

Ultrasound-guided vascular access in newborns: basics and application

Robin van der Lee,
pediatrician – neonatologist
RadboudUMC Amalia Children's Hospital,
Nijmegen, NL



European Society
for Paediatric Research

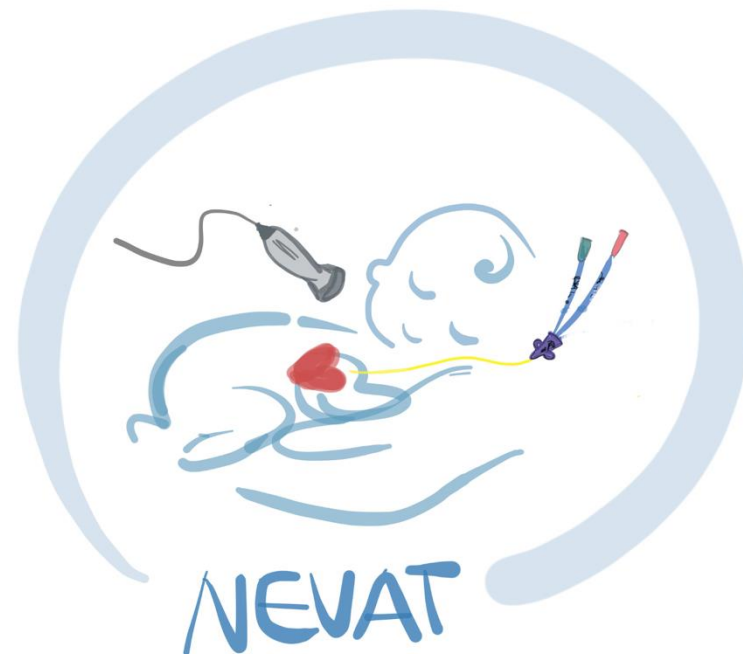


Neonatal European Vascular Access Team

Nothing to disclose



European Society
for Paediatric Research



<https://neonat.org>



Always Consider Whether Intravenous Therapy is Necessary?

The DIVA Key Difficult IntraVenous Access

	Low Risk	Medium Risk	High Risk
1. <u>A</u> cuity	No clinical urgency (>2h)	Time critical (<2h)	Urgent
2. <u>A</u> ppearance	Multiple visible/palpable veins	Few visible/palpable veins	Nil visible/palpable veins
3. <u>A</u> lerts	Previous easy access	Multiple attempts required in past	Documented alert and/or US guidance required in past
4. <u>A</u> dmissions	Previously well or mild illness	Multiple admissions and/or comorbidities	Severe comorbidities and prolonged hospital care
5. <u>A</u> ge	> 3 years	< 3 years	< 18 months History of prematurity
6. <u>A</u> nxiety	Minimal anxiety	Moderate anxiety	Severe anxiety and/or documented needle phobia

Clinician Self Assessment

	Developing	Confident	Advanced
7. <u>A</u> bility	<100 paediatric insertions <50% first pass success Minimal US skills	100-800 paediatric insertions 50-80% first pass success Developing US skills	>800 paediatric insertions >80% first pass success Proficient US skills

Insertion & Escalation Pathway

Does your insertion ability = patient DIVA risk?

8. <u>A</u> scend	Developing Inserter From Treating Team 2 Attempts Max	Confident Inserter +/- Ultrasound Guided 2 Attempts Per Inserter	Advanced Inserter Preferably US Guided
-------------------	---	--	--

Maximum 2 attempts per inserter from any ability level
After 4 insertion attempts **ESCALATE** to an Advanced Inserter

VAMS (7am-3pm)
Anaesthetist
PICU Reg

Always Provide Procedural Support

Consider where appropriate


- 1) Numbing cream
- 2) Sucrose or breast feed
- 3) Comfort position
- 4) Distraction

Consider for Anxious Patients

Inhaled Entonox® or Quantiflex®
Enteral sedation
Refer to procedure CHQ-PROC-00303,
CHQ-PROC-62111


Schults et al 2022
Avatar research group

Safe Insertion of Arterial Catheters (SIA): An ultrasound-guided protocol to minimize complications for arterial cannulation

The Journal of Vascular Access
1–6
© The Author(s) 2023
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/11297298231178064
journals.sagepub.com/home/jva



Timothy R Spencer¹ , Guglielmo Imbriaco² ,
Amy Bardin-Spencer³ , Keegan JMahoney⁴, Fabrizio Brescia⁵ ,
Massimo Lamperti⁶ and Mauro Pittiruti⁷ 

Ultrasound guided percutaneous catheterization of the brachiocephalic vein by small caliber catheter: An alternative to epicutaneo-caval catheter in newborn and premature infants

The Journal of Vascular Access
2023, Vol. 24(3) 487–491
© The Author(s) 2021
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/11297298211034311
journals.sagepub.com/home/jva






Zied Merchaoui , Quitterie Laudouar, Clémence Marais,
Luc Morin, Narjess Ghali, Ramy Charbel, Nada Seeman,
Mostafa Mokhtari and Pierre Tissières

Ultrasound-Guided Umbilical Venous Catheter Insertion With Alignment of the Umbilical Vein and Ductus Venosus


Makoto Kishigami, MD , Tomoyuki Shimokaze, MD, PhD, Masahiro Enomoto, MD, PhD, Jun Shibasaki, MD,
Katsuaki Toyoshima, MD, PhD

Systematic Review

The Role of Ultrasound in Epicutaneo-Caval Catheter Insertion in Neonates: Systematic Review, Meta-Analysis and Future Perspectives

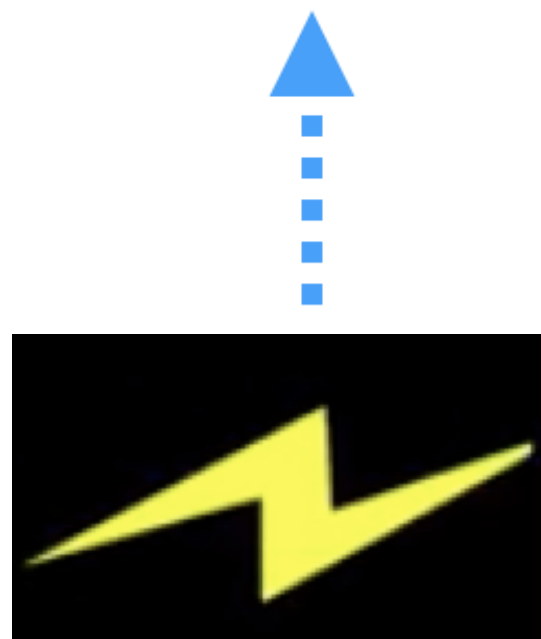
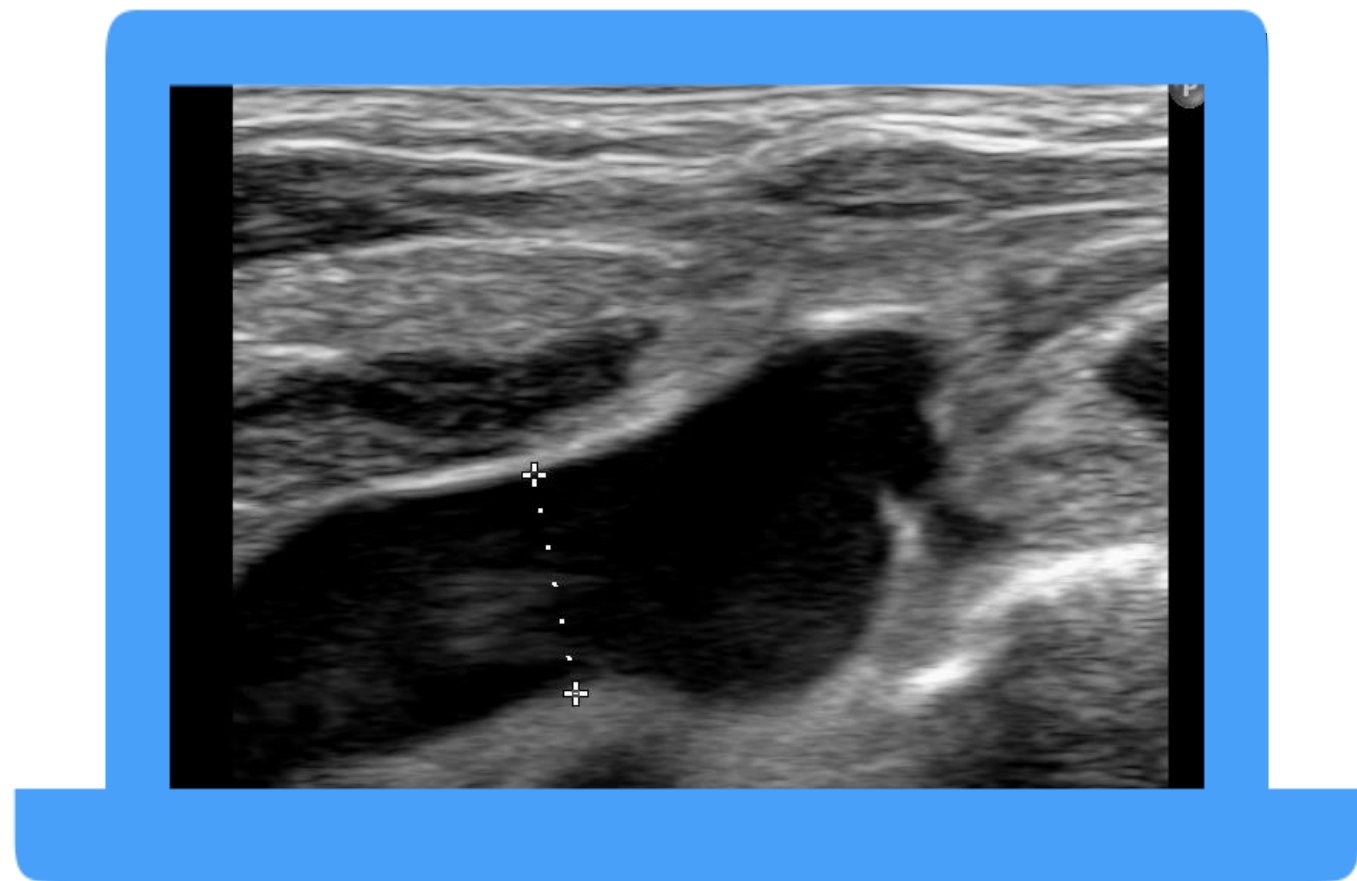
Vito D'Andrea^{1,*} , Valentina Cascini², Rosellina Russo³ , Alessandro Perri¹, Giorgia Prontera¹, Gina Ancora⁴,
Giovanni Vento¹, Gabriele Lisi^{2,5}  and Giovanni Barone⁴ 

Ultrasound-guided supraclavicular cannulation of the brachiocephalic vein may reduce central line-associated bloodstream infection in preterm infants

Ignacio Oulego-Erroz^{1,2,3}  • Alba Fernández-García⁴ • Beatriz Álvarez-Juan⁴ • Sandra Terroba-Seara⁴ •
Paula Alonso Quintela^{3,4} • Antonio Rodríguez-Núñez⁵

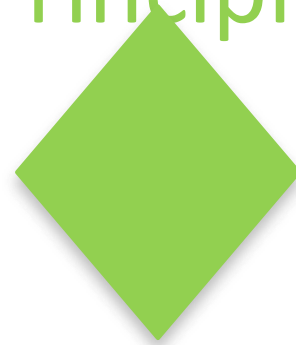
Centrally inserted central catheters in preterm neonates with weight below 1500 g by ultrasound-guided access to the brachio-cephalic vein

Giovanni Barone¹ , Mauro Pittiruti² , Gina Ancora¹,
Giovanni Vento³, Francesca Tota⁴ and Vito D'Andrea³ 

