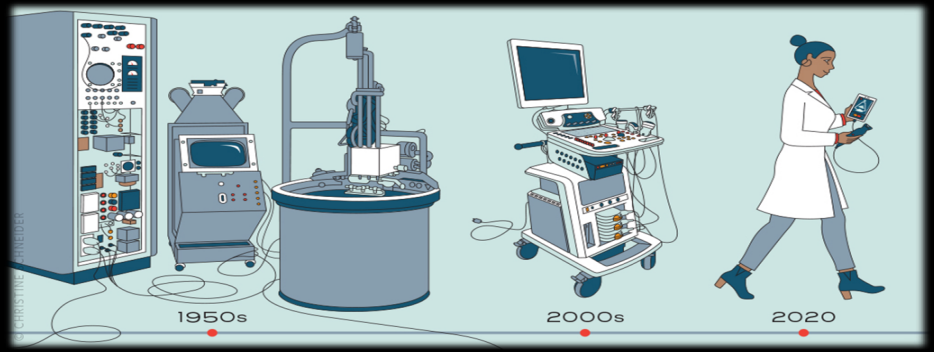
POCUS in Pediatrics
An Inside look



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Children's Hospital Los Angeles
We Treat Kids Better

USC University of Southern California

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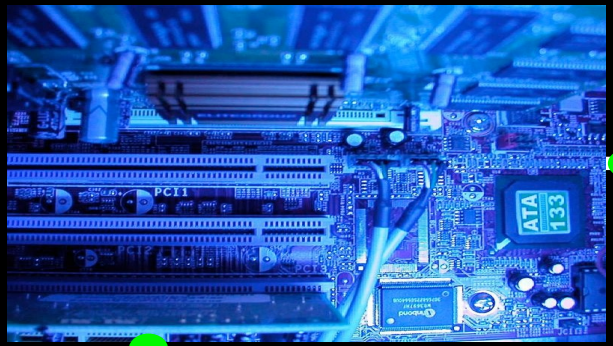
Key Topics

- Definitions
- POCUS Basics
- Pediatric POCUS Applications

What Is POCUS

- Goal Oriented/Answers A Specific Question
- Performed and Interpreted by the Provider
- At the Bedside (wherever that is)
- Dynamic/Repeatable

	Consultative "formal" imaging	POCUS
Scope	Comprehensive	Limited, goal directed
Location	Pt usually must be transported	At bedside, can be done with caregivers holding patient
Timing	Slower and usually done once	Fast, iterative


PCI1
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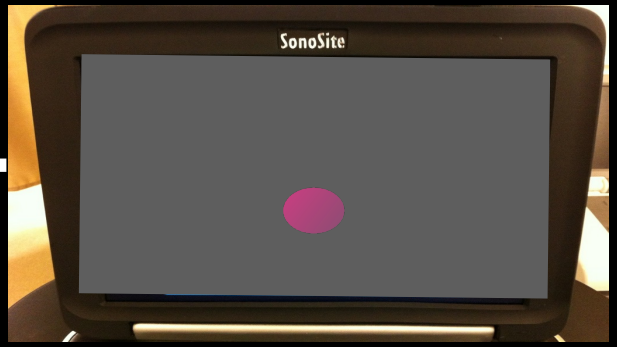
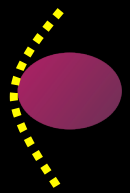
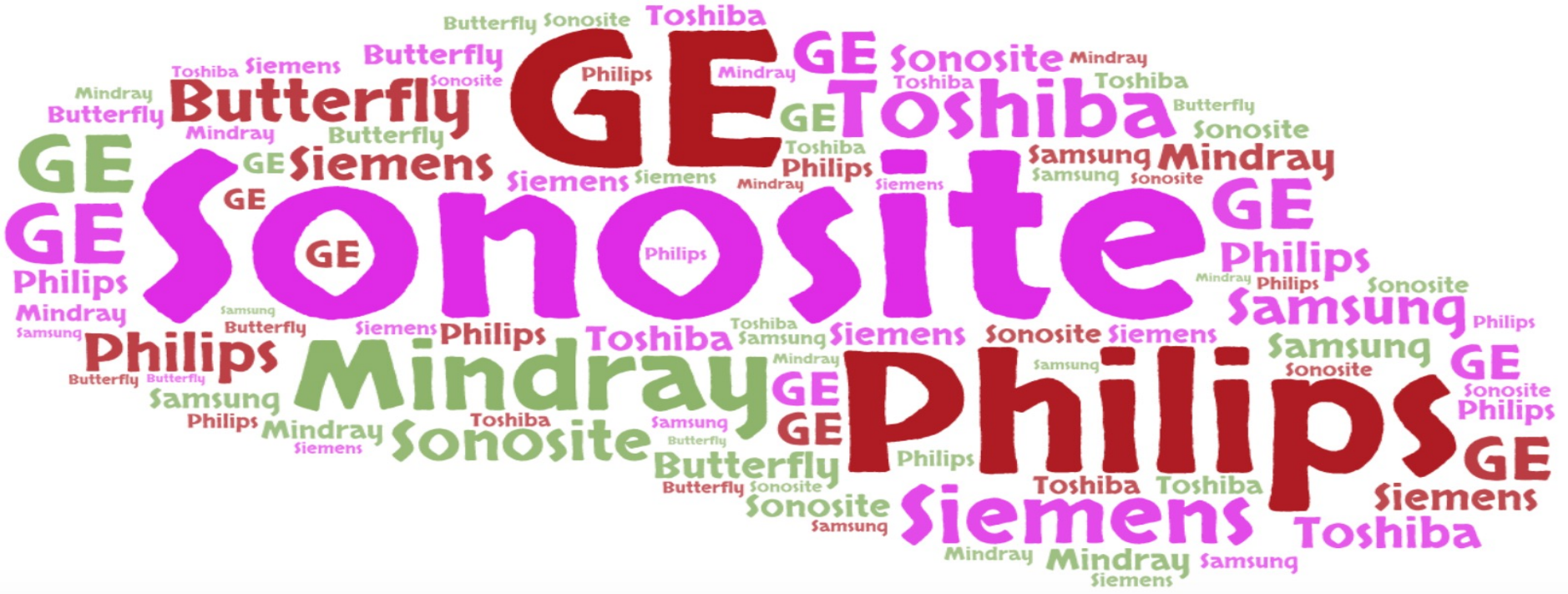
133


SonoSite



Ultrasound Equipment - Evolution

Hand-Held Systems


Butterfly Sonosite Toshiba
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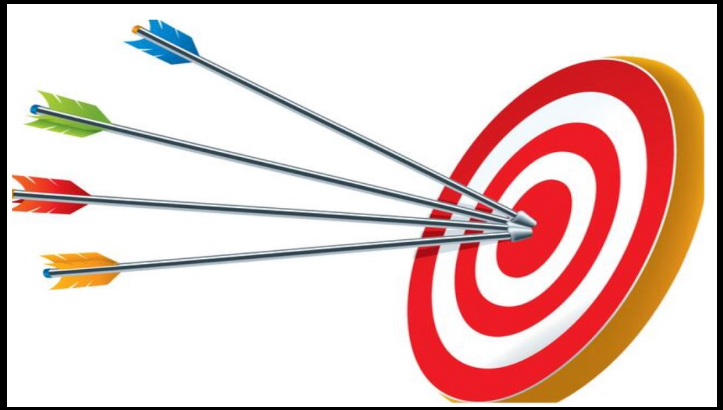
POCUS Basics

- Increased Efficiency
- Increased Patient Satisfaction
- Improved Diagnostic Accuracy
- Improved Procedural Accuracy



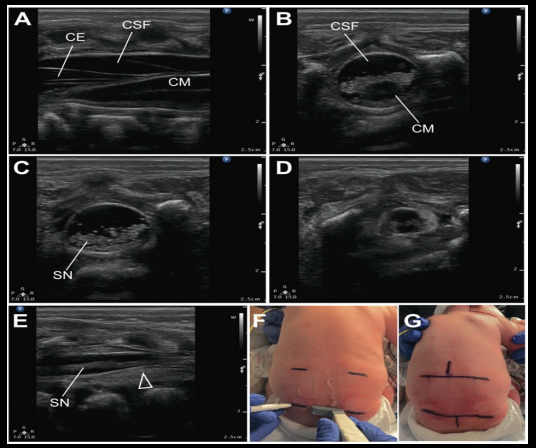
POCUS In Pediatrics

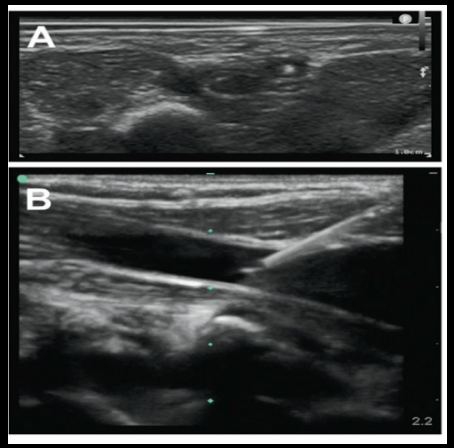
A L A R A

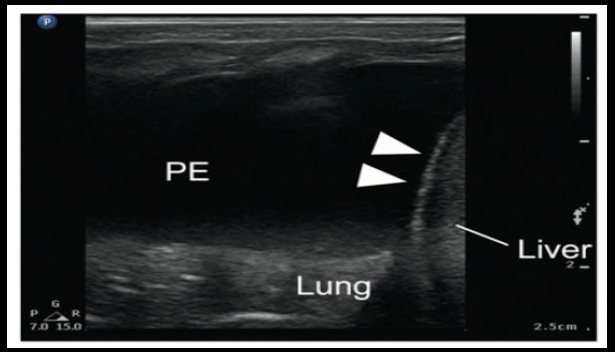
POCUS Diagnostic Applications in Pediatrics

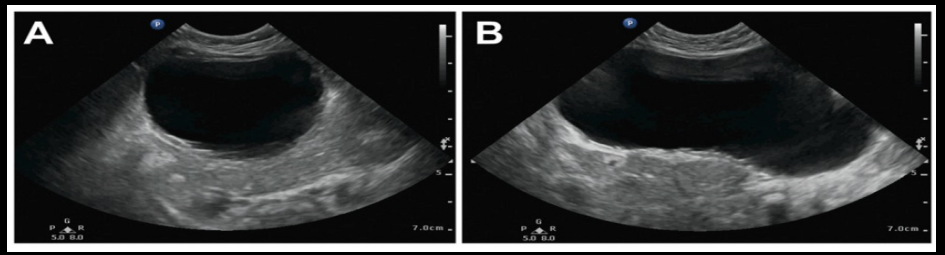
and so many more!

POCUS Procedural Applications in Pediatrics









and so many more!

1 yo girl crying with area of swelling over arm

Why use POCUS for soft tissue infections?

- Improve accuracy for abscess detection
  - Sensitivity of US 97.5%, clinical exam 78.7%
- Prevent performance of unnecessary procedures
  - Changes management in ~25%
- Provides guidance regarding further imaging or management
- Identifies additional or alternative diagnoses

COMPARISON OF ULTRASOUND GUIDANCE VS. CLINICAL ASSESSMENT ALONE FOR MANAGEMENT OF PEDIATRIC SKIN AND SOFT TISSUE INFECTIONS

Samuel H. F. Lam, MD, MPH*, Adam Sivitz, MD†, Kiyetta Alade, MD, RDMS‡, Stephanie J. Doniger, MD, RDMS§,‖, Mark O. Tessaro, MD¶, Joni E. Rabiner, MD#, Alexander Arroyo, MD**, Edward M. Castillo, PHD, MPH*, Caroline A. Thompson, PHD, MPH††, Mingan Yang, PHD††, and Rakesh D. Mistry, MD, MS‡

- POCUS vs no POCUS in SSTI
- US changed clinical management in 1/4 of cases:
  - 13.8% medical to surgical and 9.1% from surg to med

In patients presenting to the emergency department with skin and soft tissue infections what is the diagnostic accuracy of point-of-care ultrasonography for the diagnosis of abscess compared to the current standard of care? A systematic review and meta-analysis

David Barbic [1], Jordan Chenkin [2], Dennis D Cho [2], Tomislav Jelic [3], Frank X Scheuermeyer [1]

