Neonatal Cranial ultrasound

Scanning on NICU: technique & normal cranial anatomy

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Where to start?

- Assessment & understanding of the:
  - Clinical examination
  - Scanning environment & patient presentation
  - Intracranial anatomy & ultrasound appearances
  - How to perform the scan

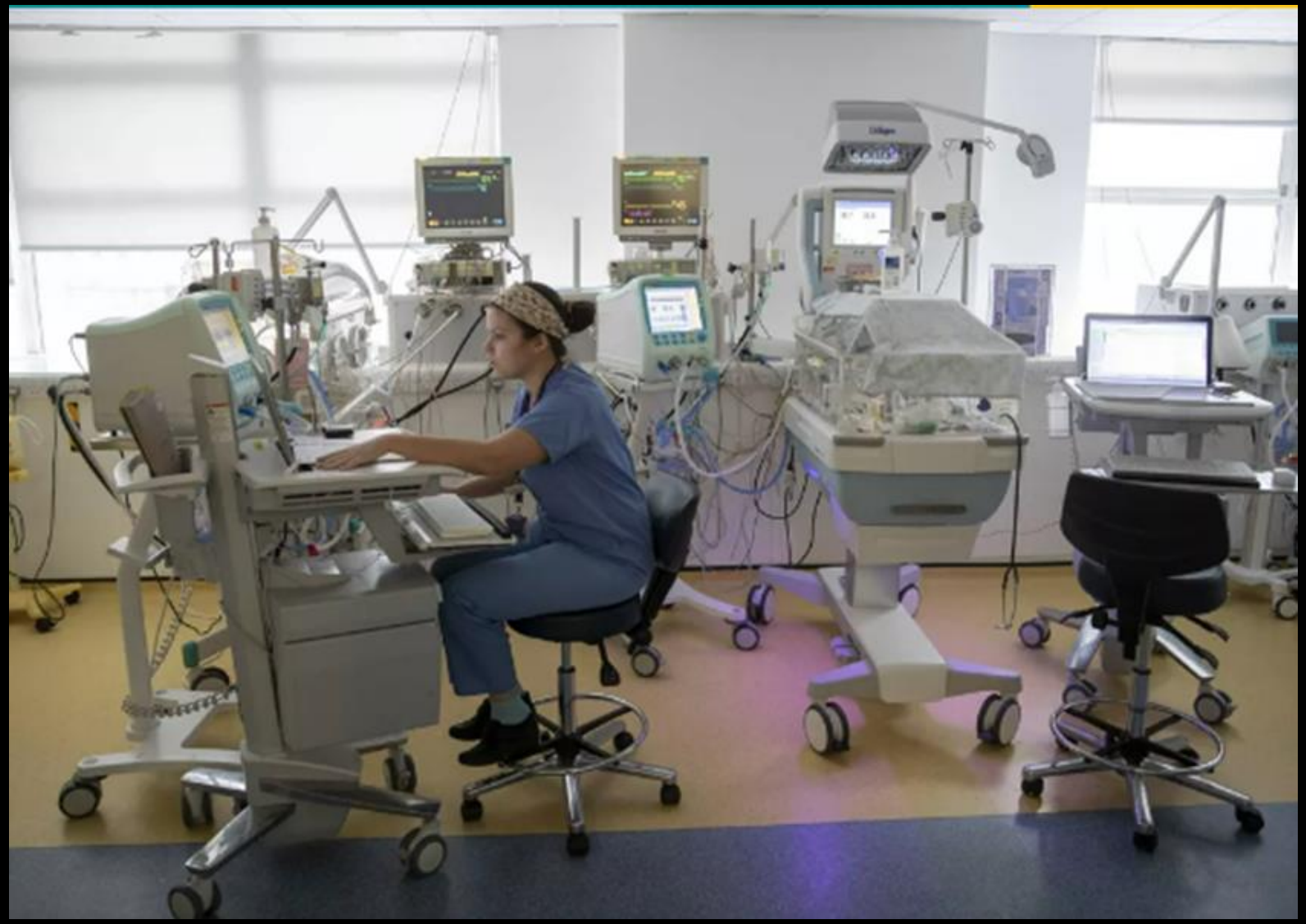
Overview

- Cranial ultrasound is an integral part of the assessment of neonates
  - Safe & easily performed with the ability to obtain high quality images of the brain
  - Scans can be used to evaluate normal brain anatomy, maturation and the evolution of pathology
  - Easily repeatable allowing for serial monitoring
  - Portable: Performed at the bedside in the Neonatal intensive care unit (NICU)

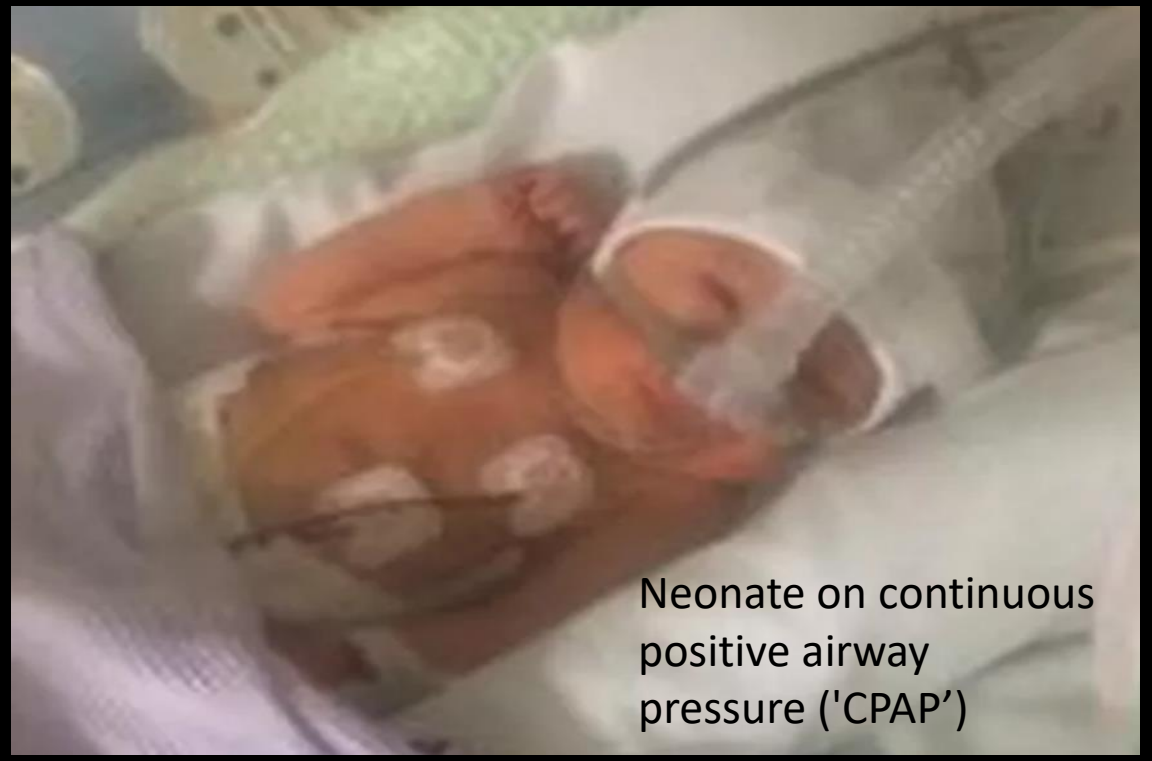
Clinical indications

- Prematurity (< 37 weeks)
- Hypoxic event
- Increased head circumference
- Persisting large fontanelle
- Craniosynostosis (premature closure of sutures)
- Trauma
- Follow up of a known pathology: Hydrocephalus & Intraventricular Haemorrhage
- Failure to thrive
- Suspected intracranial mass or infection

Assessment & understanding: Scanning Environment



Assessment & understanding: Scanning Environment



Assessment & understanding: Scanning Environment

- Infection control:
  - Gown & Gloves
  - Good handwashing & sanitisation
  - Cleaning of equipment: before & after the examination
  - Isolated unit/neonate

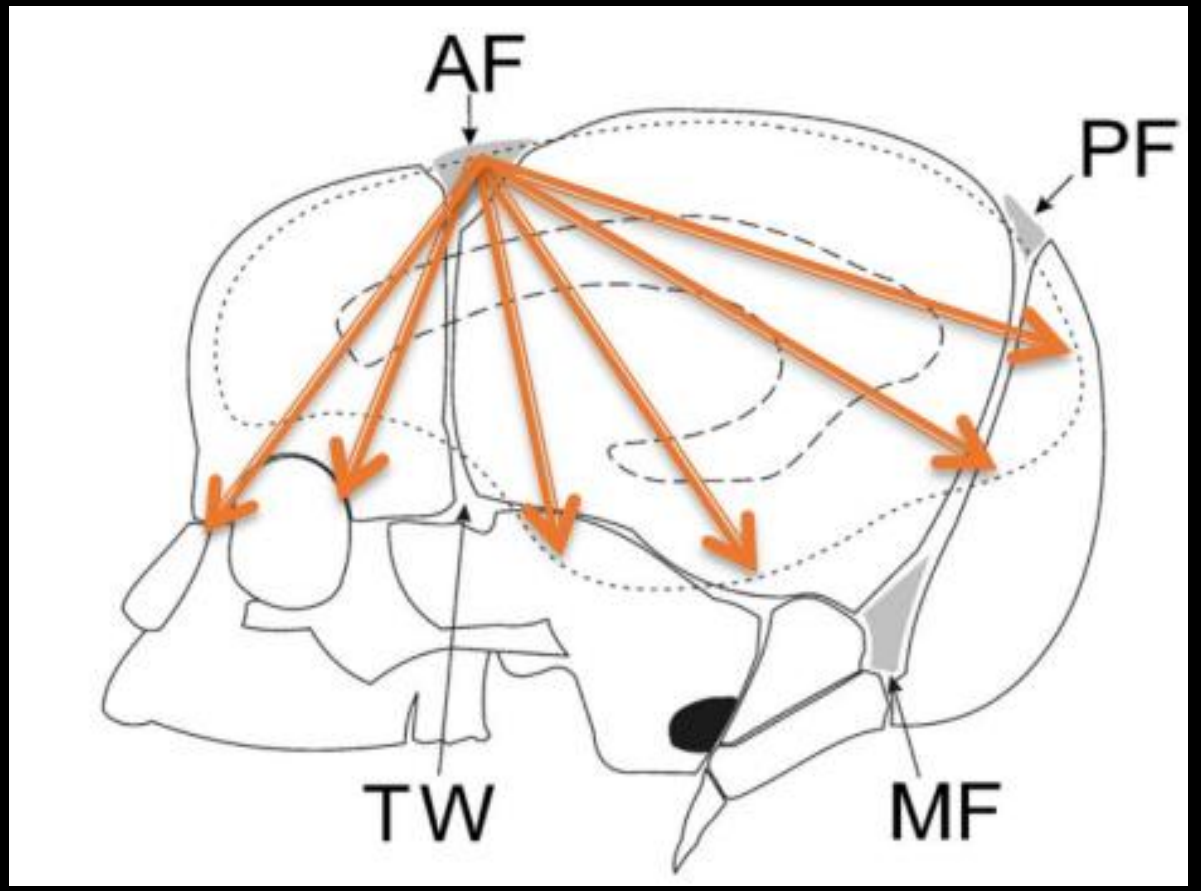
Assessment & understanding: Intracranial appearances

- Normal brain anatomy
- Brain maturity
- Parenchymal echotexture
- Ventricular diameter
- Vessel patency
- Extra-axial structures / fluid

Scan technique: Acoustic Windows

The main window used is the anterior fontanelle and supplementary windows include the posterior fontanelle, temporal window and mastoid windows.

