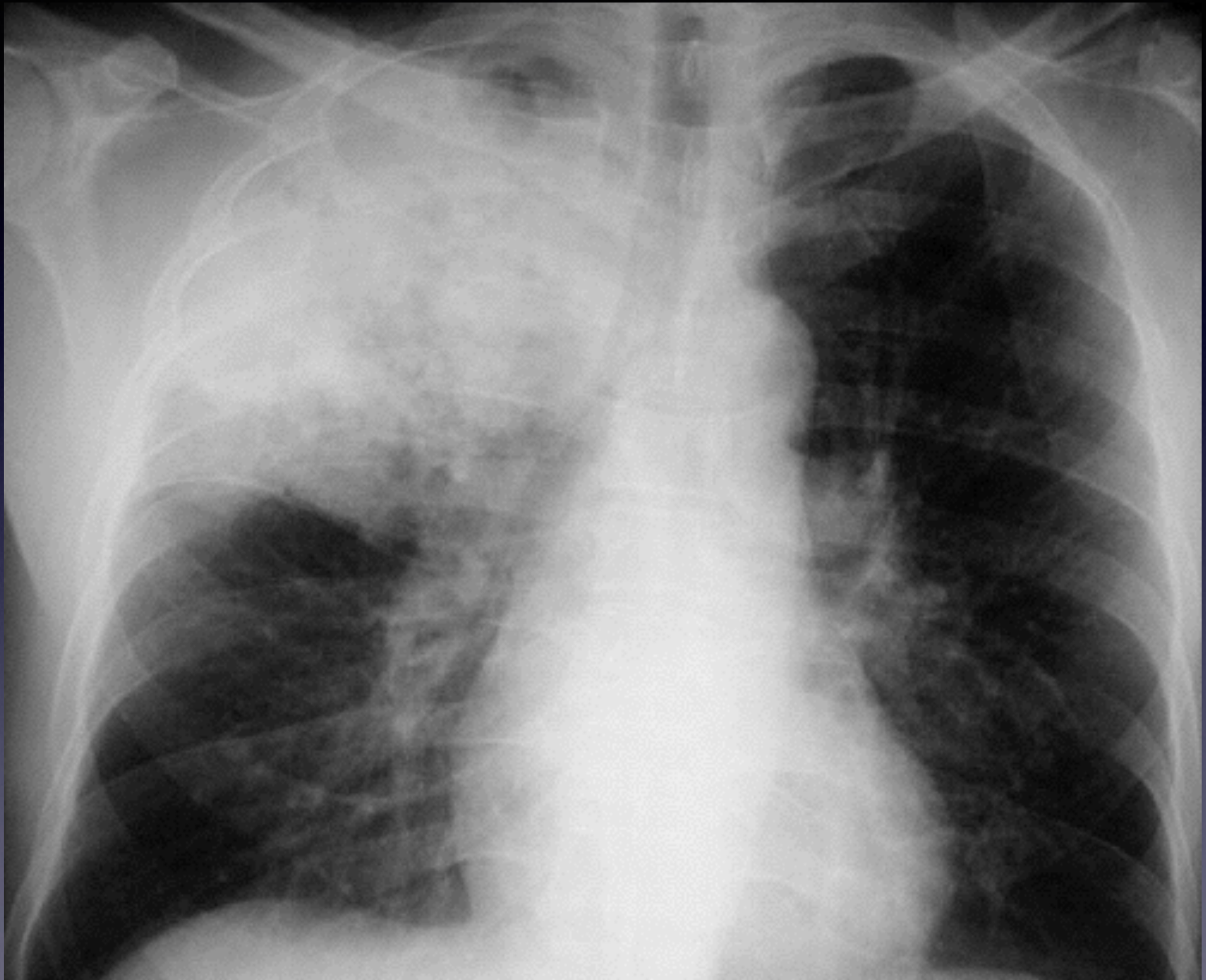




# Ultrasound: It's Not A Snow Storm

Joanna Cohen, MD  
Advances in Pediatric Medicine  
November 07, 2014













# Goals

- Talk about what pediatric ER diagnostic problems we use US for and why
- Learn how to Interpret some simple US images for common abdominal and Pelvic problems encountered in the PED



# Abdominal and Pelvic Exams

- Intussuseption
- Appendicitis
- Malrotation
- Gallbladder
- Pyloric Stenosis
- Pelvic
  - Early Pregnancy
  - Ovaries

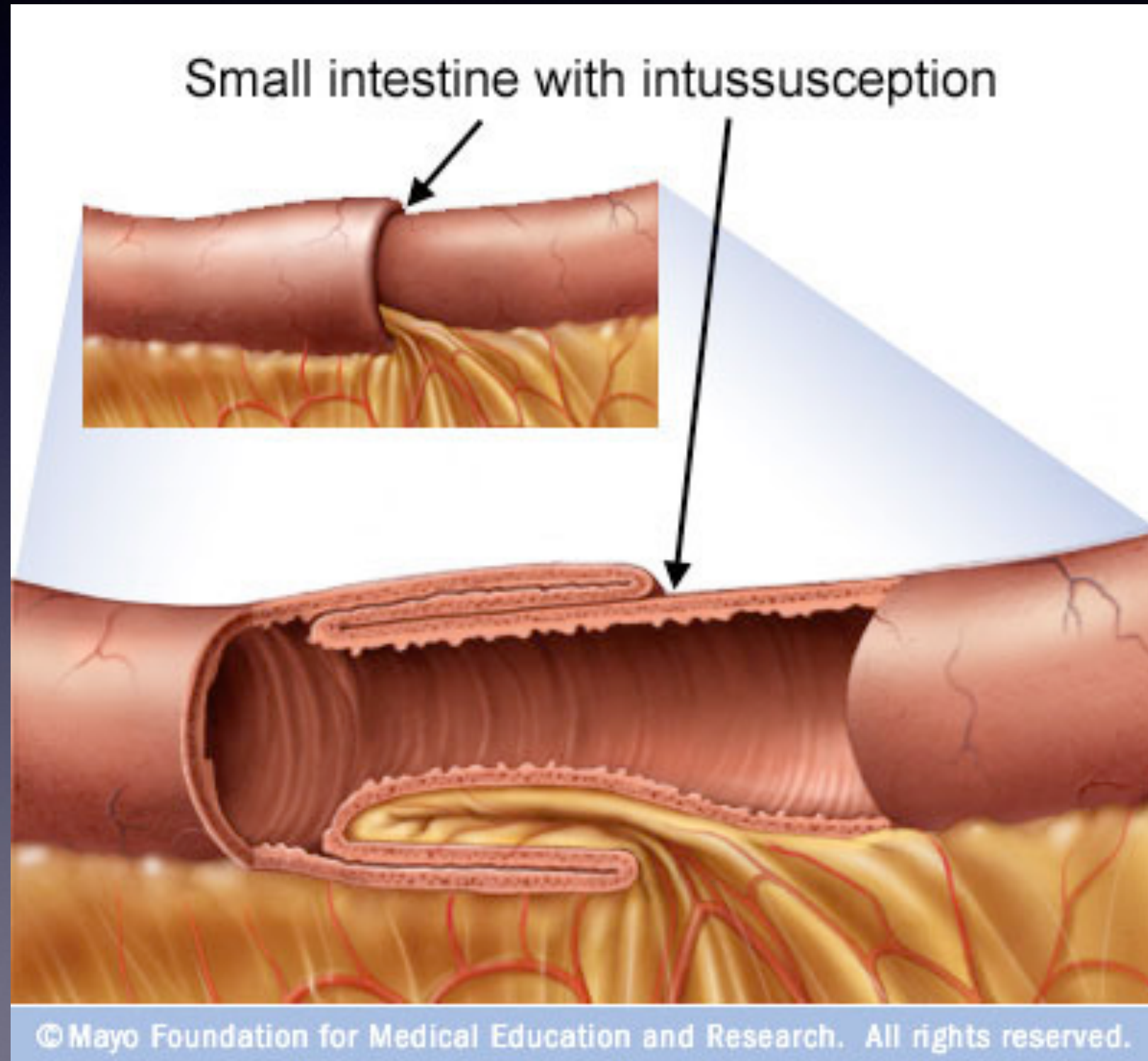


# Intussusception



- 6 mo to 3 years
- Intussusceptum (usually ileum) telescopes into intussusciens (ileocolic or ileo-ileocolic)
- Intermittent obstruction and pain, drawing up knees
- Currant jelly stools

# Invaginating mesentery



# Intussusception: clinical presentations and imaging characteristics.

Mandeville K, et al Pediatr Emerg Care. 2012

- 219 patients with intussusception
- 192 AXR - 85% had no air present in the ascending colon.
- 63 with AUS -92% showing intussusception



# US Findings

- Most common site is ascending and transverse colon under the liver
- Target, hamburger, doughnut, pseudo-kidney
- Doppler to evaluate vascularity
- Fluid between colon and intussusceptum associated with lower rate of successful reduction

# Ultrasound findings: Target sign





3.7



# Normal bowel: 2 Layer

## Only 2 visible layers



# Ultrasound findings: long view of bowel: 4 visible layers



Gen THI  
S MB

Abd  
P21  
G  
MB  
1.2



A  
B

7.6



# APPENDICITIS

- Peak incidence 10-12 years
- Begins as dull, steady pain in periumbilical area...

Progresses over 4-6 hours & localizes to right lower quadrant

- Low grade fever
- Nausea
- Anorexia

- Sudden pain relief may indicate rupture of appendix (Leads to peritonitis)



## **\*Diagnosis\***

- Clinical signs and symptoms
- ↑ WBC
- Abdominal Sonogram
- Exploratory Lap

- Rebound Pain or Tenderness (RLQ) at McBurney's Point

# US or CT for diagnosis of appendicitis in children and adults? A meta-analysis.

Doria AS, et al. Radiology 2006

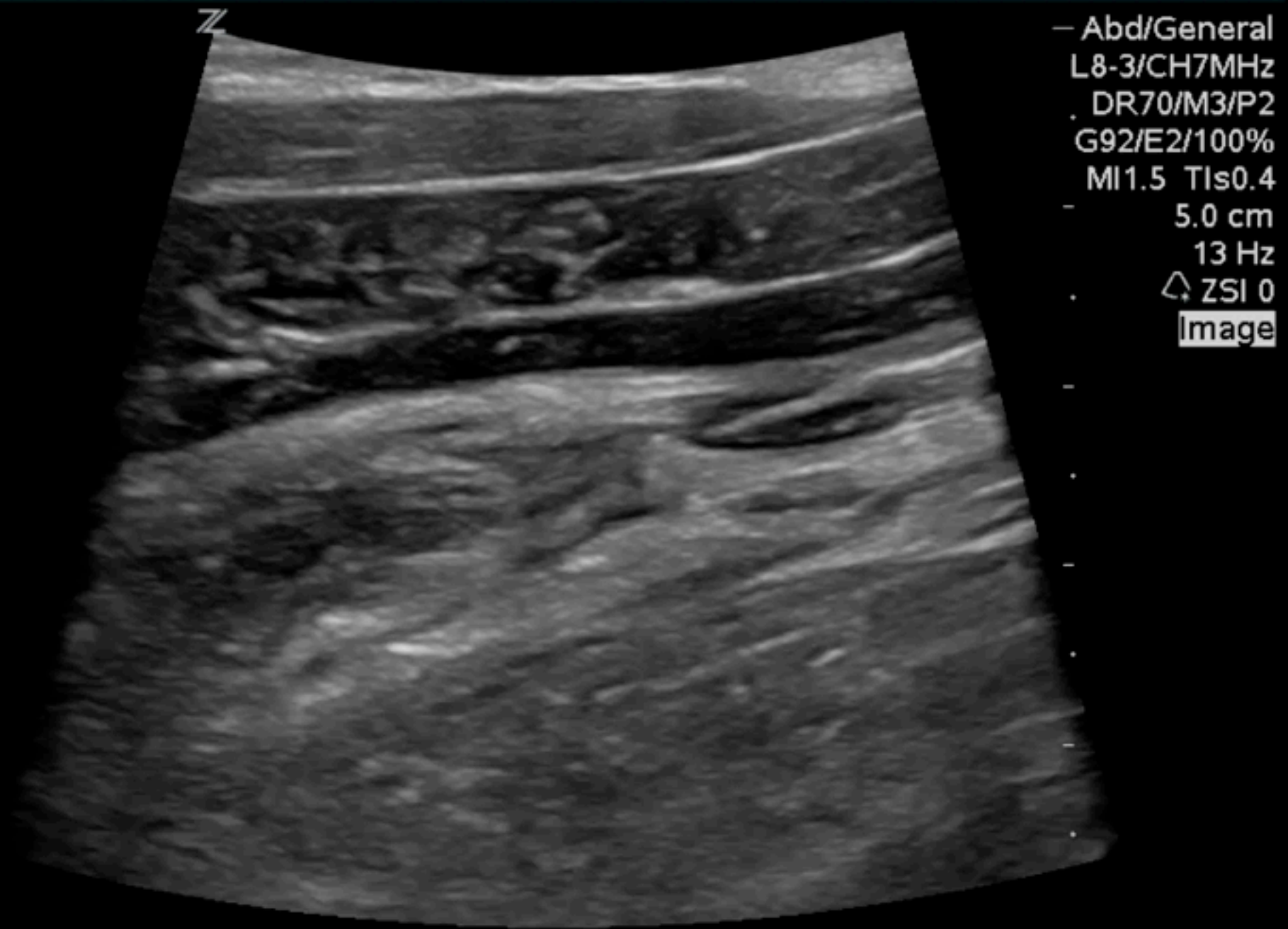
- Overall sensitivity of ultrasound for appendicitis in children is 88% and its specificity is 94%
- Ultrasonography a good "rule in" test to confirm appendicitis as its specificity rivals that of CT scanning in some studies.
- Poor sensitivity in comparison to CT does not allow it to be utilized as a good "rule out" test

# Appendicitis on US

- Inflamed noncompressible appendix
- $> 6$  mm
- Echogenic inflamed surrounding mesentery and omentum
- 30% fecolith
- Free fluid if perforated
- Ileus
- Para-appendiceal abscess



