ISUOG Basic Training

Distinguishing between Normal & Abnormal Appearances of the Skull & Brain

Learning objectives

At the end of the lecture you will be able to:

- Describe how to obtain the 3 planes required to assess, including measuring, the fetal head correctly
- Recognise the differences between the normal & most common abnormal ultrasound appearances of the 3 planes of the fetal brain

The 20 + 2 planes

Anatomical area	Plane	Description
Overview 1	Sweep 1	longitudinal head & body for initial orientation
Spine	1 2 3	sagittal complete spine with skin covering coronal complete spine coronal section of body
Head	4 5 6	transventricular plane* transthalamic plane* transcerebellar plane*
Thorax	7 8 9 10	lungs, 4 chamber view of heart left ventricular outflow tract (LVOT) right ventricular outflow tract (RVOT) & crossover of LVOT 3 vessel trachea (3VT) view of heart

* measurement required

Requirements from each plane

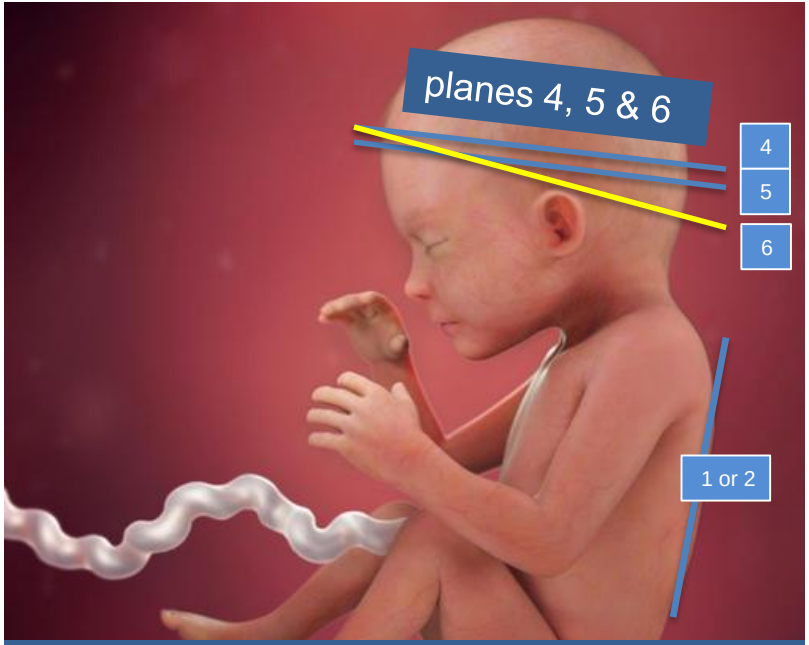
Plane	Description	Structures to be evaluated[2,3,4]	Measurement[1,2] & criteria for referral	Abnormalities that can be excluded from the normal appearances of the section
4	Transventricular plane	Skull shape, size, integrity & bone density Cavum septum pellucidi (CSP) Frontal/anterior horns of both lateral ventricles Posterior horn (PH) of lower lateral ventricle	PH, Refer if PH >10.0mm BPD HC, refer if HC outside normal range of size chart	Anencephaly Lemon shaped skull (open spina bifida) Ventriculomegaly Alobar holoprosencephaly
5	Transthalamic Plane	Frontal horns of both lateral ventricles CSP Thalami Hippocampal gyruses		Ventriculomegaly
6	Transcerebellar Plane	Frontal horns of both lateral ventricles CSP Thalami Cerebellum Cisterna magna (normal range 2.0 – 10.0mm)	TCD	Banana shaped/absent cerebellum (open spina bifida) Large cyst in posterior fossa Occipital encephalocoele Cystic hygroma Skin oedema

1. ISUOG Education Committee recommendations for basic training in obstetric & gynecological ultrasound (UOG 2014; **43:** 113-116)
2. Practice guidelines for performance of the routine midtrimester scan (UOG 2010)
3. Sonographic examination of the fetal central nervous system (UOG 20007)
4. ISUOG Practice Guideline (updated): sonographic screening examination of the fetal heart (UOG 2013)

