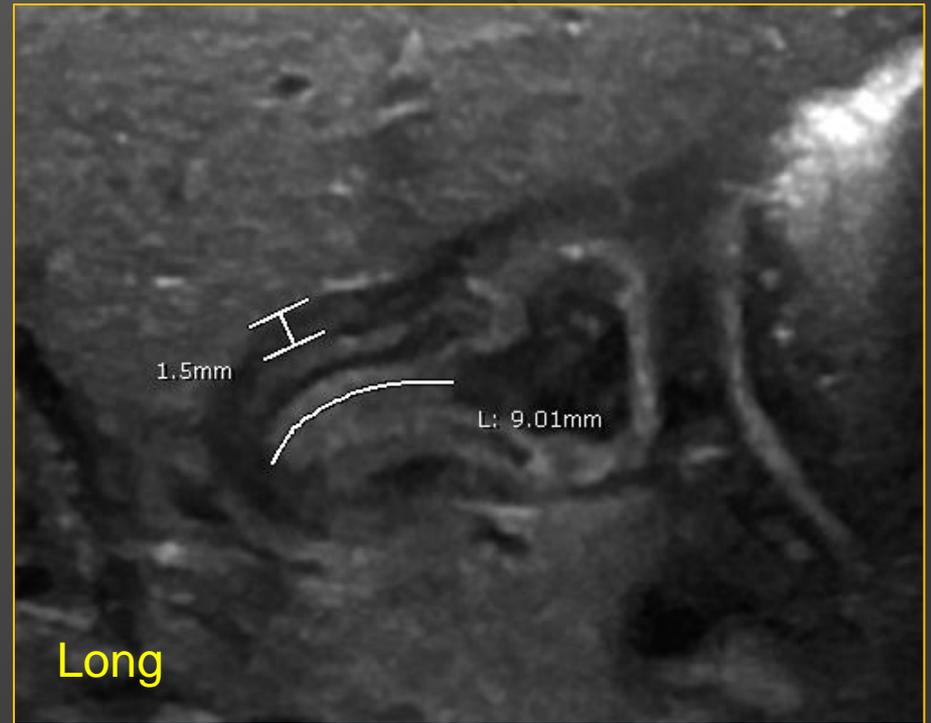
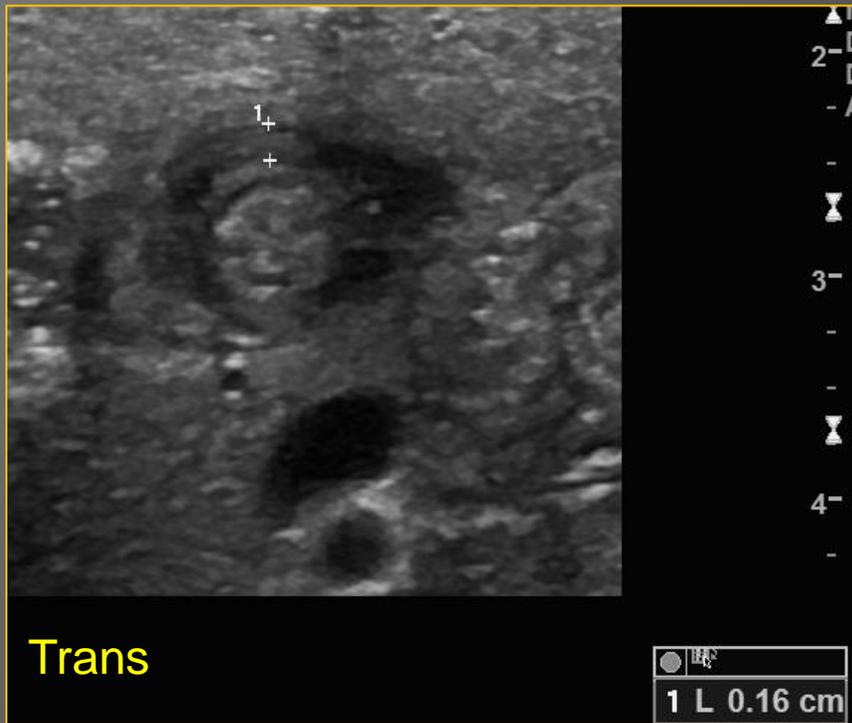


Pitfalls in Diagnosis

Over measuring pyloric muscle thickness-



First Ultrasound: Pyloric muscle thickness read as 3 mm, and hence equivocal for pyloric stenosis.