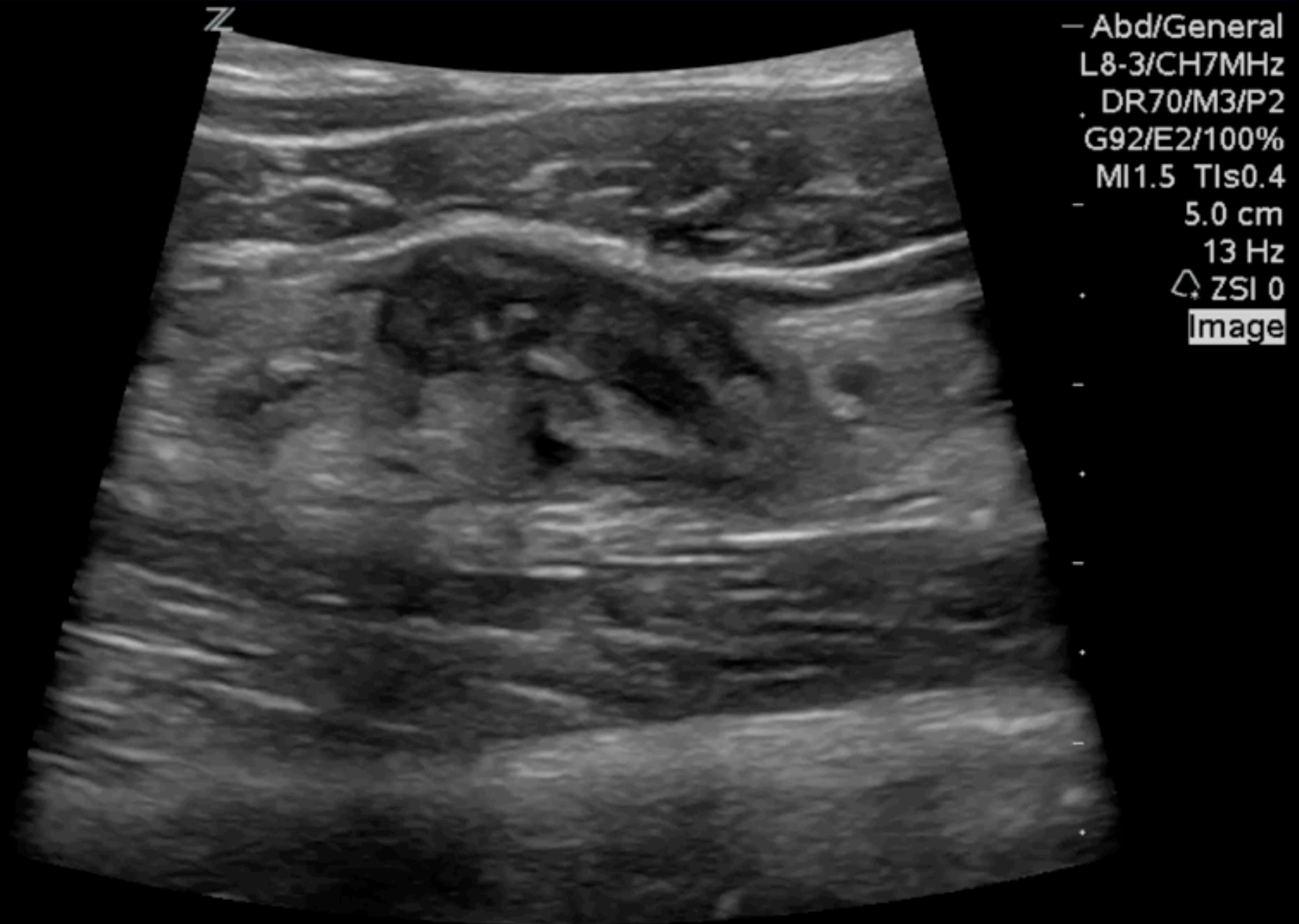
# Appendicitis



# Appendicitis with Fecolith



# Appendicitis



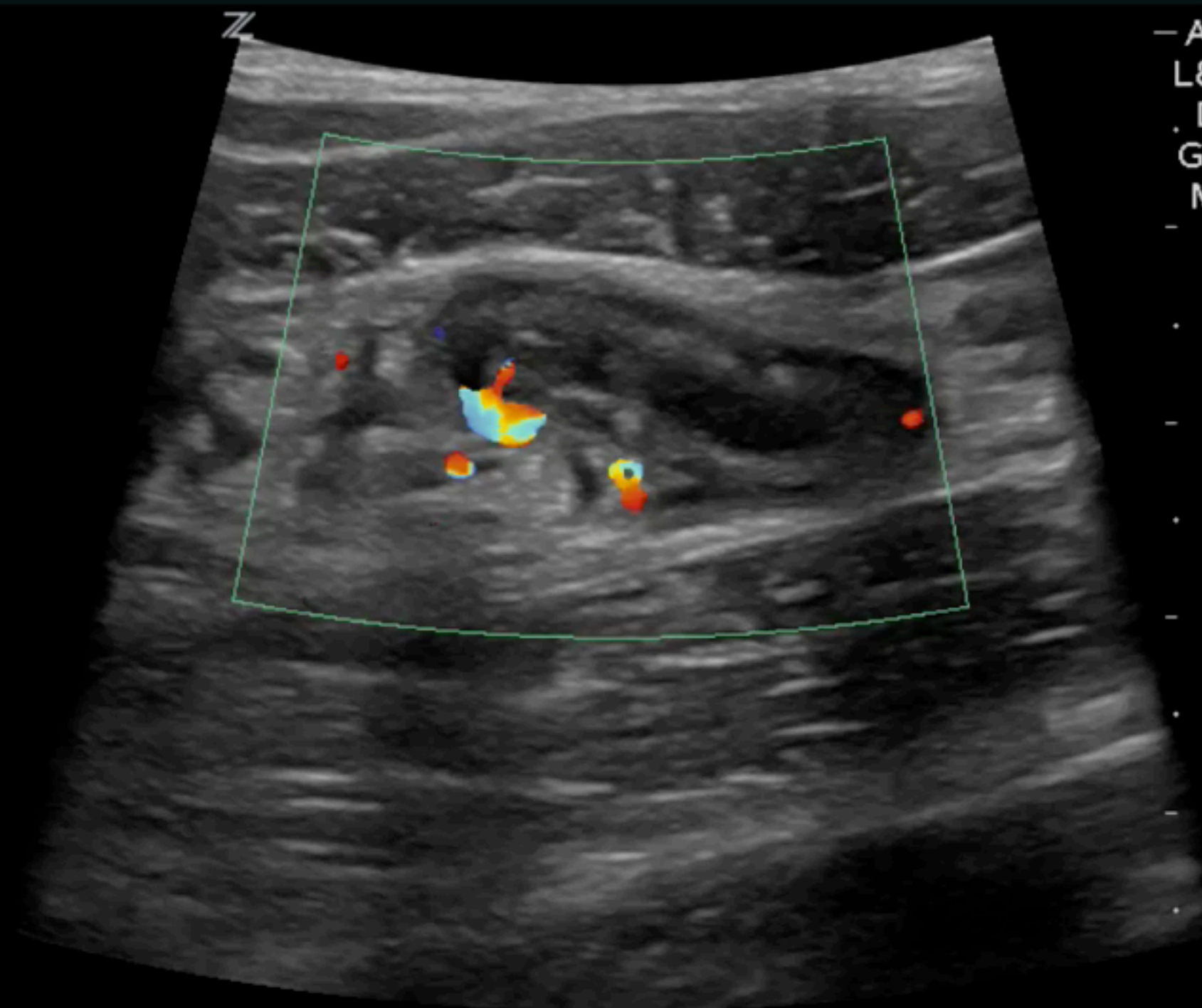


+ 6.9



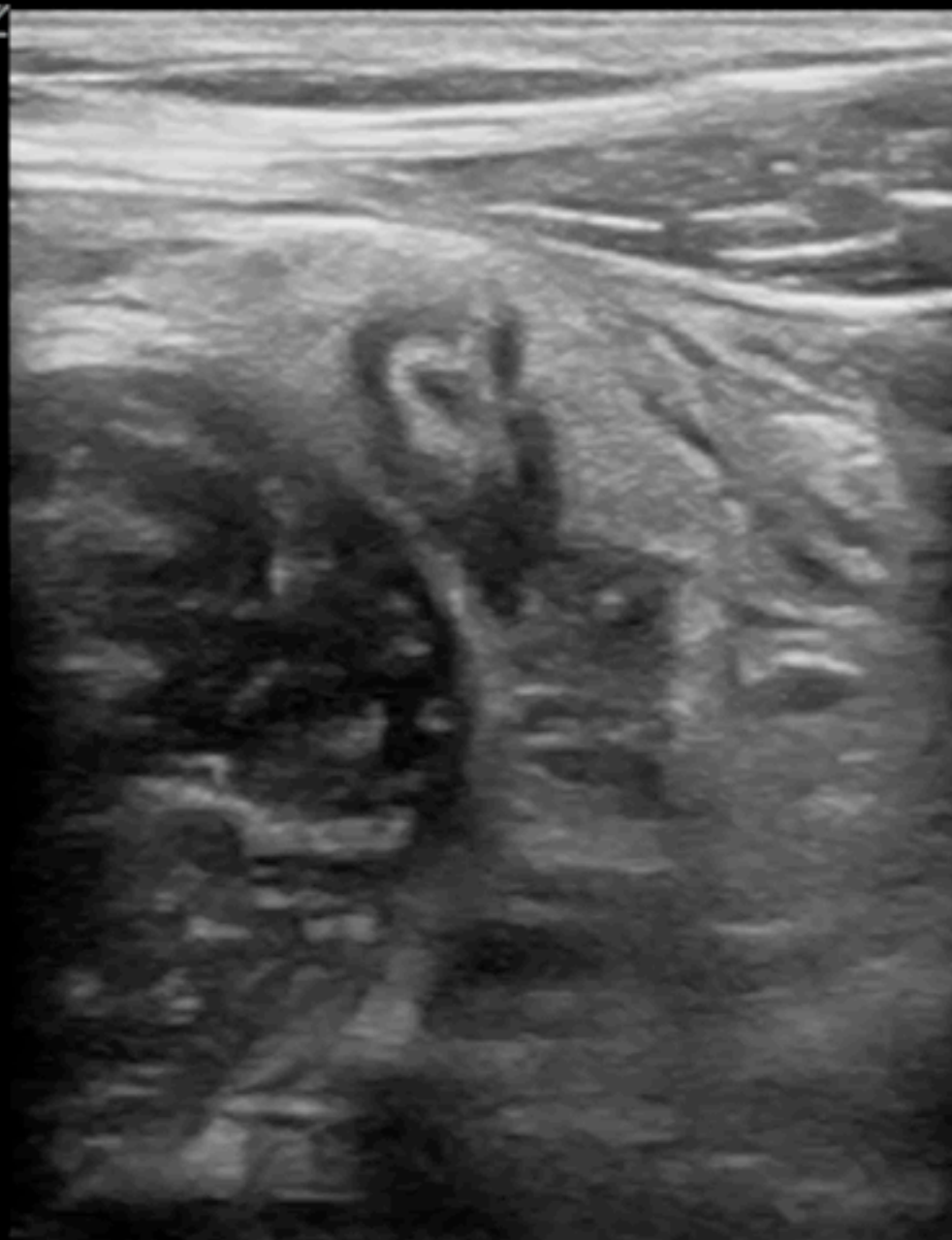
- 6.9

cm/s  
4.0MHz  
M3/P2  
G54/E1  
WF H



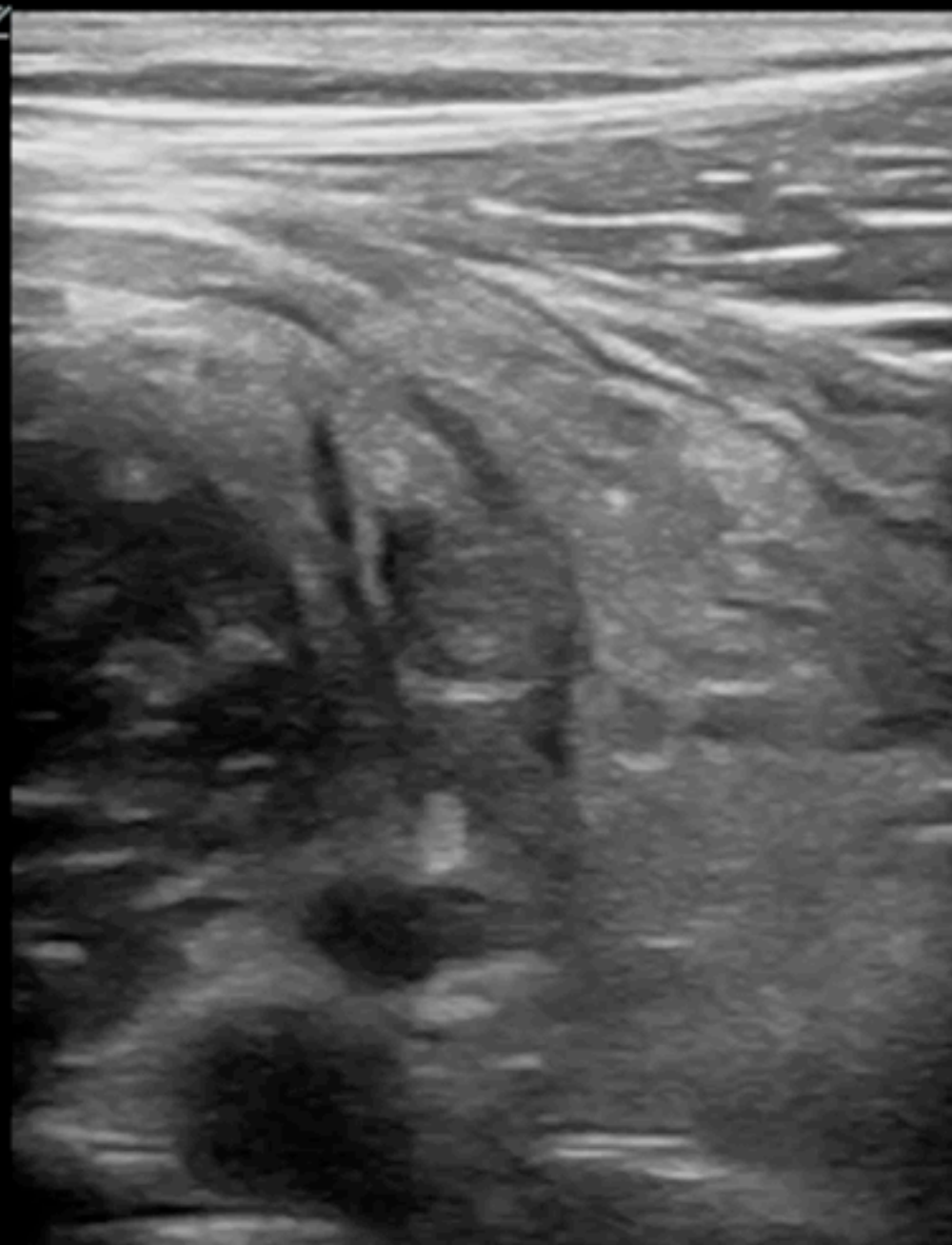
— Abd/General  
L8-3/CH7MHz  
DR70/M3/P2  
G94/E2/100%  
MI1.4 TIs0.6  
5.0 cm  
12 Hz  
△ ZSI 0  
**Image**

Z



— Abd/General  
L8-3/CH7MHz  
DR70/M3/P2  
G84/E2/100%  
MI1.5 TIs0.4  
— 5.0 cm  
13 Hz  
ZSI 0  
Image

Z



— Abd/General  
L8-3/CH7MHz  
· DR70/M3/P2  
· G84/E2/100%  
MI1.5 TIs0.4  
— 5.0 cm  
13 Hz  
· ZSI 0  
Image

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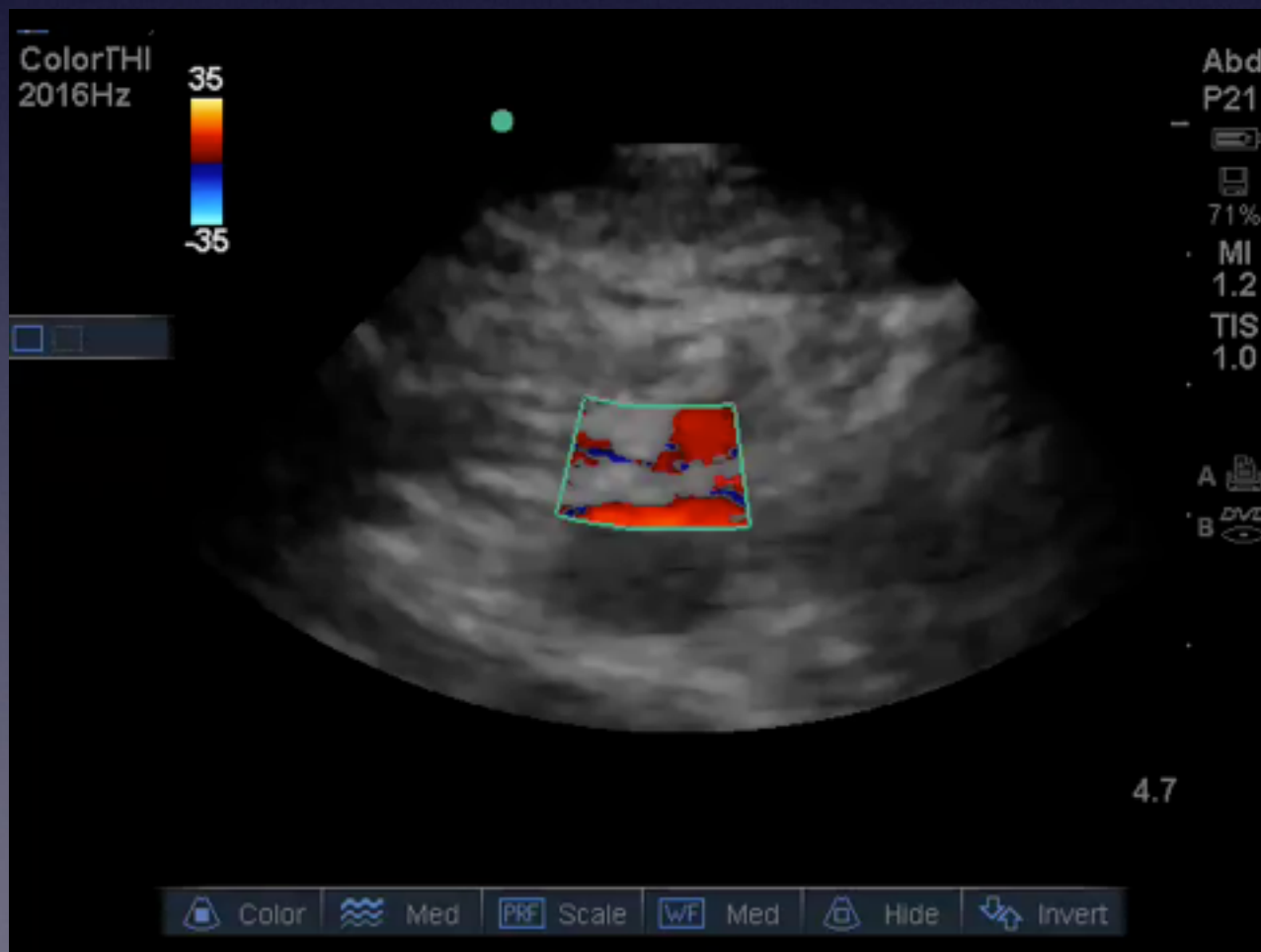
# Malrotation

- Abnormal bowel position
- Volvulus: twisting of mesentery around SMA
- Bilious emesis



# SMA and SMV Position

- Normal SMV to the right of SMA
- SMA anterior or right of SMV: concern for Malrotation



- Artery is thick walled, pulsatile
- Vein is more oval, collapsible and has lower flow.