Coronal and sagittal imaging should be performed.



AF - Anterior Fontanelle PF - Posterior Fontanelle
TW - Temporal Window MF - Mastoid Fontanelle

Coronal planes

1 - Level of frontal lobes

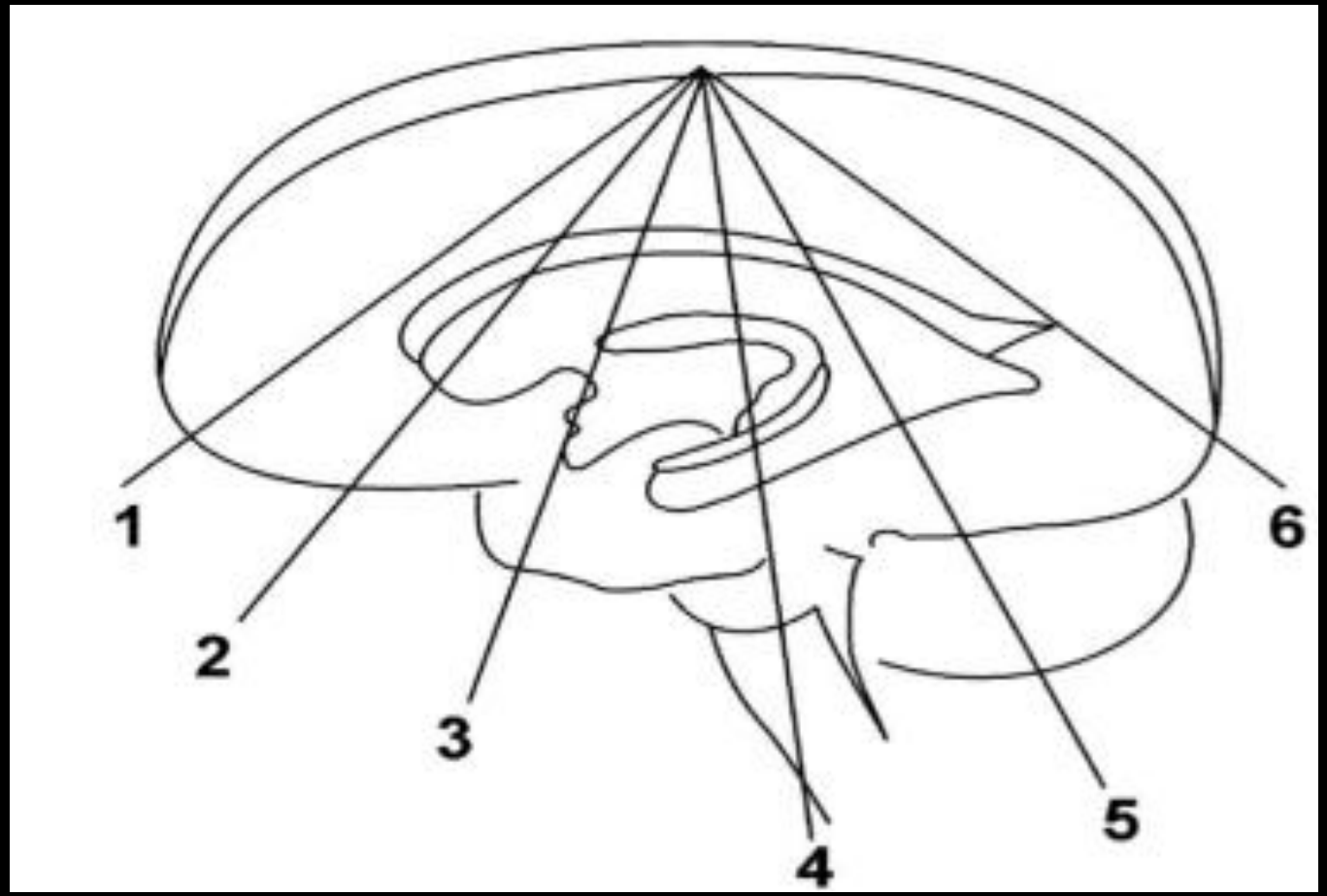
2 - Level of frontal horns of lateral ventricles