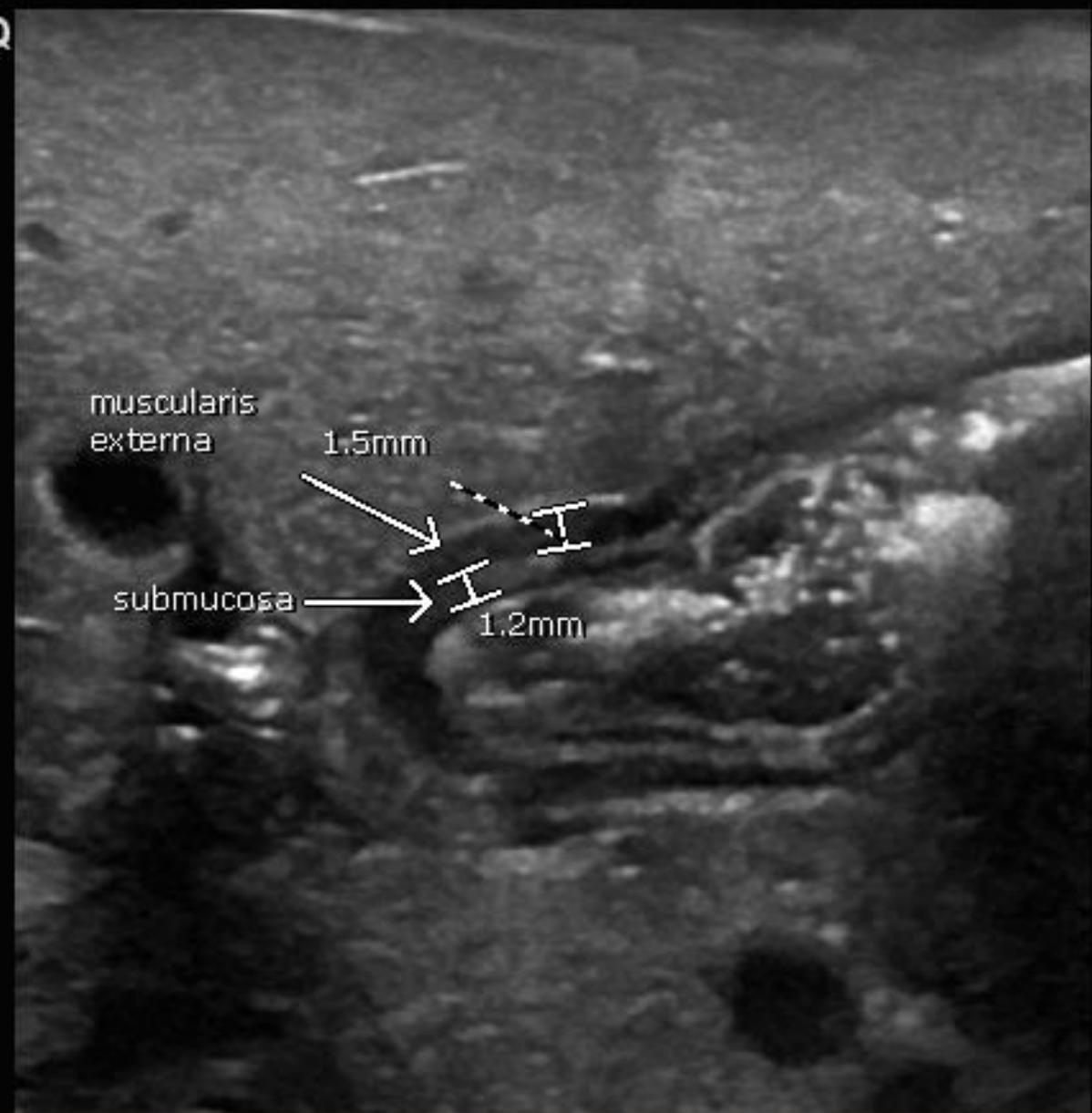
Repeat Ultrasound (next day): Pyloric muscle thickness read as 1.5 mm and normal.