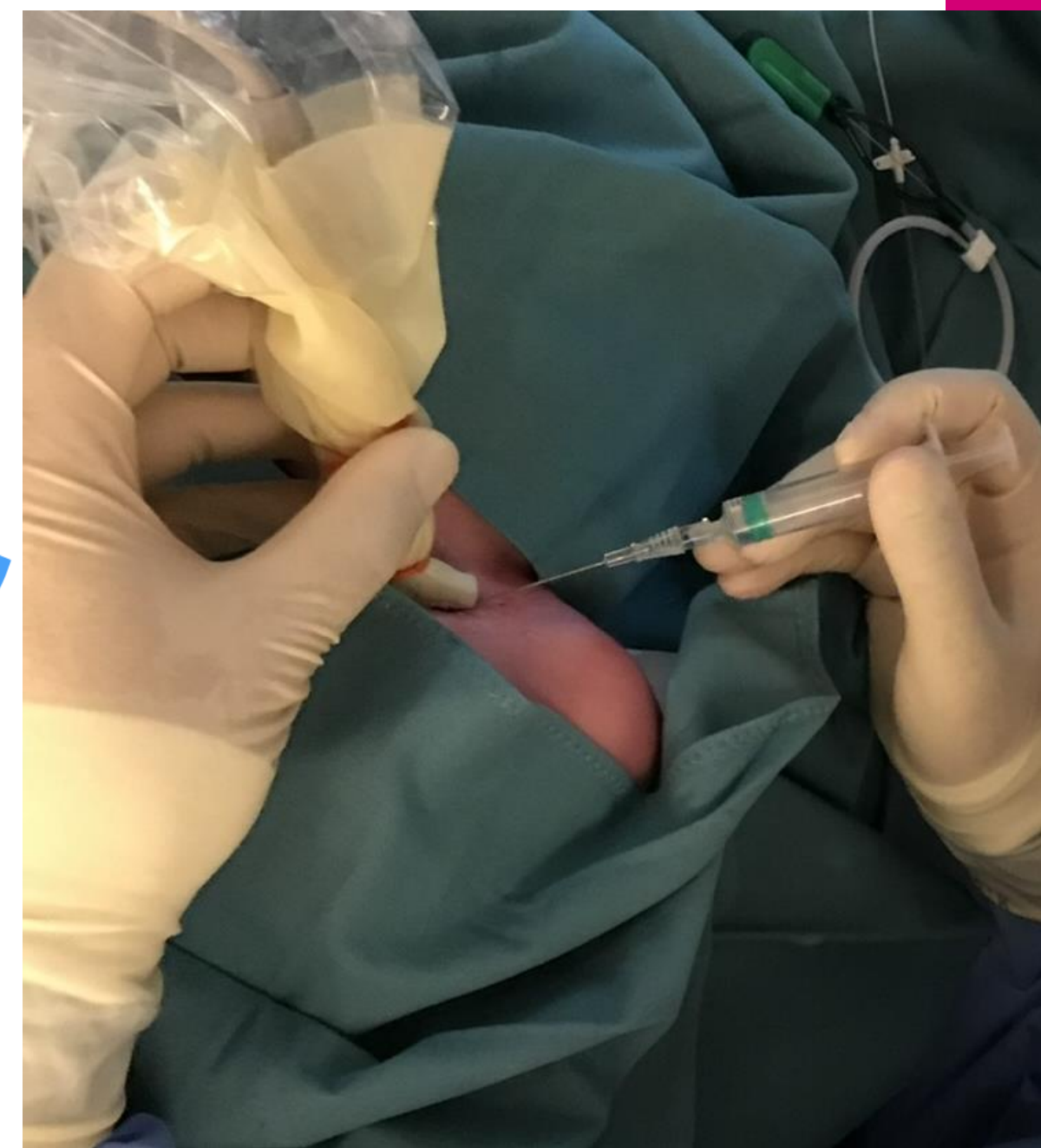


Voltage

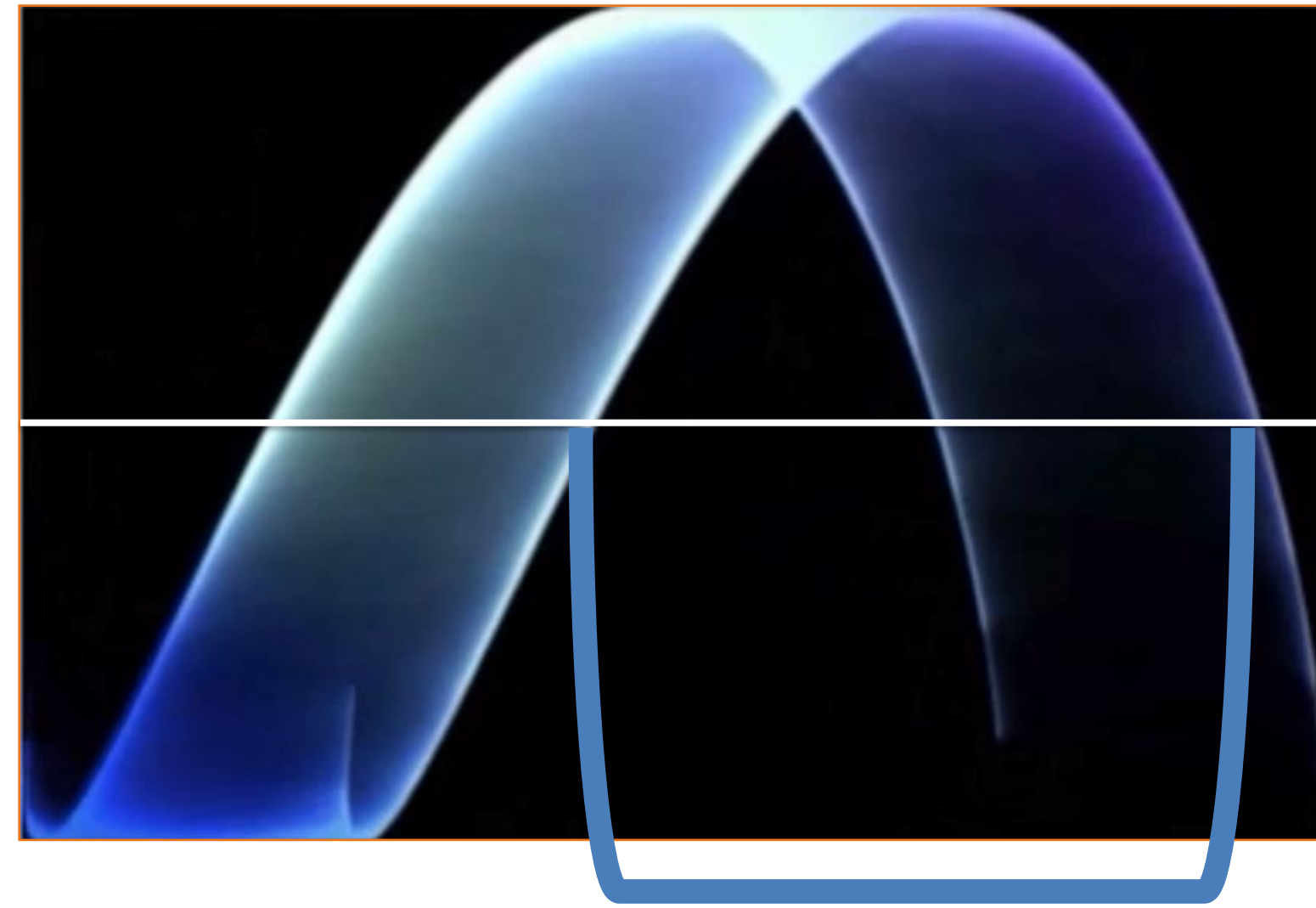
Piezoelectrical
Principle



P.E. crystal



ULTRASOUND WAVES



AMPLITUDE

X2 = WAVE LENGTH

Number



= Frequency

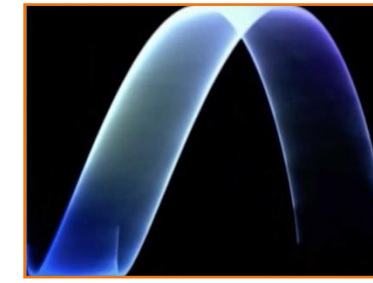


Hertz

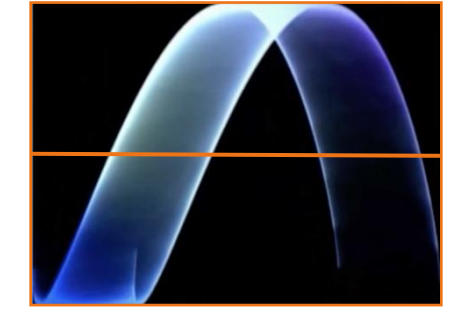
Seconds

Sound velocity
(Constant!) =

Number
Seconds
Frequency



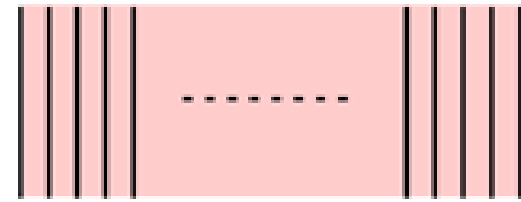
X



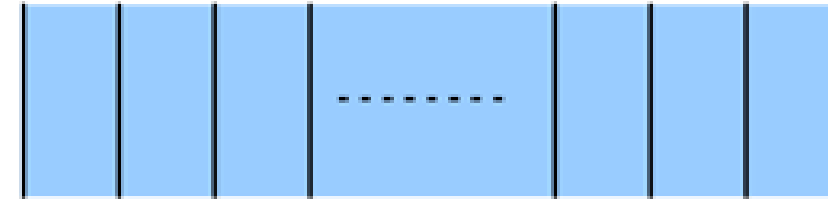
Wavelength

10 kHz bandwidth from
540-1600 kHz for
106 possible bands

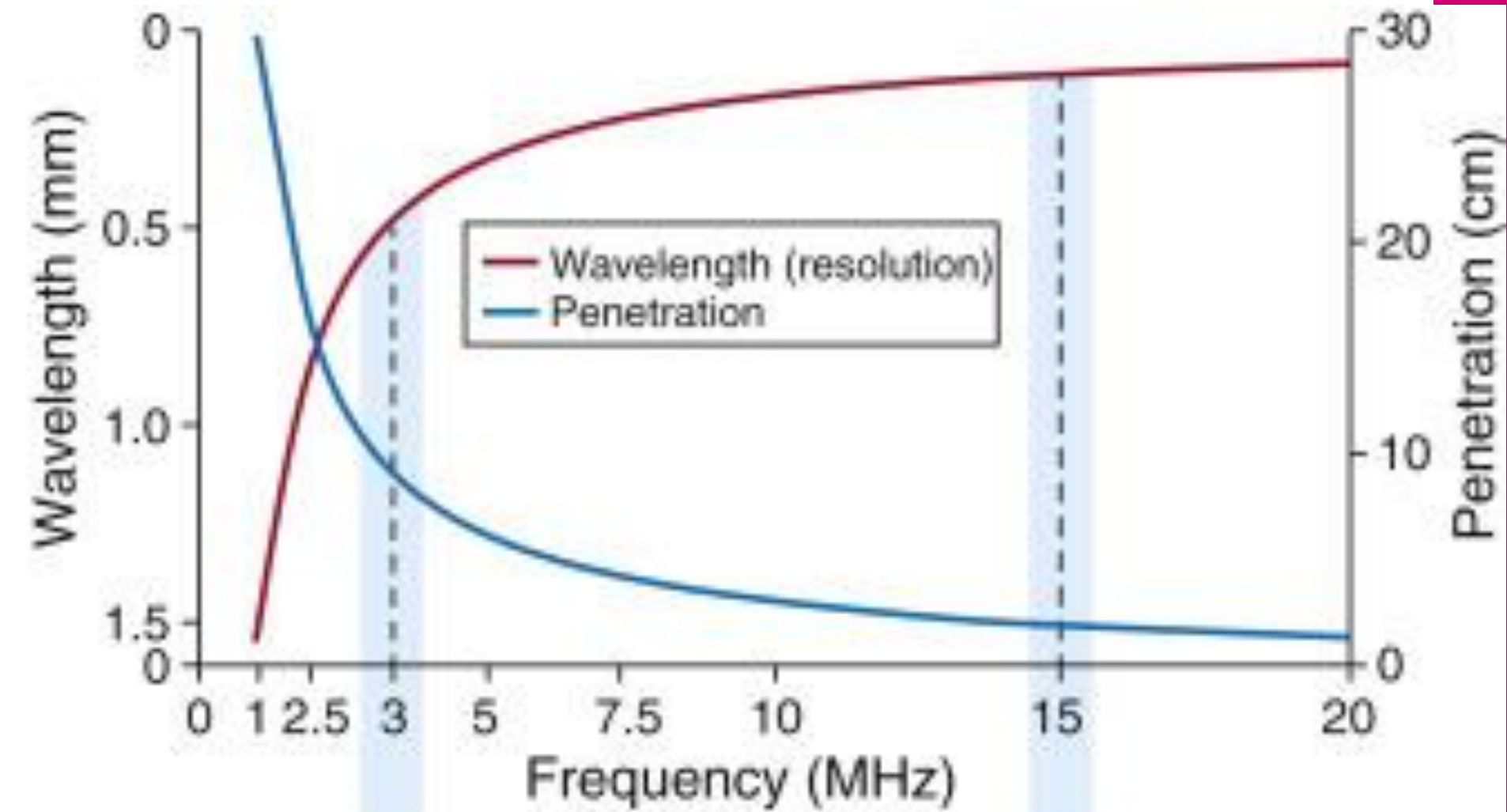
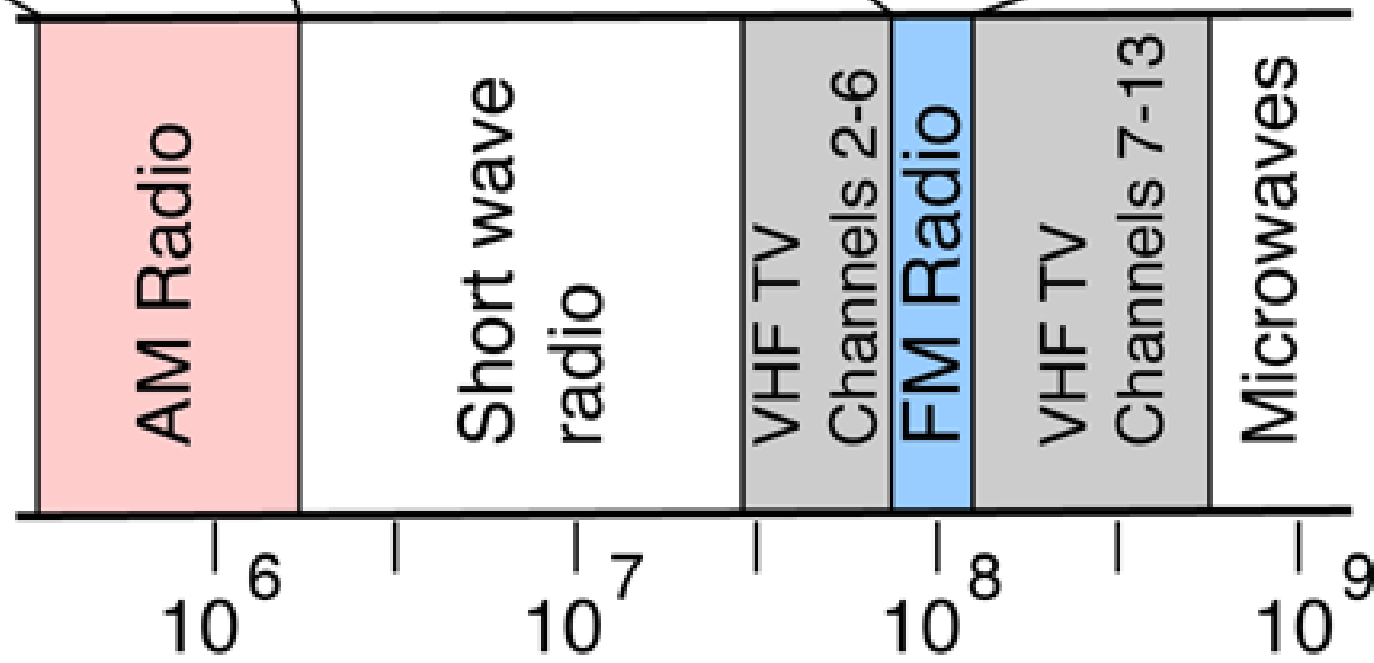
200 kHz bandwidth from
88.1-108.1 MHz for
100 possible bands