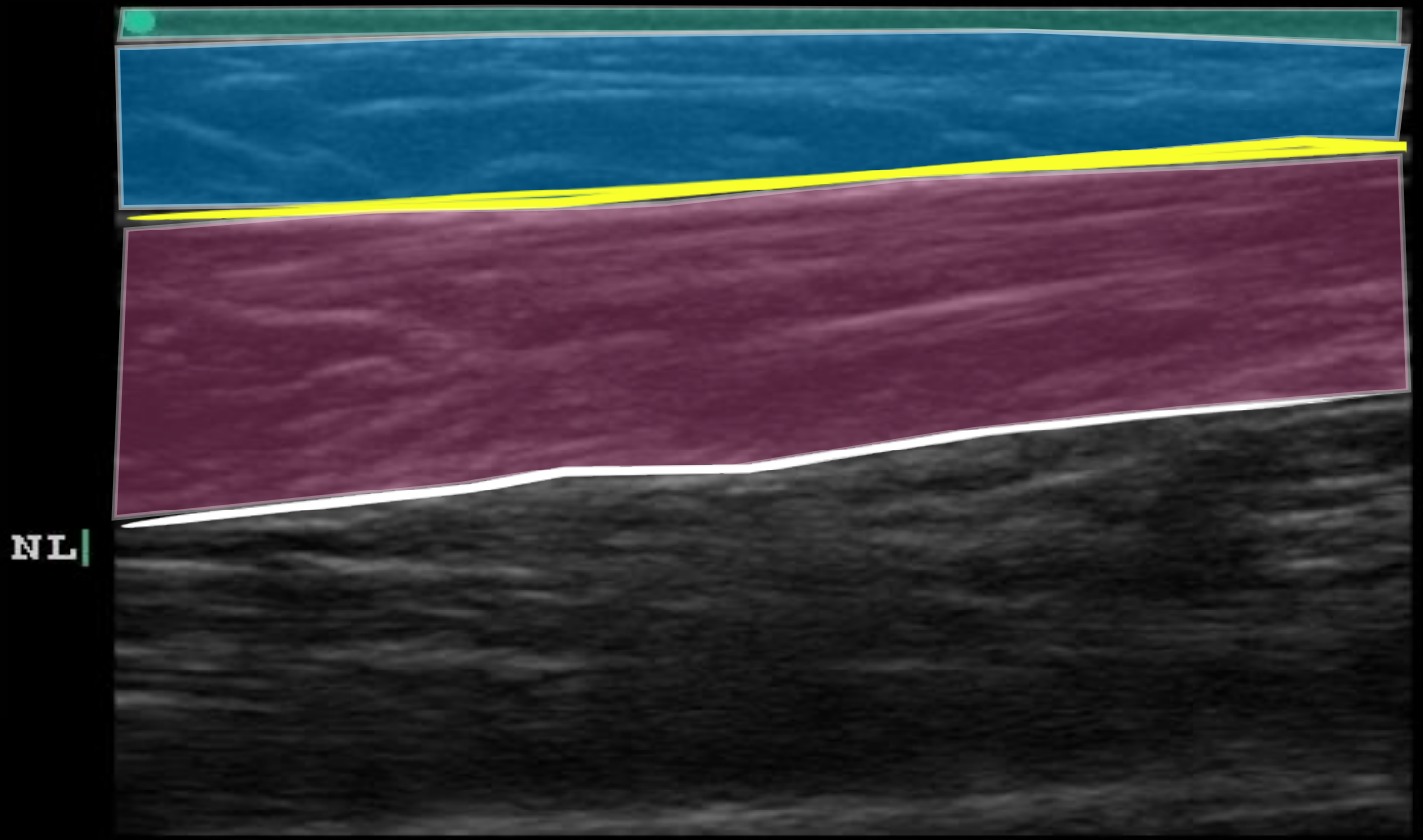
Results: Of 3028 articles, 8 were identified meeting inclusion criteria; all were rated as good to excellent according to QUADAS-2 criteria. Combined test characteristics of POCUS on the ED diagnosis of abscess for patients with SSTI were as follows: sensitivity 96.2% (95% CI 91.1% to 98.4%), specificity 82.9% (95% CI 60.4% to 93.9%), positive likelihood ratio 5.63 (95% CI 2.2 to 14.6) and negative likelihood ratio 0.05 (95% CI 0.01 to 0.11).

Conclusions: A total of 8 studies of good-to-excellent quality were included in this review. The use of POCUS helps differentiate abscess from cellulitis in ED patients with SSTI.

Technique

- High frequency linear transducer
- Water bath or step-off pad
- Soft tissue setting
- Scan in two orthogonal planes
- Compare sides

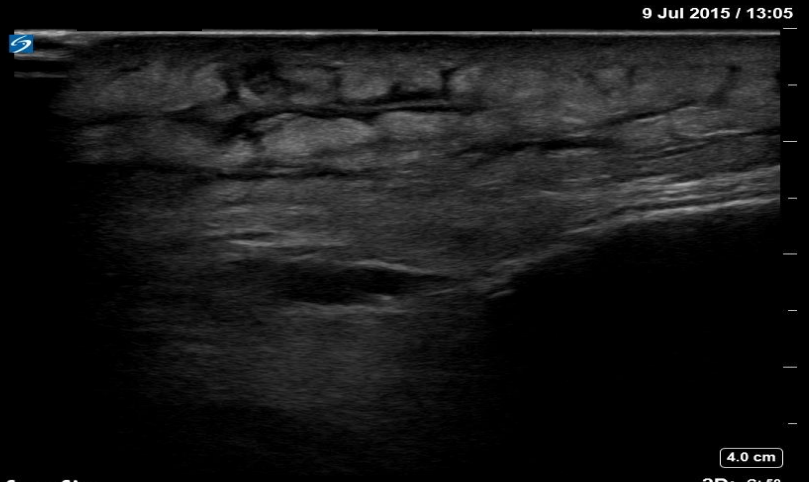
Normal Anatomy

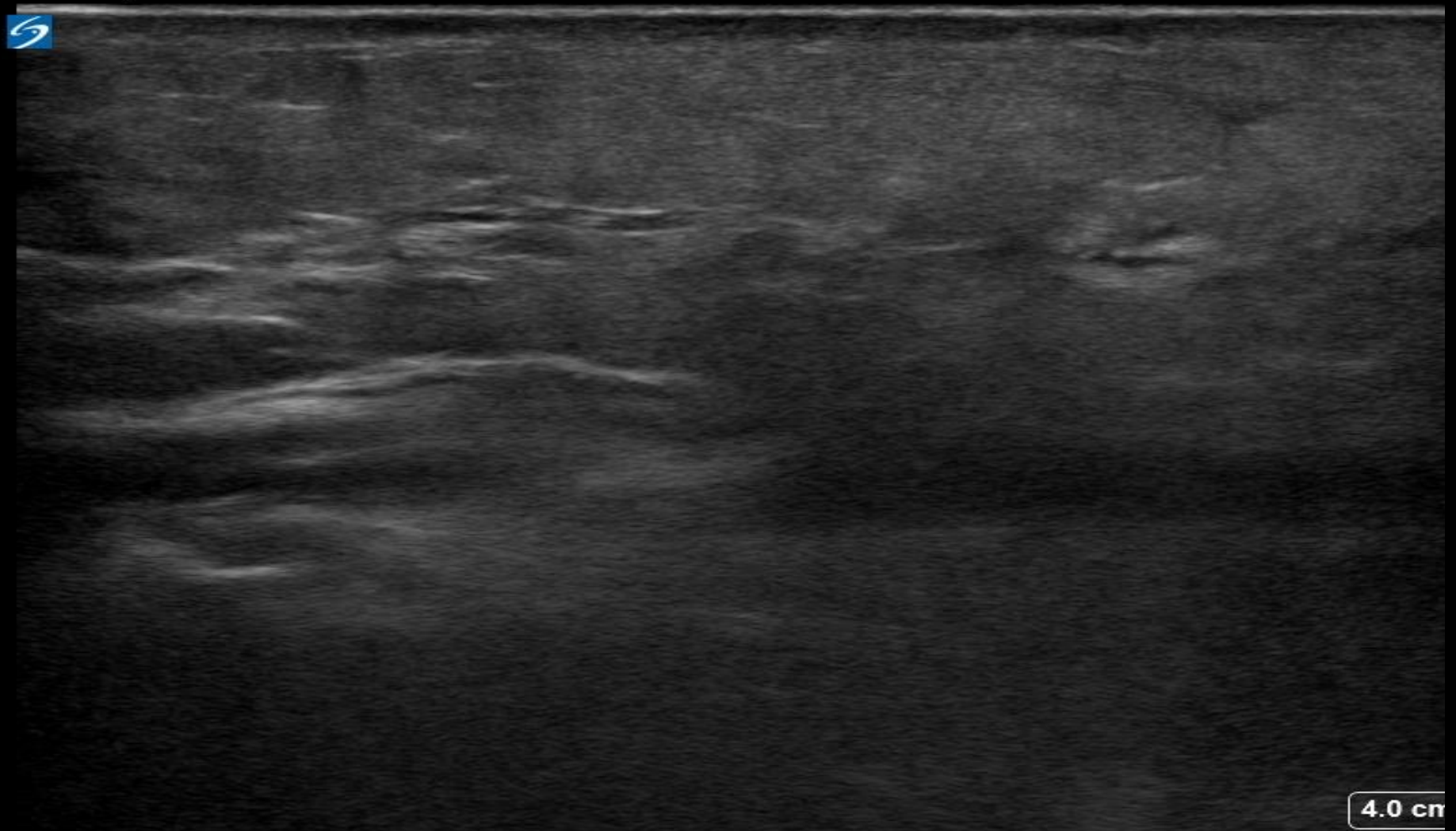


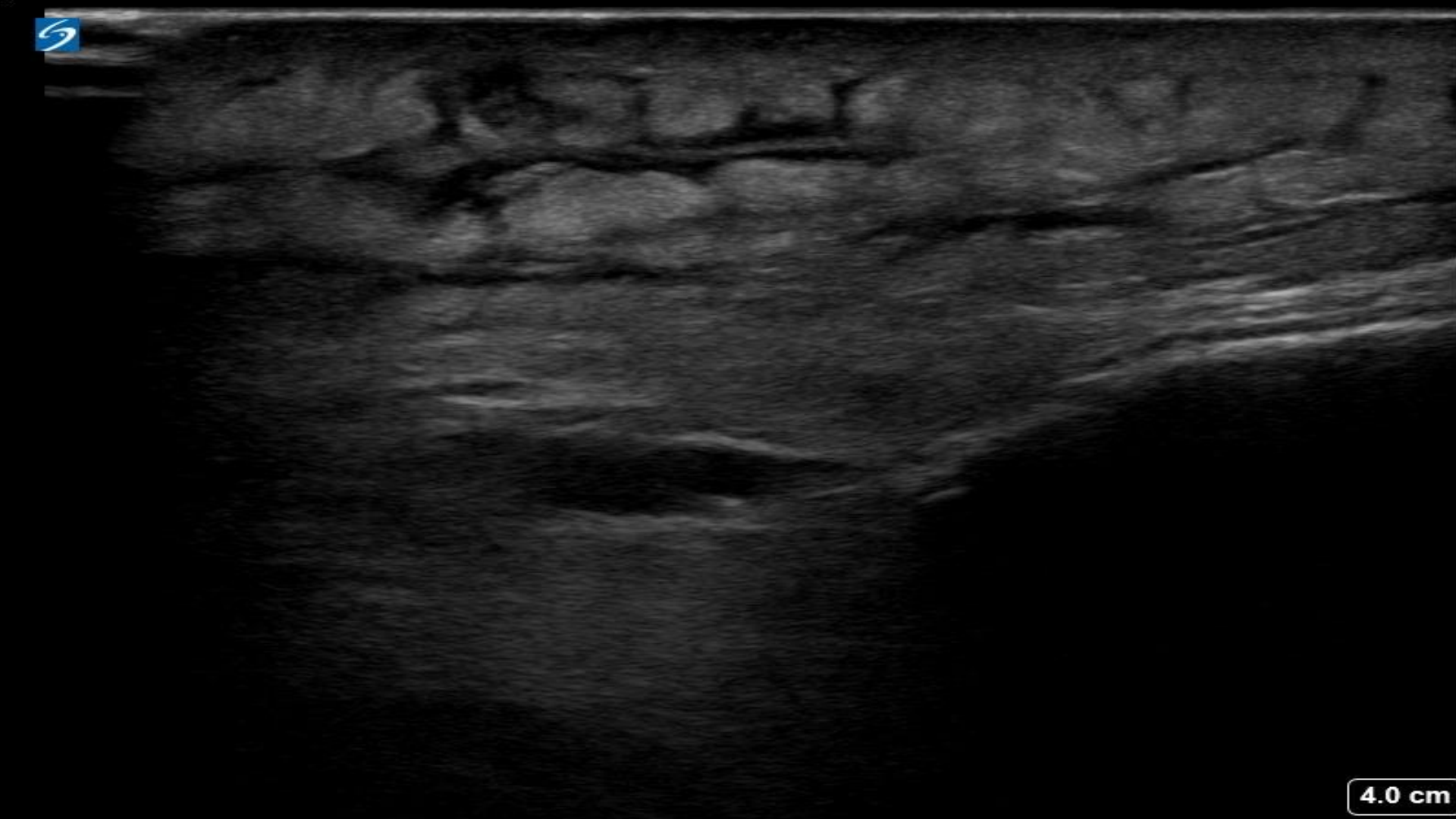
Cellulitis

- Early cellulitis- increase in thickness and echogenicity of the soft tissue, blurred tissue margins