Correct measurement obtained using **higher frequency(15MHz)** transducer with **MSK setting**, and **excluding the submucosa**.

PYLORUS

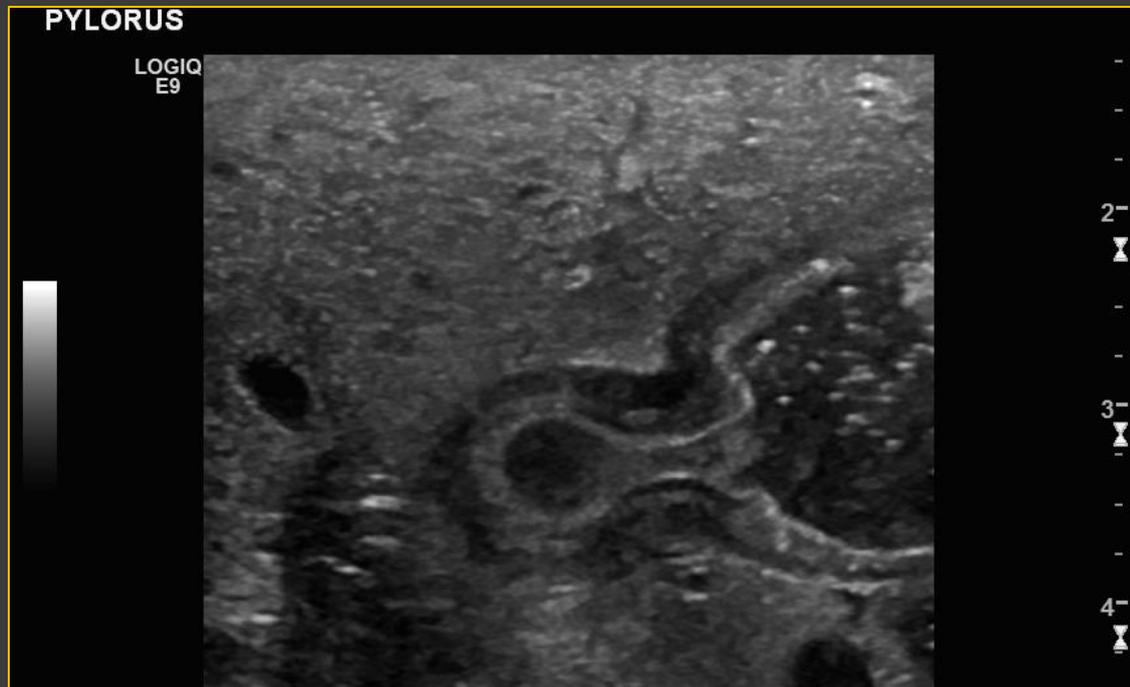
LOGIQ
E9

Correctly measured



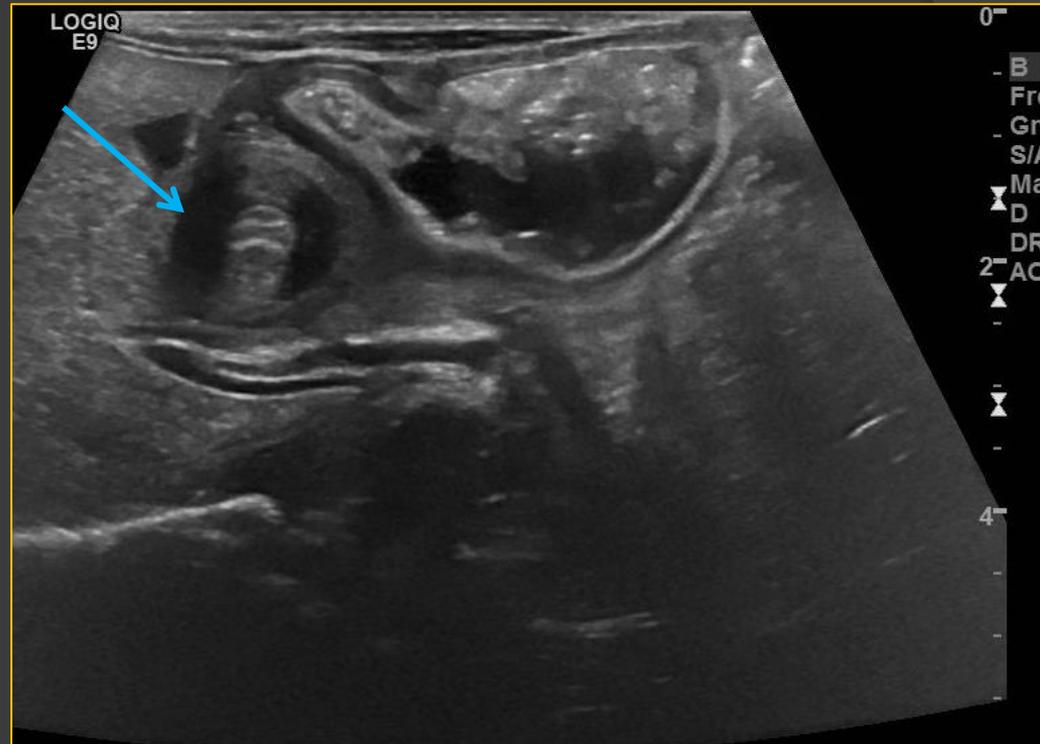