# Is ultrasonography a good screening test for intestinal malrotation?

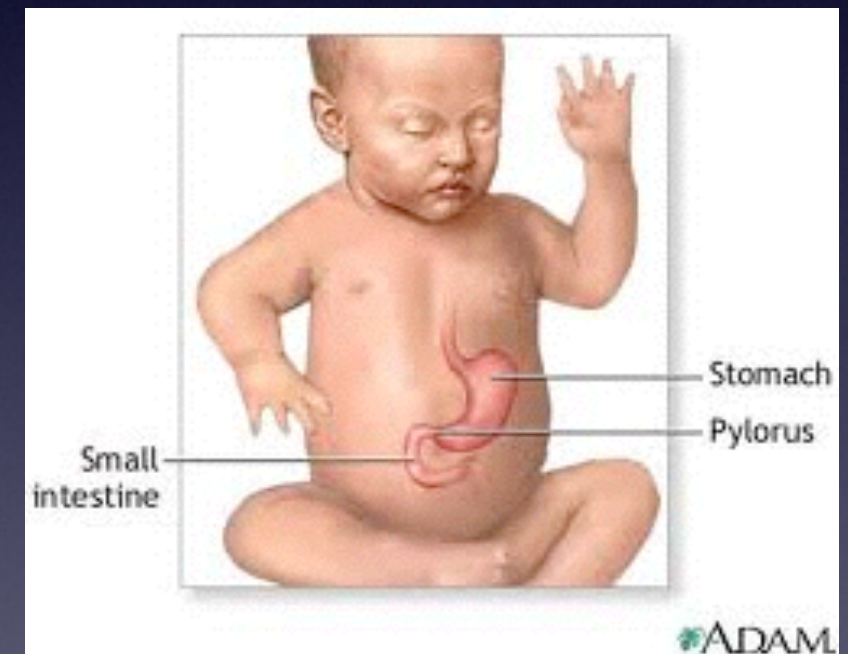
Orzech N, et al J Pediatr Surg. 2006 May

- 211 children with UGI and US for possible malrotation
- UGI and US were both normal in 62%
- 44 had abnormal US and normal UGI (false positive, 21%)
- 5 patients had normal US and abnormal UGI (false negative, 2%).
- Inversion of SMV/SMA and a "whirlpool" sign were more predictive for malrotation and volvulus than anterior/posterior orientation.
- Children with an abnormal ultrasound should have an UGI or go to the OR



# Pyloric Stenosis

- 6 week old first born male infant
- projectile vomiting
- FTT
- palpable olive in epigastric region



Hypertrophic pyloric stenosis in the infant without a palpable olive: accuracy of sonographic diagnosis.

Hernanz-Schulman M, et al. Radiology. Dec 1994

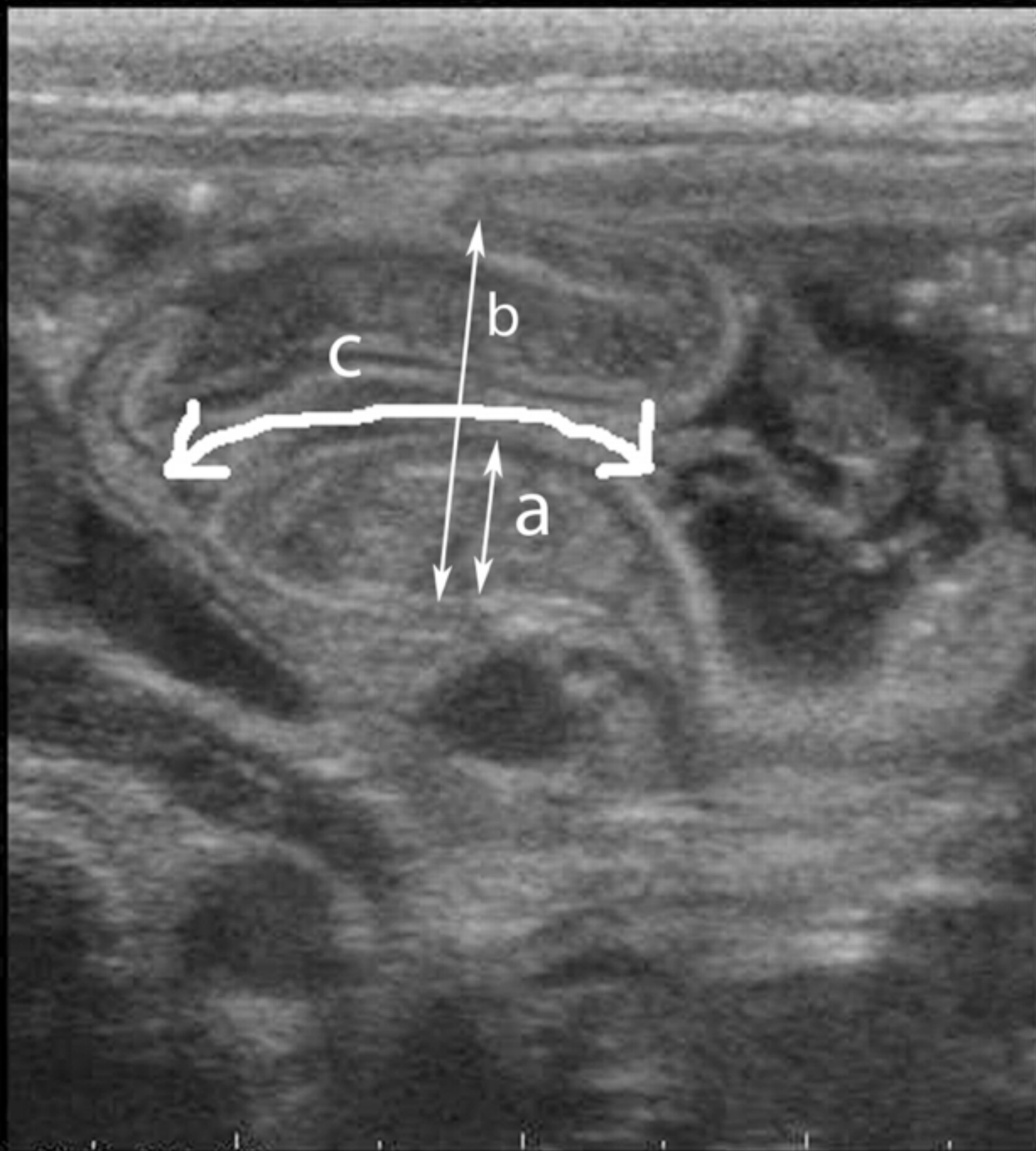
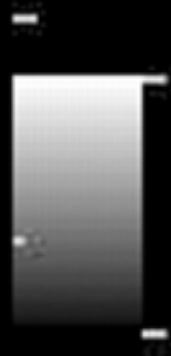
- Pyloric olive historically felt by surgeons in up to 80% of patients.
- Recent studies felt much less frequently (23% of the time in one reported case series)
- Preferred diagnostic test for hypertrophic pyloric stenosis
- Ultrasonography sensitivity and specificity are close to 100% for this disease.



# Pyloric Stenosis

- Center is echogenic mucosa
- Hypoechoic muscle
- Muscle thickness  $> 3\text{-}4$  mm in the transverse view
- Canal length  $> 10\text{-}15$  mm in the longitudinal view

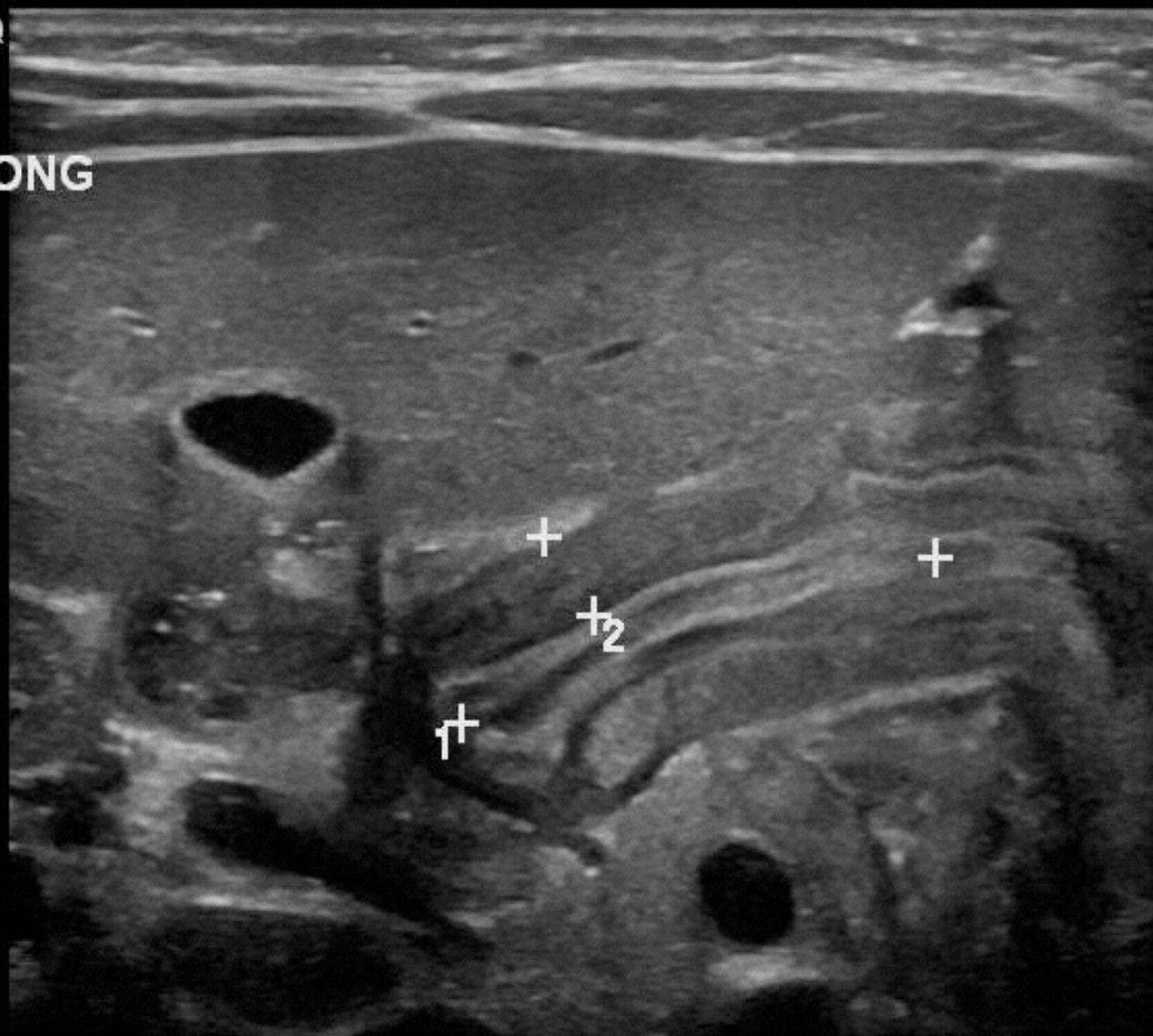




SEX:M

LOGIQ  
E9

PYLORUS LONG



●	1
1 L 2.18 cm	
2 L 0.40 cm	

[W=256, L=127]