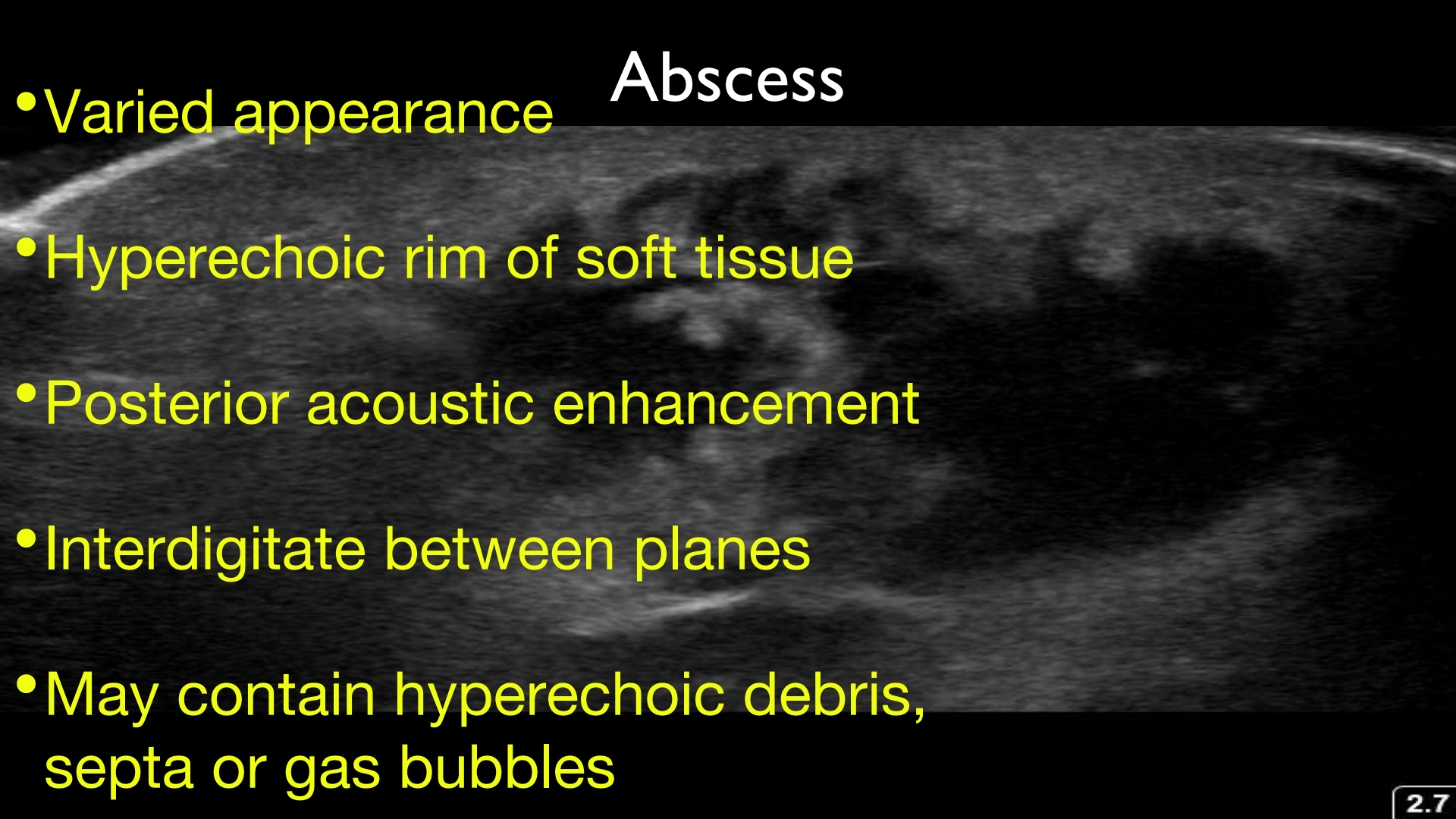
- Late cellulitis- increased edema separates fat lobules—> “cobblestoning”