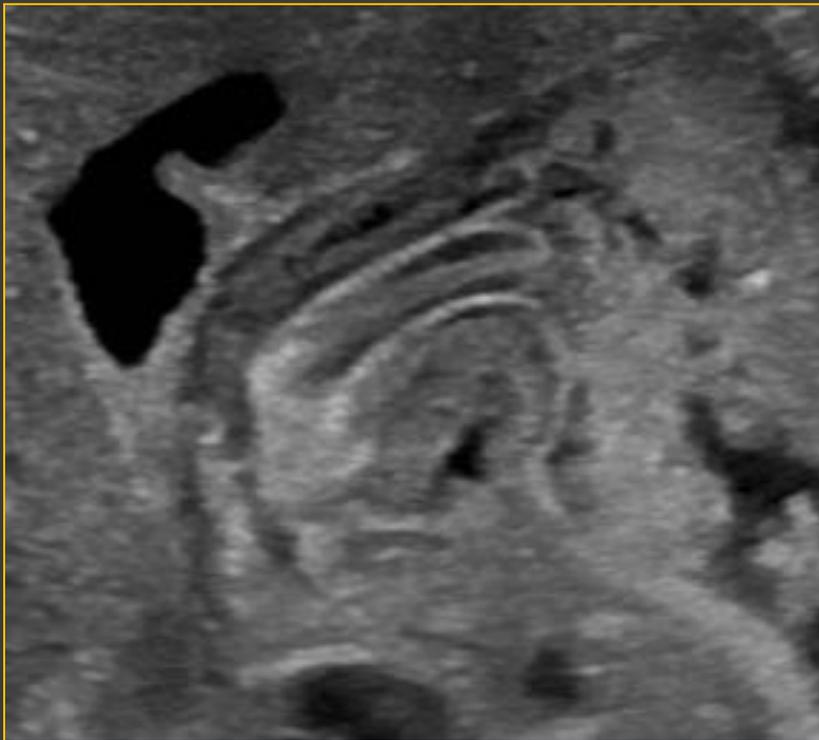
Stomach gas can obscure the pylorus

Patient should be turned to right posterior oblique position to displace stomach gas, and to better visualize the pylorus as fluid distends the gastric antrum.