CHI	
- Frq	15.0
- Gn	36
- S/A	2/1
- Map	F/0
- D	4.5
1- DR	63
- AO%	100



2-

-



3-

-

-



4-

-

-

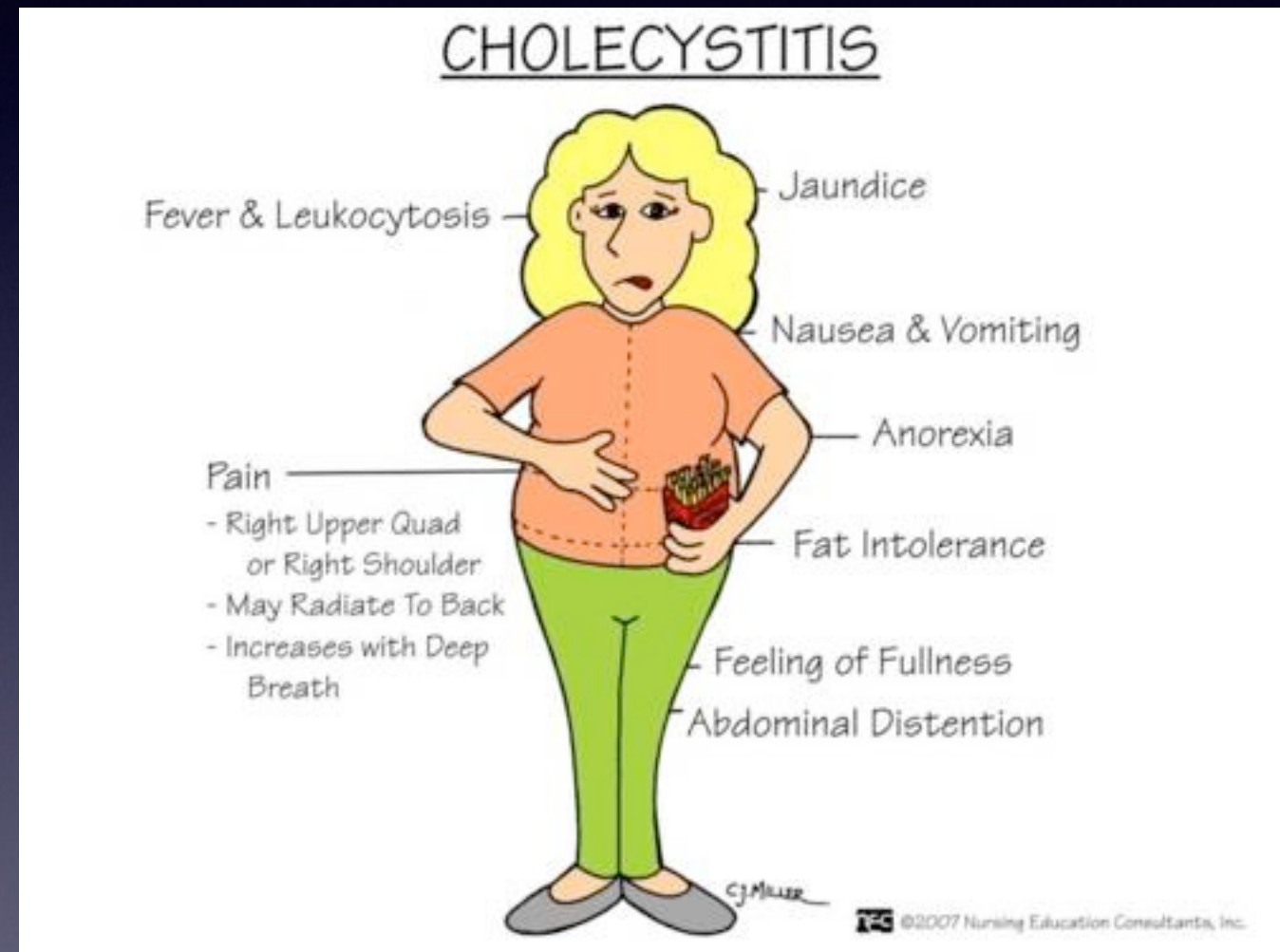






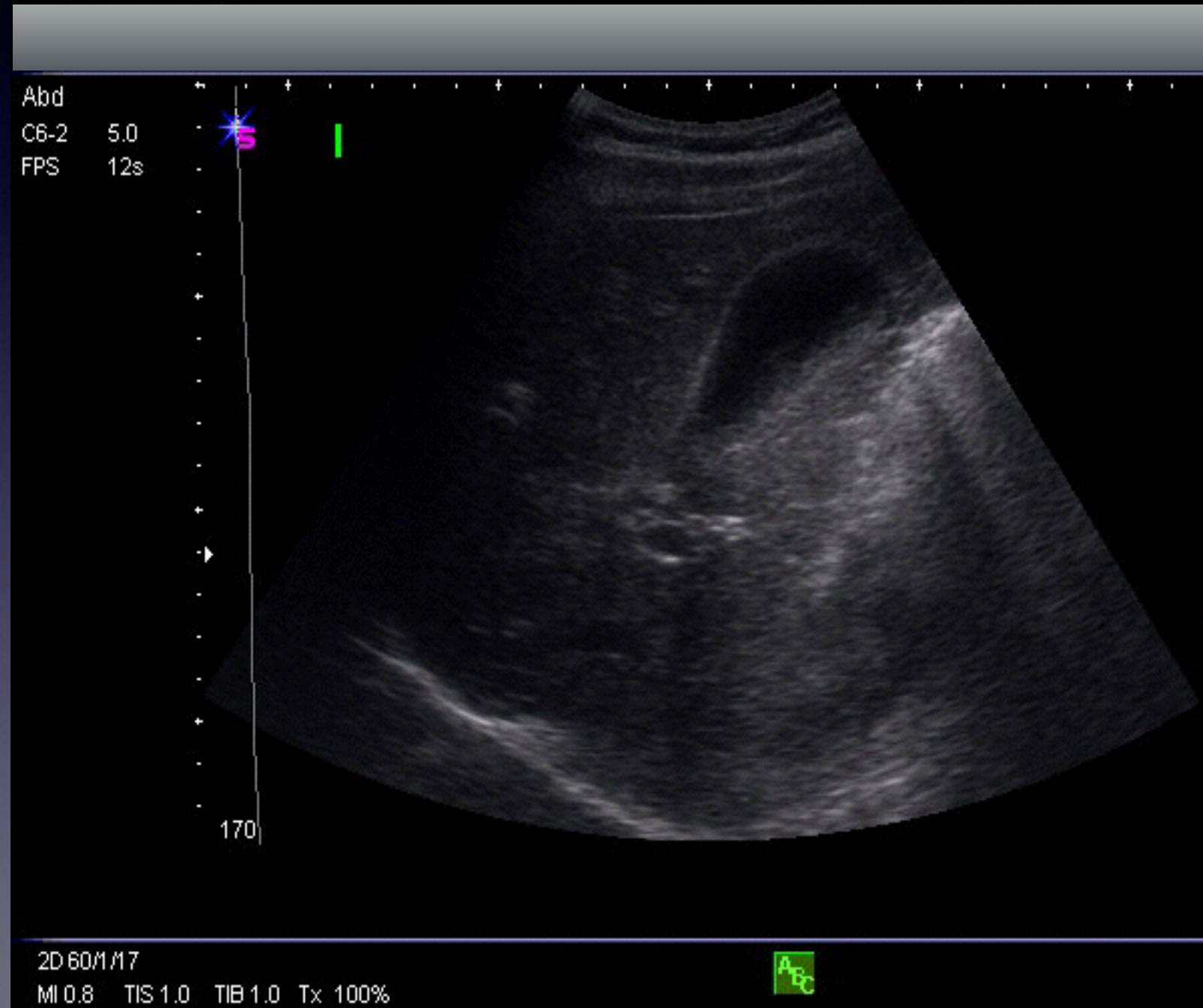
# Gallbladder Disease

- Sickle cell patients
- Obese patients
- RUQ postprandial pain



# Gallbladder

- Gallbladder
  - 7-8 cm long
  - 2-3 cm diameter
    - Max normal <4 cm
- GB wall
  - <2mm (97% cases)
  - Measure anterior wall



# Important GB measurements

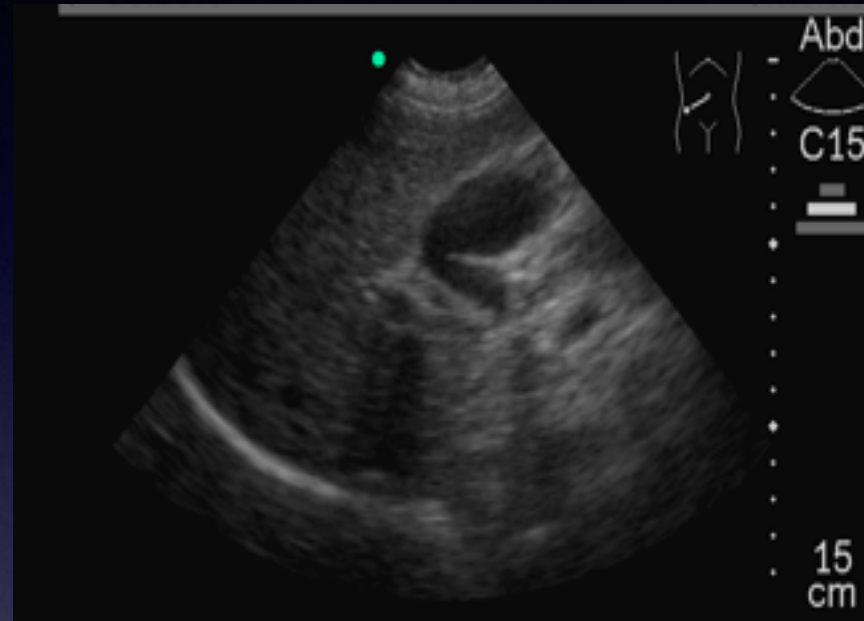
- GB wall thickness
  - anteriorly
- GB diameter
- Common bile duct

4



# Anatomy Consideration

- Normal Folds
  - Crisp folds are normal
  - Hartman's pouch
    - folded neck
- Apical fold 3%
  - “Phrygian cap”
- Septations in neck
  - “valves of Heister”



# Portal Triad

- Portal Triad
- Hepatic Artery
- Common Bile Duct
- Portal Vein



# CBD US Anatomy

- $<4\text{mm}$  (98% cases) up to age 40
  - Inner wall to inner wall
    - Bachar JUM 2005
- Can be up to 10 mm after cholecystectomy
- $>10\text{ mm}$  = Likely obstruction

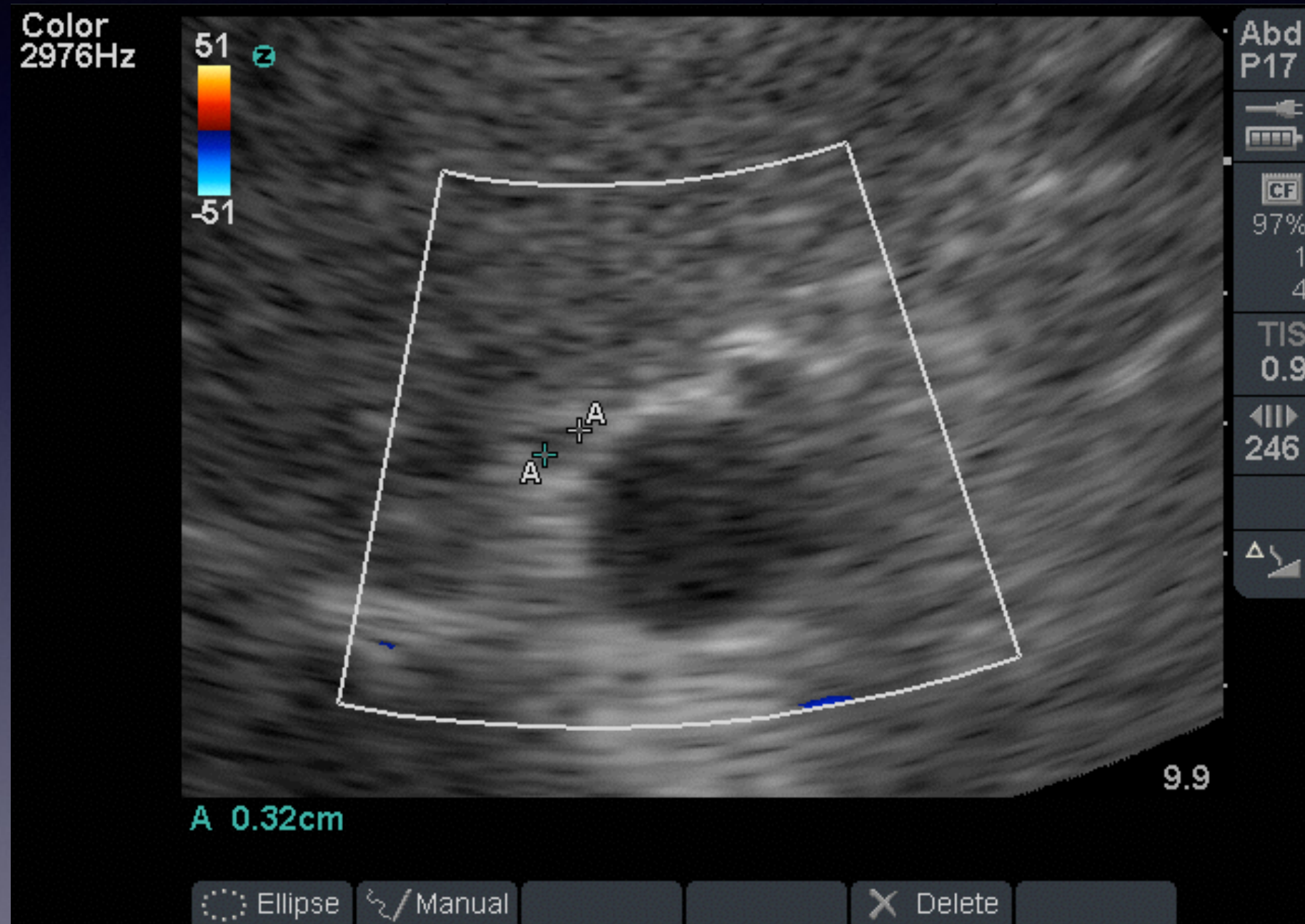


# Porta Hepatis

- Mickey Mouse Sign
- Right Ear – Common Bile Duct
- Left Ear – Hepatic Artery
- Face – Portal Vein