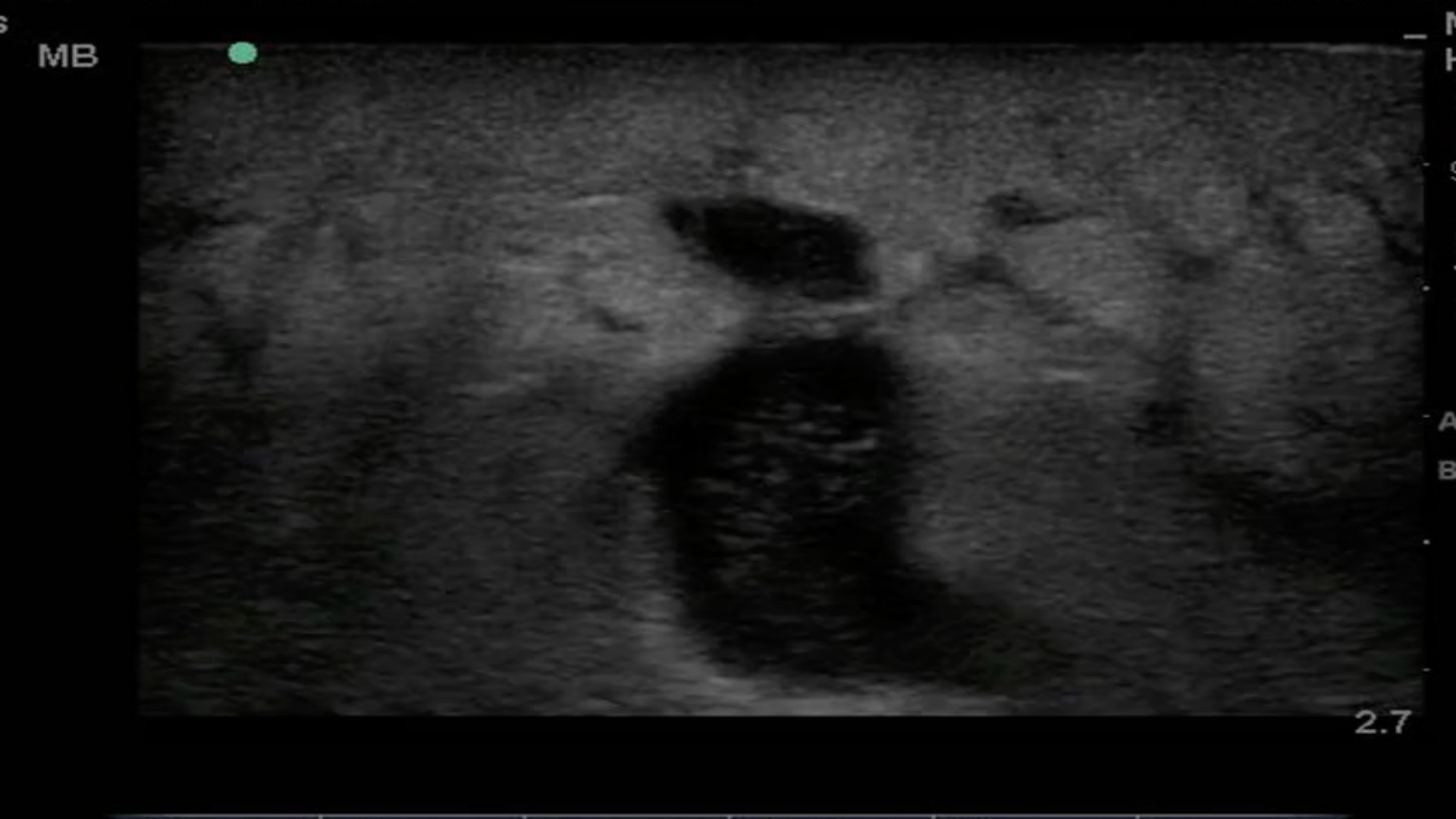

4.0 cm

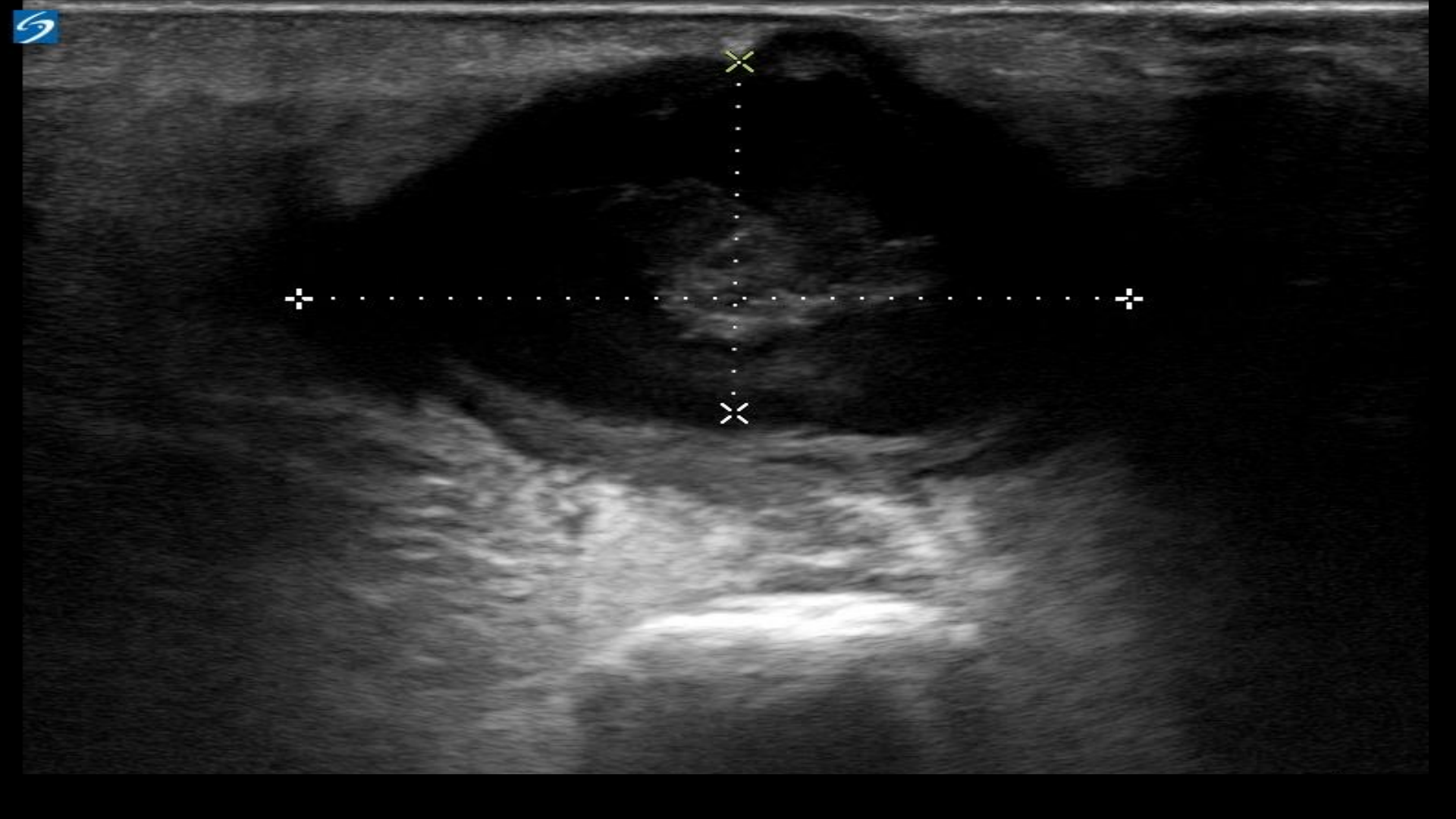

4.0 cm

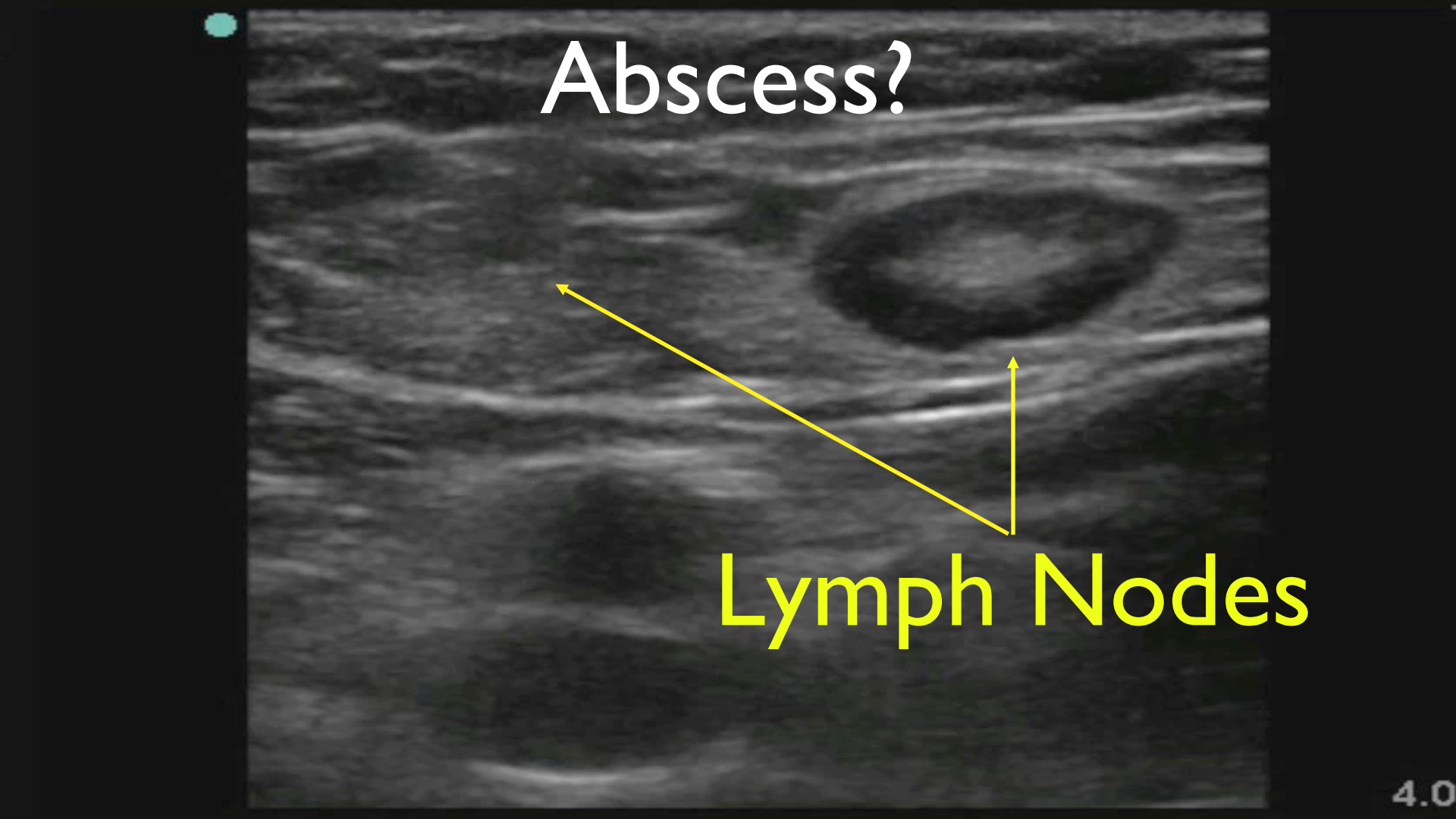
Abscess



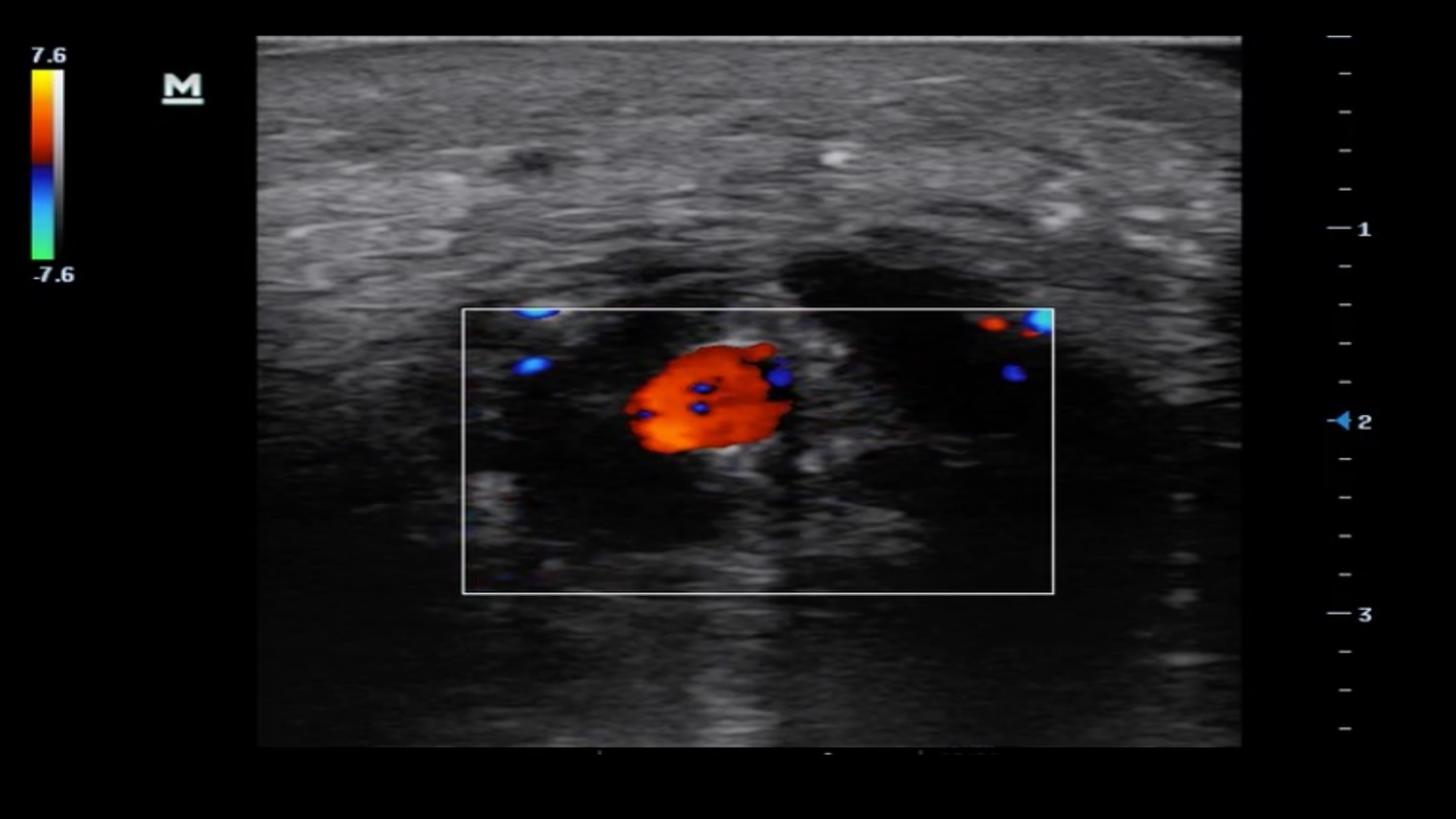
- Varied appearance
- Hyperechoic rim of soft tissue
- Posterior acoustic enhancement
- Interdigitate between planes
- May contain hyperechoic debris, septa or gas bubbles


MB
2.7




Abscess?
Lymph Nodes
4.0

Check Before You Stick!


7.6
-7.6
M
1
2
3

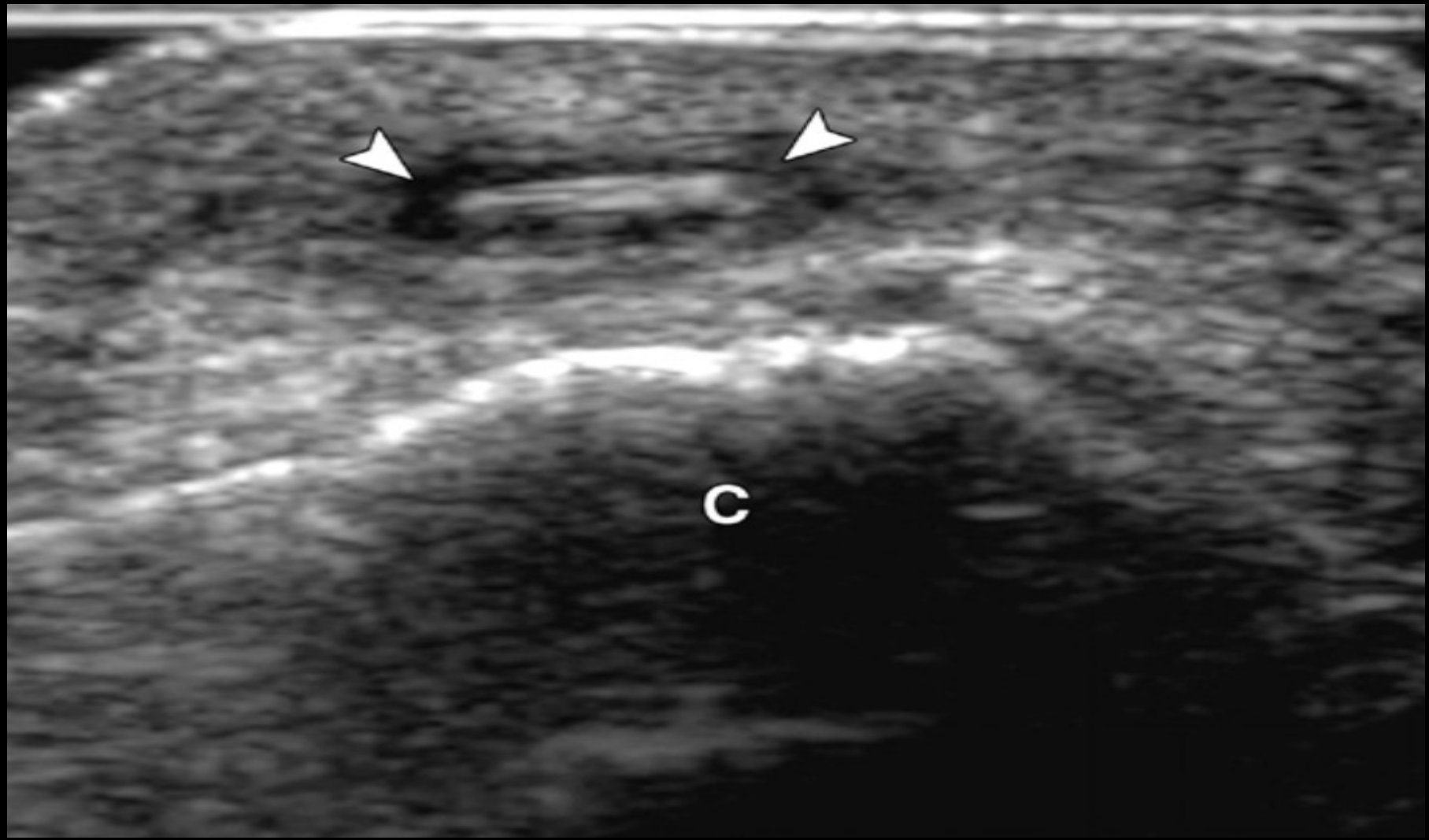
Foreign body

- Many foreign bodies cannot be seen on X-ray but can on US (~40%) missed
- US has good sensitivity/specificity for FB detection (has sentitivities reported 80% to 95% and specificity 86%-97%)
- Missed foreign bodies cause of litigation
- Helps guide removal