3 - Level of foramen of monro and 3rd ventricle

4 - Level of bodies of lateral venticles

5 - Level of trigone of lateral ventricles

6 - Level of parieto-occipital lobes

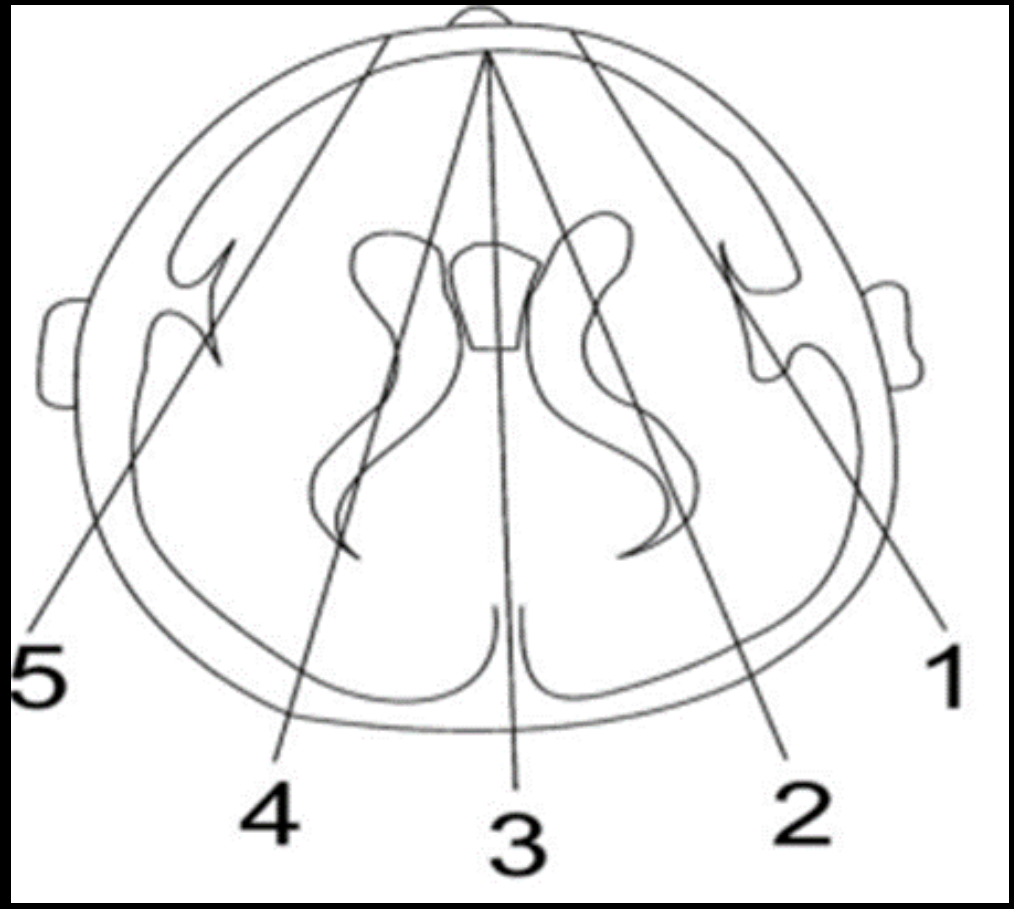


Sagittal Planes

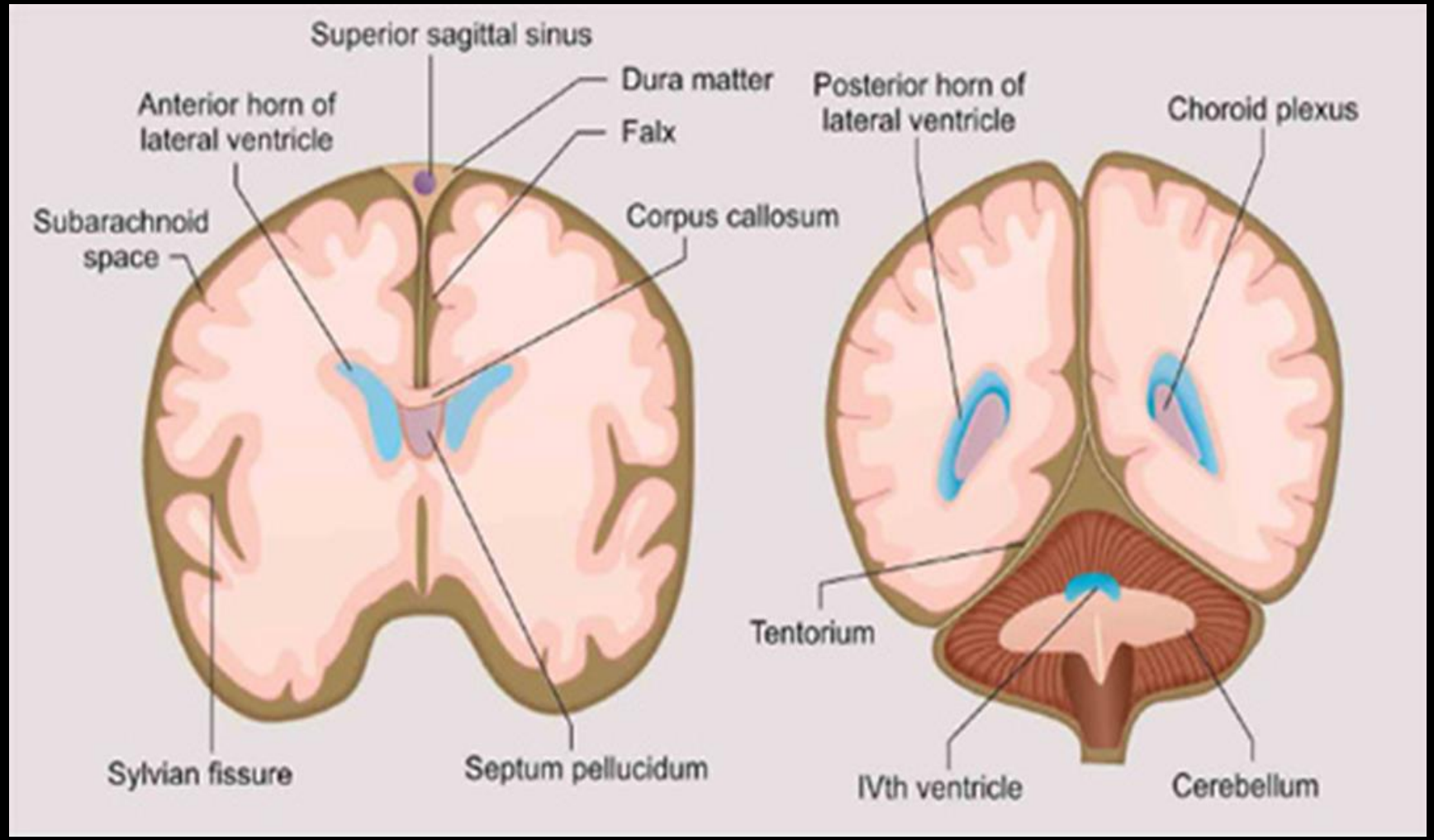
1 & 5 - Temporal / lateral lobes

2 & 4 - Right and left ventricles

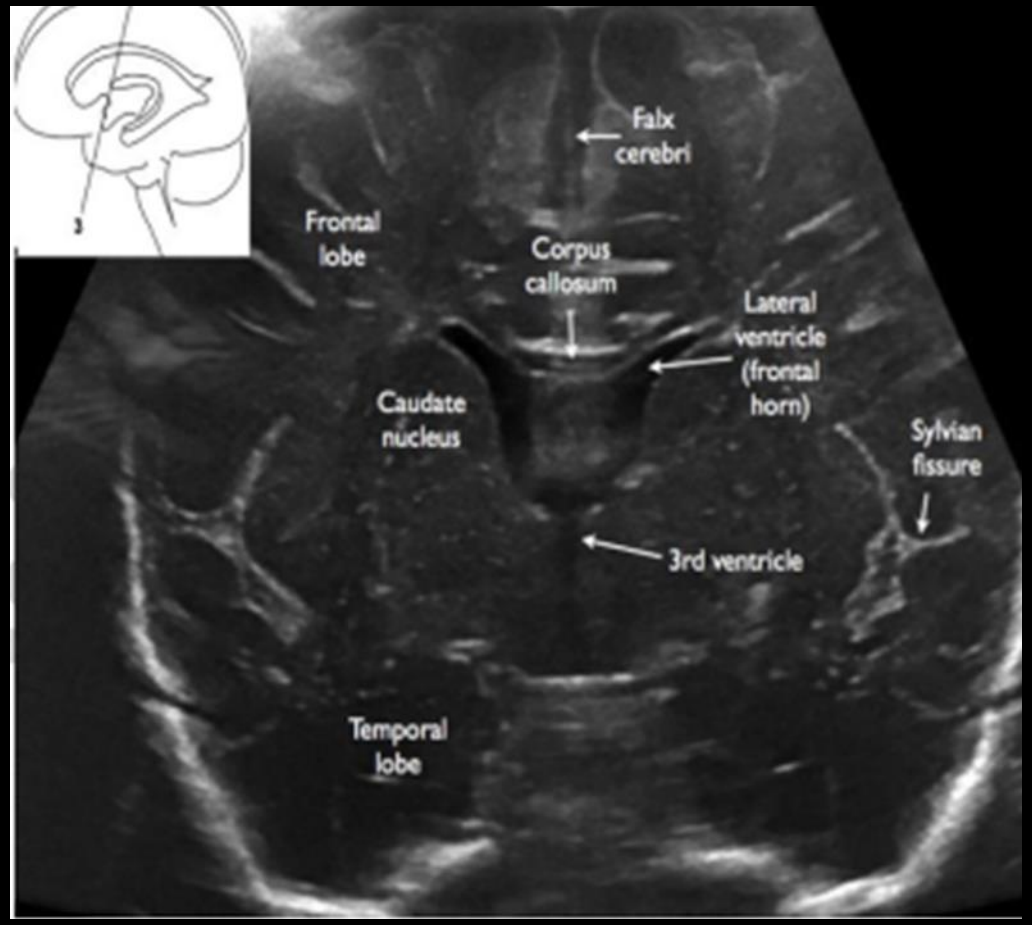
3 - Midline / 3rd and 4th ventricle

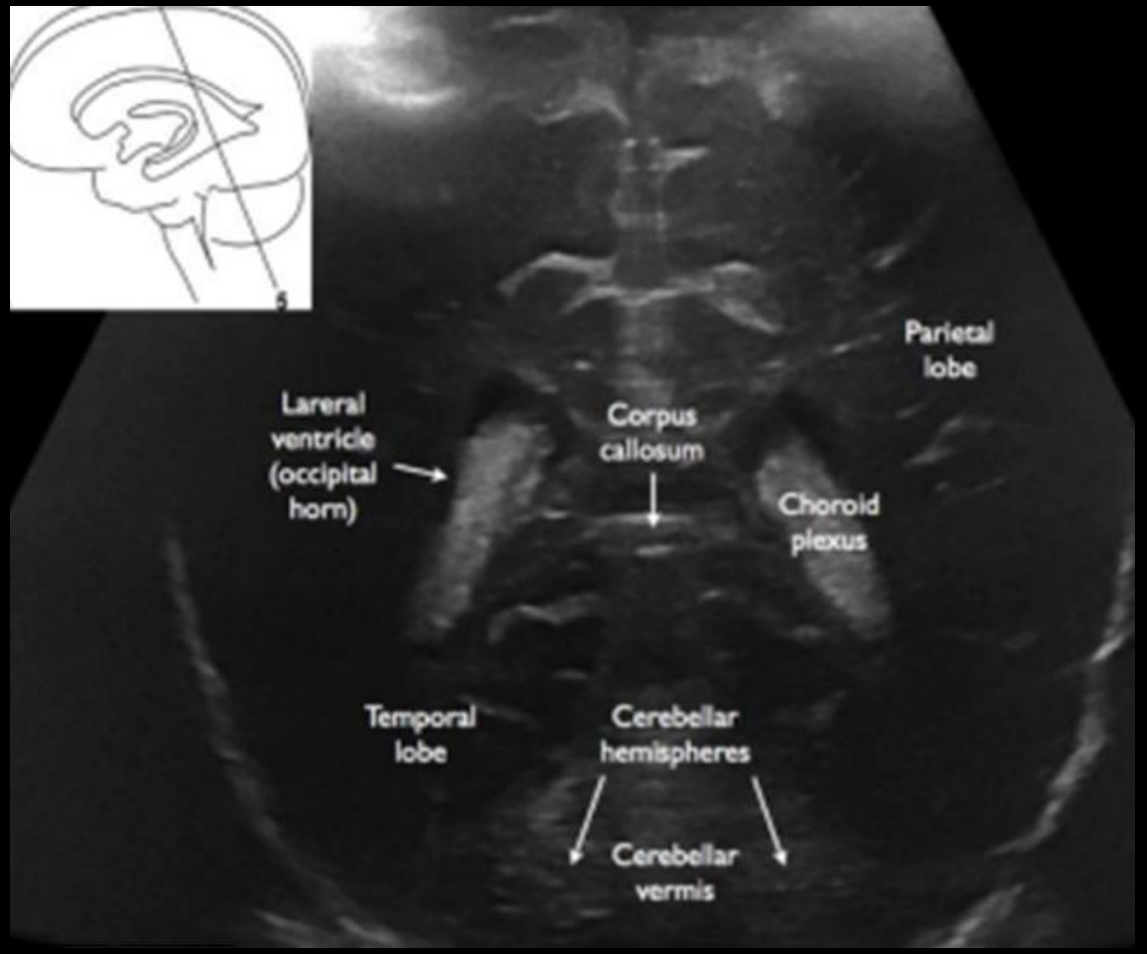


Intracranial anatomy: Coronal section

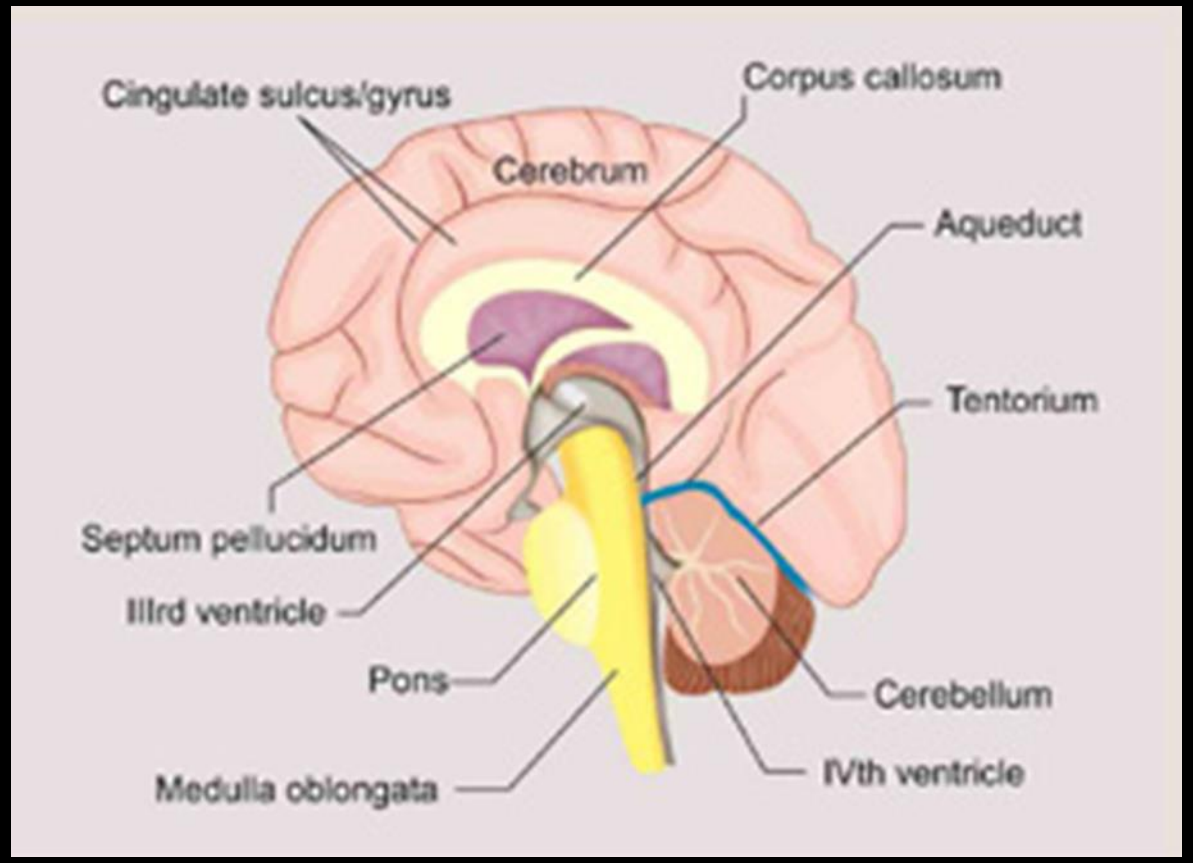


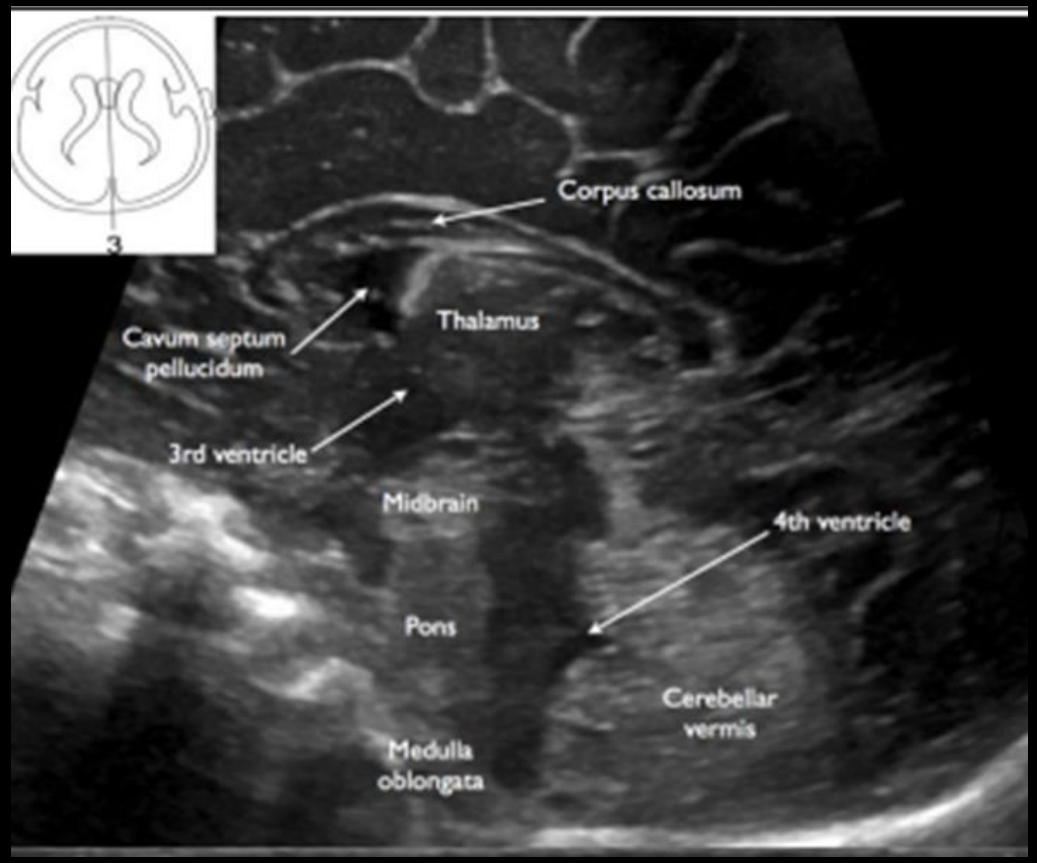
Intracranial anatomy: Coronal section



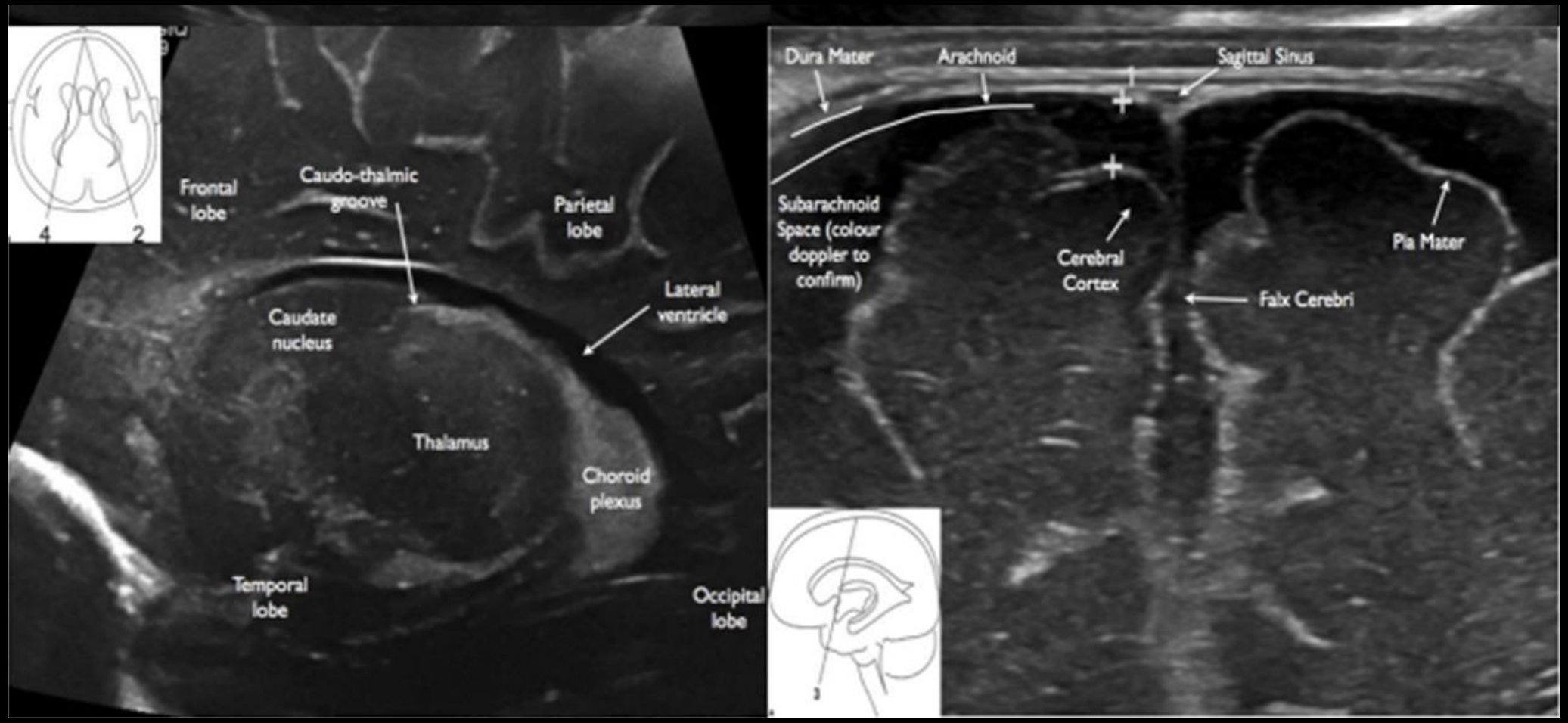