AM



FM



Low-frequency transducer



High-frequency transducer

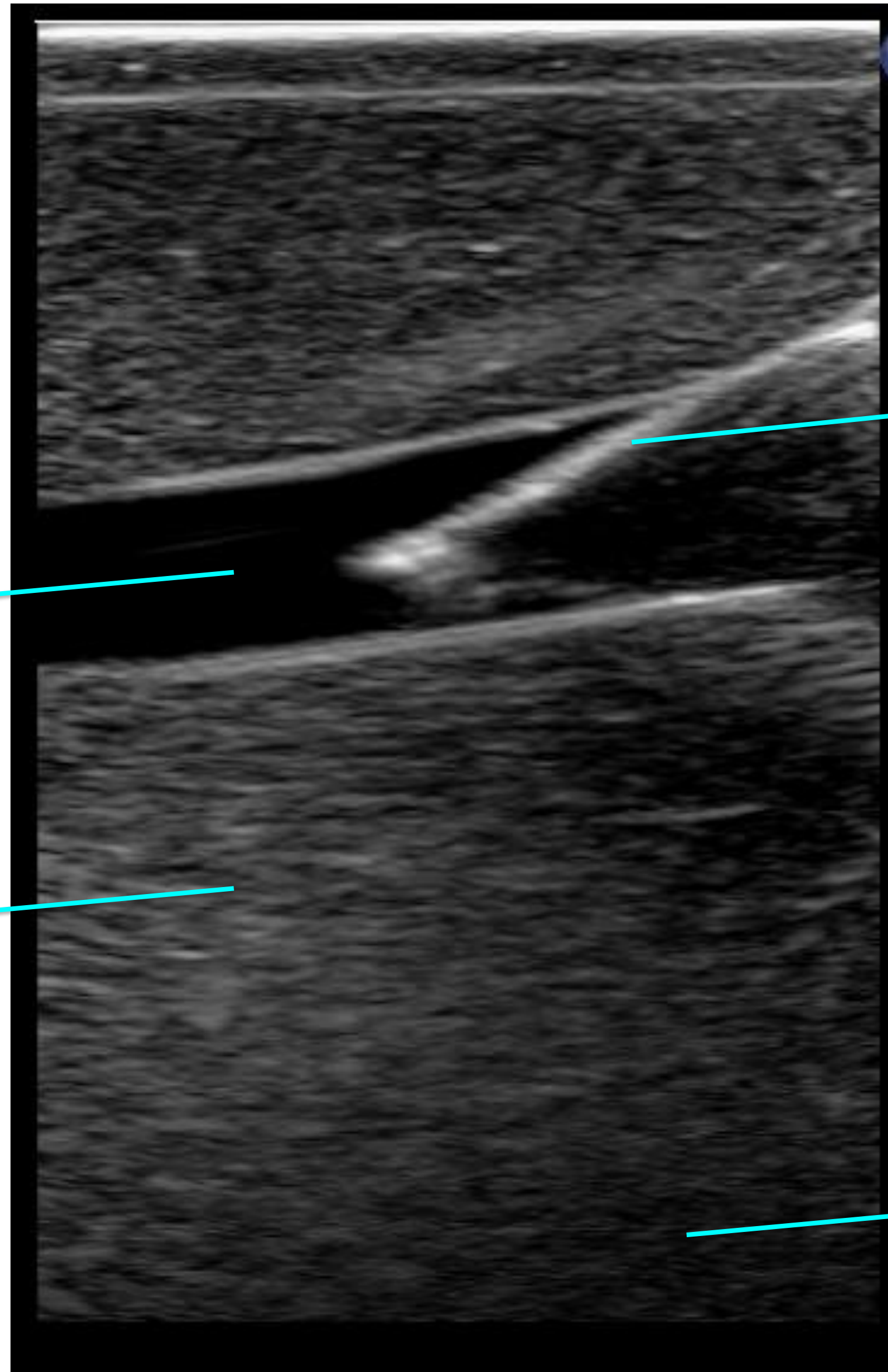


anechoic

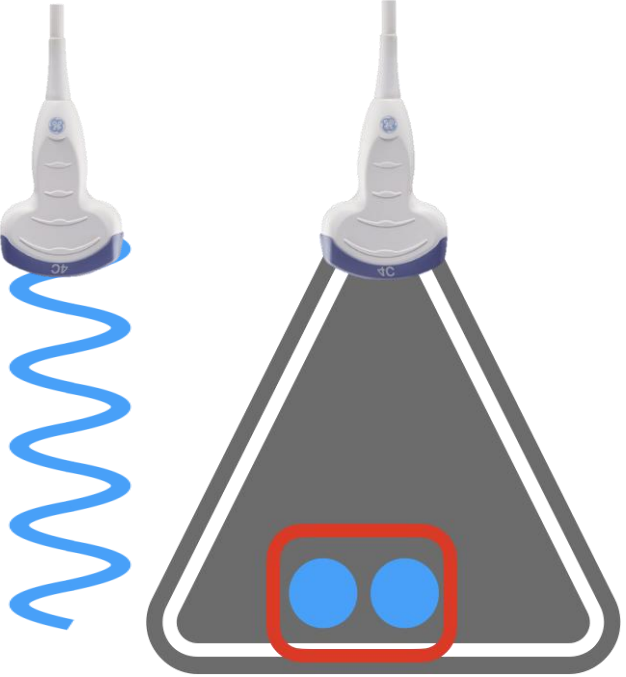
Iso-echoic

hyperechoic

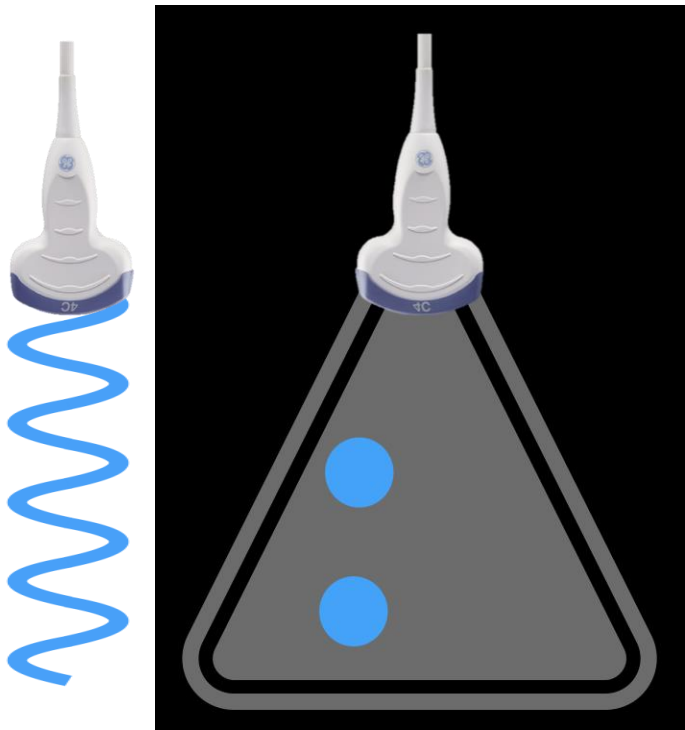
Hypo-echoic



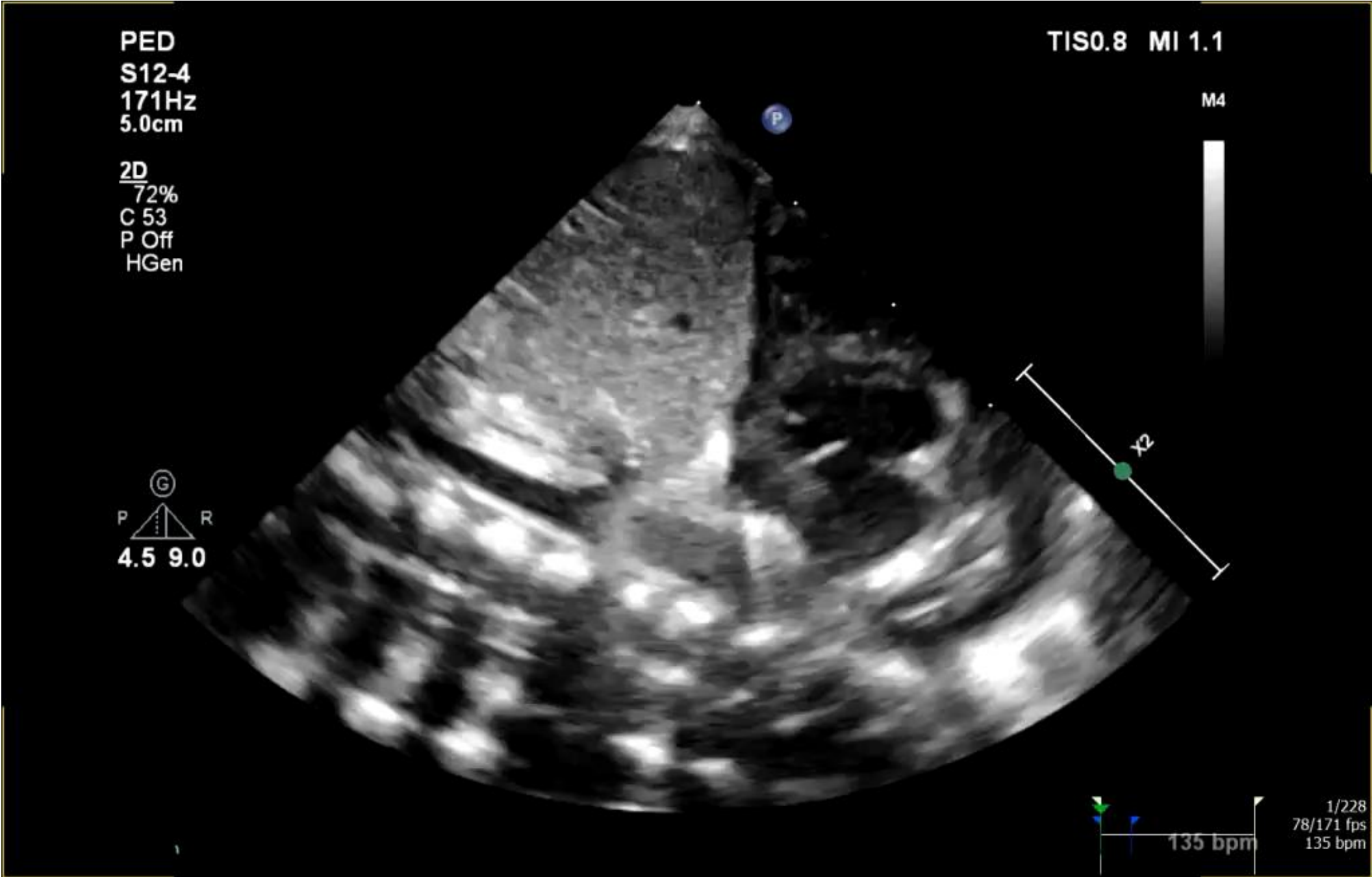
RESOLUTION



LATERAL



A
X
I
A
L