Moving through the 20 planes

Plane	Description
1	Sagittal complete spine with skin covering
2	Coronal complete spine
3	Coronal section of body
4	Transventricular plane*
5	Transthalamic plane*
6	Transcerebellar plane*
7	Lungs, 4 chamber view of heart
8	Left ventricular outflow tract (LVOT)
9	Right ventricular outflow tract (RVOT) & crossover of LVOT
10	3 vessel trachea (3VT) view of heart

* measurement required



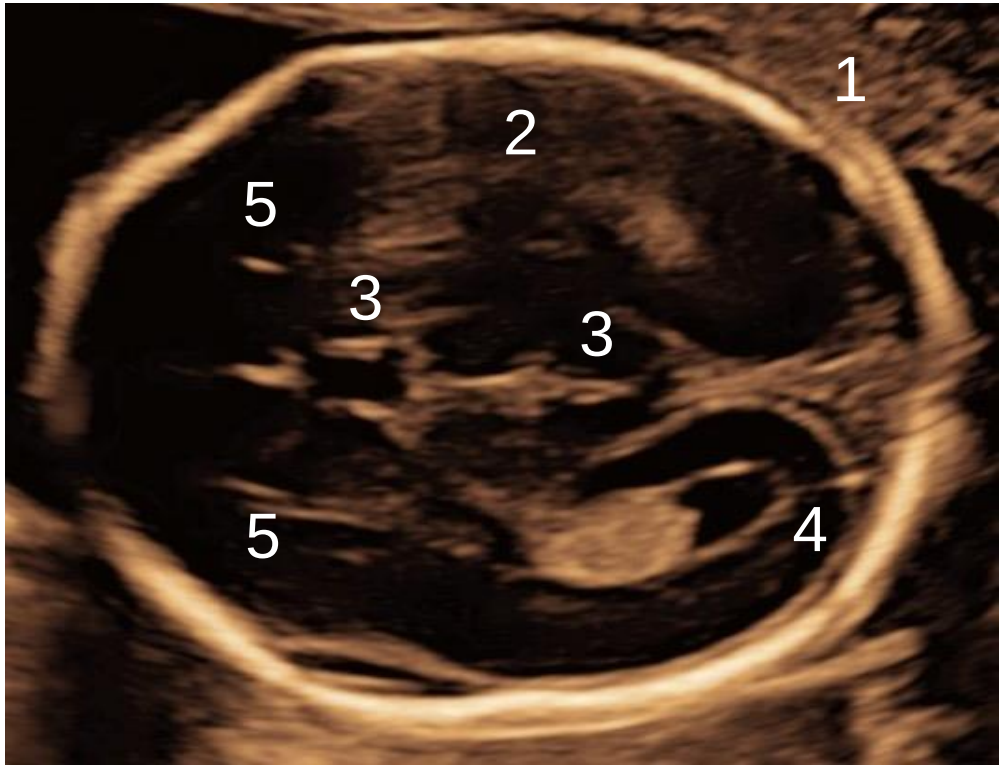
From plane 1 or 2 to 4 - rotate through 90^0
From plane 4 to 5 – (rotate &) slide minimally
From plane 4 to 6 - rotate

Imaging the head – the three planes - technique

1. Identify cervical spine & occipital junction in sag plane
2. Rotate probe 90^0 & identify the cranial vault
3. *Gently* angulate probe to identify transventricular plane & transthalamic plane
4. *Gently* rotate probe towards occiput for transcerebellar plane – ensure CSP is also seen anteriorly