Intracranial anatomy: Sagittal section





Intracranial anatomy:



Equipment:

- B-mode imaging with Colour Doppler
- +/- Pulsed wave Doppler
- The appropriate pre-set needs to be selected:
  - Depth
  - TGC Overall gain
  - Sector width & Focus
- Thermal index (TI): ALARA principle.

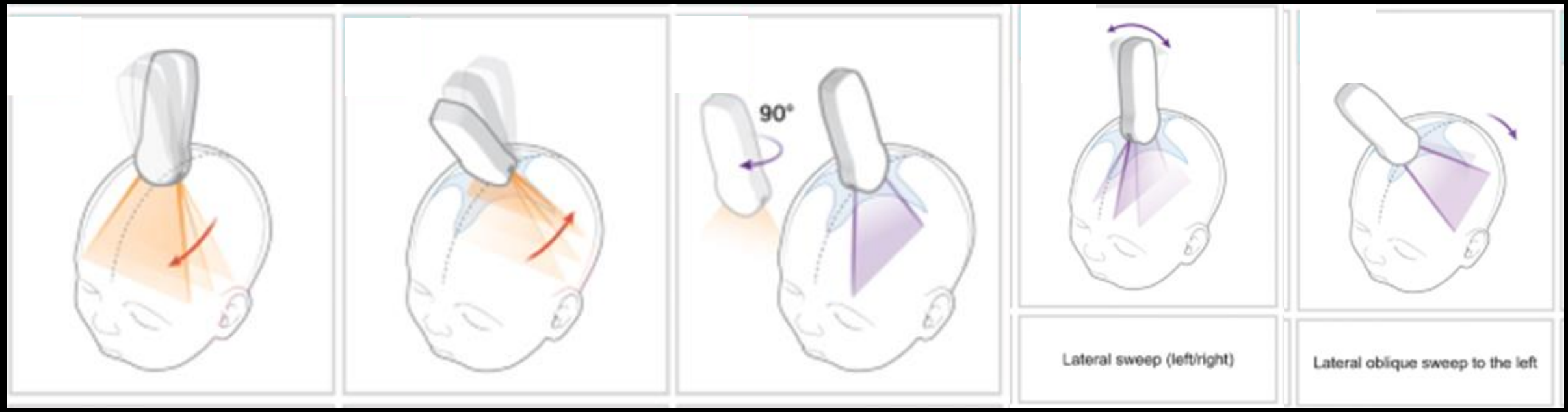
C12-3MHz

L12-5 or 18-4MHz

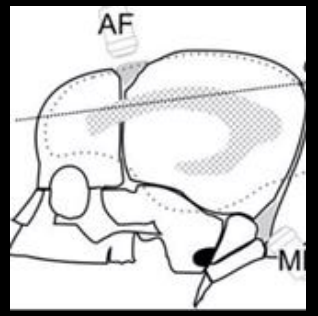
How to perform the scan:

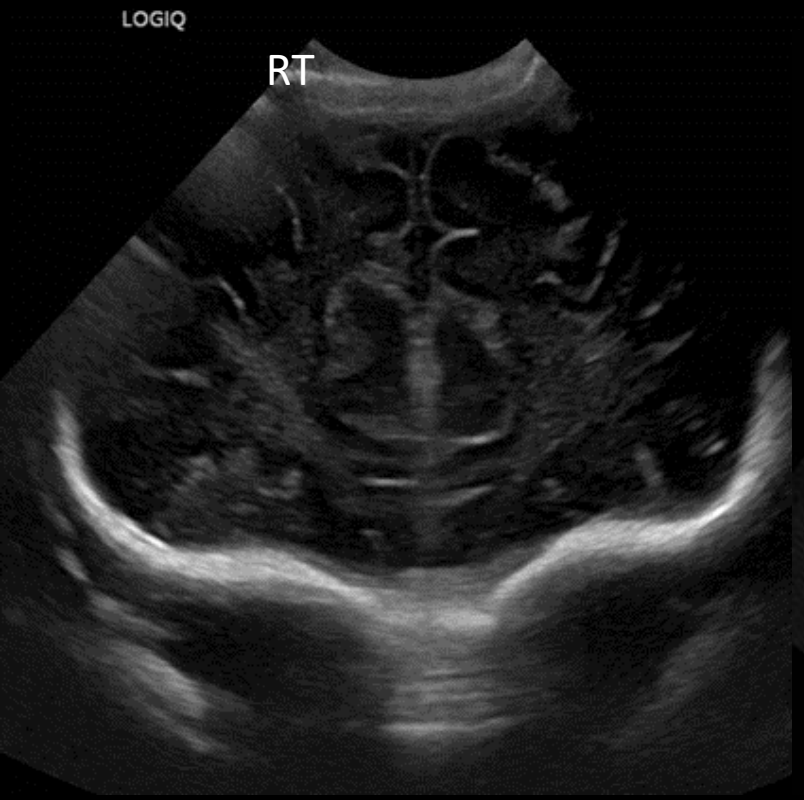
- Sterile gel to ensure contact but minimize pressure
- Slow methodical sweep anterior-posterior.
- Obtain a series of images in a coronal and sagittal planes

How to perform the scan:

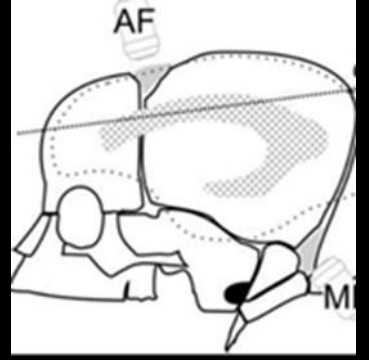


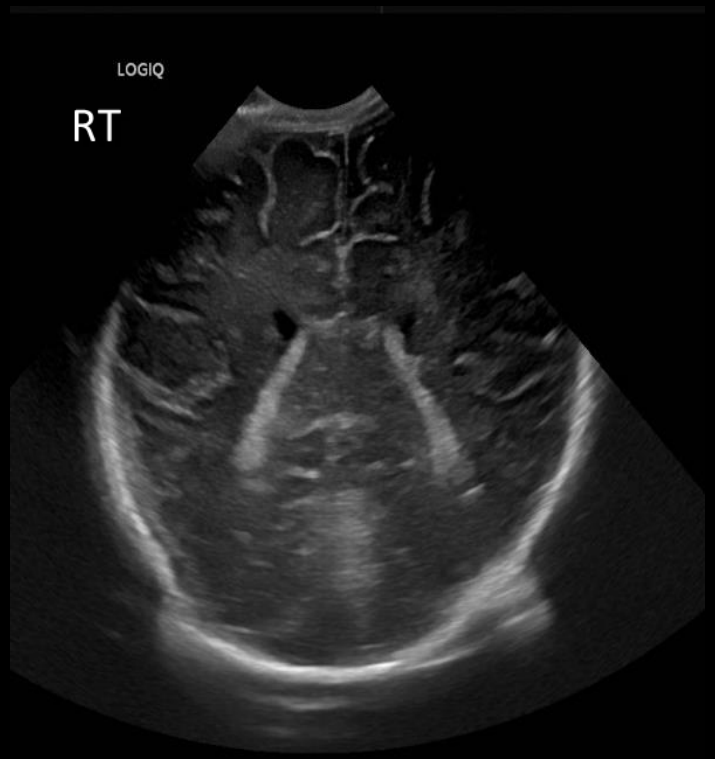
Cranial ultrasound technique: Coronal sections

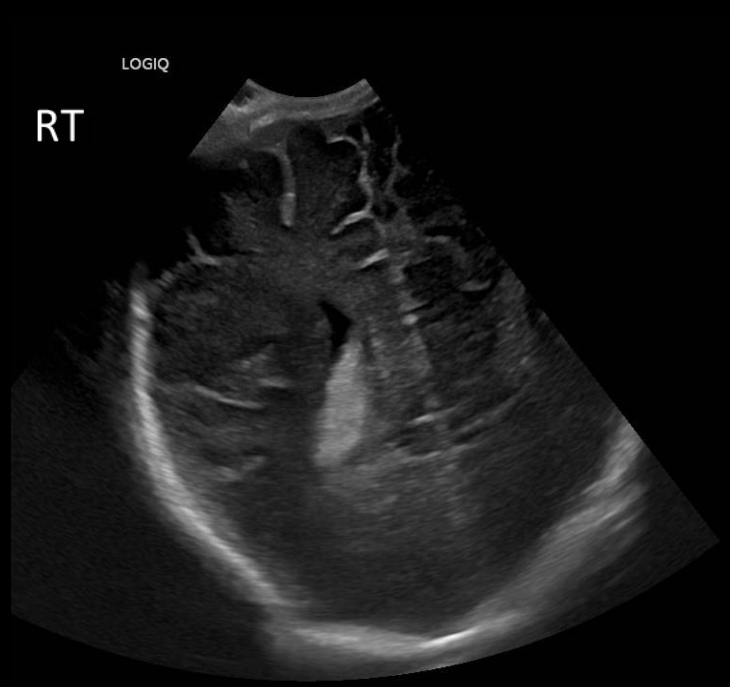


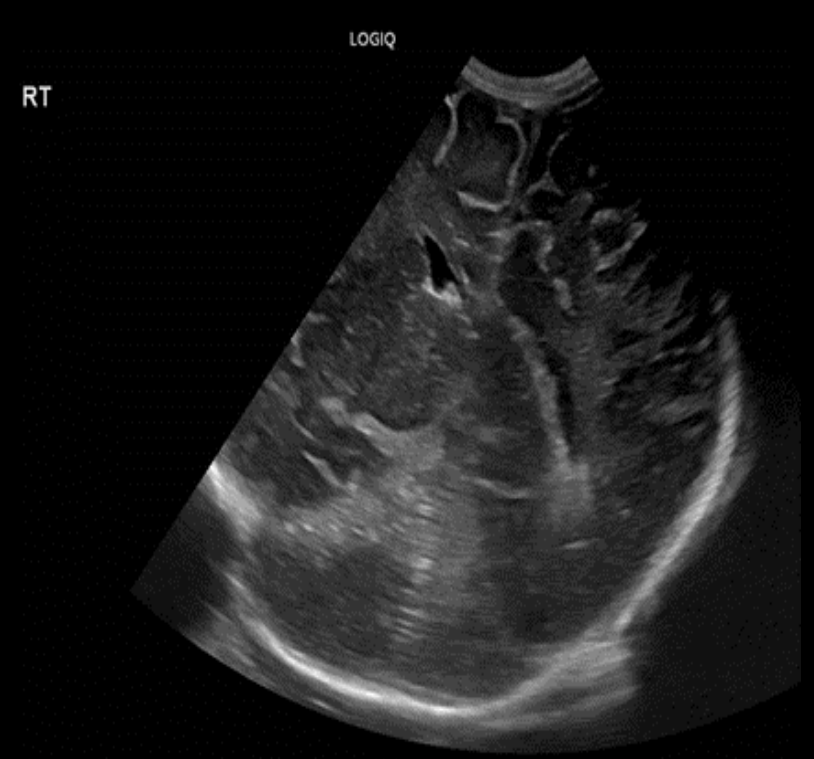


Cranial ultrasound technique: Coronal sections



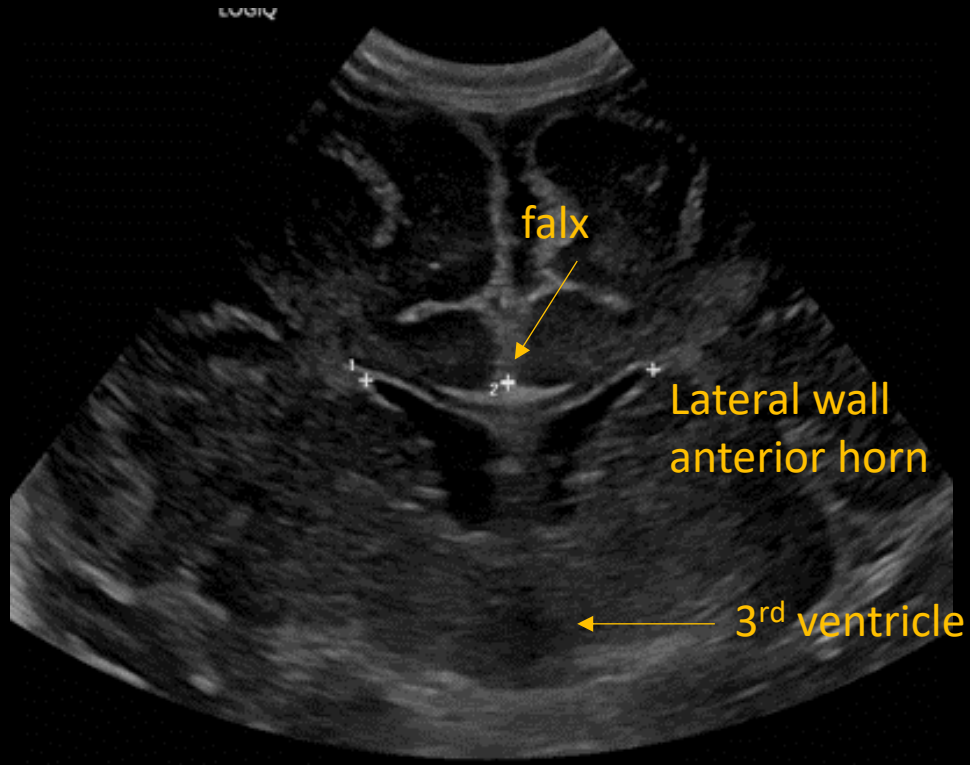






Ventricular measurements

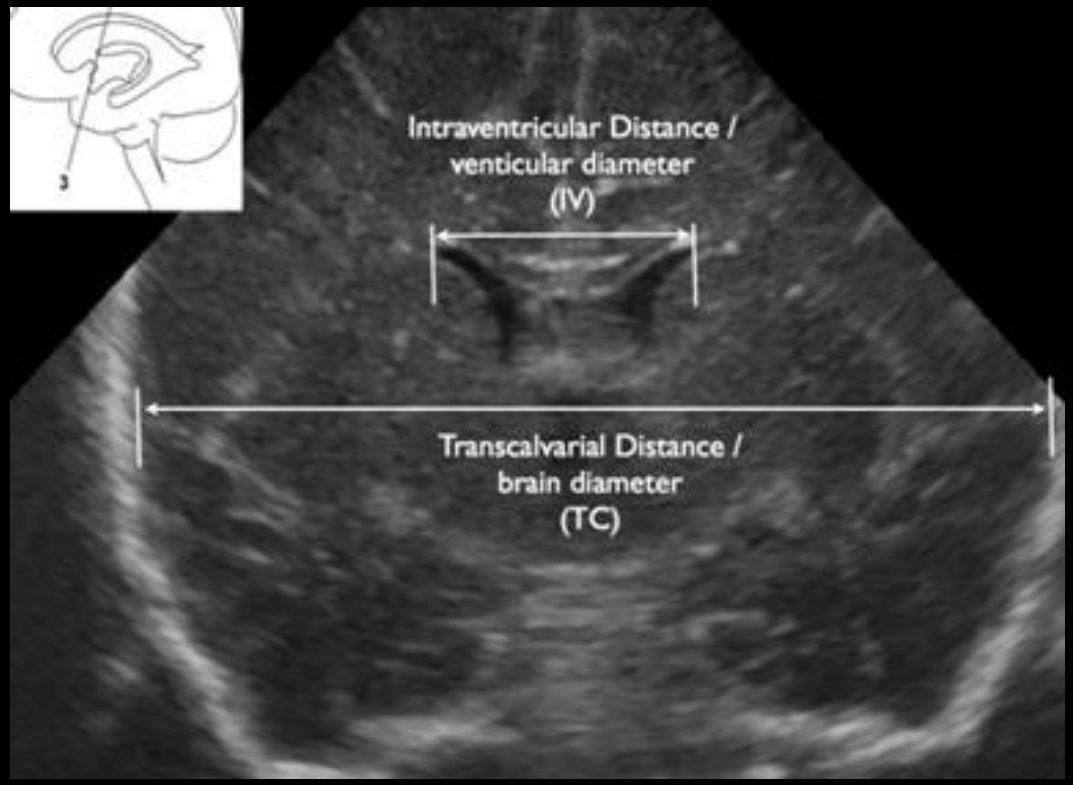
- Levene index is the distance between the falx and the lateral wall of the anterior horn of the ventricle
- It is used to assess for ventricular dilatation up to 40 weeks gestation
- Measurements are performed on a coronal image at the level of the 3rd ventricle
- Change or degree of asymmetry or ventriculomegaly
- Measurements can be assessed on follow up scans.
- Premature baby a standard VI 10mm