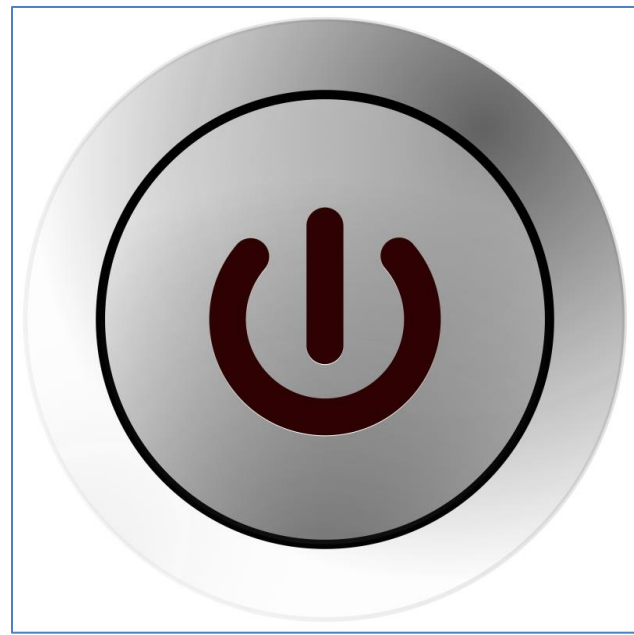


TEMPORAL

Equipment



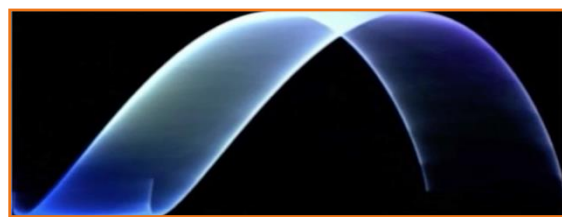
Knobology



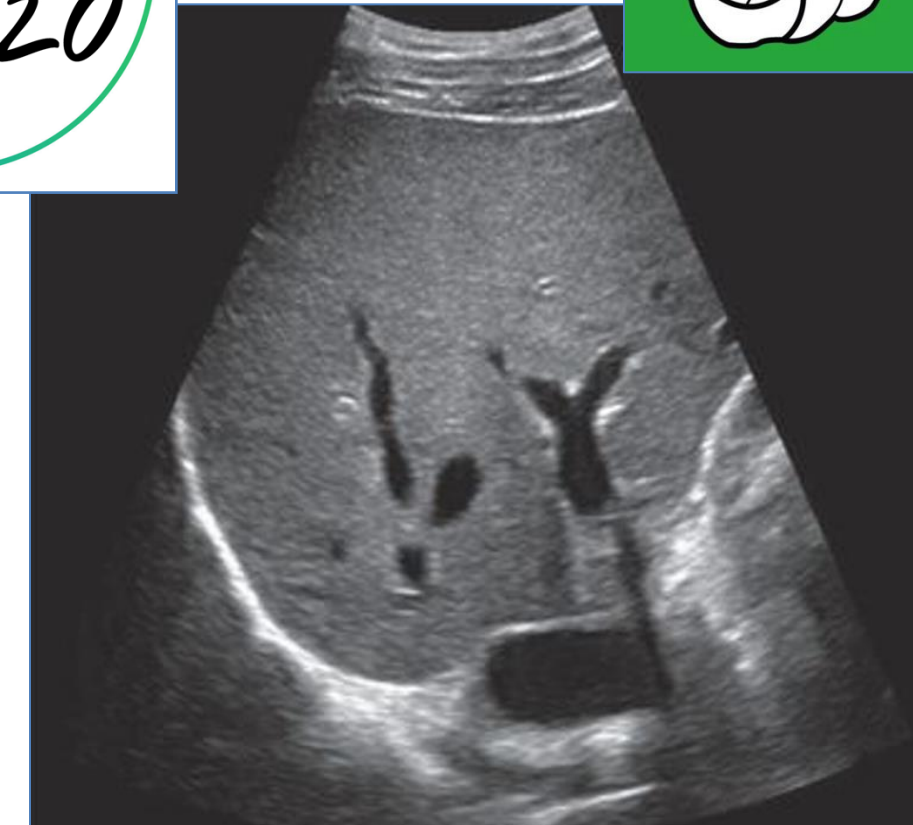
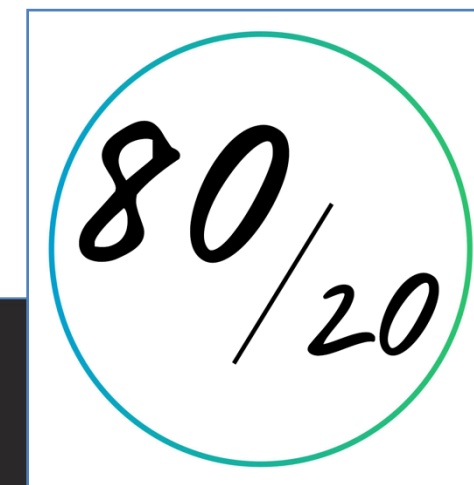
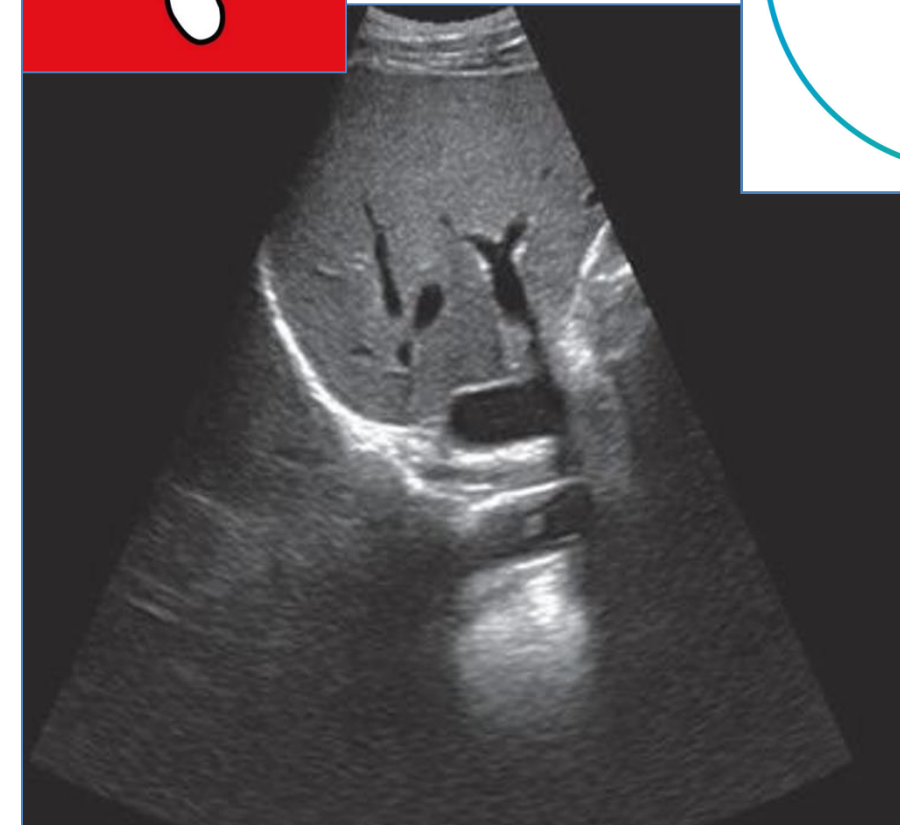
ON / OFF



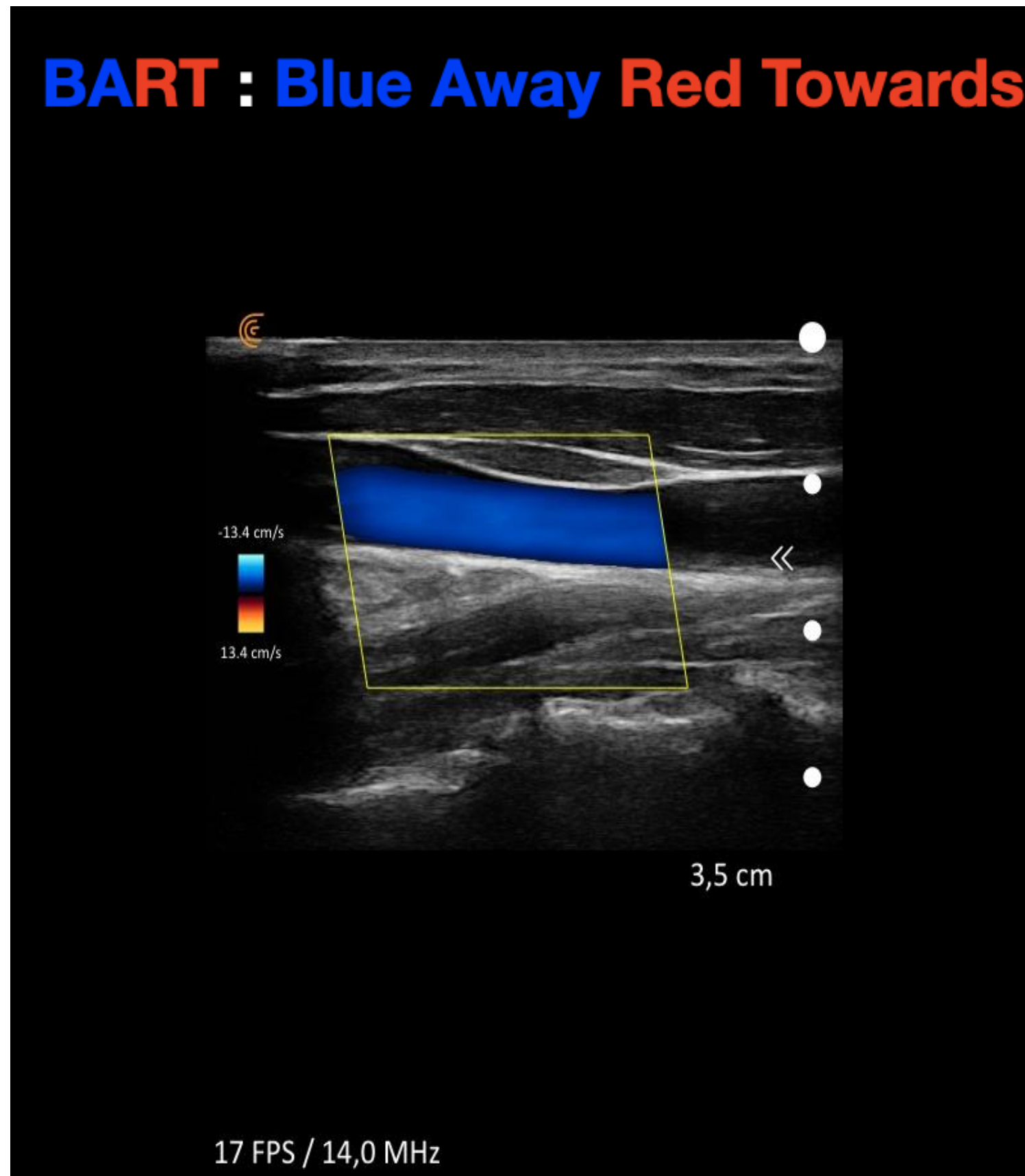
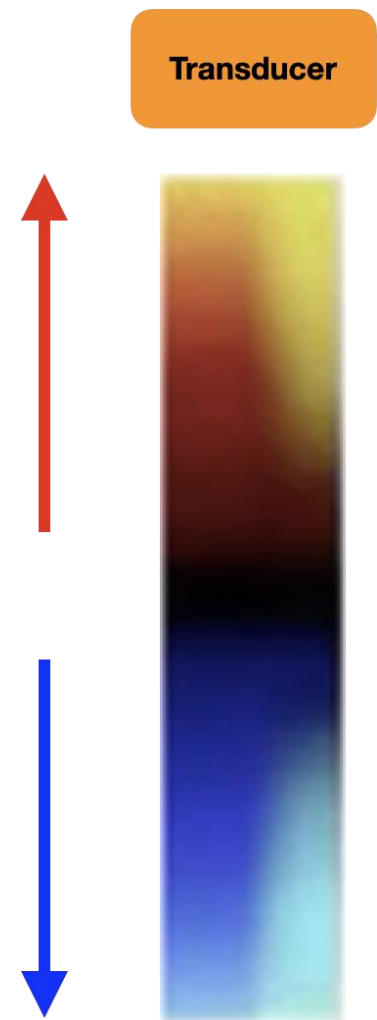
DEPTH