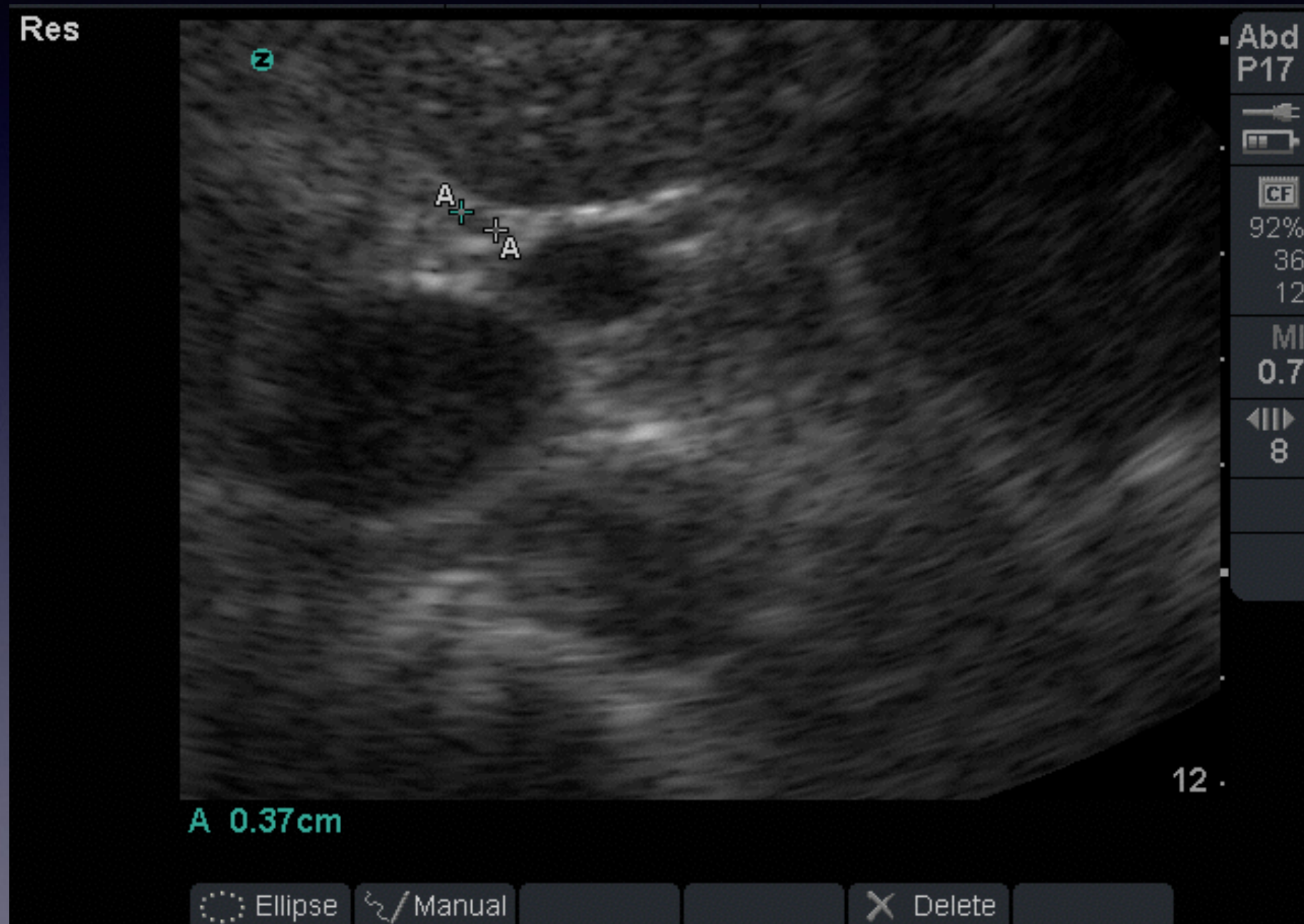


# Common Bile Duct





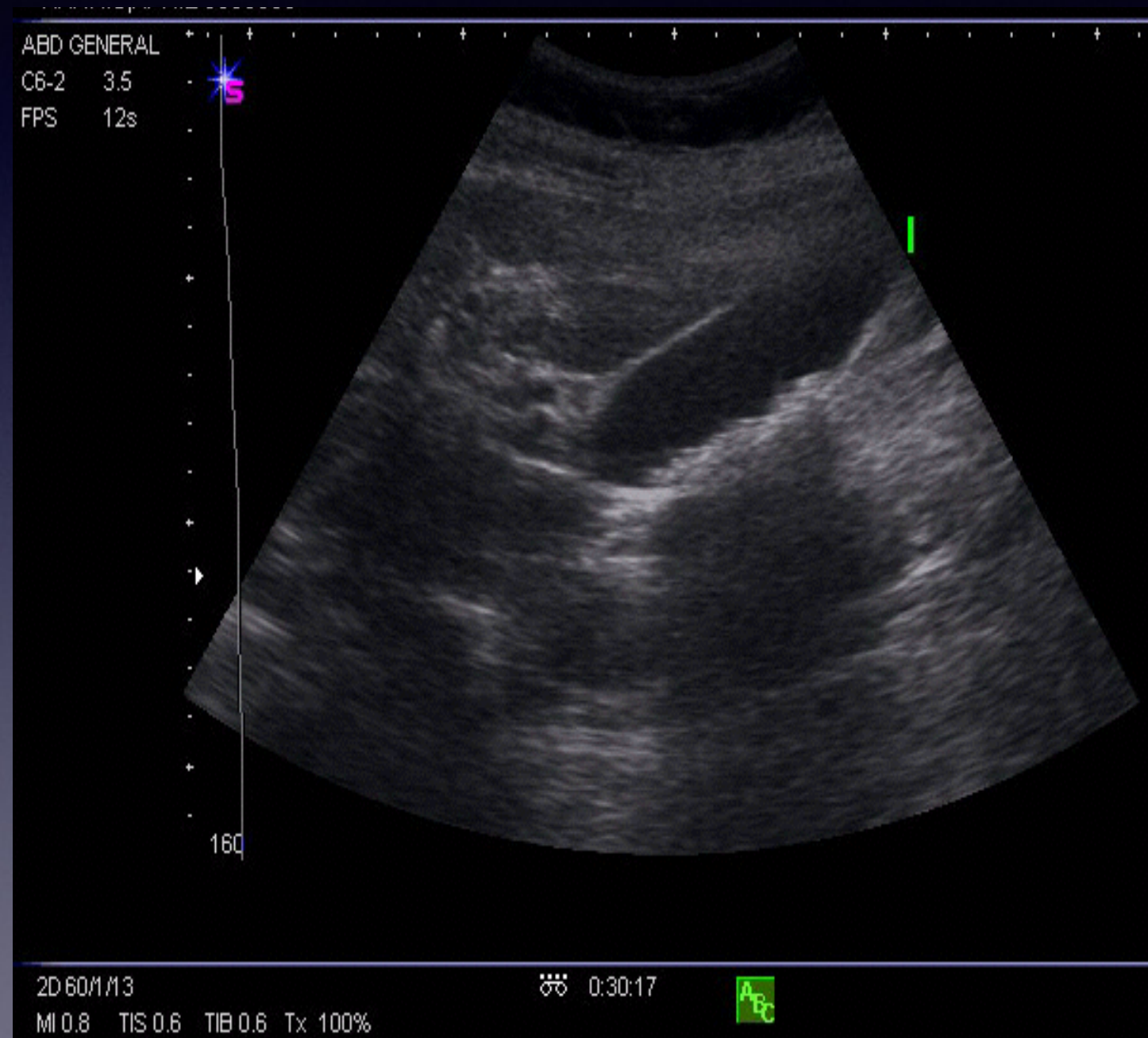
# Common Bile Duct



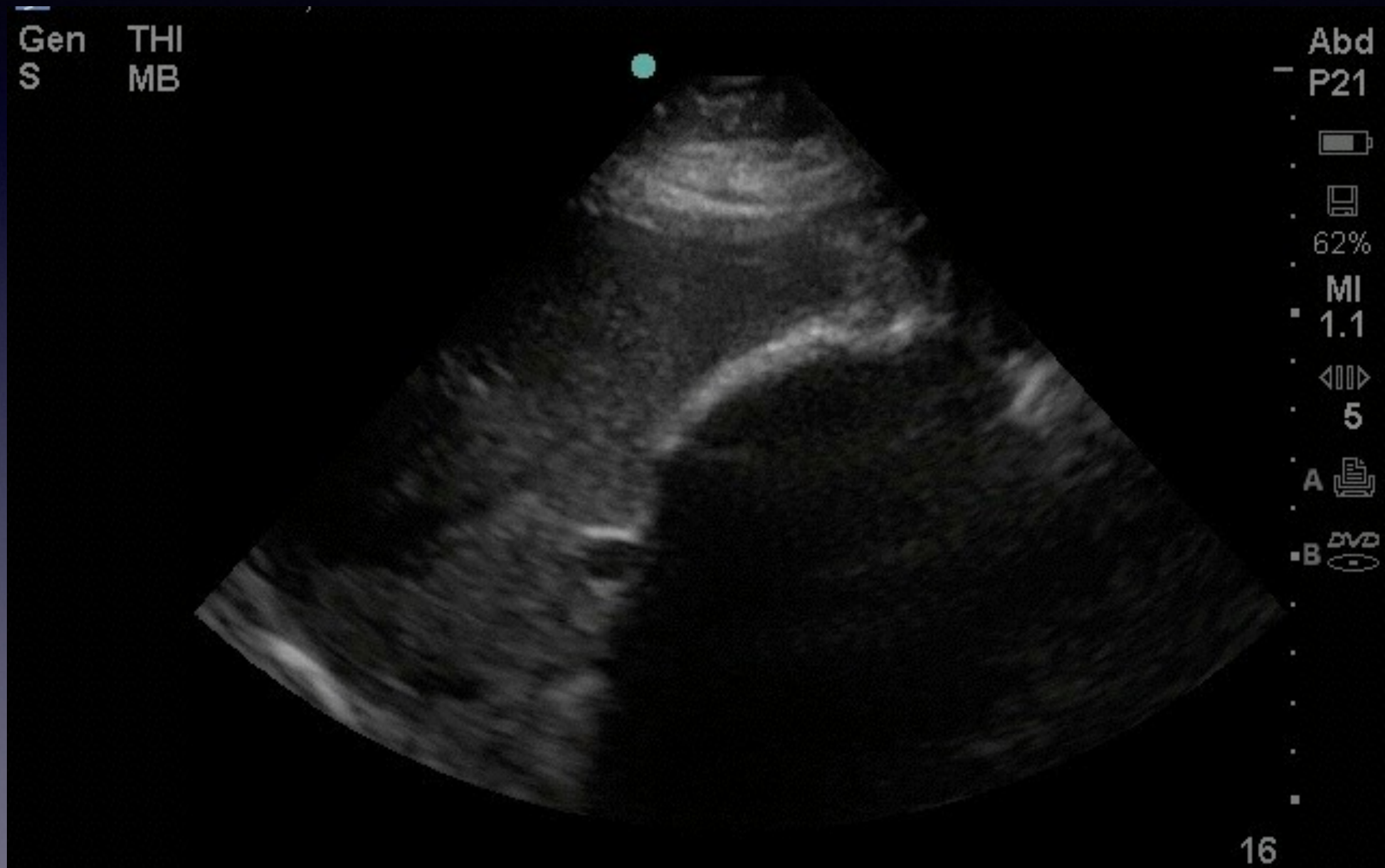


# Cholelithiasis

- Strongly Echogenic
- Posterior Acoustic Shadowing
  - “Clean” shadowing
- Mobile
  - Move with change in patient position

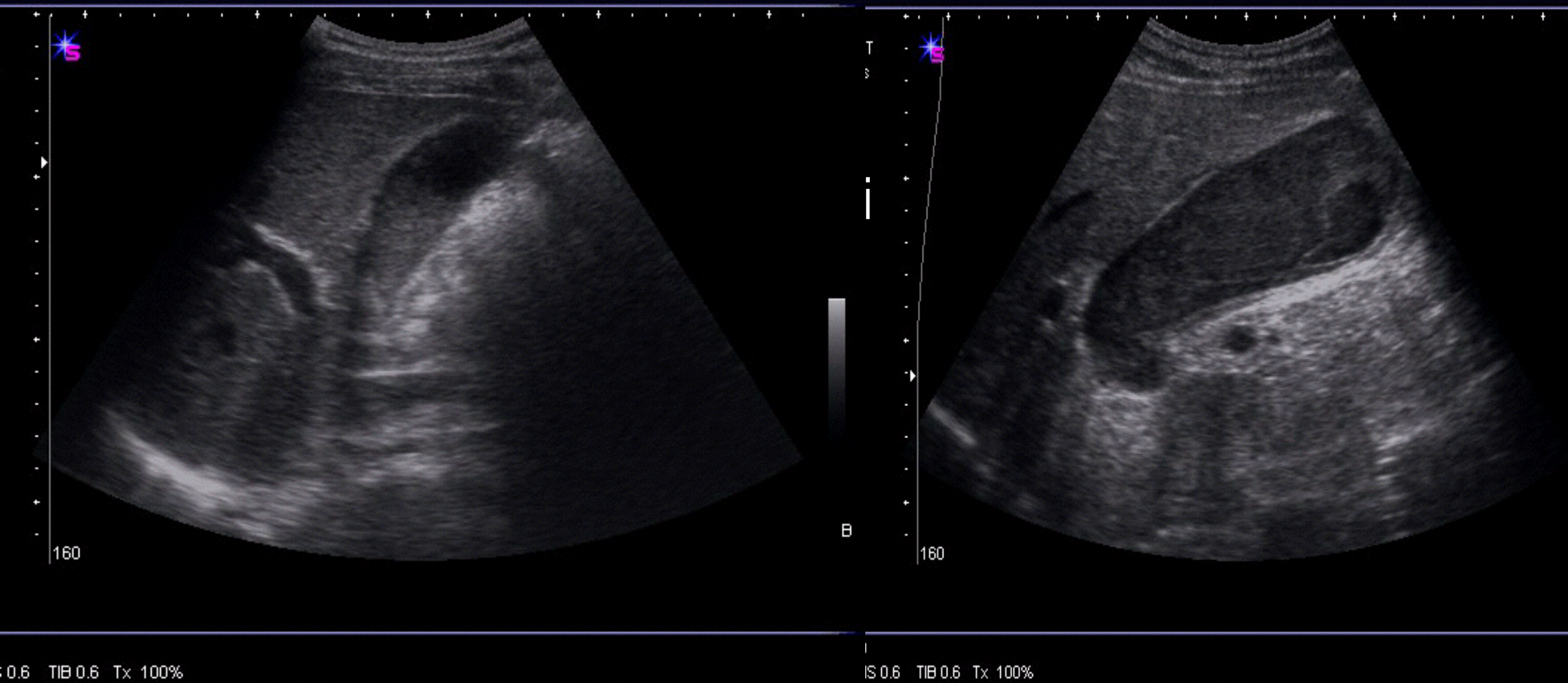


# Cholelithiasis - WES sign





# Sludge



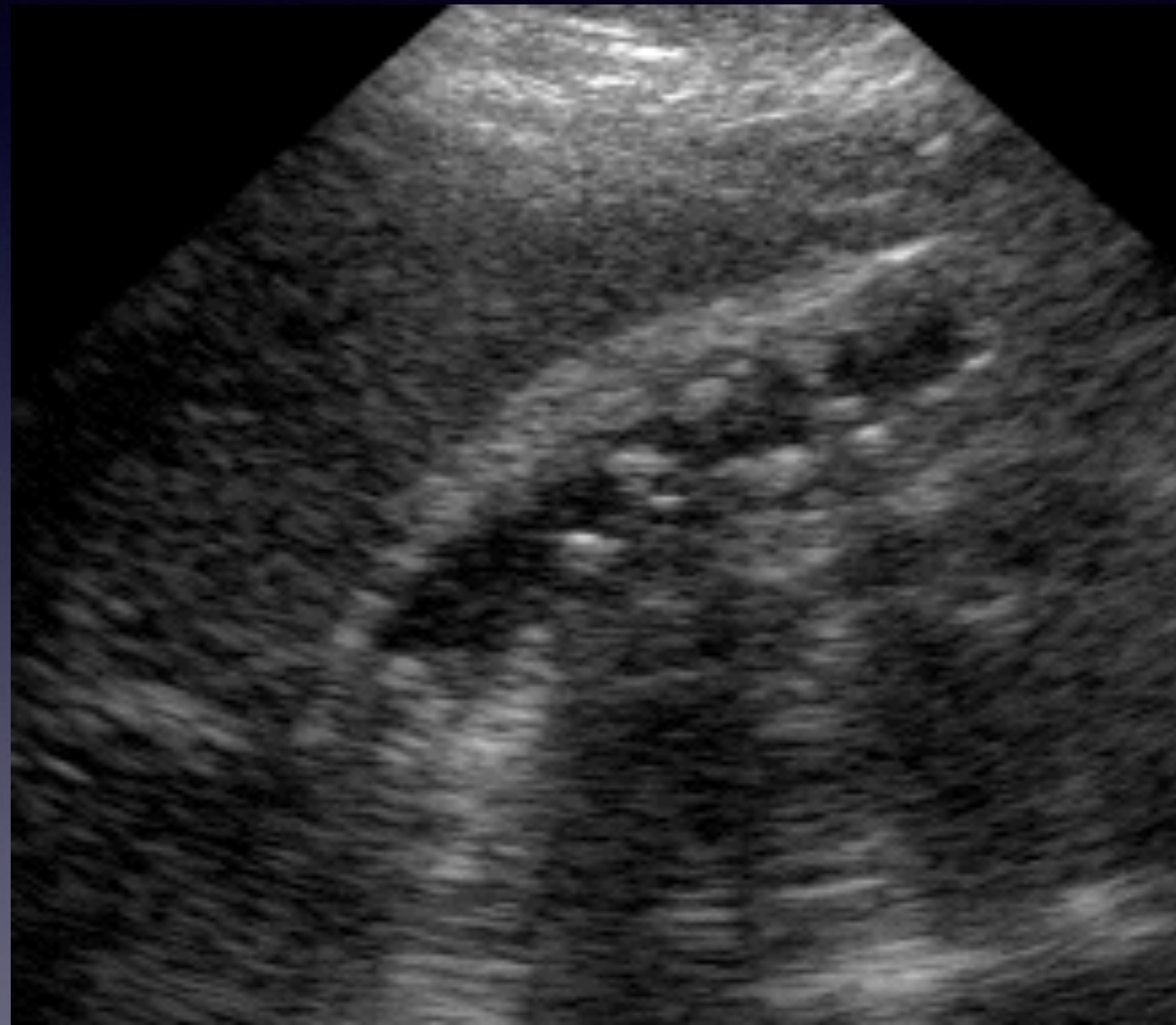


# Cholecystitis

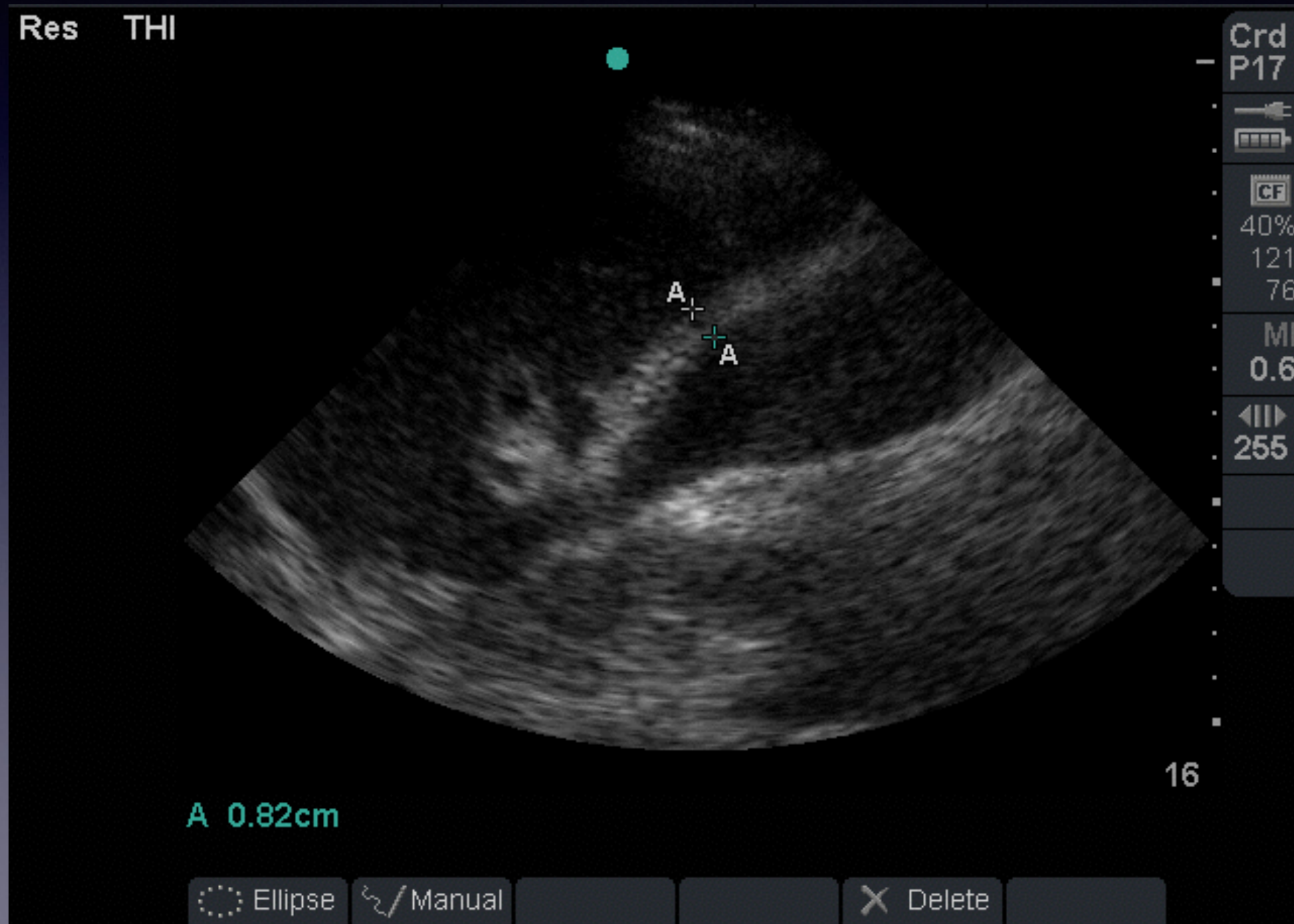
- Signs and symptoms
  - RUQ abdominal pain
  - Murphy's sign
  - Fever/ Chills
  - Leukocytosis
  - Jaundice (choledocolithiasis)