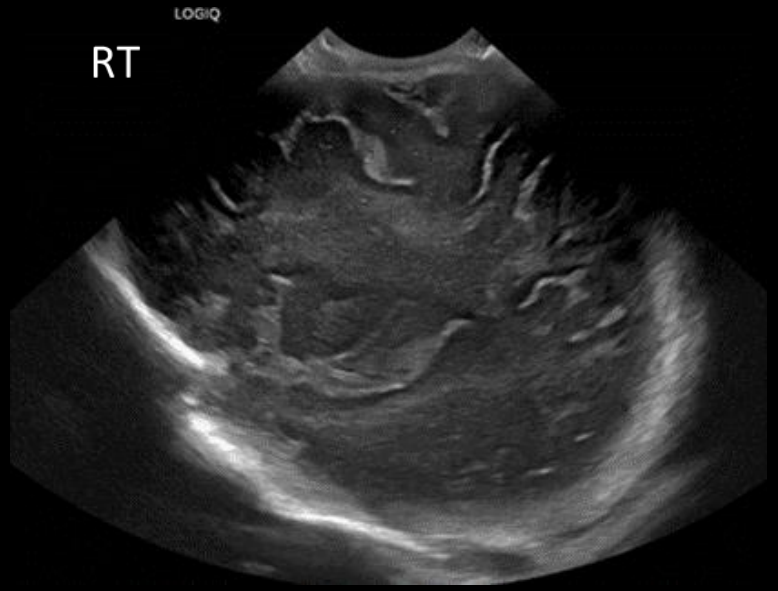
Ventricular measurements

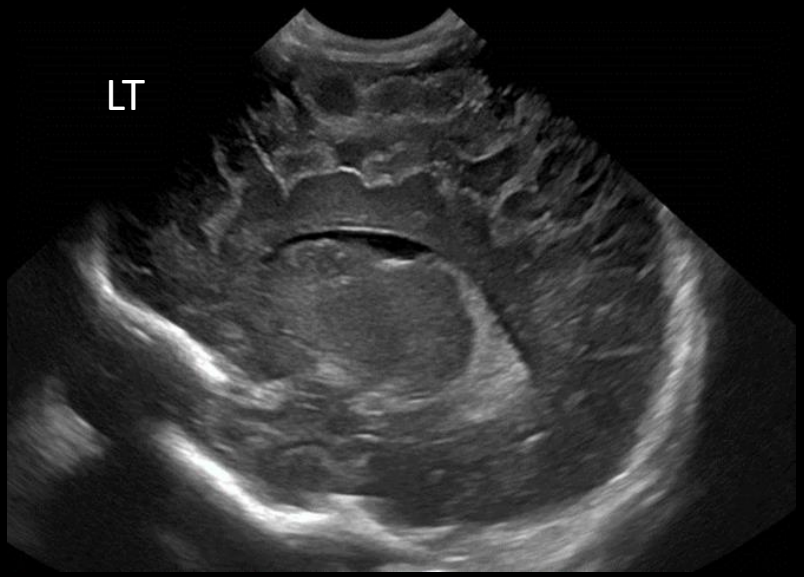
Ventricular hemispheric ratio:

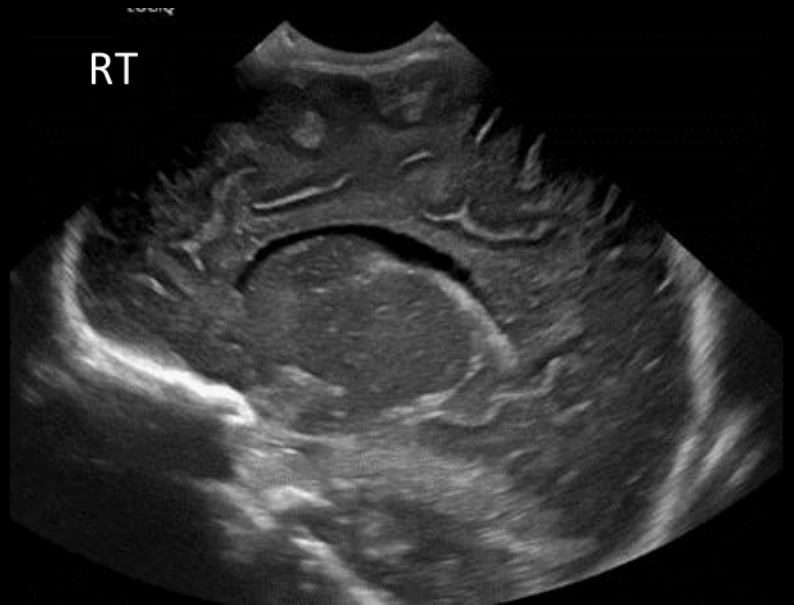
- Ventricular dilatation
- Measurements are performed on a coronal image at the level of the 3rd ventricle
- Ratio – ventricular diameter/brain diameter
- Comparing the degree of ventriculomegaly on follow up scans.