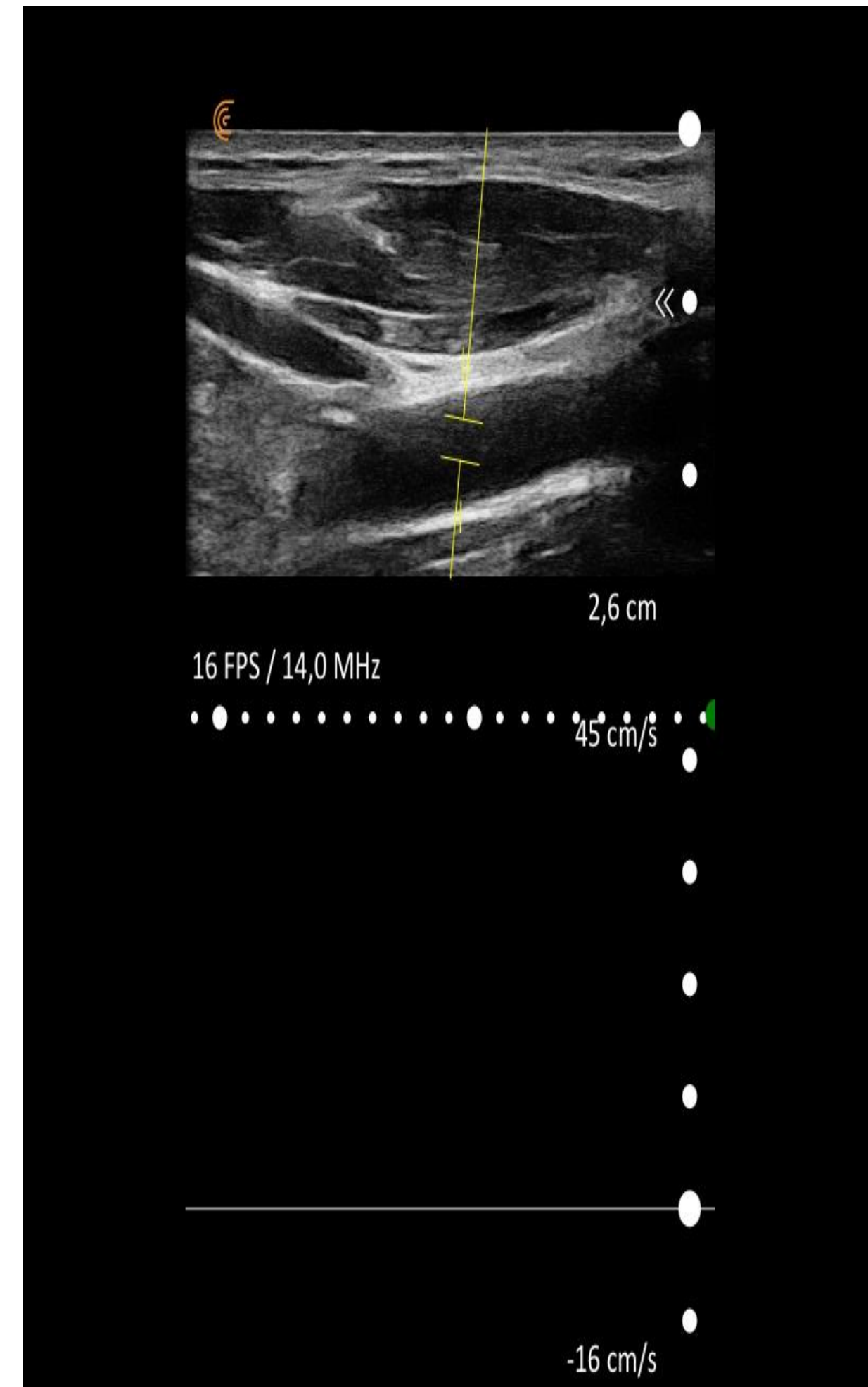
GAIN



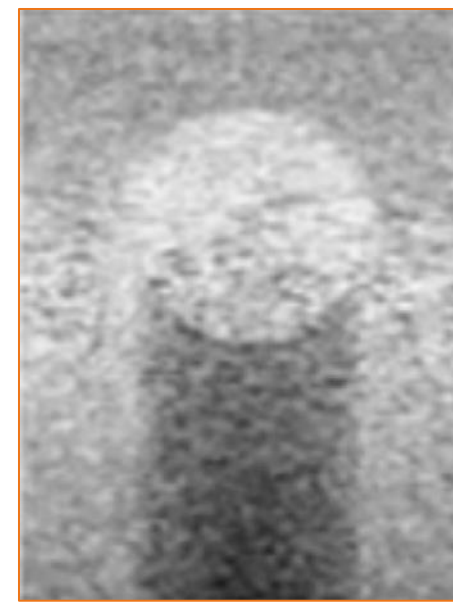
Color Doppler



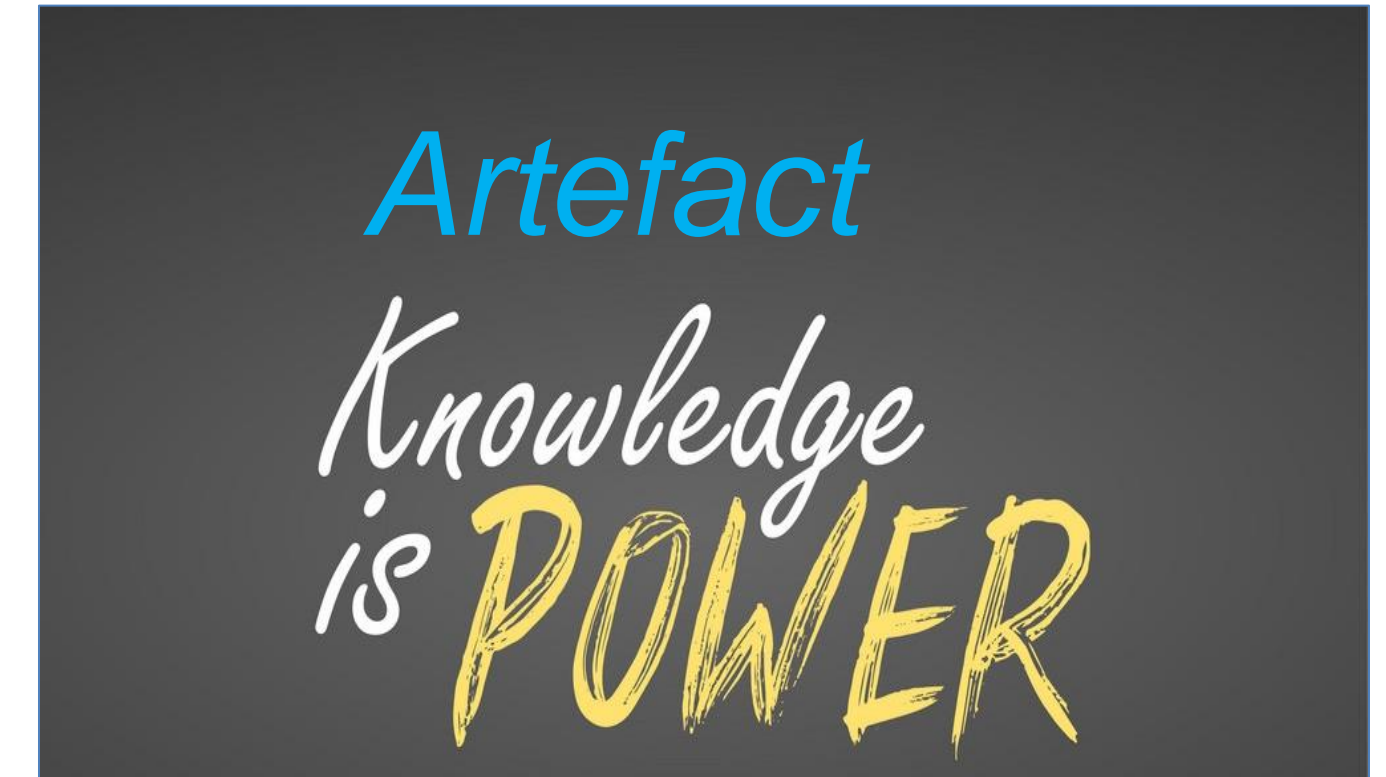
Pulse Wave



Artefacts

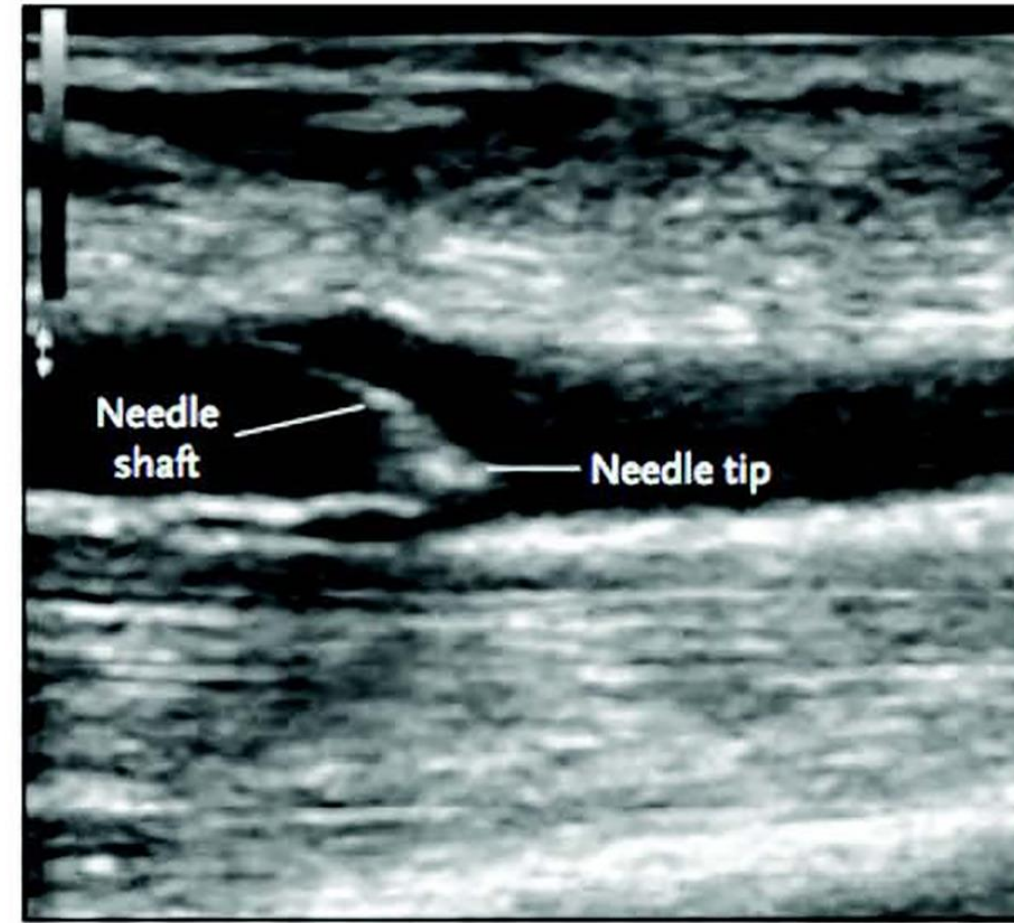
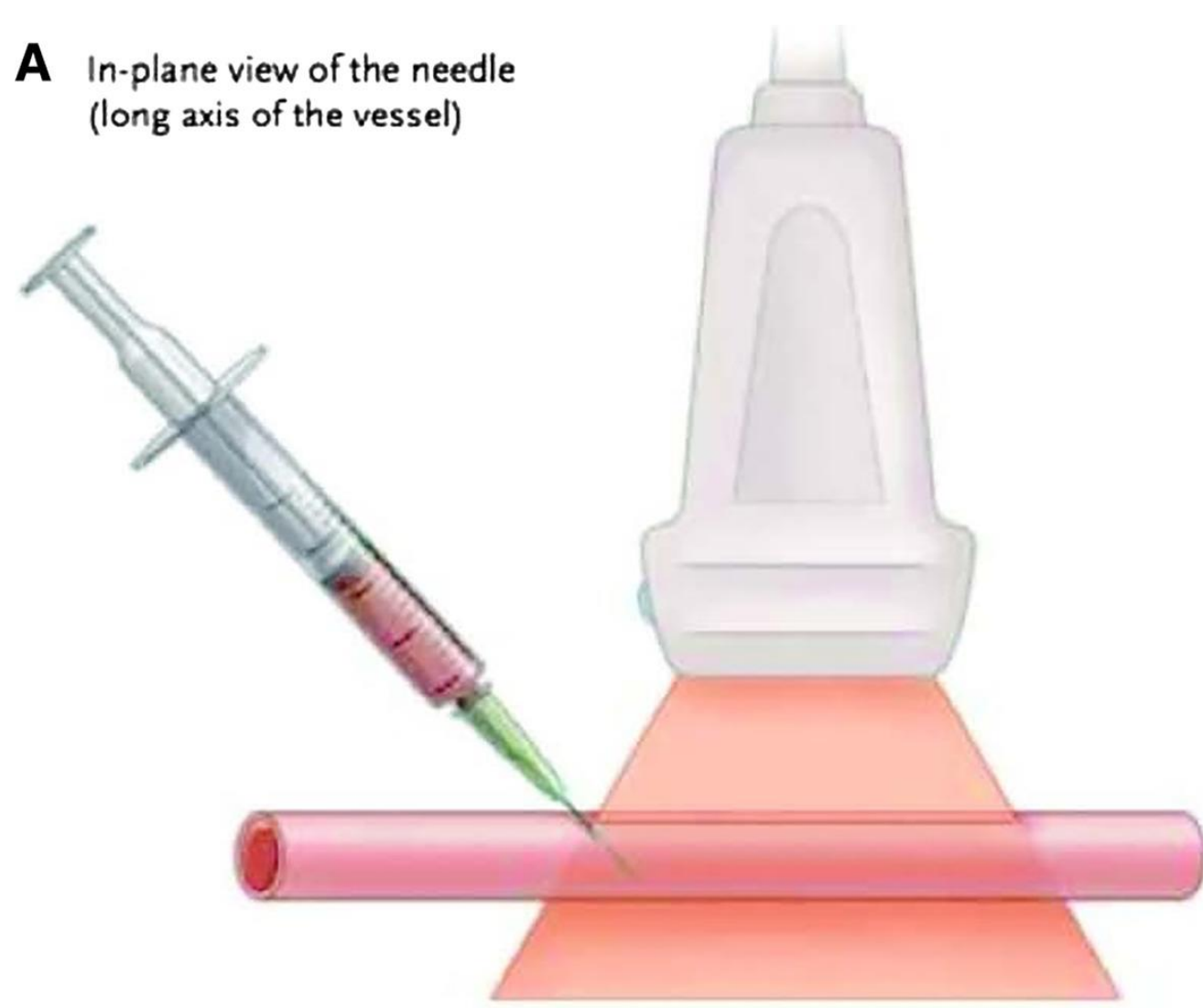