Foreign Body

- Size matters
- Hyperechoic
- Shadowing
- Ring down artifact
- Halo sign


Philips Medical Systems
HD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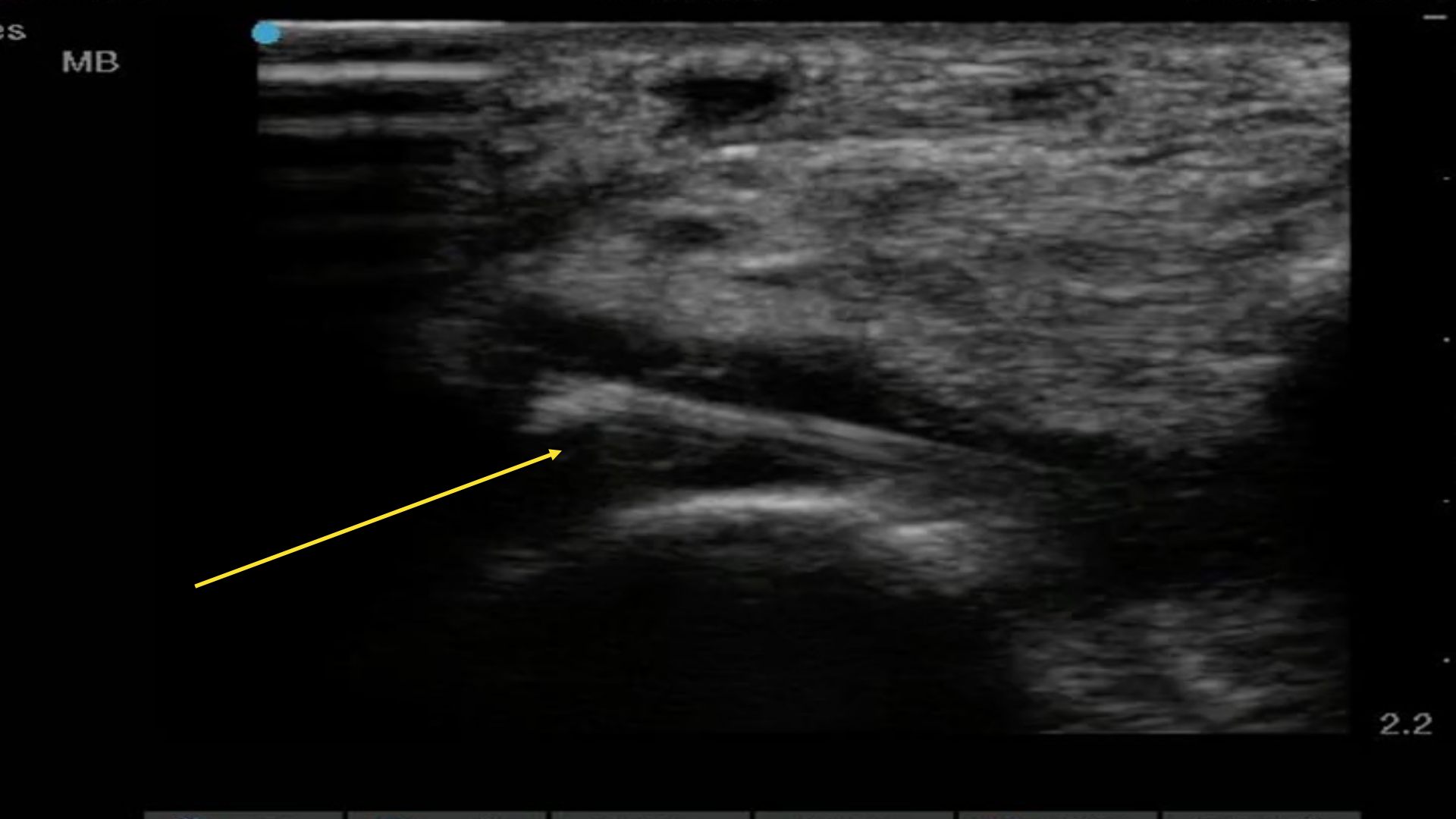
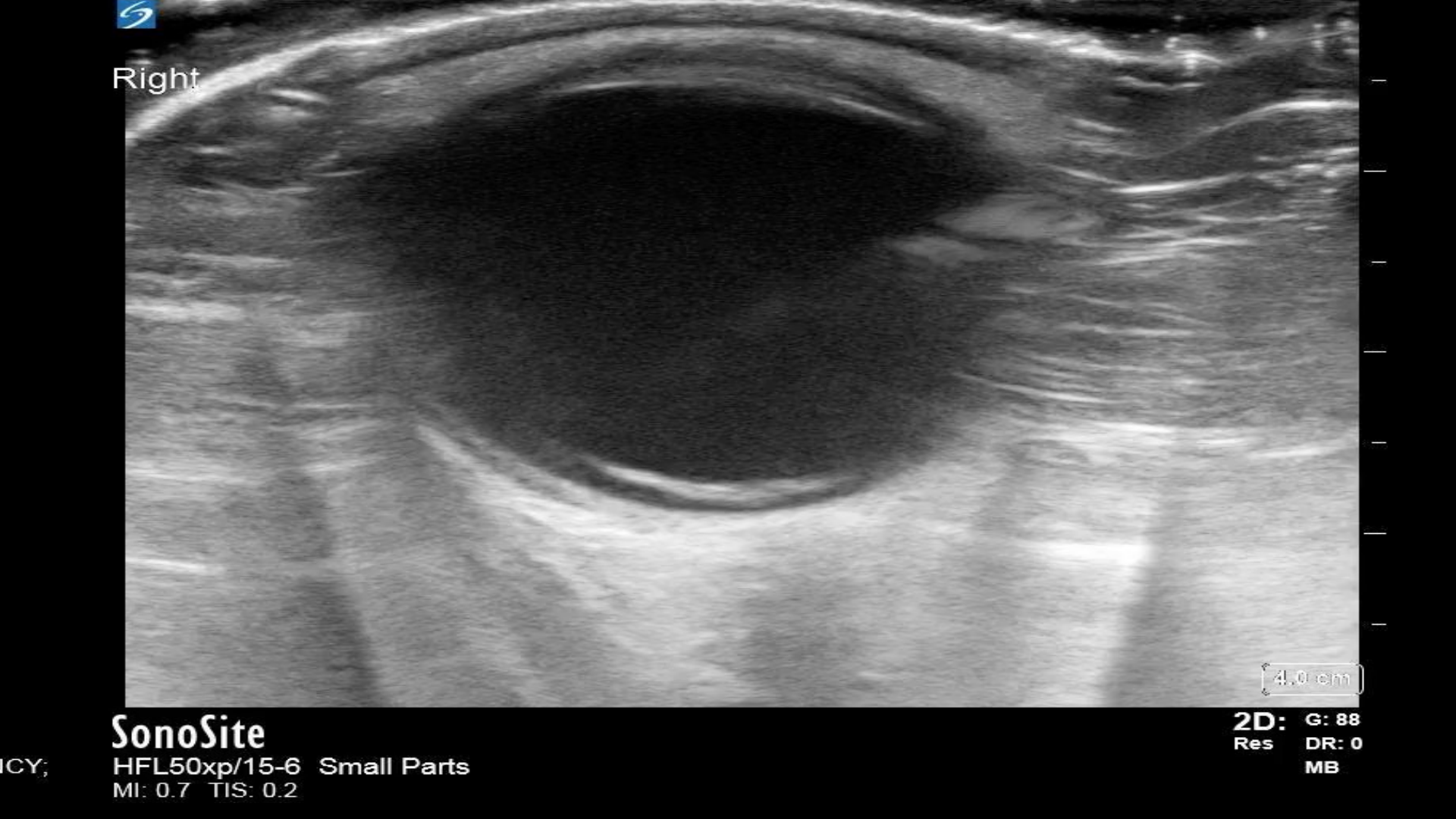

MB
2.2

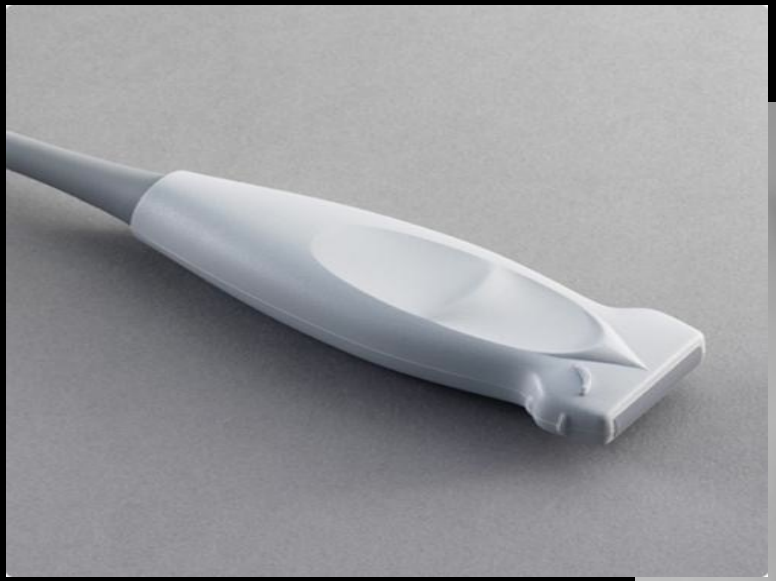
8 yo girl with sudden vision loss after a minor fall

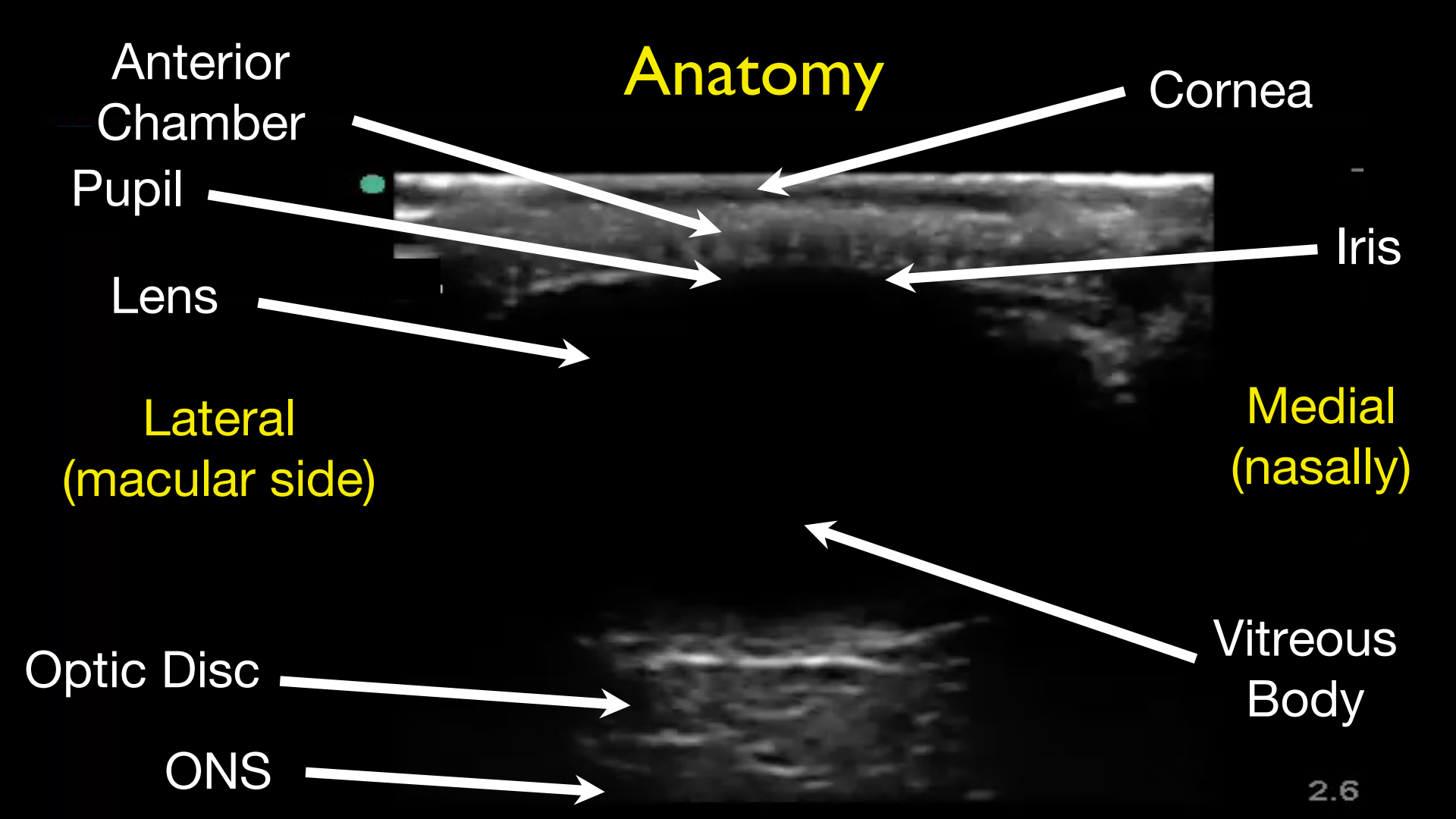

Right
4.0 cm
SonoSite
HFL50xp/15-6 Small Parts
MI: 0.7 TIS: 0.2
2D:
Res
G: 88
DR: 0
MB

Indications

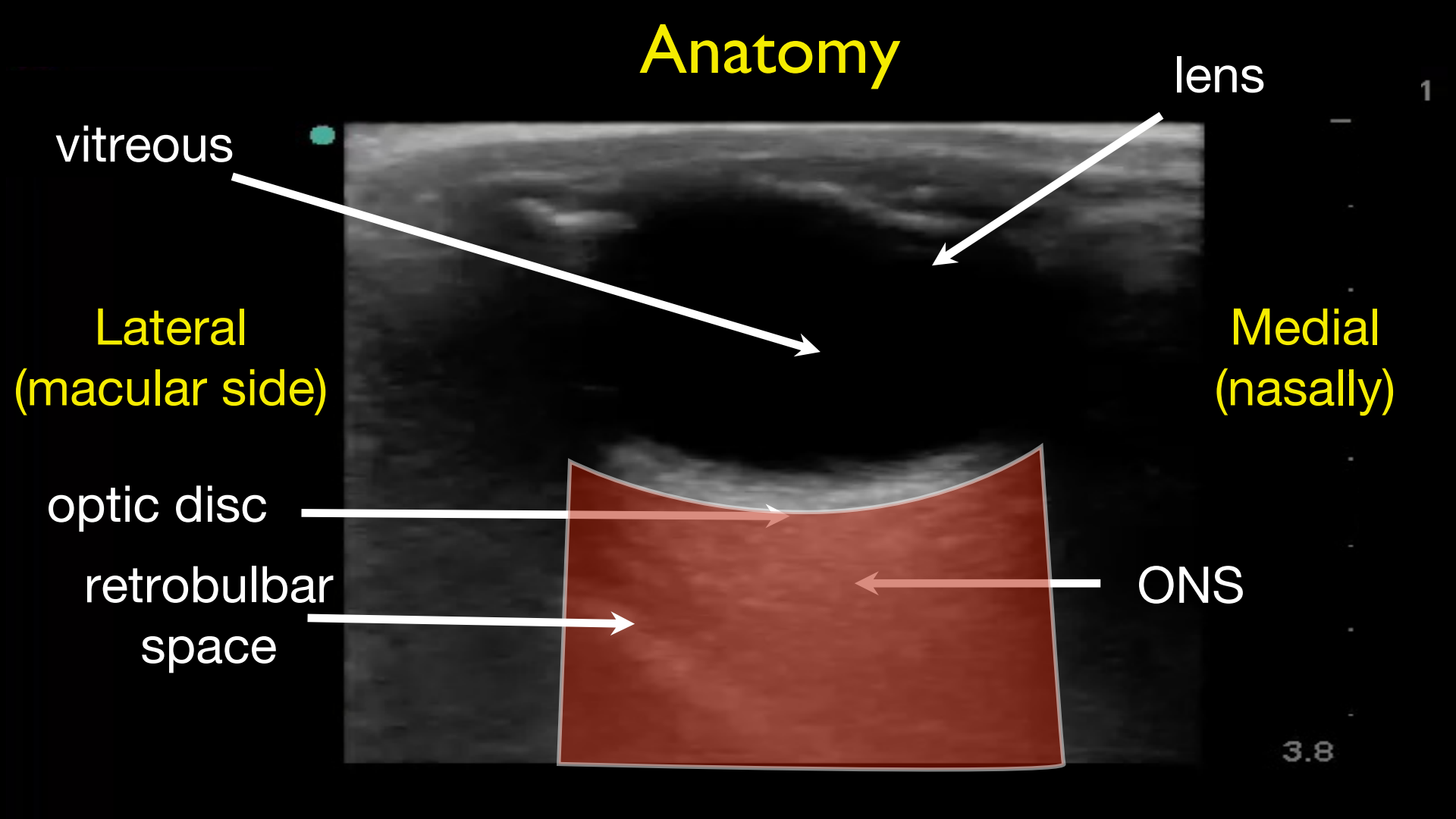
- Acute vision loss/visual changes
- Eval for papilledema
- Suspect FB
- Concern for RB
- *Contraindication: suspect globe rupture, sig trauma