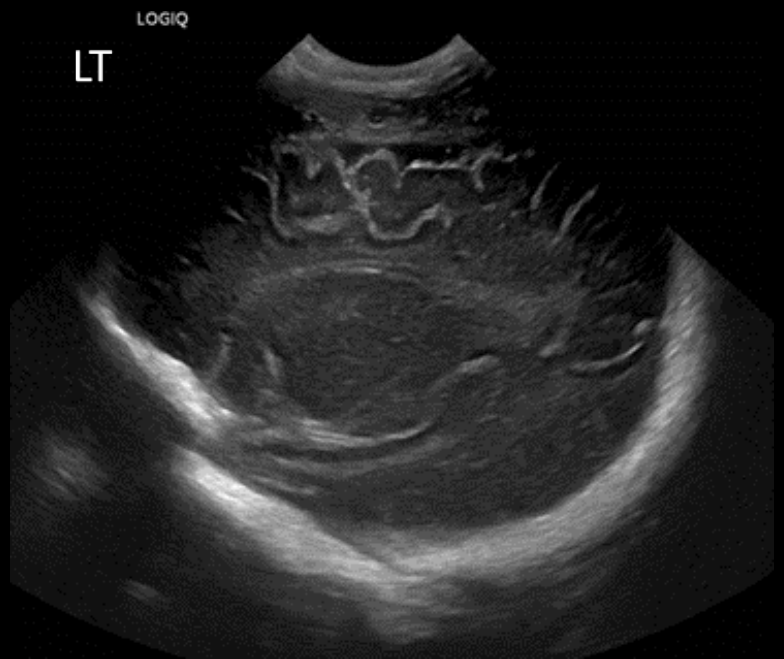


Cranial ultrasound technique :Sagittal sections

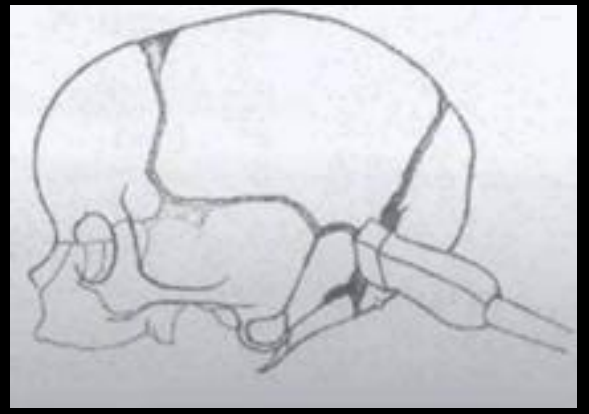


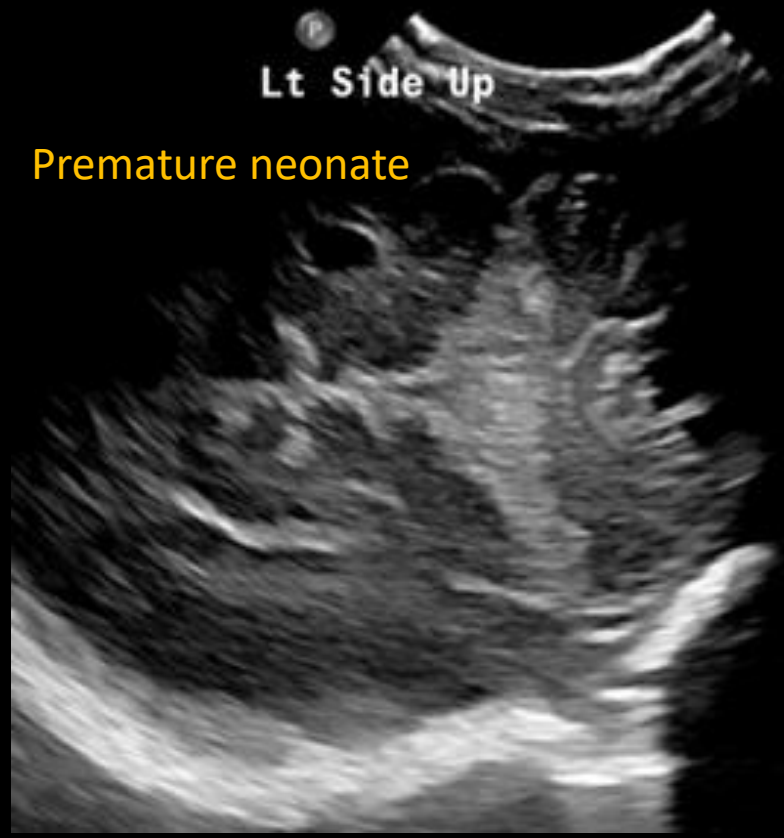




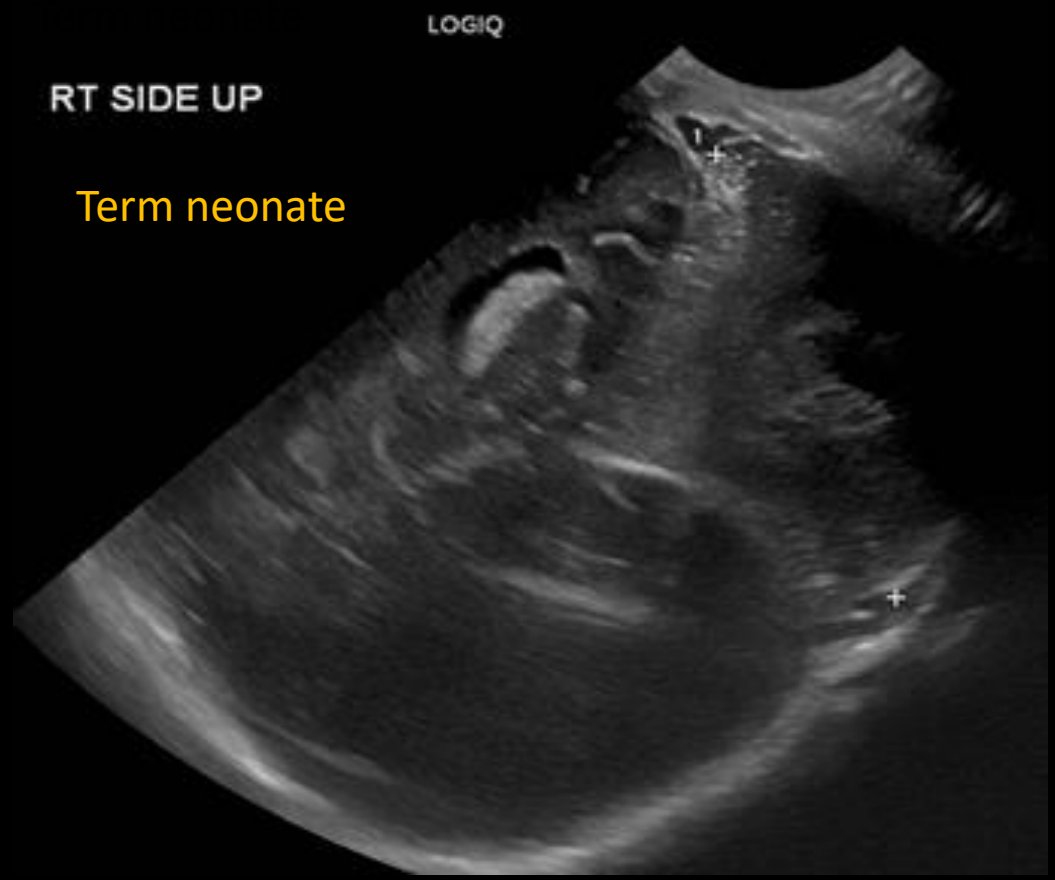


Posterior fossa : Mastoid fontanelle



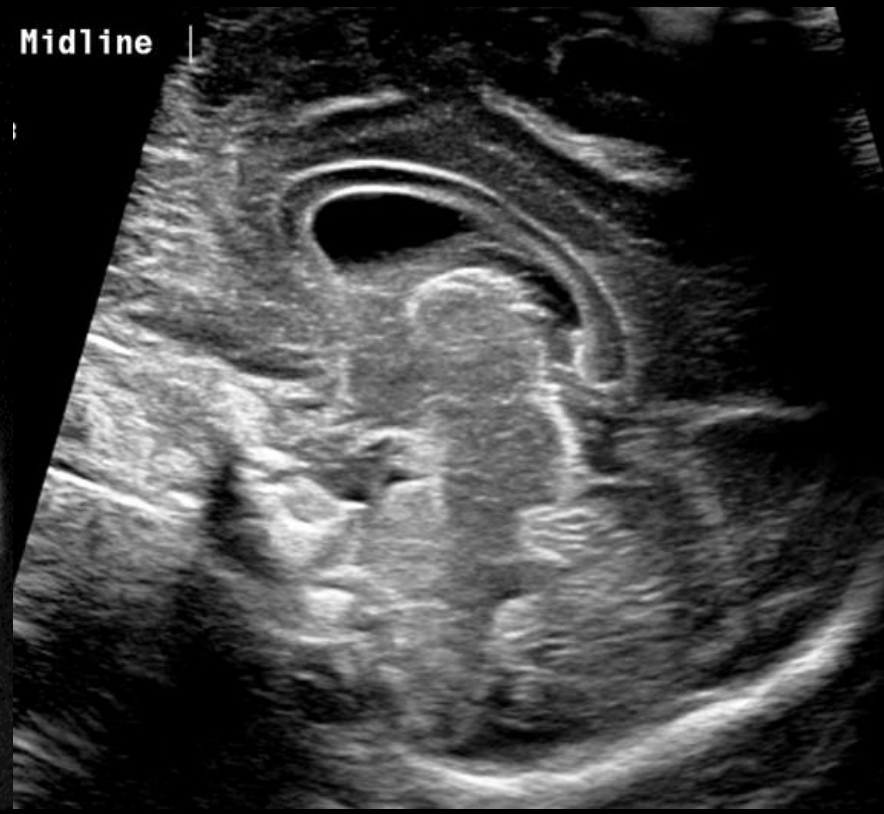


Premature neonate

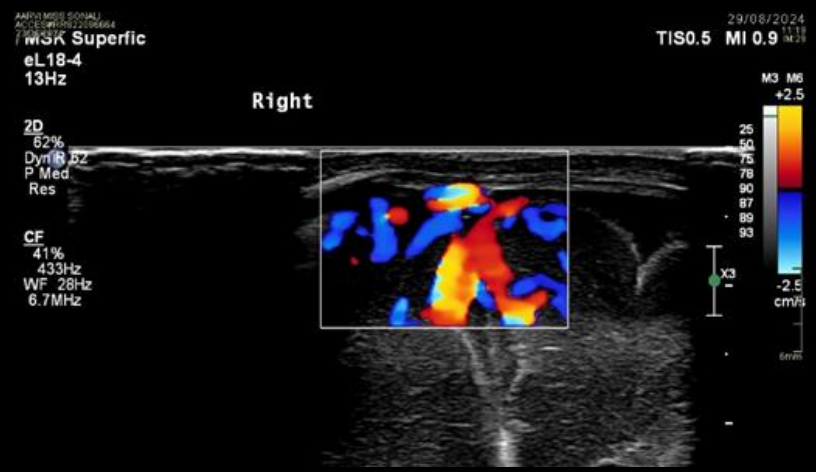


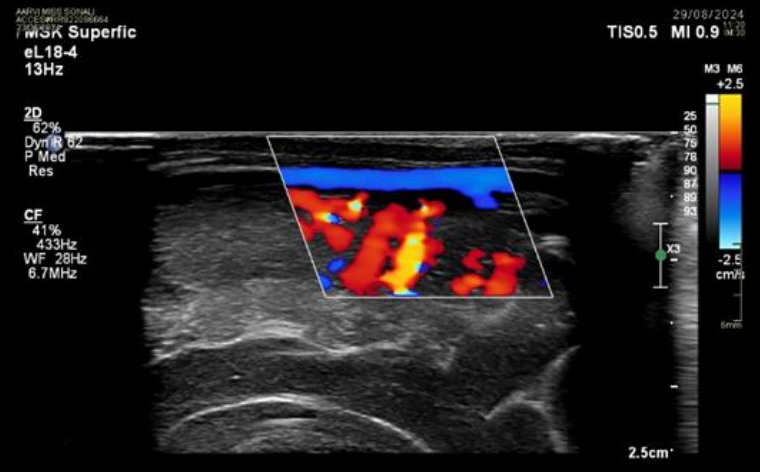
Term neonate

Cranial ultrasound technique: Linear sections

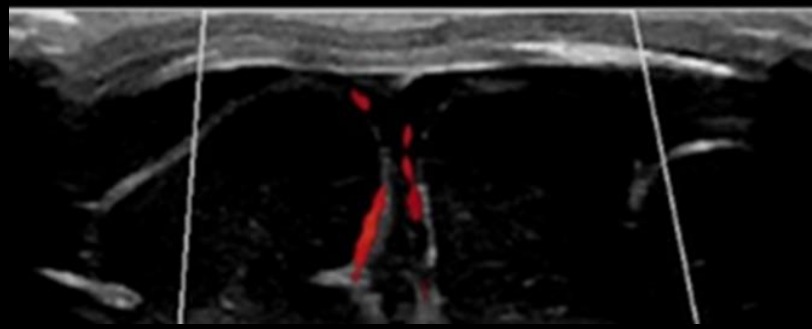


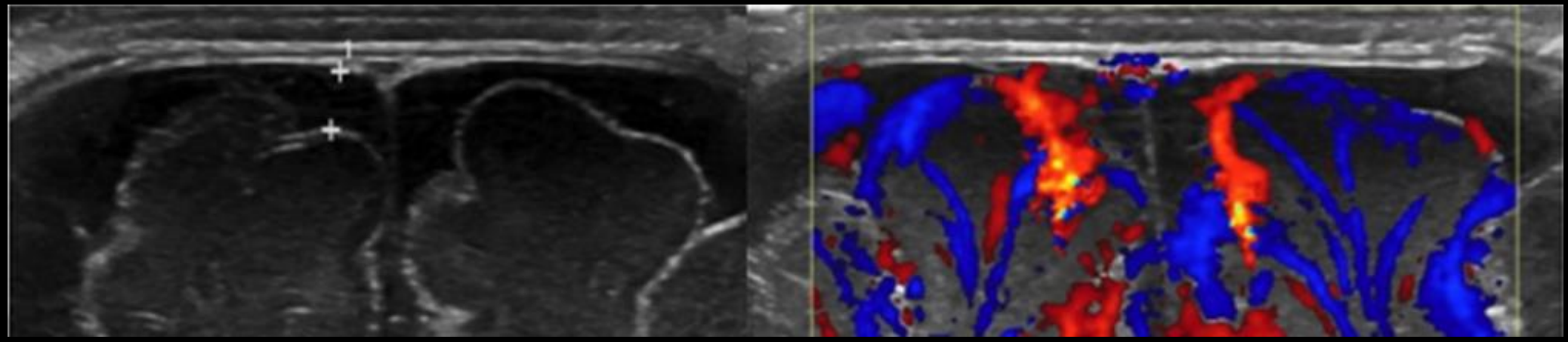
Sagittal Sinus & Extra-axial fluid





Top tip: use an MSK setting!





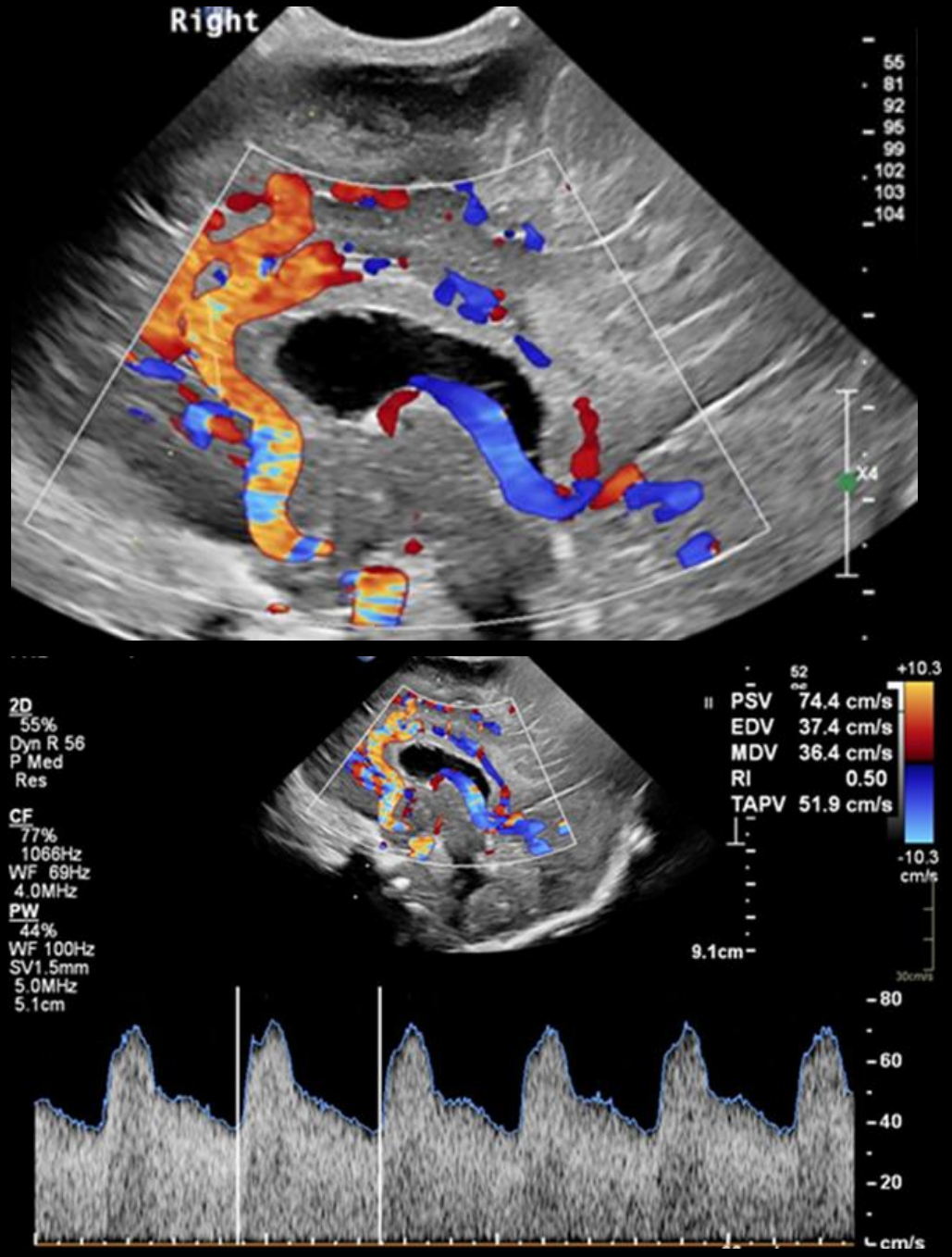
The use of colour Doppler will determine if this is fluid or simply subarachnoid space (vessels transverse the subarachnoid space)