- Acoustic shadowing
- Acoustic enhancement
- Refraction
- Mirror artefact
- Reverberation
- Bundle artefacts (especially side lobe)

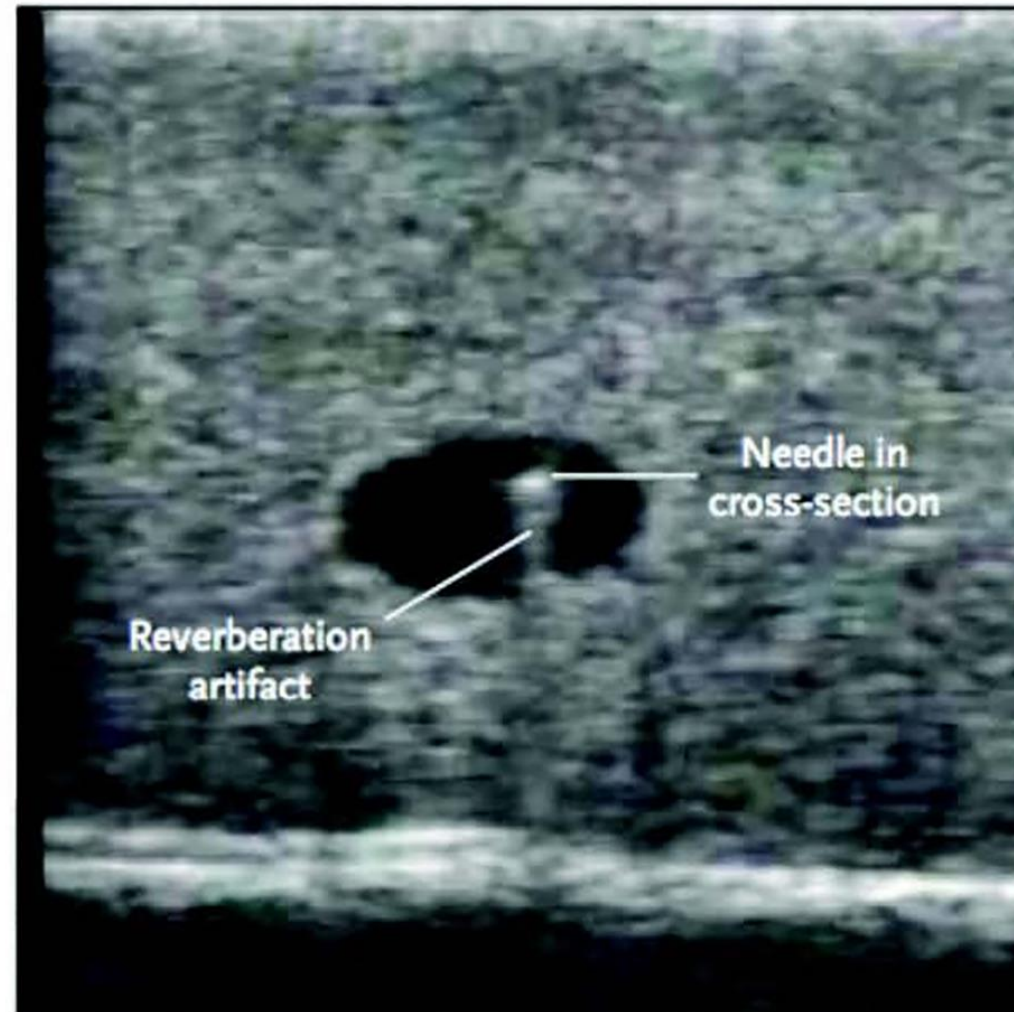
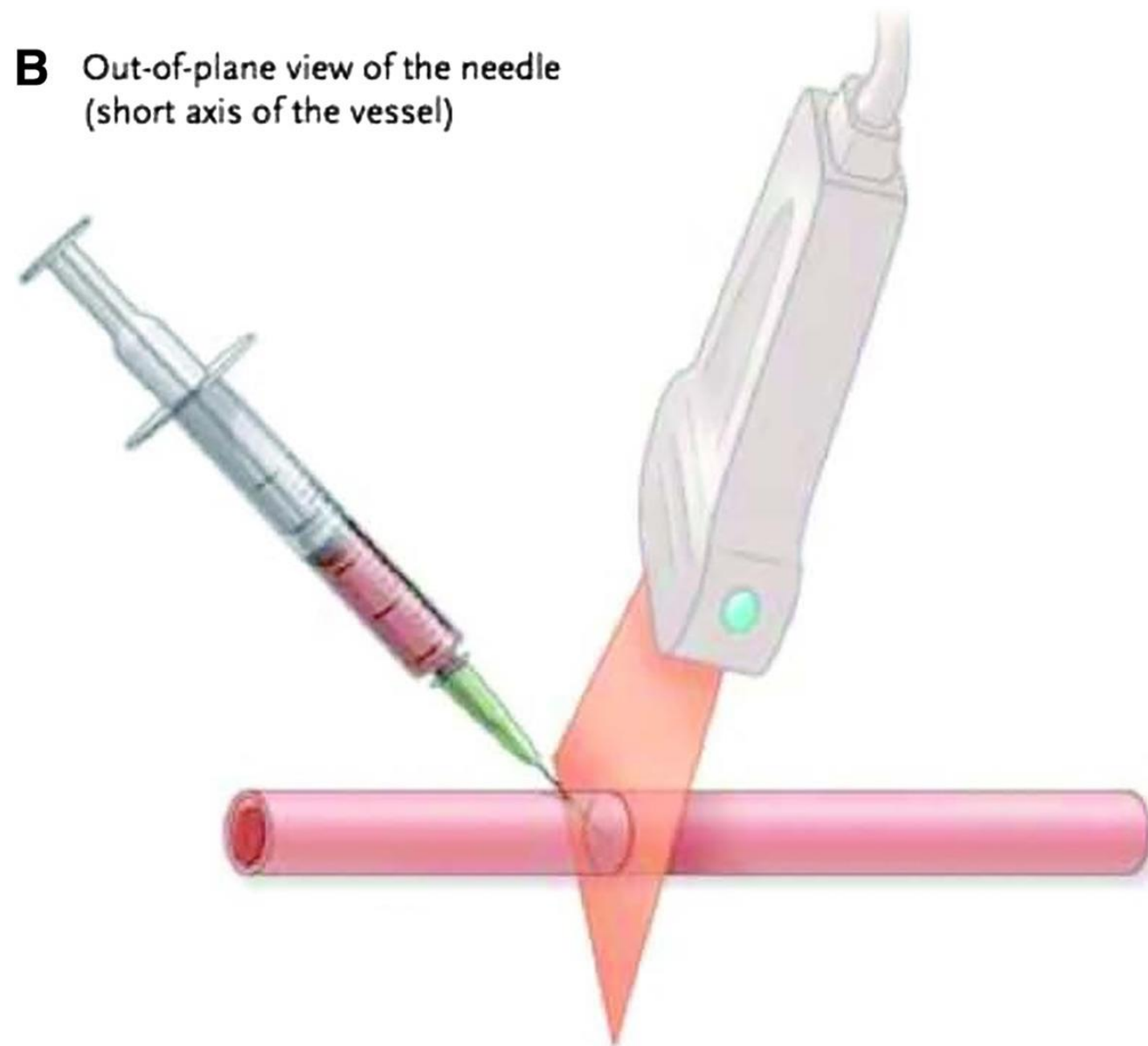