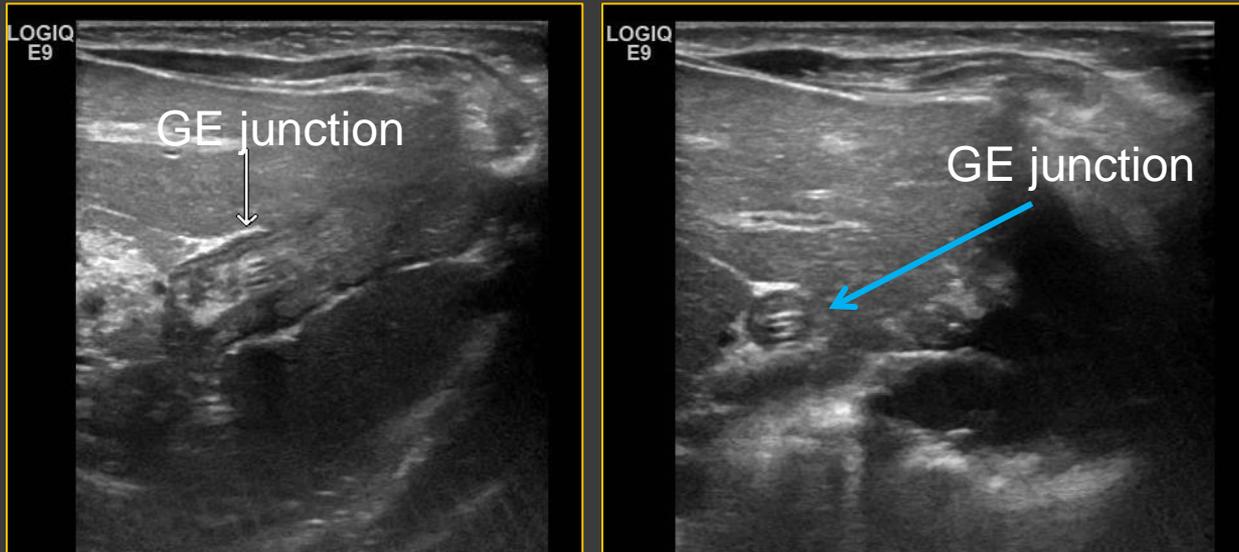
Posterior displacement of pylorus

It is important to know that when the stomach is over distended, the pylorus can flip posteriorly and may be hard to find



Beware of the GE junction!

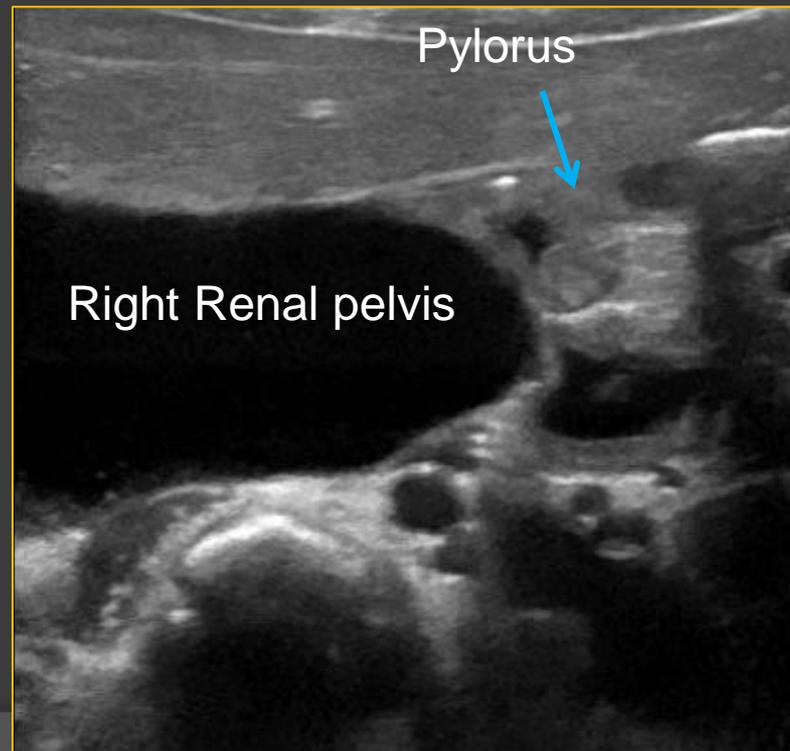
The gastro esophageal junction can be mistaken for pylorus, so remember to look carefully, by ensuring you see the stomach antrum proximally and duodenal bulb distally.