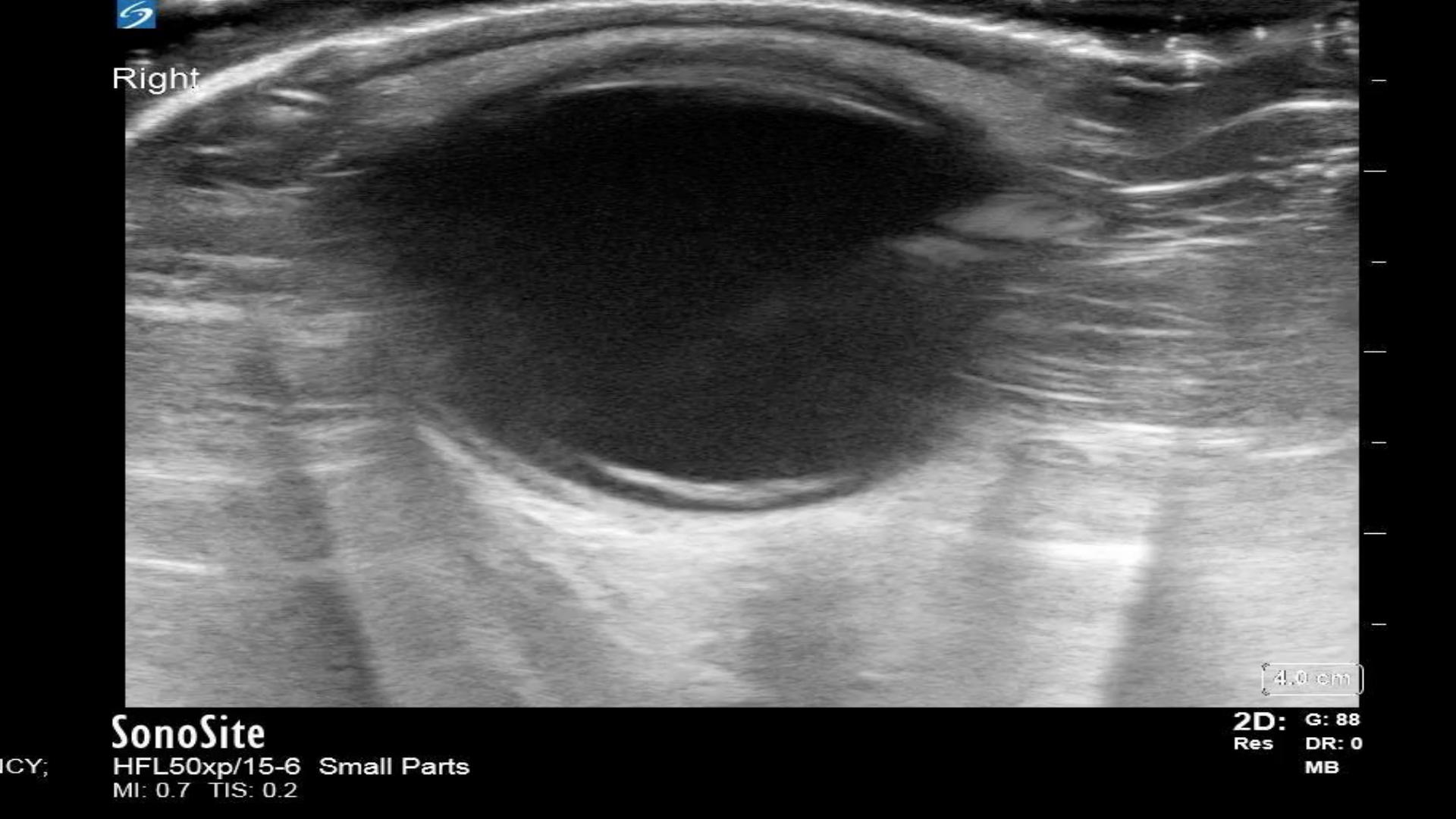
Technique



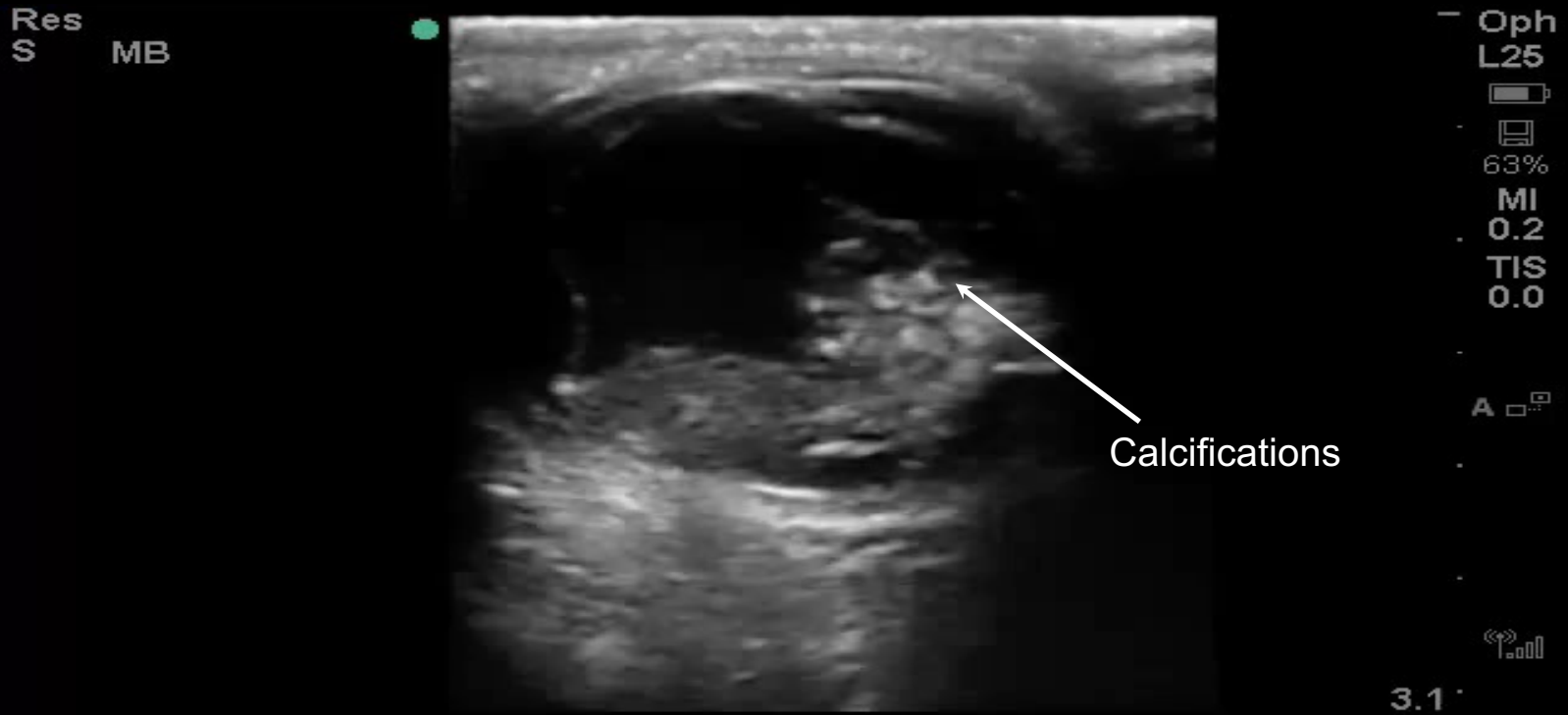

Anterior Chamber
Anatomy
Cornea
Pupil
Iris
Lens
Lateral (macular side)
Medial (nasally)
Vitreous Body
Optic Disc
ONS
2.6

Anatomy

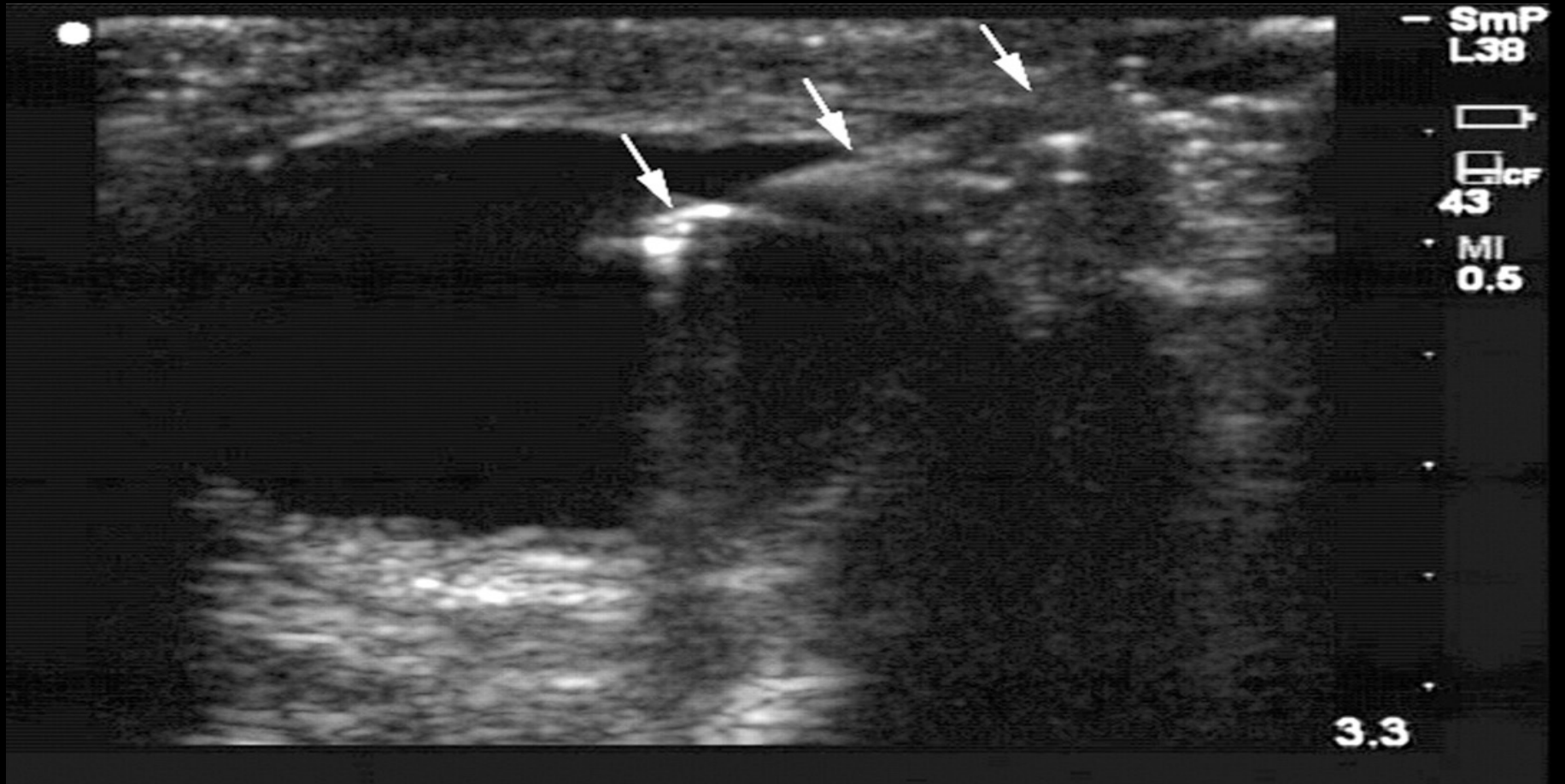

lens
vitreous
Lateral
(macular side)
Medial
(nasally)
optic disc
retrobulbar
space
ONS
1
3.8


Right
4.0 cm
SonoSite
HFL50xp/15-6 Small Parts
MI: 0.7 TIS: 0.2
2D:
Res
G: 88
DR: 0
MB

Retinoblastoma



Foreign Body



11 yo boy with a week of URI symptoms and now with fever

Lung Ultrasound Characteristics of Community-Acquired Pneumonia in Hospitalized Children

Vito Antonio Caiulo, MD,[1]* Luna Gargani, MD,[2] Silvana Caiulo, MD,[3] Andrea Fisicaro, MD,[3] Fulvio Moramarco, MD,[1] Giuseppe Latini, MD,[4] Eugenio Picano, MD, PhD,[2] and Giuseppe Mele, MD[5]

- Final diagnosis of pneumonia made in 89/102 patients
- Lung US positive for diagnosis of PNA in 88/89
- Chest X-ray positive for diagnosis of PNA in 81/89
- Only 1 patient with a normal lung US had an abnormal chest x-ray
- 8 patients with a normal chest x-ray had an abnormal lung US

Prospective Evaluation of Point-of-Care Ultrasonography for the Diagnosis of Pneumonia in Children and Young Adults

Vaishali P. Shah, MD; Michael G. Tunik, MD; James W. Tsung, MD, MPH

Table 1. Test Performance Characteristics Using Chest Radiography as a Reference Standard Among 200 Patients