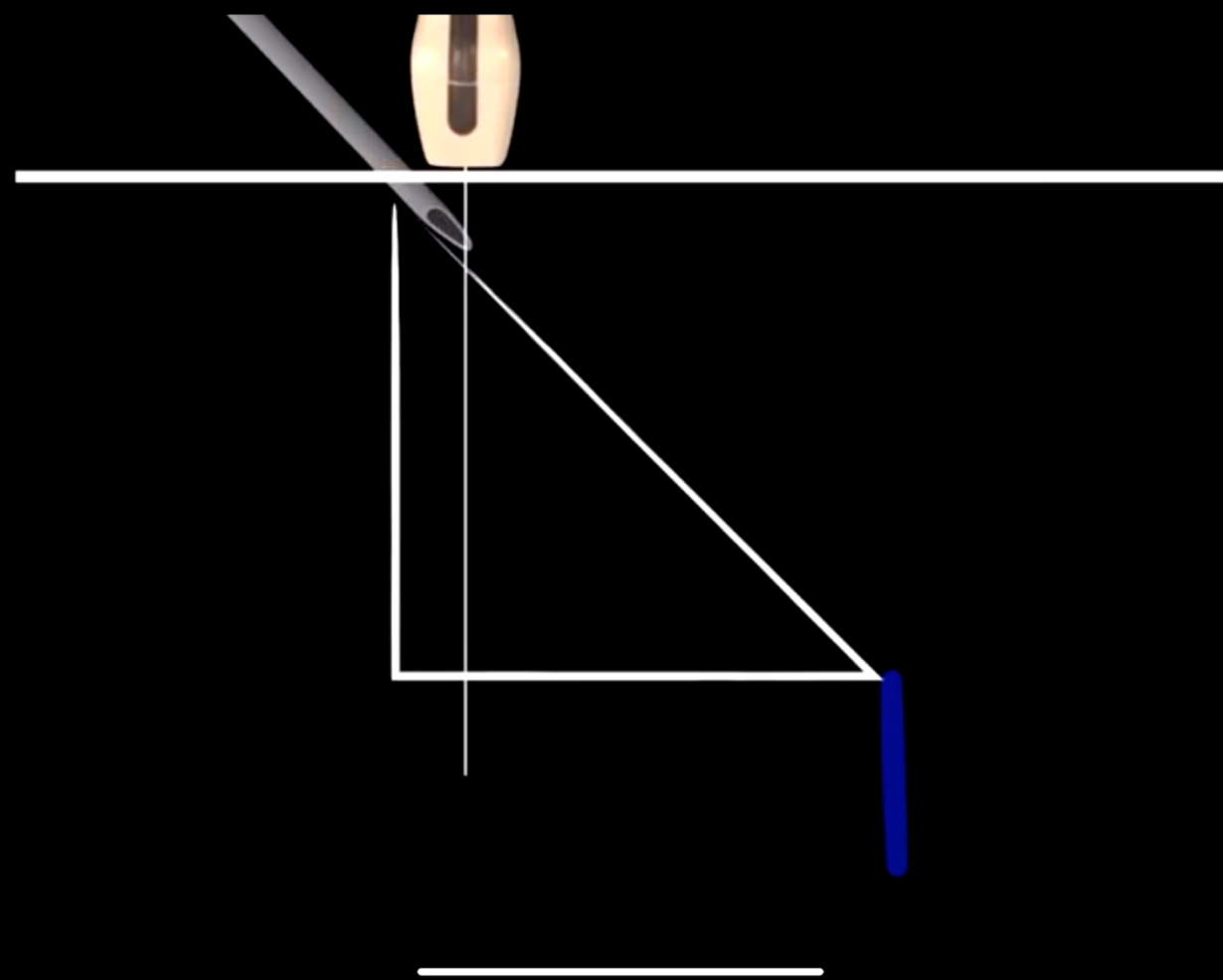
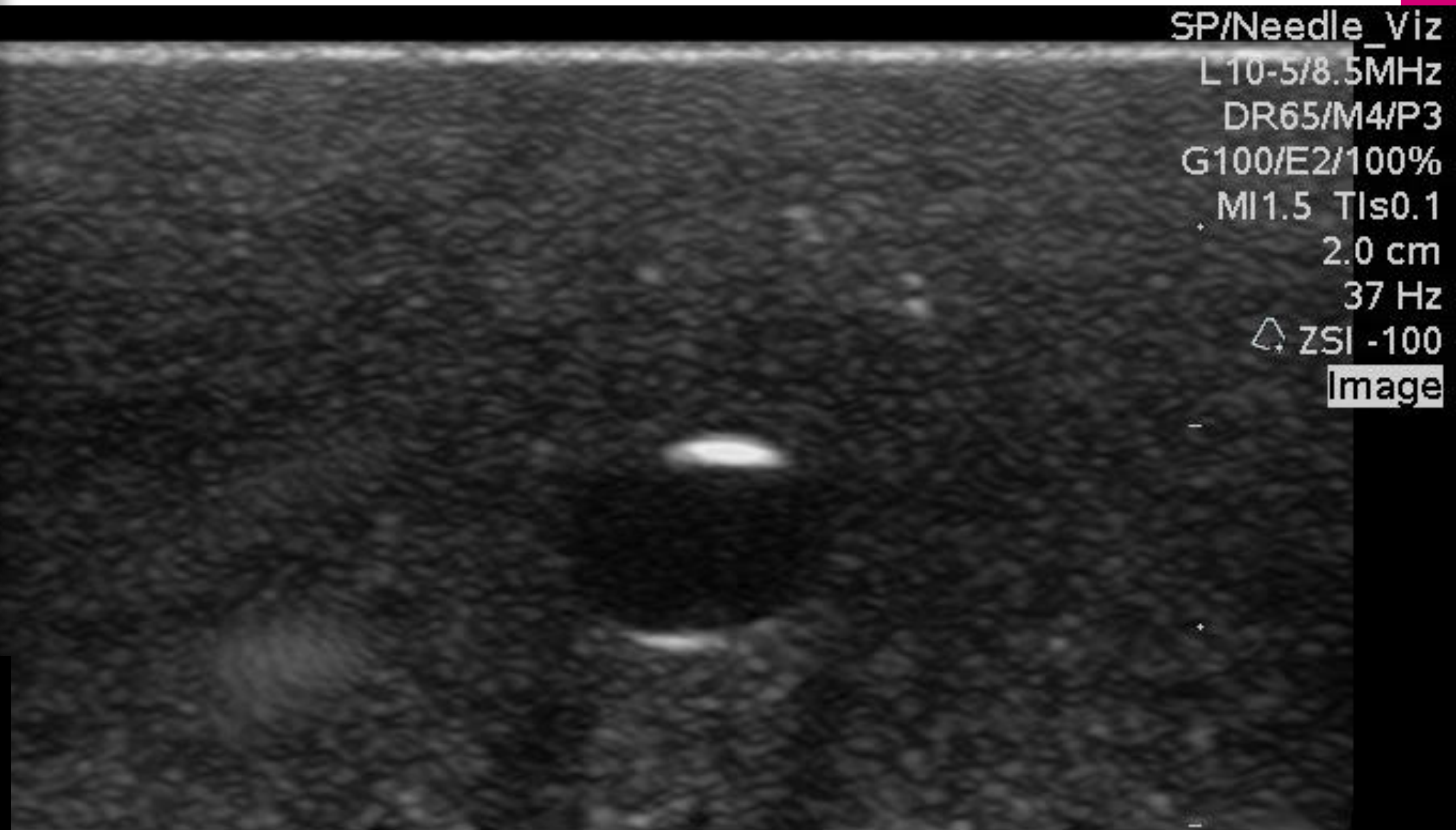
ASSUMPTION IS THE MOTHER OF
ALL FUCK UPS.

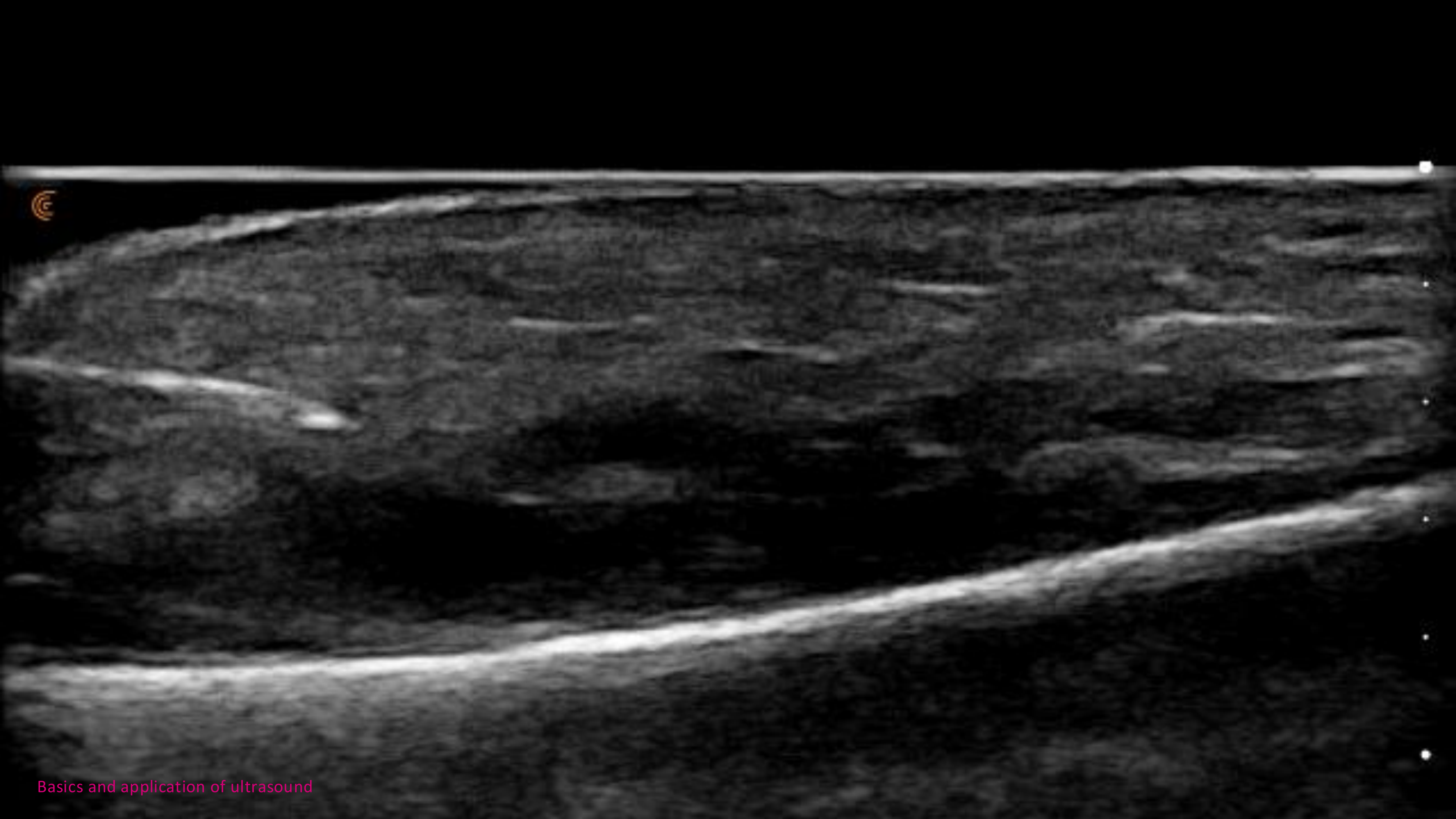
A In-plane view of the needle
(long axis of the vessel)