In this infant, the enteric tube was seen passing through the gastro esophageal junction which was thus distinguished from the pylorus.

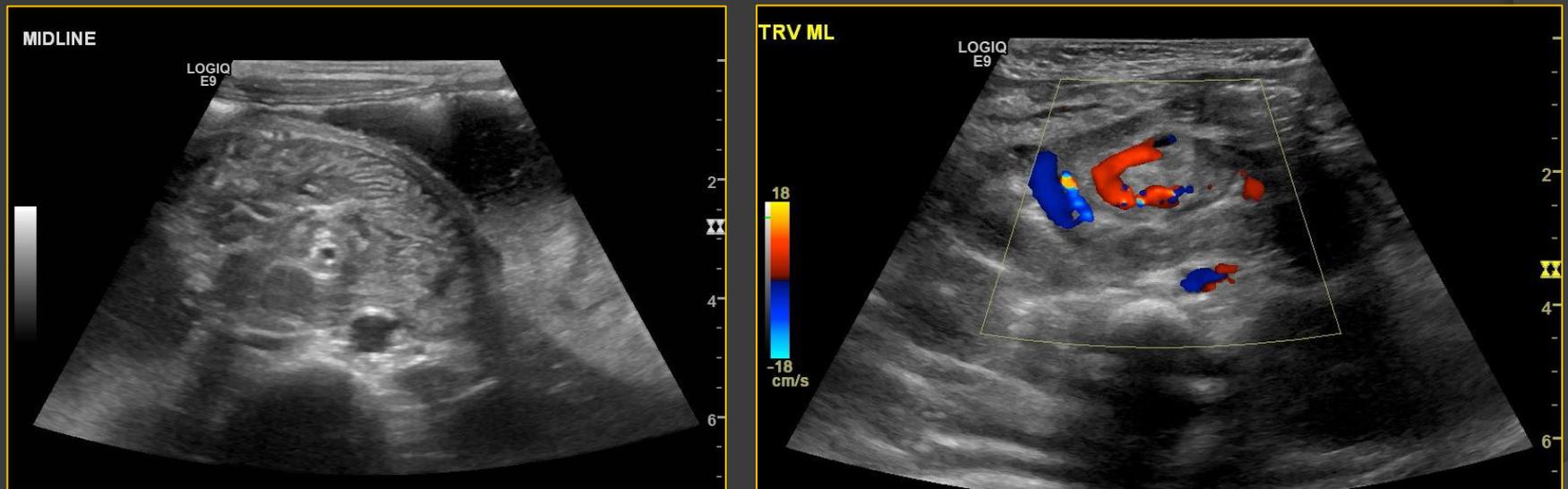
Look for hydronephrosis as a potential cause of emesis

When the pylorus is normal, remember to scan the kidneys to evaluate for hydronephrosis or ureteropelvic junction obstruction, where the renal pelvis causes mass effect on the pylorus.



If pylorus is normal, evaluate the midline vessels

When the pylorus is normal, and there is strong history of emesis, remember to evaluate the midline mesenteric vessels carefully to look for whirlpool sign.



In this infant, there was abnormal swirling of midline mesenteric vessels concerning for malrotation & volvulus!

Take Home Points:

1. Recognize **muscularis externa as the outermost hypoechoic layer** that should be measured for pyloric muscle thickness.
2. Differentiate this from submucosa which is the thick echogenic layer deep to muscularis externa. **Submucosa should be excluded** while measuring muscle thickness.
3. Most textbooks recommend measuring the pylorus in transverse section, but **in our experience**, measurements are easier and **more accurate in longitudinal** sections, so try both.

Thank You

Author info: tcielma@childrensnational.org
anjumnb@gmail.com