# Cholecystitis: US Findings

- Gallstones
- GB wall edema >4mm
- Pericholecystic fluid
- Sonographic Murphy's



# Cholecystitis

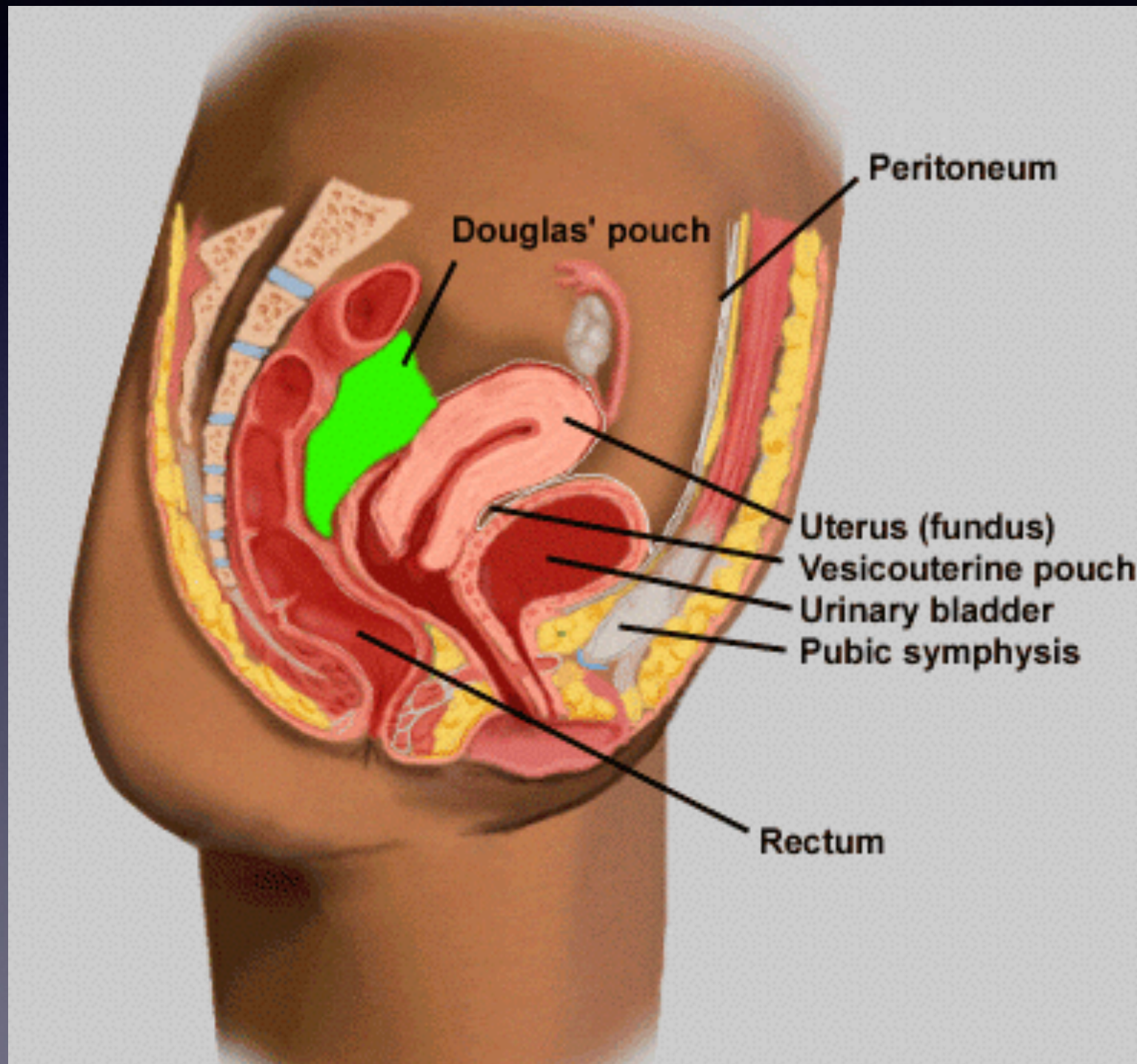




# Pregnancy

- Identify intrauterine pregnancy
- Recognize signs of ectopic pregnancy

# Anatomy

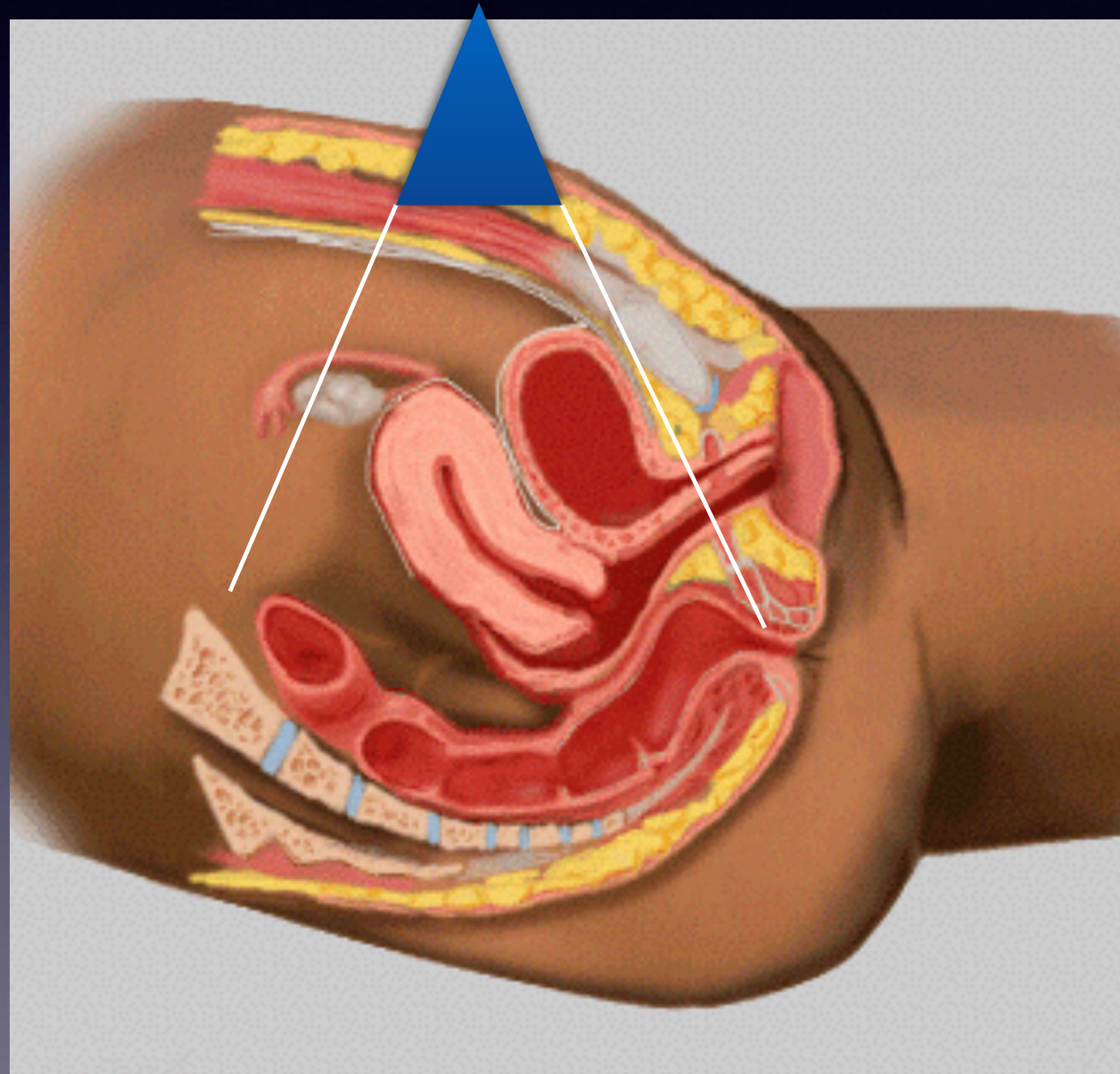


# Transabdominal vs. Transvaginal

- Larger field of view
  - Less invasive
  - Bladder discomfort
  - Lower frequency therefore poorer resolution
- Narrow field of view
  - Invasive
  - Probe discomfort
  - Higher frequency therefore better resolution

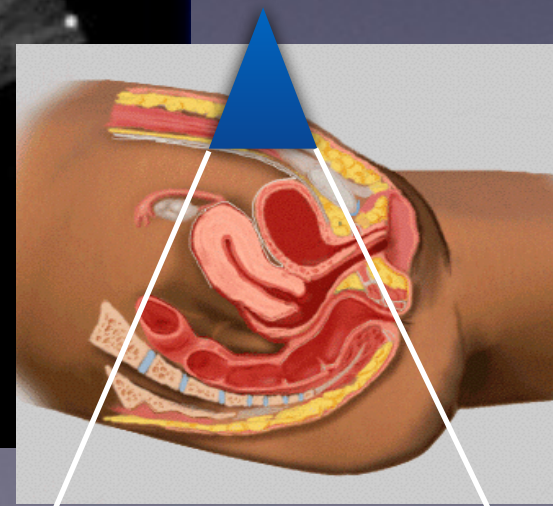


# Transabdominal View



# Transabdominal Sagittal View

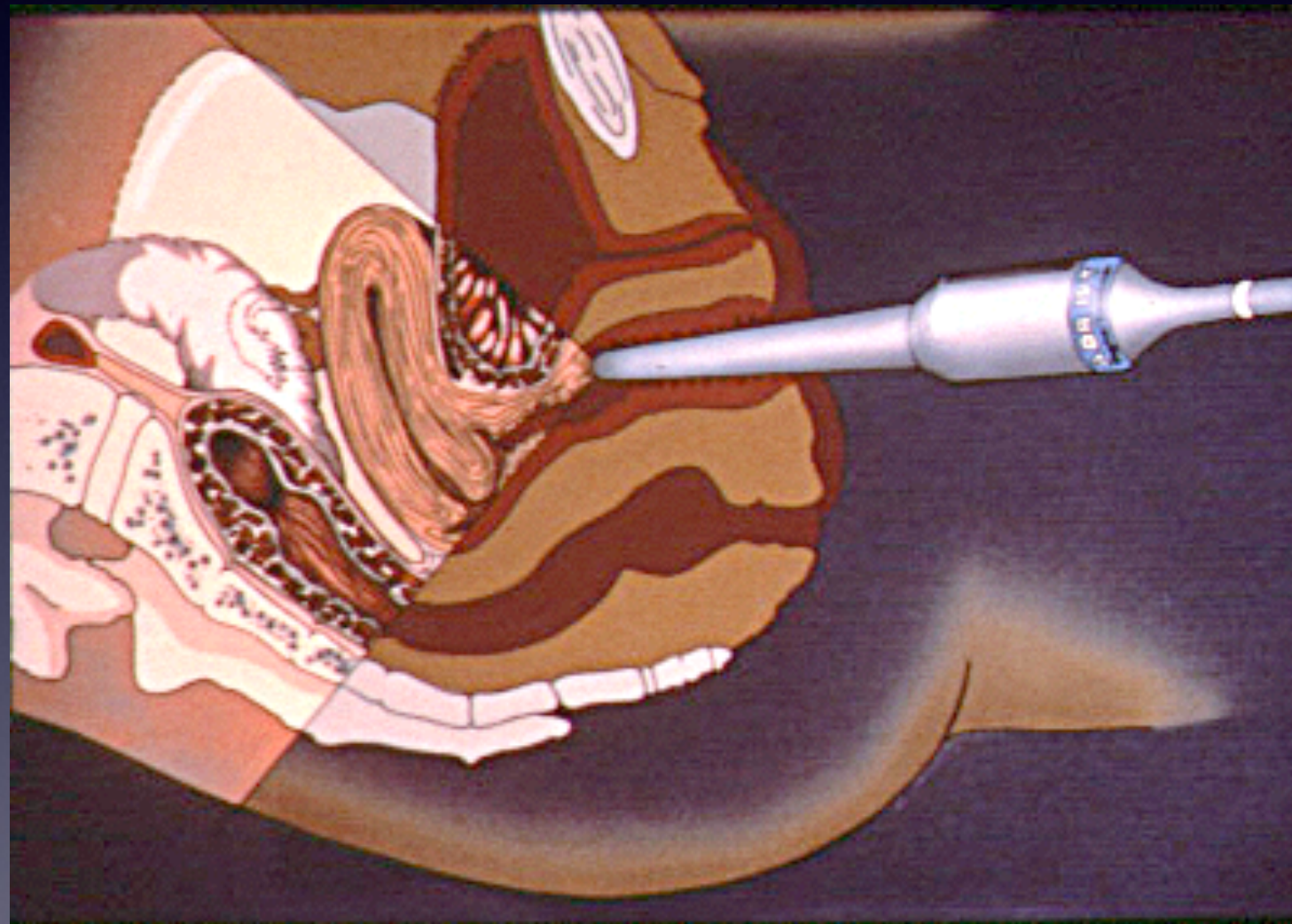
Anterior





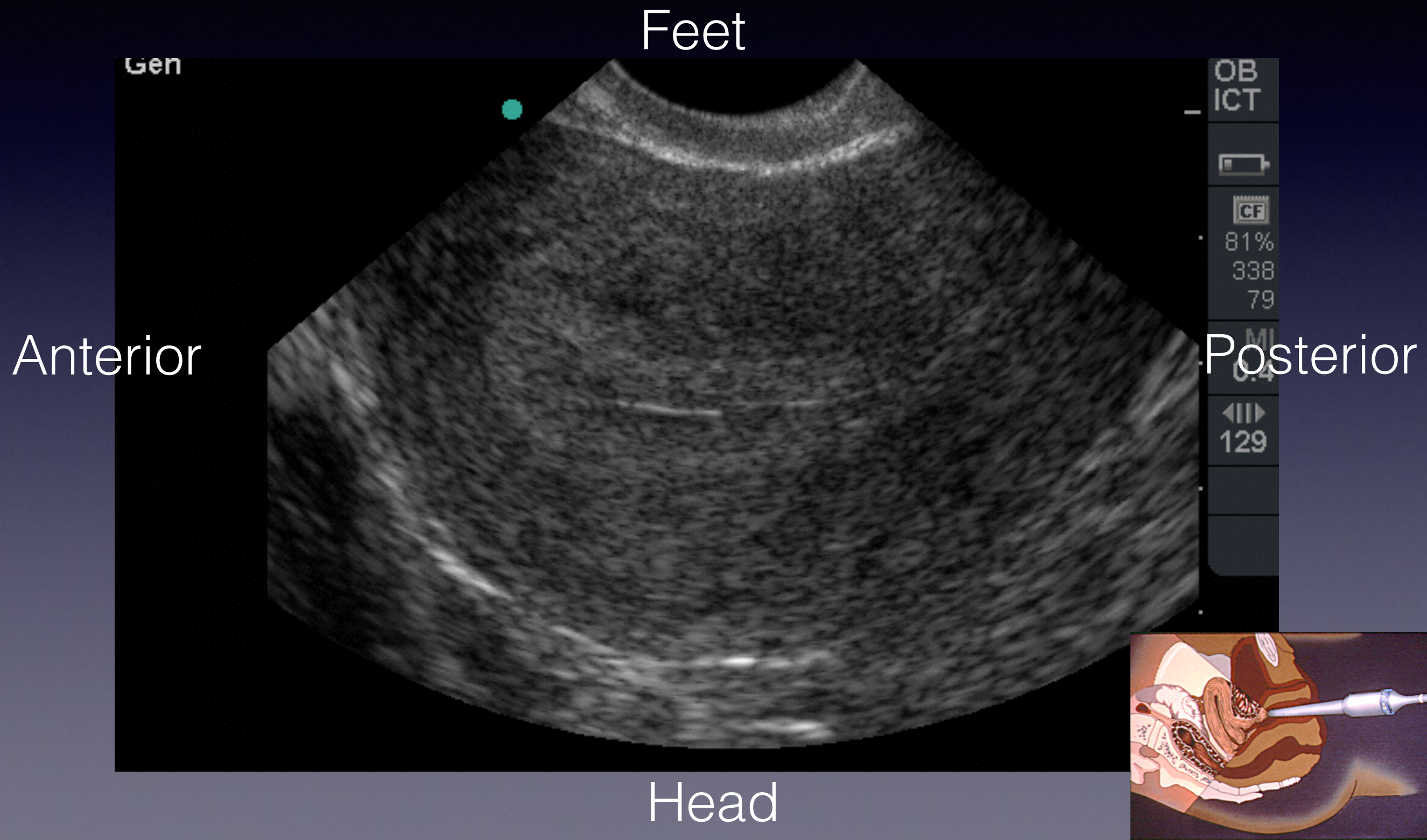
# Transvaginal Scanning

- Insertion technique
- Probe location





# Transvaginal Sagittal View



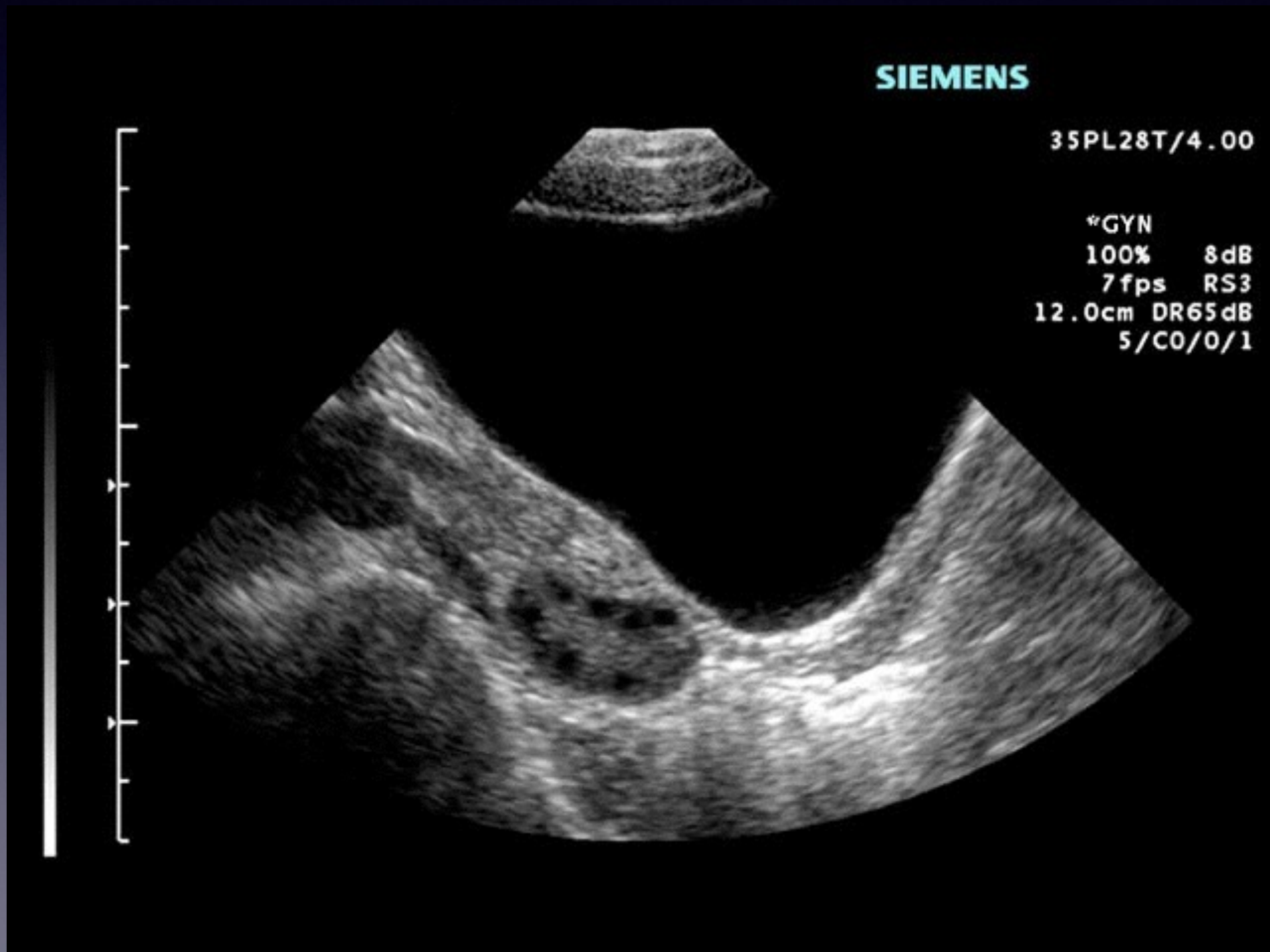
# Normal Ovaries

- Normal size 3 x 3 x 2 cm
- hypoechoic follicles (chocolate chip cookies)
- Anterior and medial to the iliacs