Variable	LR (95% CI)		% (95% CI)	
	Positive	Negative	Sensitivity	Specificity
Point-of-care ultrasonography (n = 200)	7.8 (5.0-12.4)	0.16 (0.07-0.35)	86 (71-94)	89 (83-93)
Subgroup with point-of-care ultrasonography >1-cm lung consolidation (n = 187)[a]	28.2 (11.8-67.6)	0.14 (0.06-0.32)	86 (71-94)	97 (93-99)
Clinical Examination				
Overall clinical impression (n = 200)	1.4 (1.1-1.7)	0.41 (0.19-0.88)	84 (69-92)	39 (32-57)
Tachypnea (n = 200)	1.7 (1.0-2.7)	0.79 (0.60-1.04)	41 (26-57)	76 (68-81)
Decreased breath sounds only (n = 200)	1.5 (0.8-2.9)	0.91 (0.75-1.1)	24 (13-40)	83 (77-88)
Crackles only (n = 200)	1.0 (0.5-1.9)	1.0 (0.82-1.23)	24 (13-40)	75 (68-81)
Overall Results Stratified by Clinician-Sonologist Experience (n = 200)[b]				
Clinician-sonologist with ≤25 ultrasonography examinations (n = 131)	6.9 (4.0-11.8)	0.20 (0.08-0.48)	83 (63-93)	88 (81-93)
Clinician-sonologist with >25 ultrasonography examinations (n = 69)	10.3 (4.4-24.2)	0.08 (0.01-0.56)	92 (67-99)	91 (81-96)
Subgroup Results Stratified by Clinician-Sonologist Experience[c]				
Clinician-sonologist with ≤25 ultrasonography examinations (n = 122)	23.1 (8.6-61.7)	0.18 (0.07-0.44)	83 (63-93)	96 (91-99)
Clinician-sonologist with >25 ultrasonography examinations (n = 65)	51.7 (7.3-363.0)	0.08 (0.12-0.52)	92 (67-99)	98 (90-100)

Abbreviation: LR, likelihood ratio.
[a] Subgroup with lung consolidation of 1 cm or less detected on point-of-care ultrasonography excluded.
[b] Including lung consolidation of 1 cm or less, ultrasonography positive, and chest radiography negative.
[c] Lung consolidation exceeding 1 cm detected by point-of-care ultrasonography, ultrasonography positive, and chest radiography positive only.

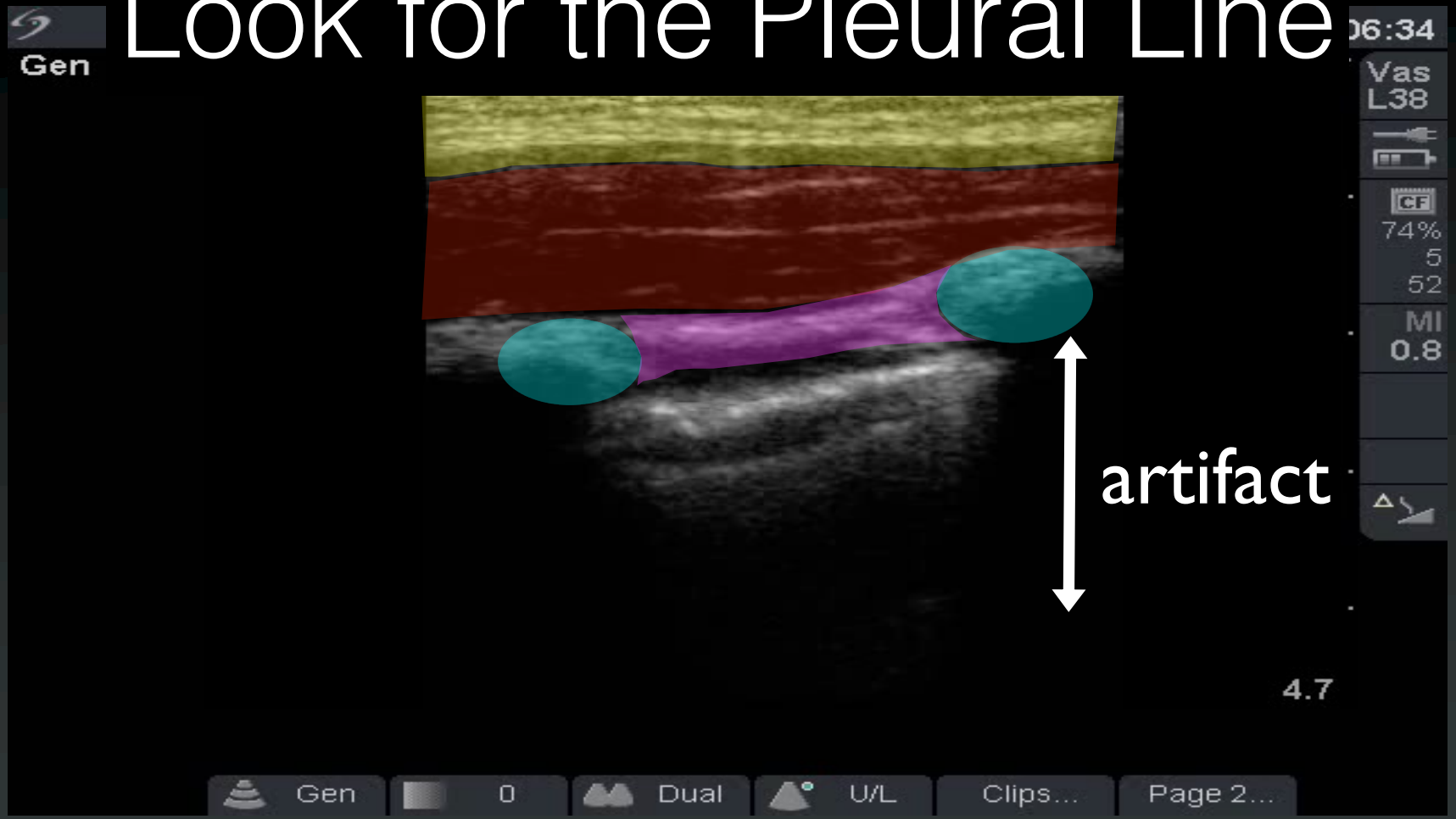
What is Lung Ultrasound?

- Is it possible to ultrasound an air filled organ?
  - Lung ultrasound relies on the analysis of artifacts
  - In the lung, air and water are closely mixed
    - “Dependent disorders” - water rich
    - “Nondependent disorders” - air rich

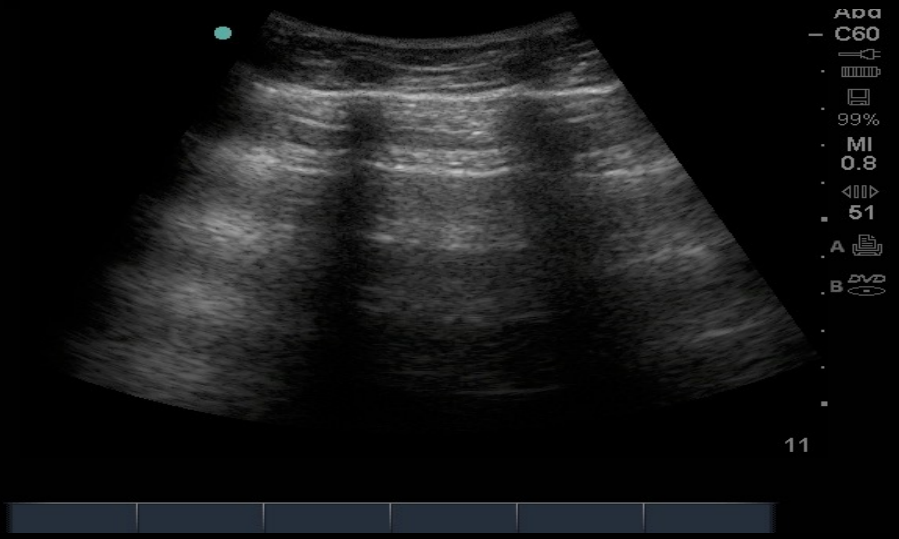
Technique

- Sagittal Plan
- Indicator towards head
- Look between ribs
- Curvilinear or linear probe

Look for the Pleural Line



Analysis of Artifacts

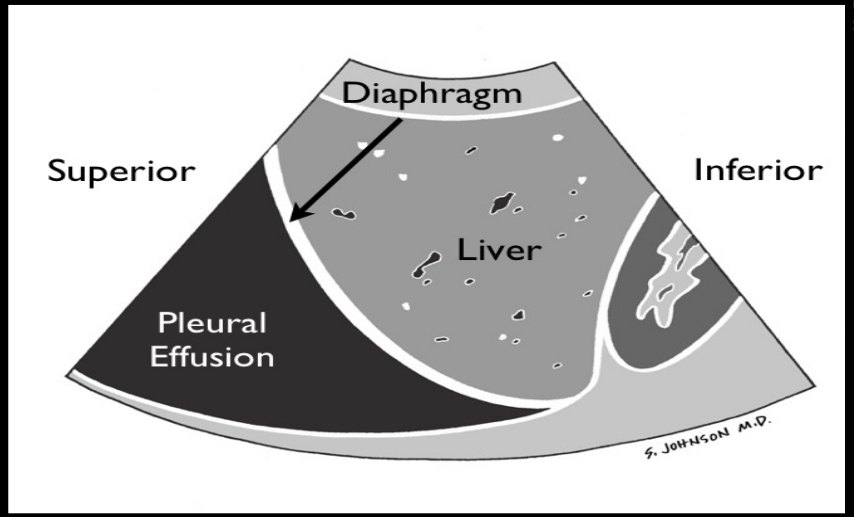


Lung Pathology

- Pleural Effusion
- Alveolar Consolidation
- Pneumothorax
- Bronchiolitis

Pleural Effusion

RUQ View with Pleural Effusion:

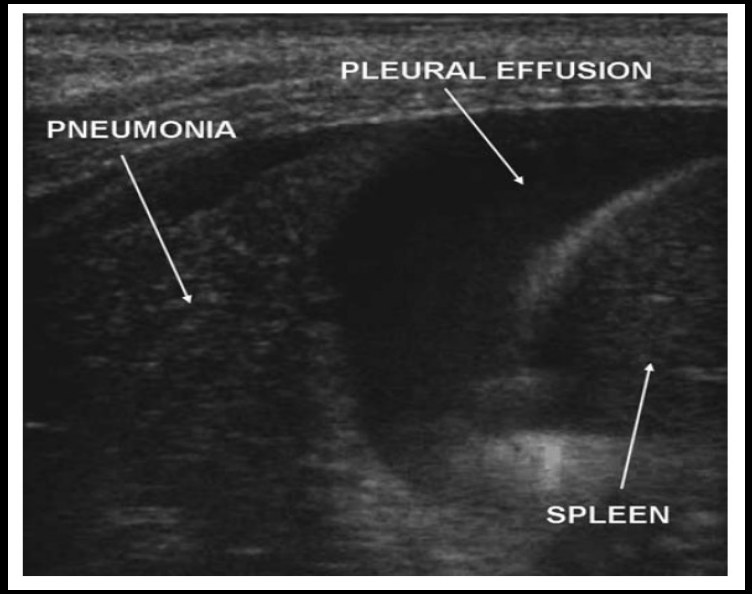


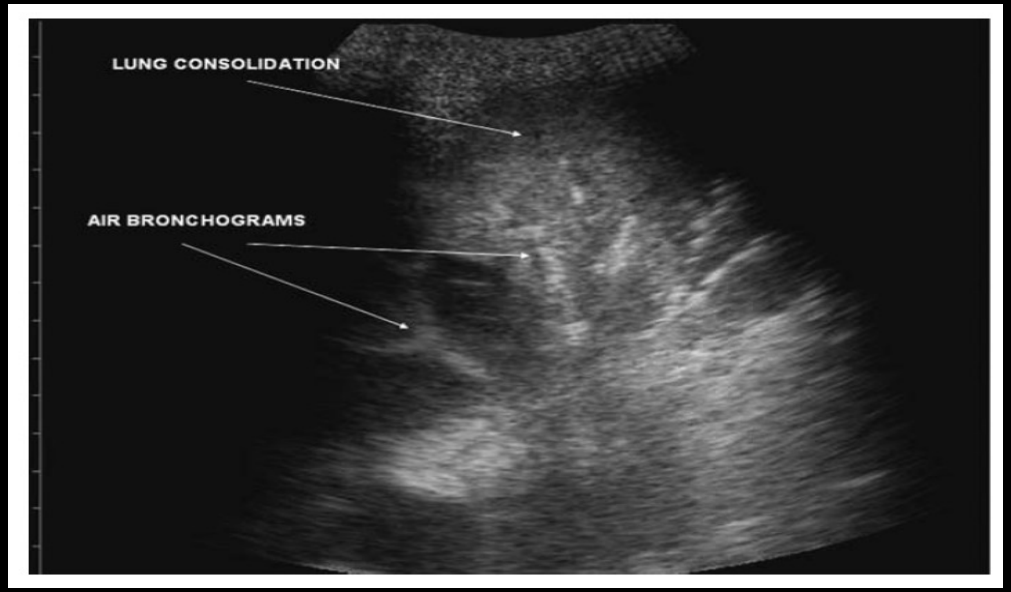
THE “SPINE SIGN”