Spectral Doppler

- HIE (Hypoxic-Ischemic Encephalopathy)
- Measure cerebral blood flow velocity
- Resistance index (RI) to help detect the time and evolution of the clinical encephalopathy.
- Performed between hours of birth 48-72 hours of birth
- Anterior cerebral artery (ACA) and Middle cerebral artery (MCA)

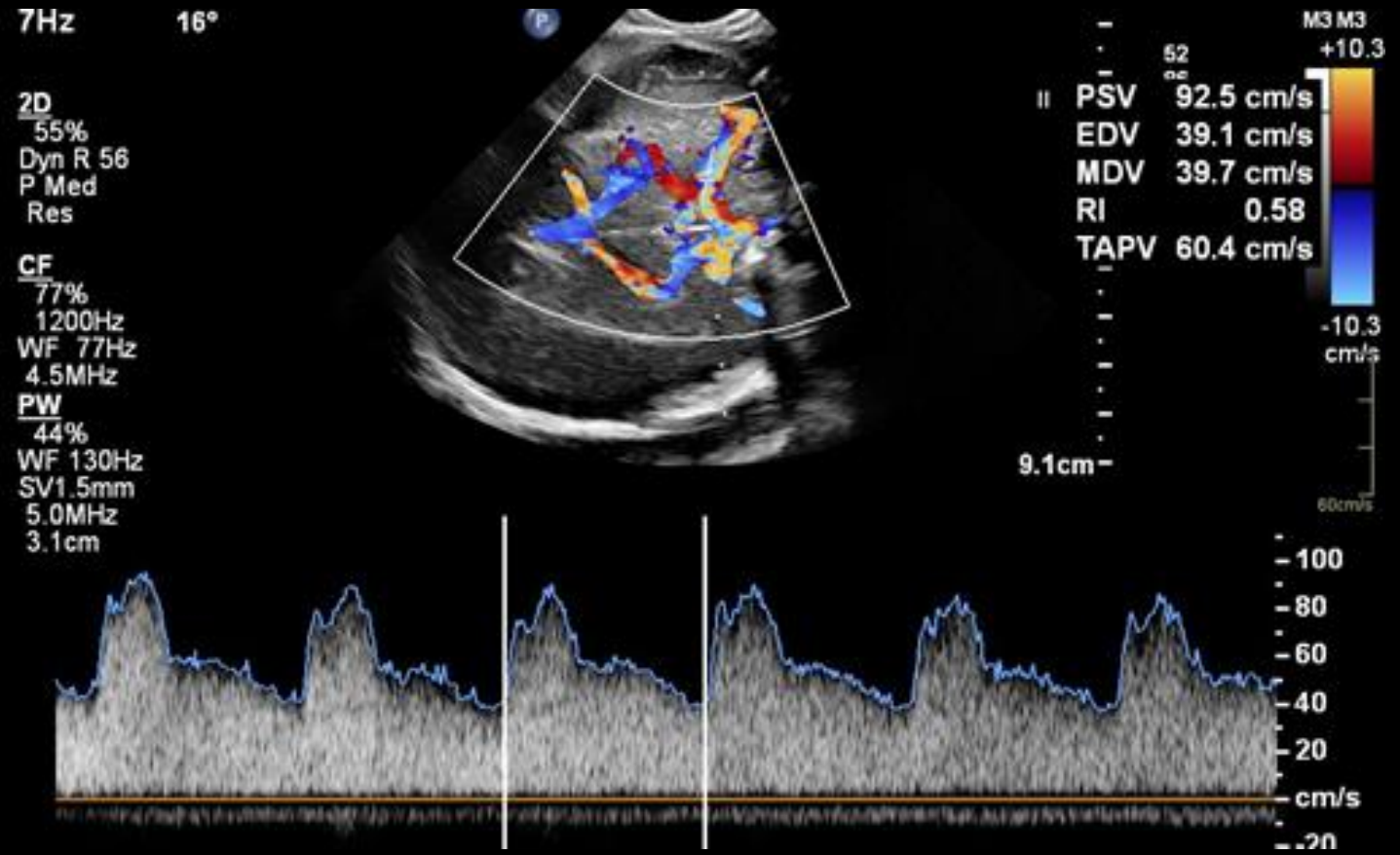
Spectral Doppler

- ACA
- Anterior fontanelle
- Small footprint transducer
- ACA is examined in a sagittal plane
- Anterior to the corpus callosum
- Peak systolic and end diastolic velocity
- RI: 0.65-0.9 normal range

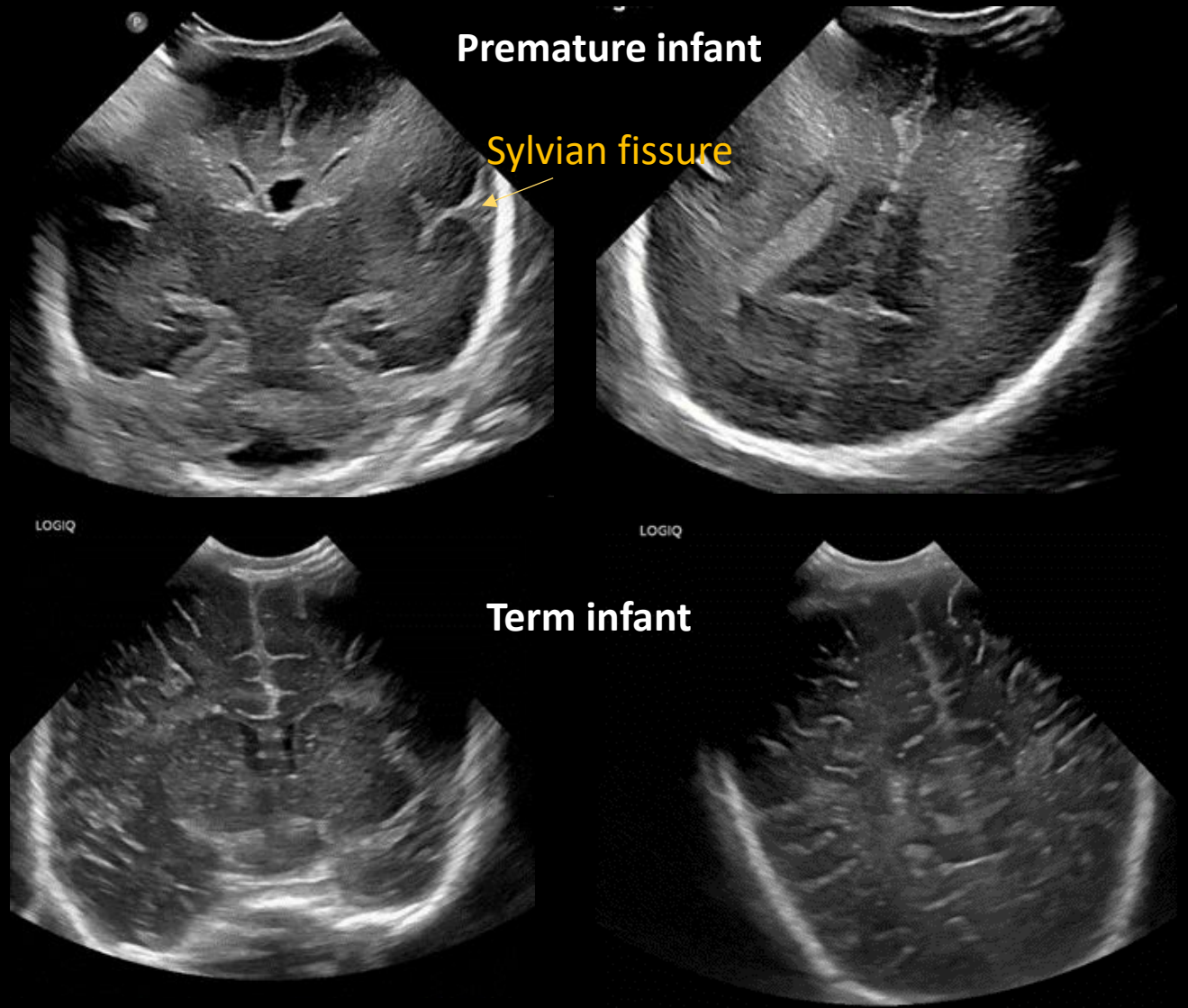


Spectral Doppler

- MCA
- Temporal window
- Small footprint transducer
- *Remember doppler settings!*
  - *Angle correct*
  - *Scale & baseline*



Normal developmental variants: Brain parenchyma



Smooth cerebral convexity, exhibiting only the occipito-parietal (sagittal section) and sylvian fissures (coronal section)

Defined cerebral cortex: sulcus & gyrus

Normal variants

- Conatal cysts (coarctation of the lateral ventricles)
- Often seen in the early post natal period & can regress spontaneously
- Bilateral, symmetrical cysts adjacent to the frontal horns

Example Cranial ultrasound report:

- Normal intracranial structures identified
- No Intraventricular haemorrhage seen
- No ventriculomegaly
- Normal appearances of the parenchyma and posterior fossa
- No increased extra-axial fluid
- Patent sagittal sinus

Limitations

- Image quality can be affected by:
  - Size of the fontanelle & age of the neonate
  - Access to the acoustic window:
    - Supporting equipment : CPAP
    - Hair
  - Patient position : Adaptation of technique
  - Incorrect machine settings
  - Don’t be afraid to ask the neonatal team for help & support!

Thank you!
Any questions?

References

- News | Bliss
- Equipment on the neonatal unit | Bliss
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