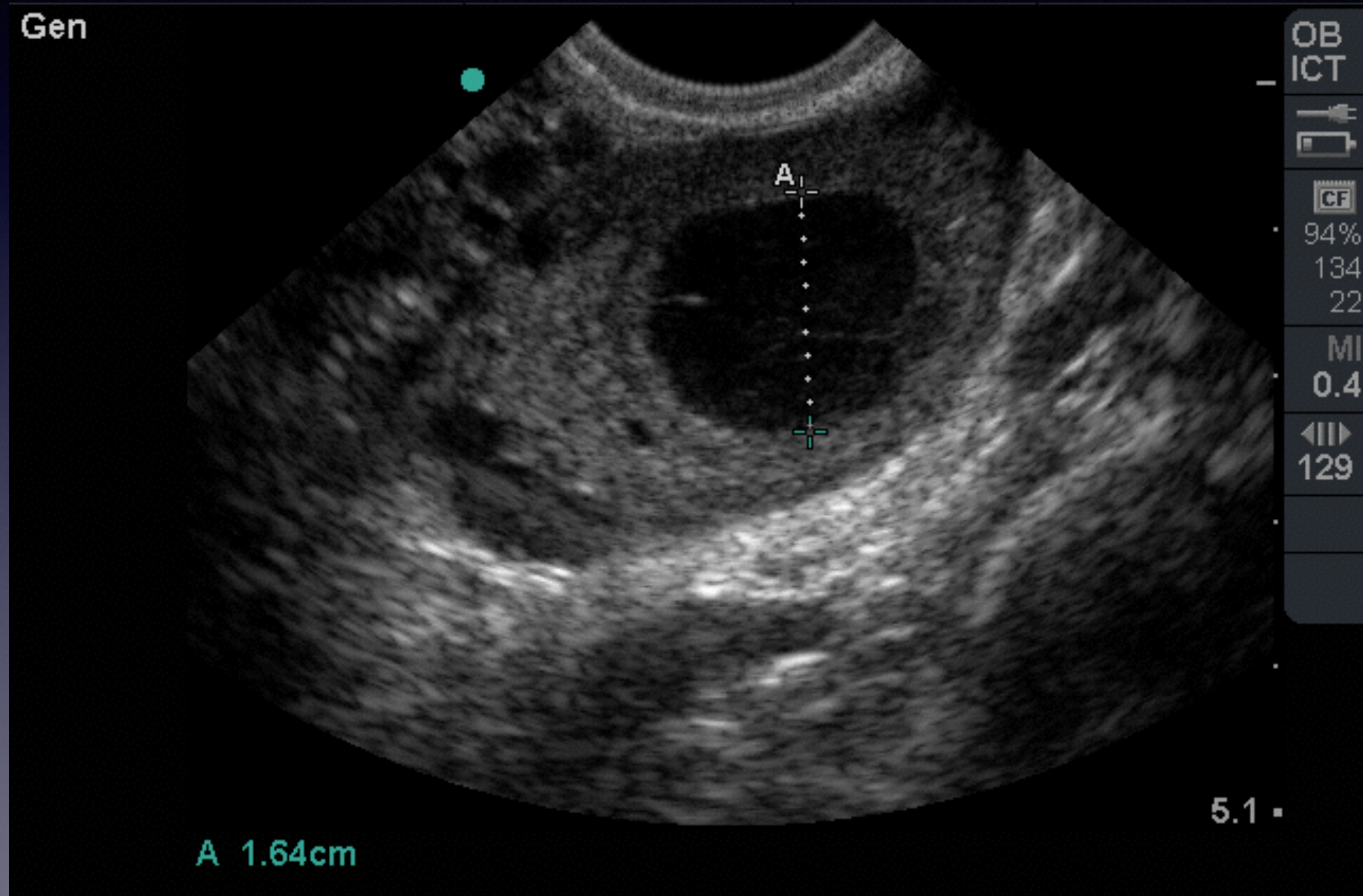


# Normal ovary

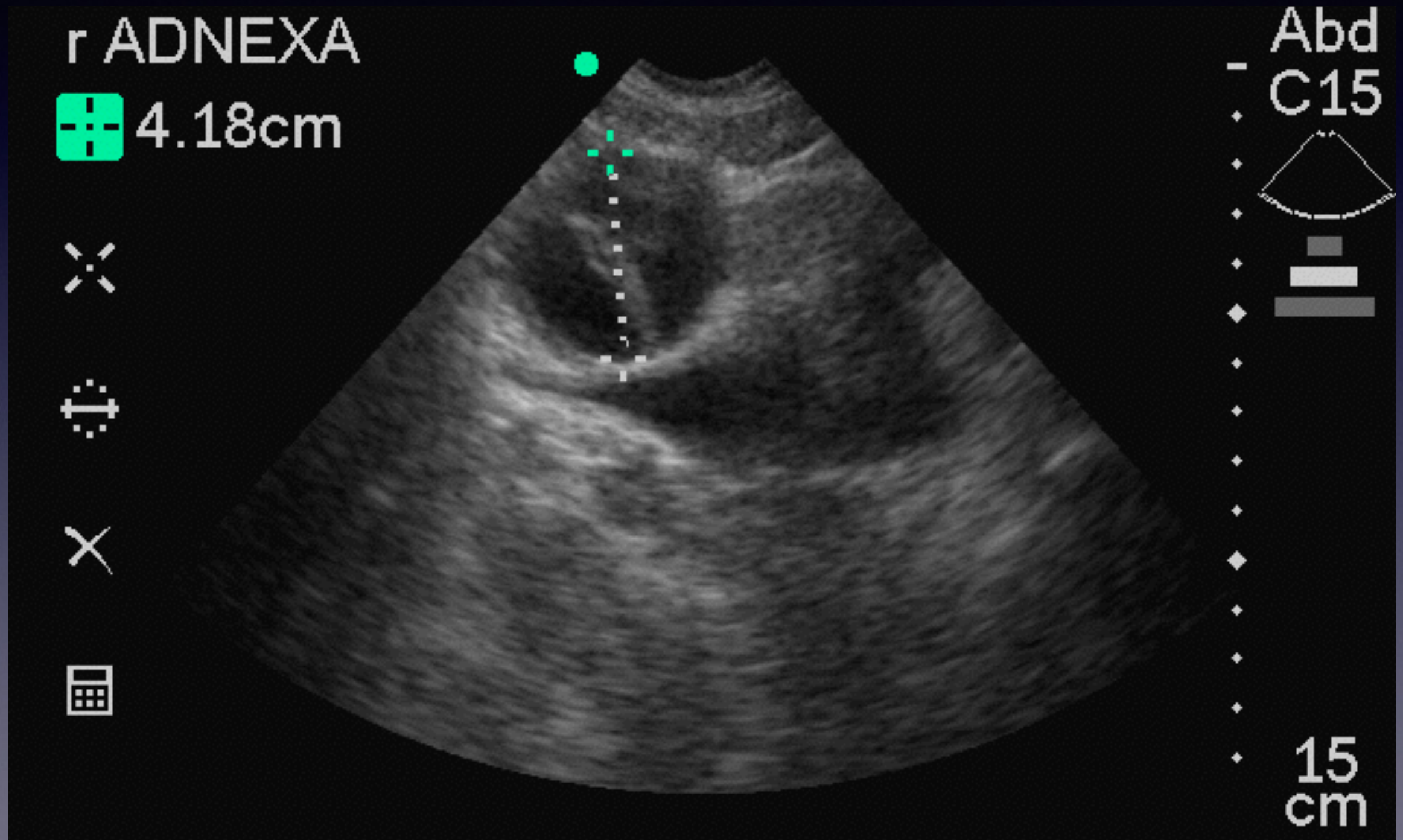




# TV – Hemorrhagic cyst



# Complex cyst with free fluid



# First Trimester Sonography

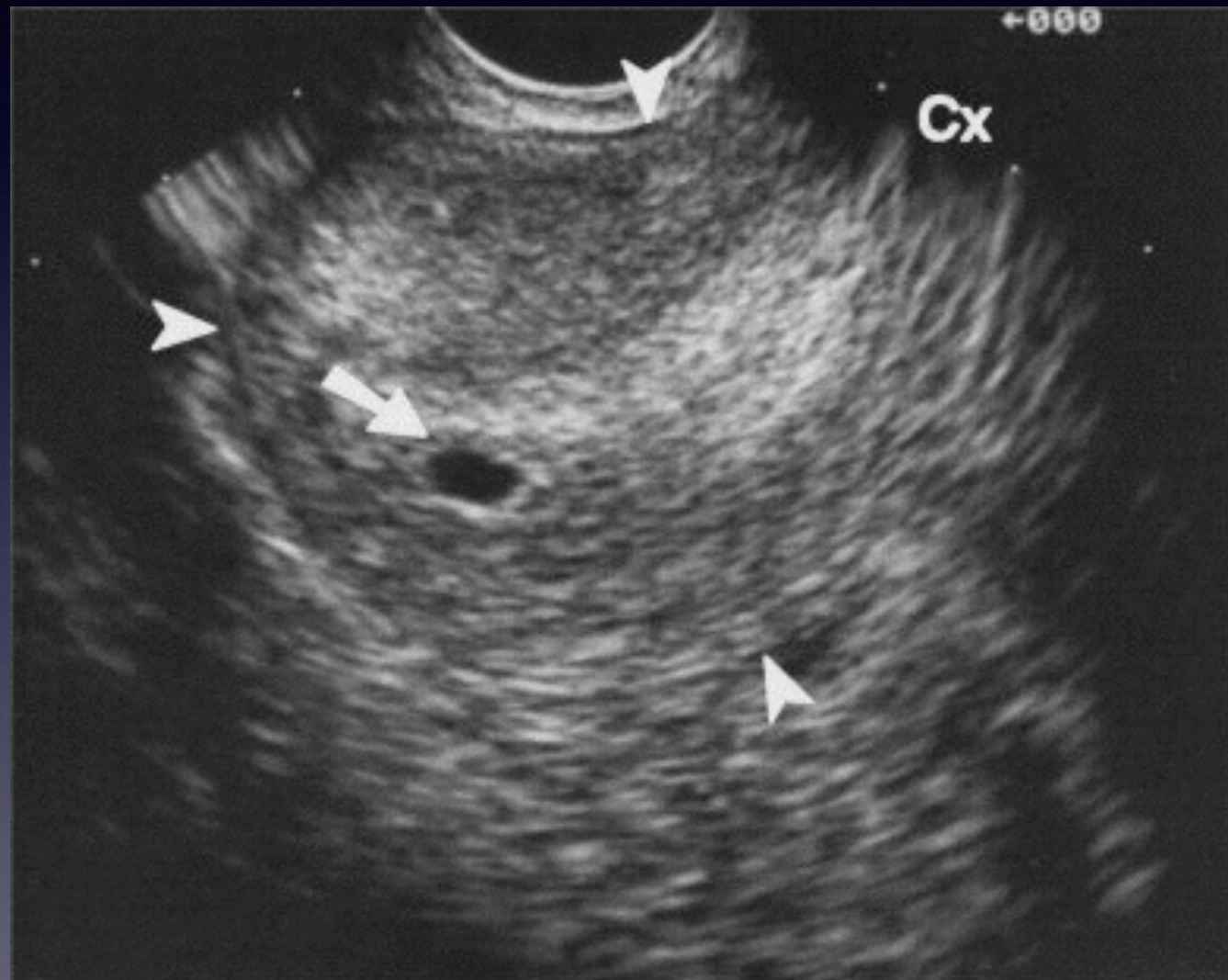
- Gestational sac (mean sac diameter, MSD)
- Yolk sac
- Fetal pole (crown rump length, CRL)
- Cardiac activity (M mode)



# Gestational Sac

- Seen by 5-6 weeks by TAS
- NOT diagnostic of IUP
  - “pseudogestational sac” in 10-20% of ectopics!