Alveolar Consolidation

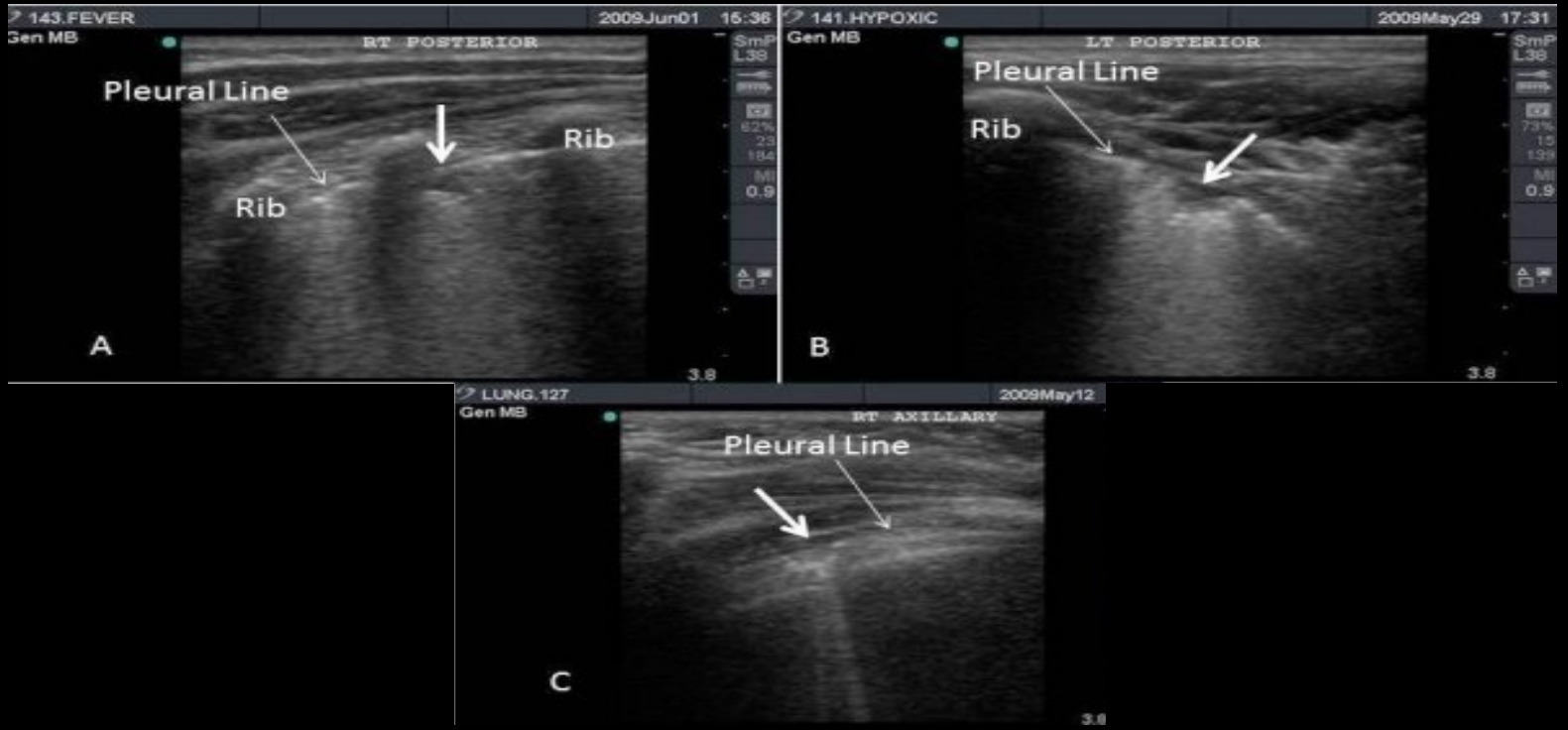
- Tissue-like pattern (looks like liver)
- Can have associated effusion
- Air bronchograms
- Pleura line irregurlaity
- Multiple B-lines

US findings in PNA

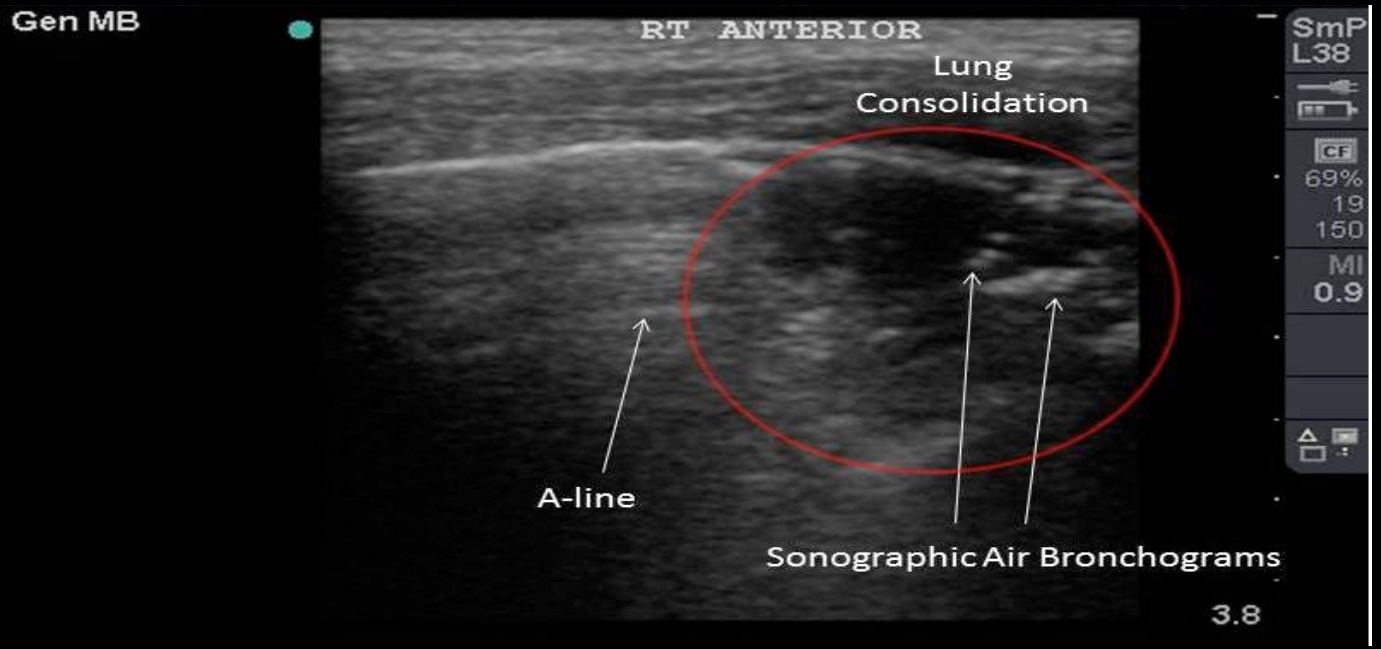




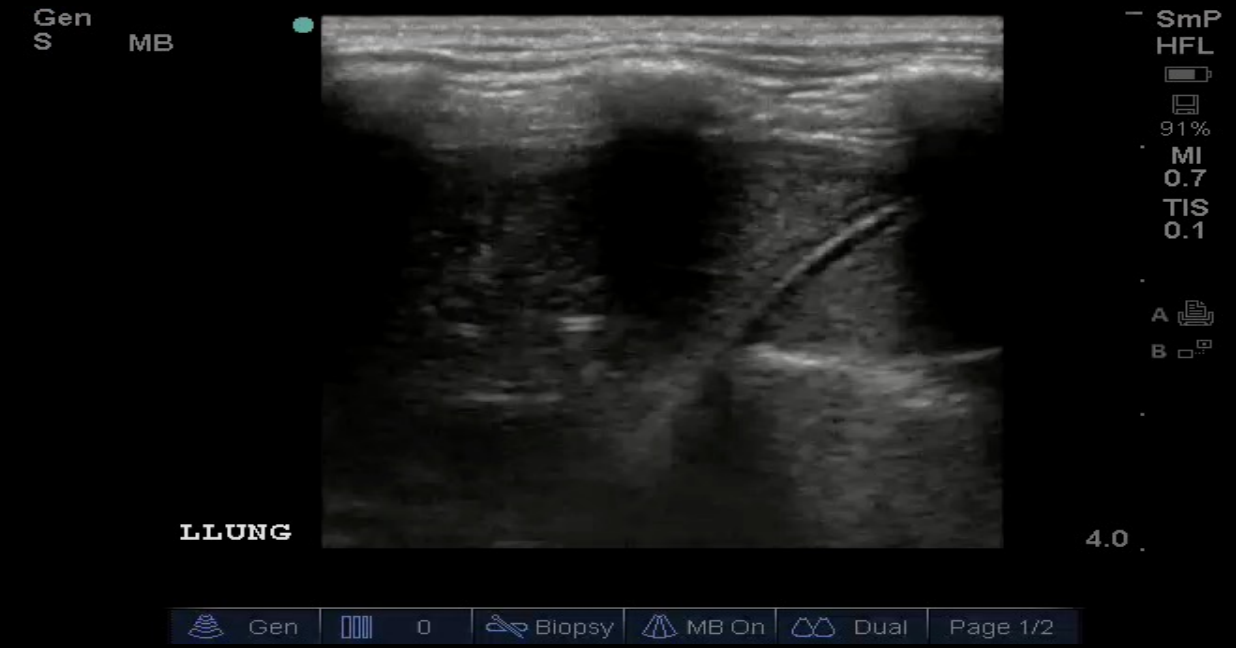
US Findings in Bronchiolitis



Air Bronchograms



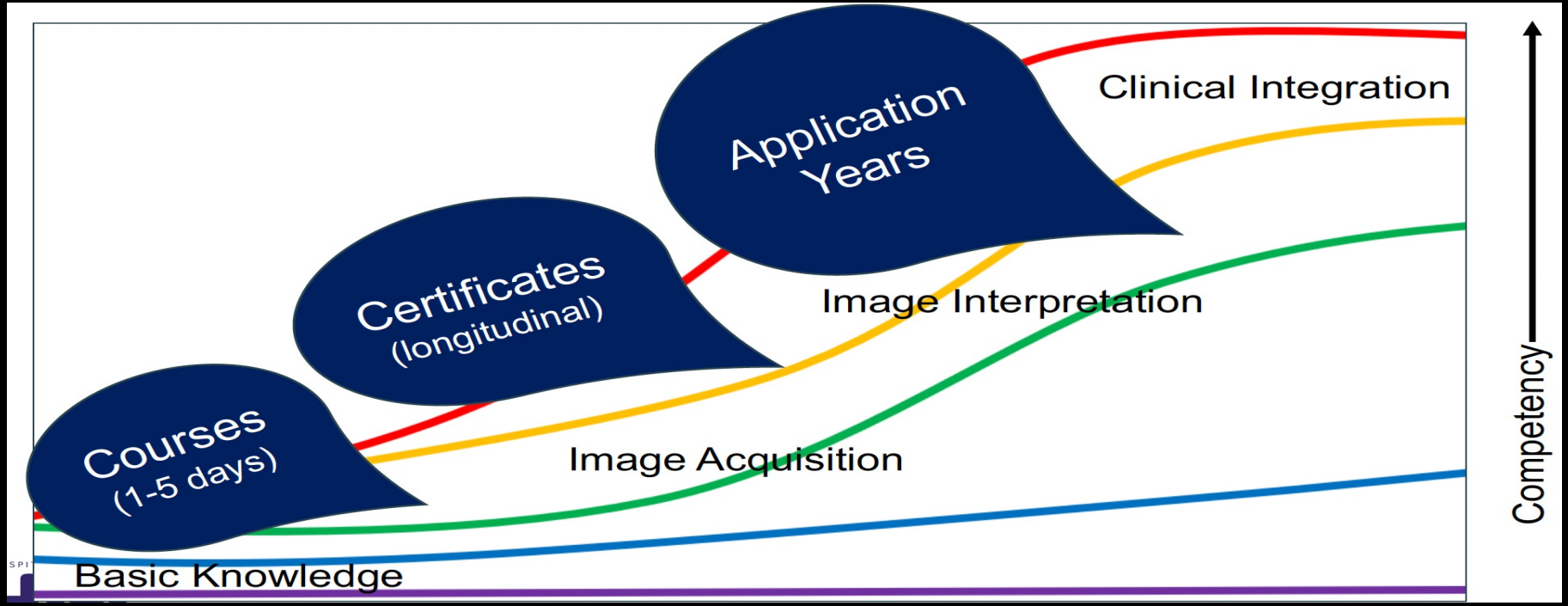
Pneumonia


Gen
S
MB
SmP
HFL
91%
MI
0.7
TIS
0.1
A
B
LLUNG
4.0
Gen
0
Biopsy
MB On
Dual
Page 1/2

Pneumonia + Effusion

Pneumonia


Gen THI
S MB
Abd
P21
90%
MI
1.2
TIS
0.8
A
10
Gen
0
Guide
MB On
THI
On
Page 1/2


Application Years
Clinical Integration
Certificates (longitudinal)
Image Interpretation
Courses (1-5 days)
Image Acquisition
Basic Knowledge
Competency

Additional References

- Braverman J. Bedside ultrasound for procedural guidance in pediatrics. *Pediatr Ann*. 2021;50(10):e404-e410.

- Conlon T, et al. Moving beyond the stethoscope: diagnostic point-of-care ultrasound in pediatric practice. *Pediatrics*. 2019;144(4):e20191402.

- Fraga M, et al. Seeing is believing: ultrasound in pediatric procedural performance. *Pediatrics*. 2019; 144(5): e20191401.

Thank you

Questions?
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