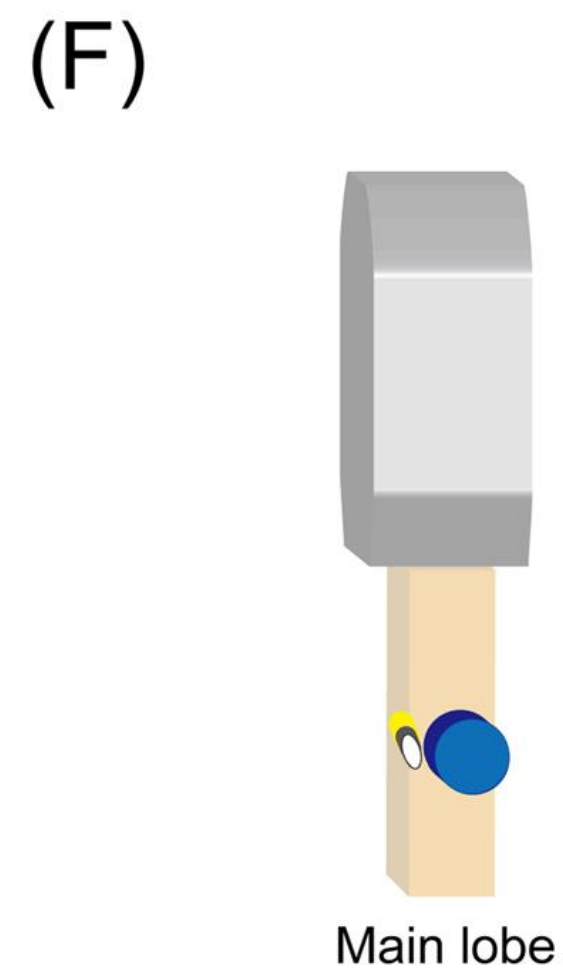
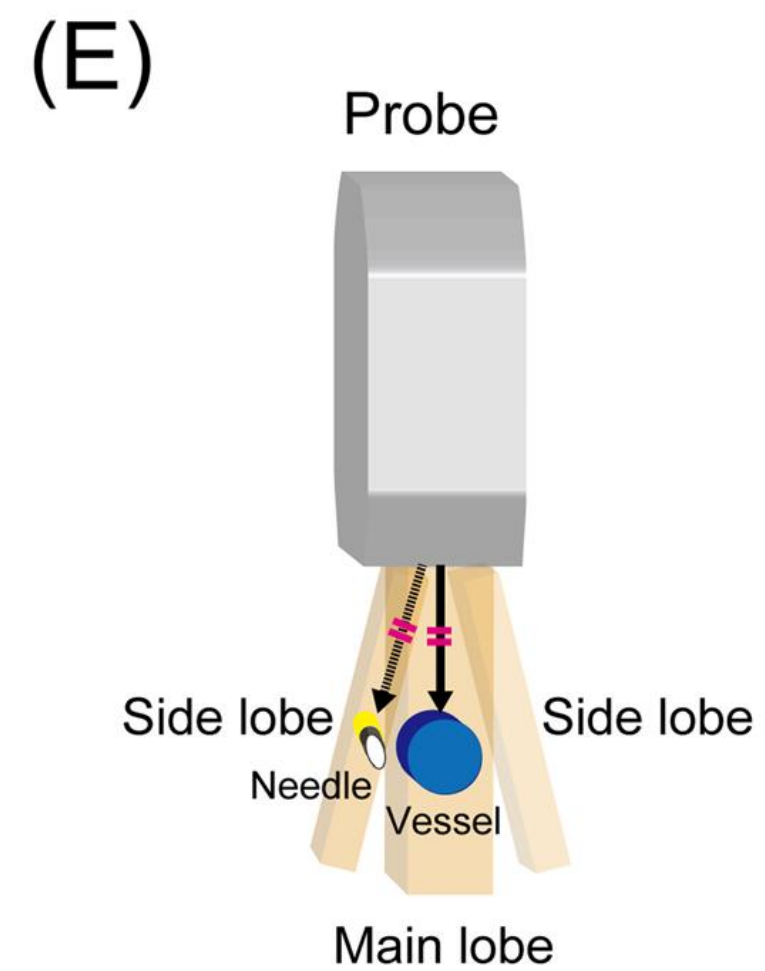
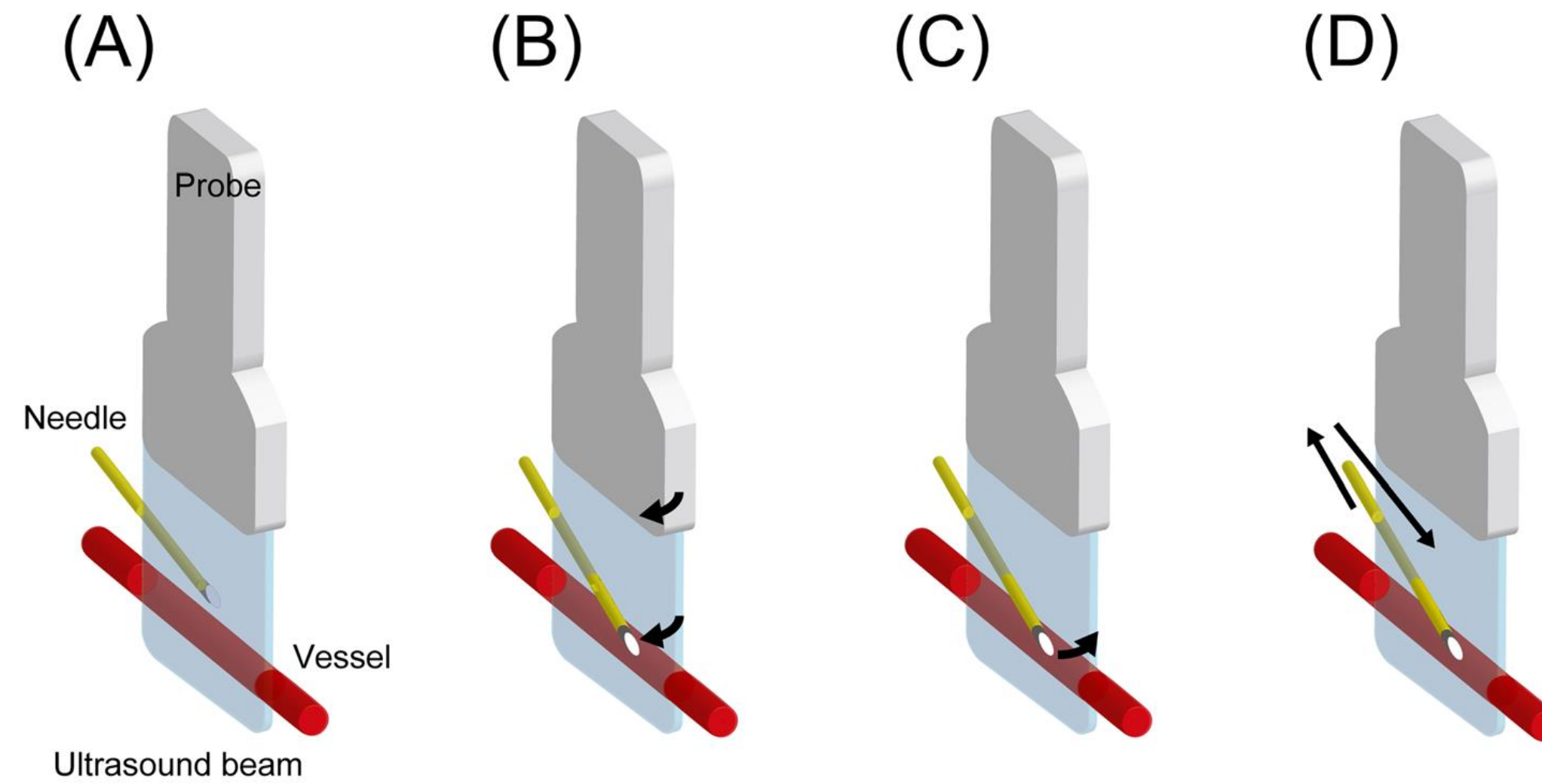
B Out-of-plane view of the needle
(short axis of the vessel)

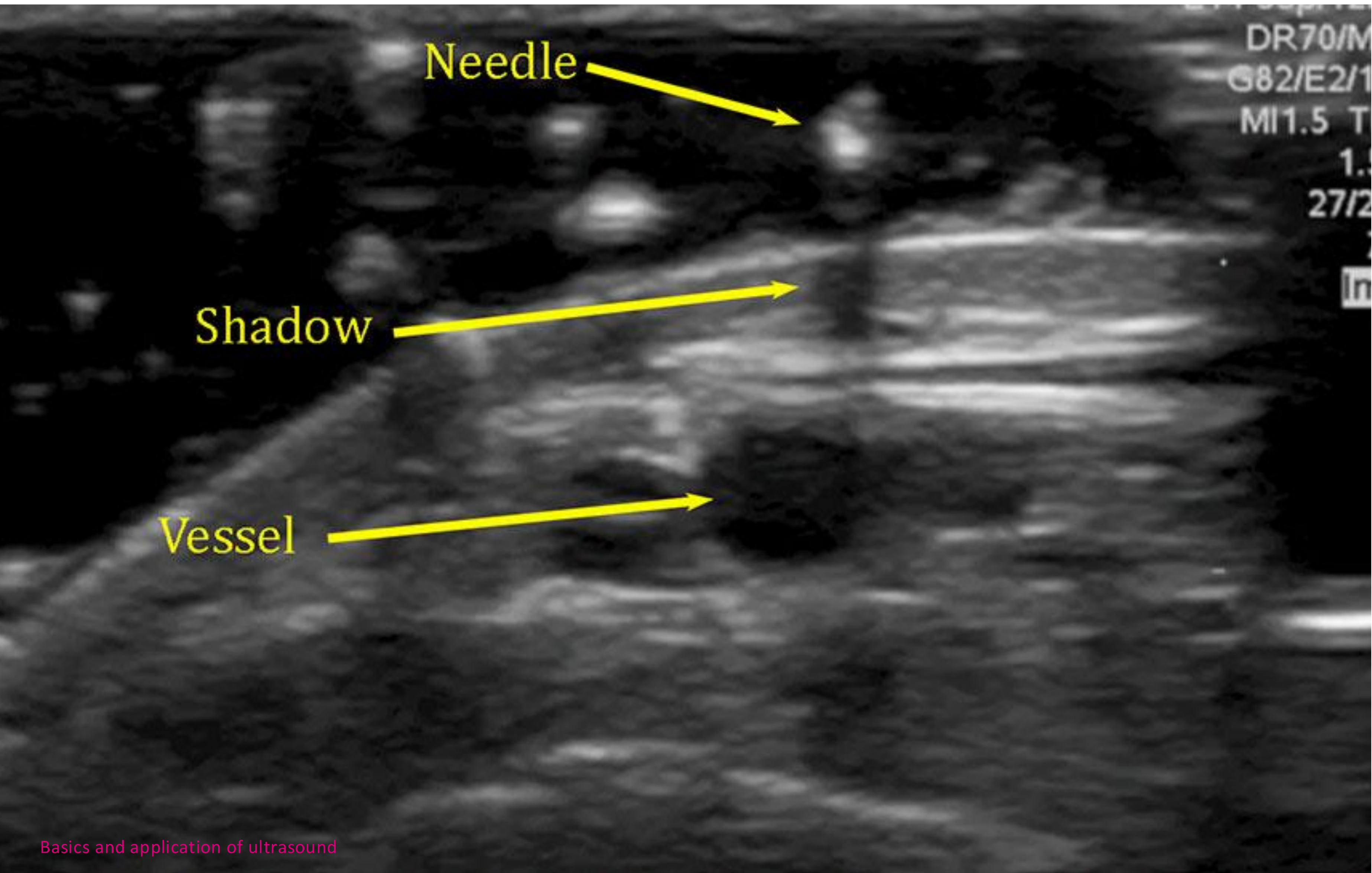












Needle

Shadow

Vessel

DR70/M
S82/E2/1
MI1.5 T
1.
27/2



Take to work messages

Artefact knowledge is POWERRRR!

A physics mindset can help

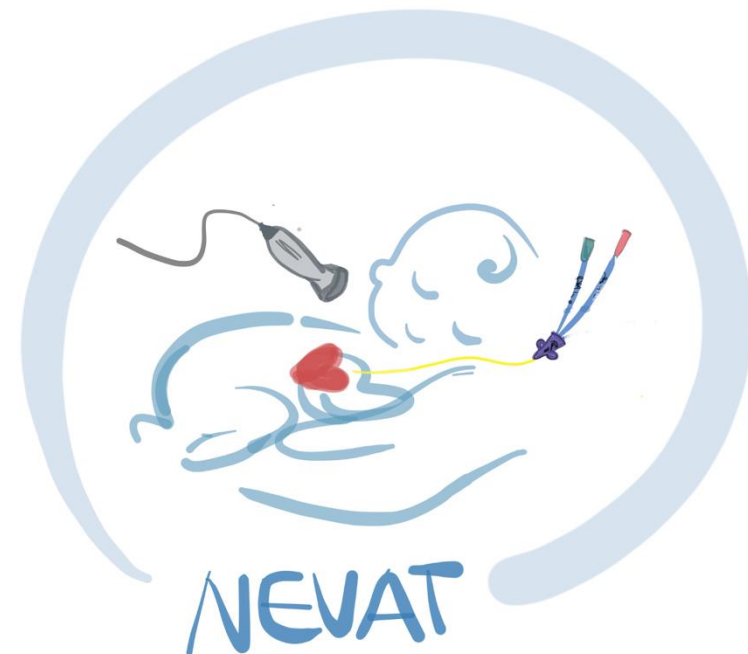
Practice: start big, then go smaller



Thank you



European Society
for Paediatric Research



<https://neonat.org>