# Gestational Sac





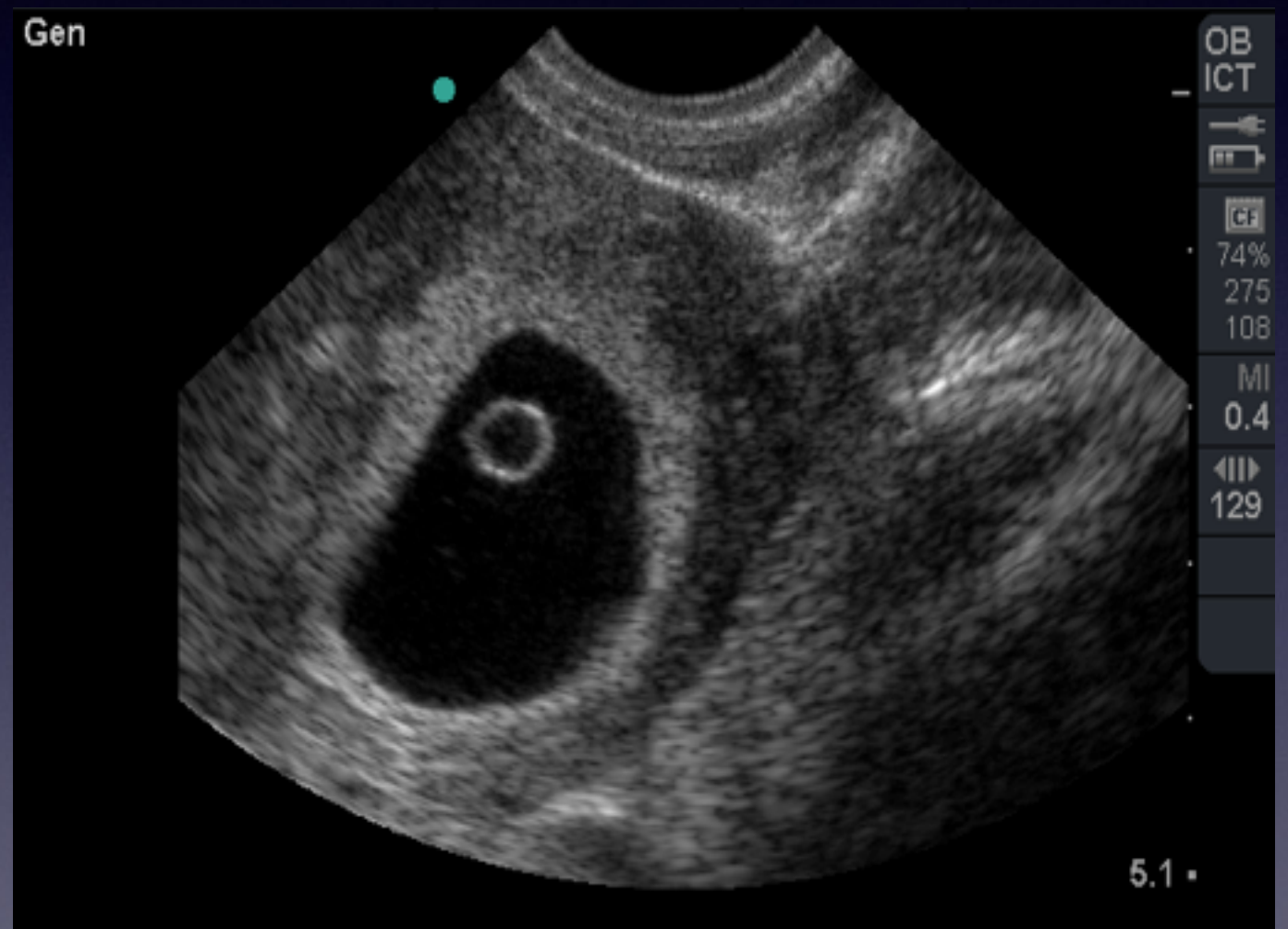
# Pseudogestational Sac





# Yolk Sac

- Seen at 6 weeks by TAS
- Found inside gestational sac

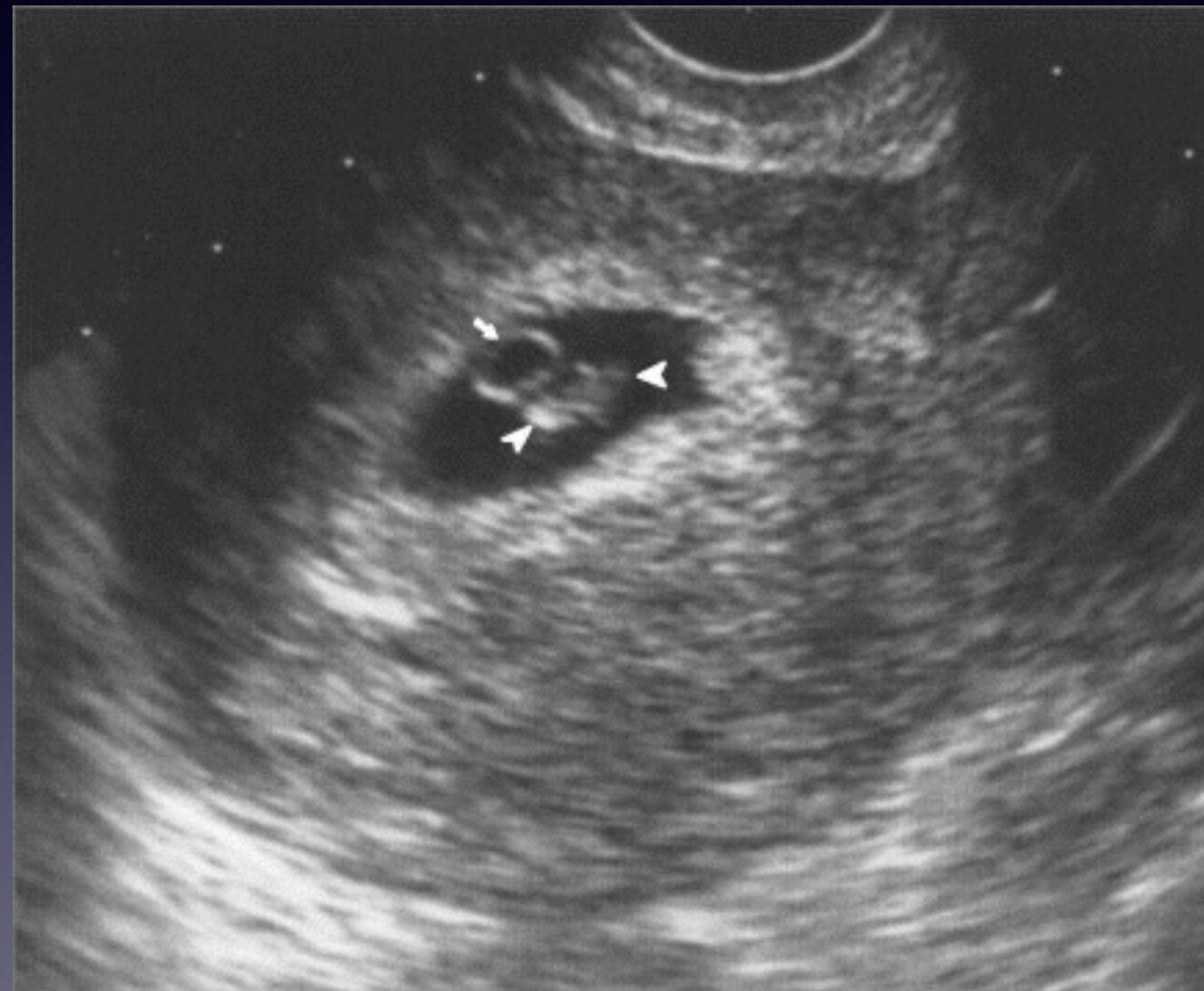


# Yolk Sac (TA)



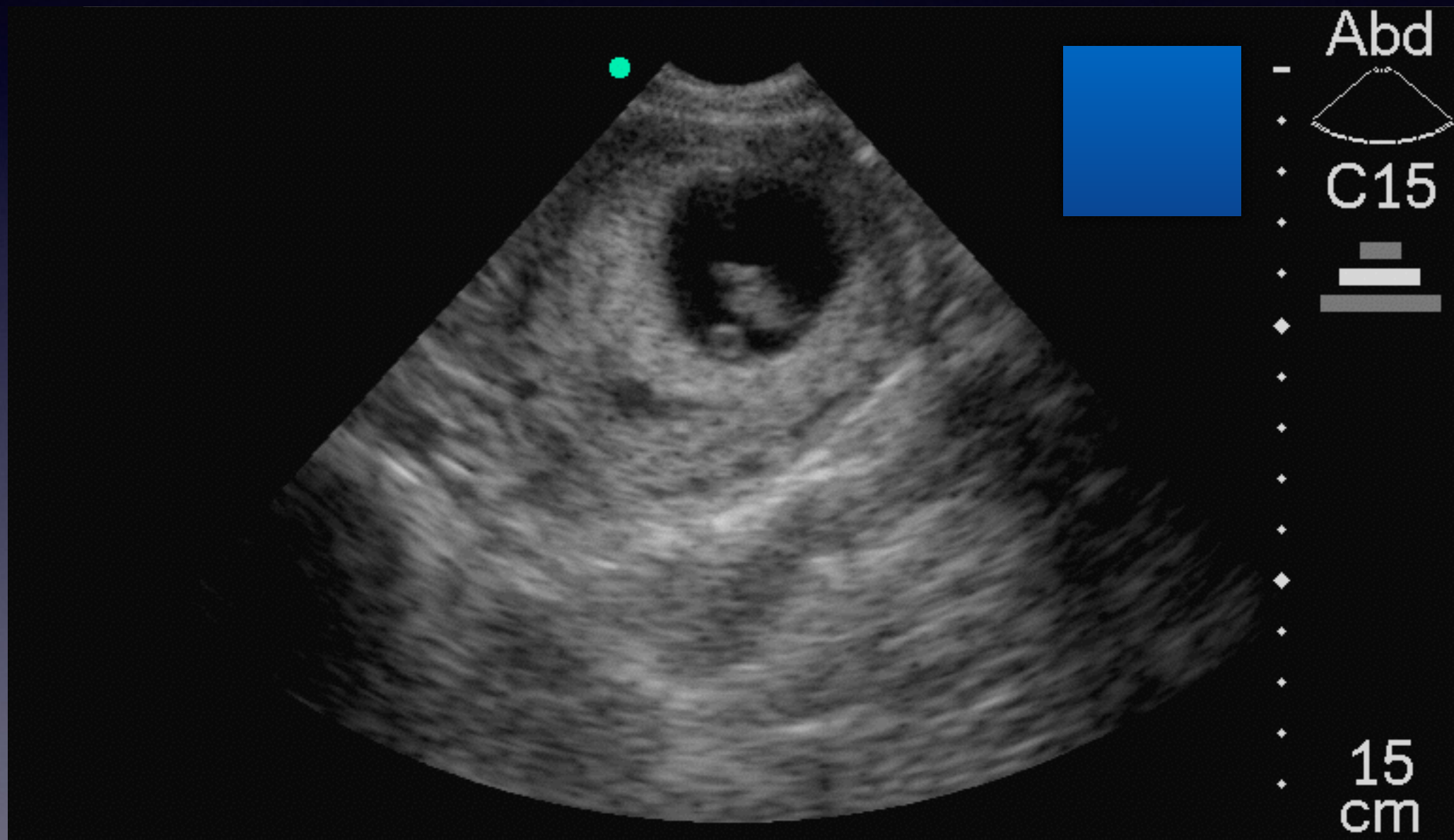
# Fetal Pole

- Seen at 6-7 weeks by TAS
- Crown-rump length (CRL) - most accurate sono measure for gestational age dating





# Fetal Pole



# Cardiac Activity

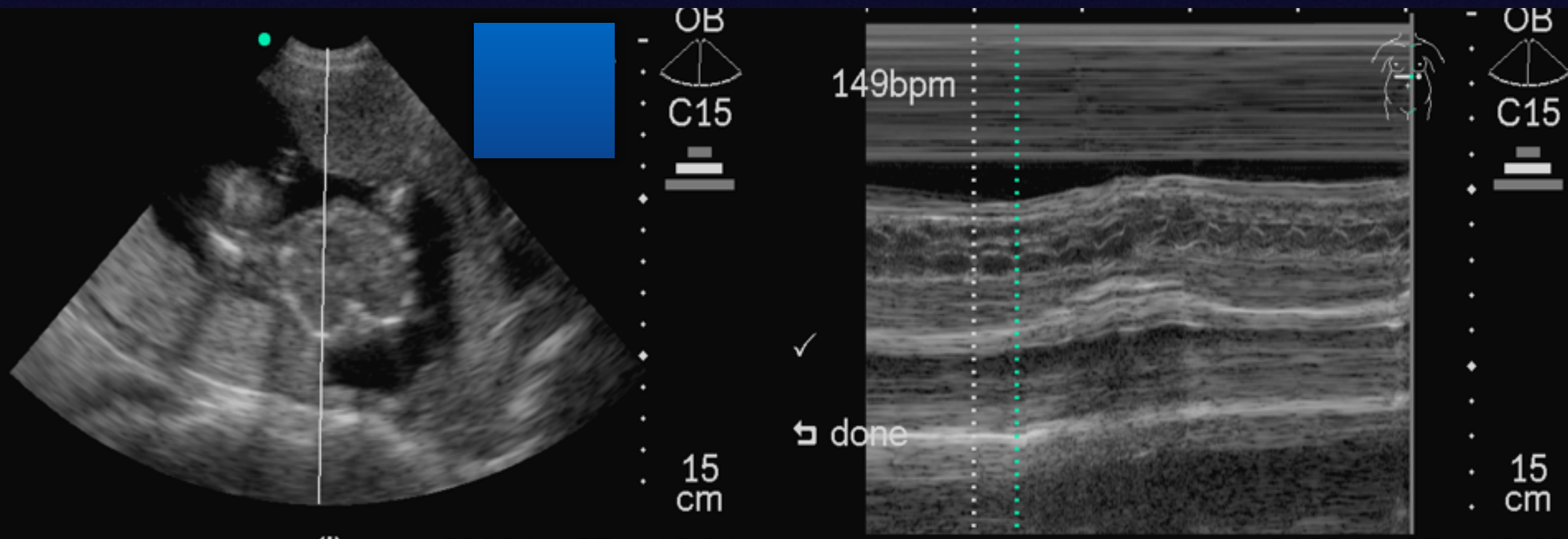
- Seen at 7 weeks by TAS
- Normal - 100-110 at 6 weeks, 150-170 at 8 weeks
- Important prognostic sign in threatened miscarriage

# Cardiac Activity

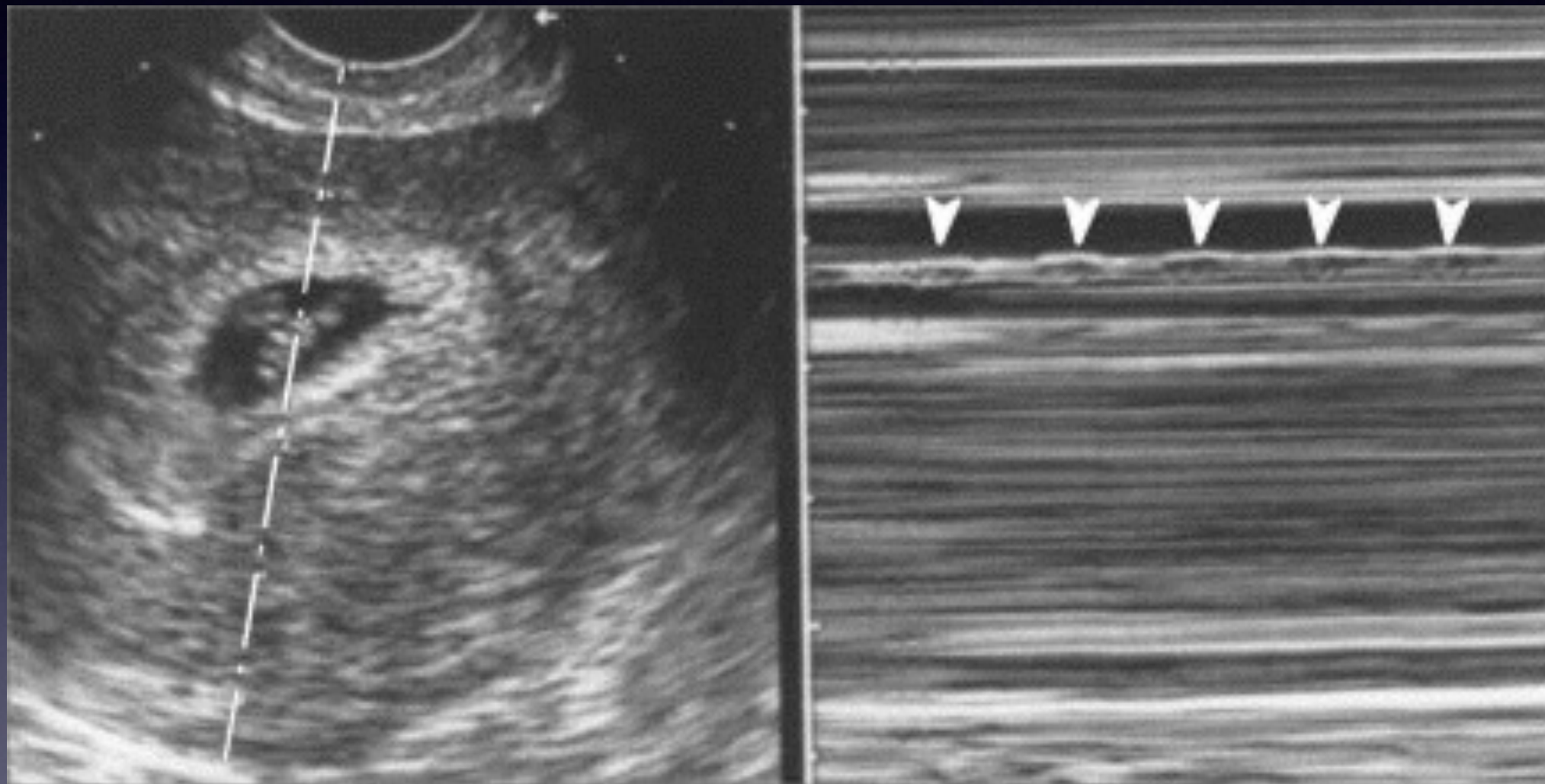




# M Mode



# Cardiac activity via M mode



# Ectopic vs IUP - three possibilities

- Definite IUP
- Definite ectopic
- Indeterminate ultrasound



# Definite IUP

- Yolk sac within gestational sac within uterus
- OR fetal pole with or without cardiac activity
- Rules out ectopic unless heterotopic pregnancy is present
  - 1:2,500 - 1:30,000
  - up to 1:100 if fertility rx

# Definite Ectopic

- Fetal pole outside of uterus with or without cardiac activity
- OR Yolk sac inside gestational sac outside of uterus

# Ectopic pregnancy

ECTOP









P80  
6C3  
T5.0  
23fps  
DR80  
2DG  
78



Free 32

CINE REVIEW ▶  

# Take Home Pearls

- Intussusception=donut
- Appendicitis  $>6\text{mm}$
- PS  $>3\text{mm}$  thick or  $1\text{cm}$  long
- GB  $>4$
- Pelvic - Look for the yolk sac







# Questions?

[jcohen@childrensnational.org](mailto:jcohen@childrensnational.org)