The transventricular plane – plane 4/20

The most cephalad of the three planes



1. **Integrity**: intactness of skull

2. **Bone density**: poor visualization of near field

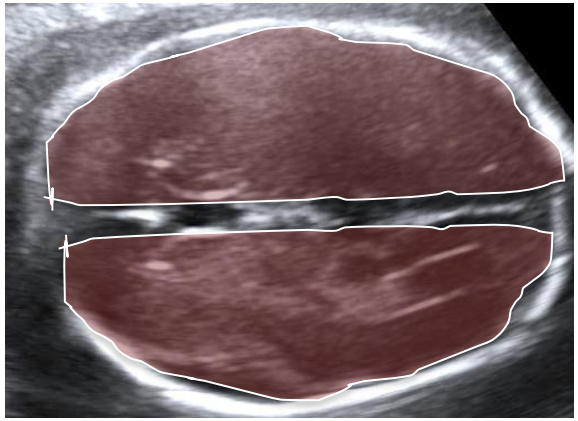
3. **Falx**: interrupted by CSP

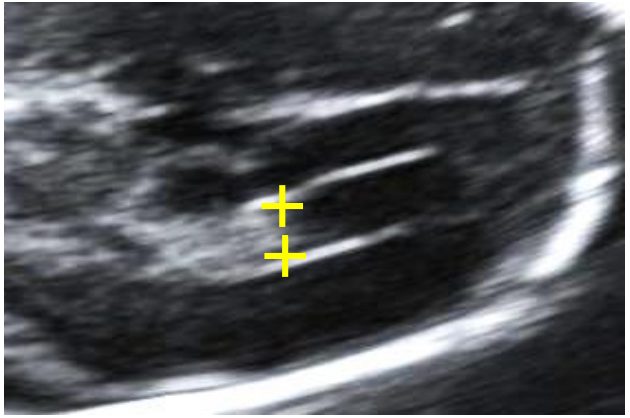
4. Occipital / posterior horn of lower lateral ventricle

5. Frontal horns of **both** lateral ventricles

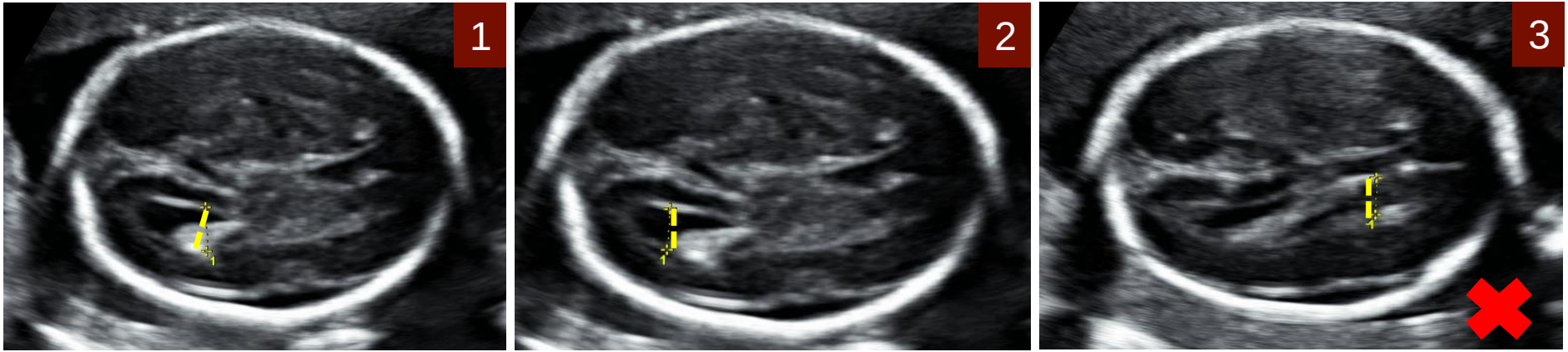
Lateral ventricles – measurement technique

- Symmetrical axial view / optimal zoom
- Atrium measured at the level of the glomus of the choroid plexus, opposite the parieto-occipital sulcus
- Calipers placed touching the inner edges of the ventricle wall, at its widest part, aligned perpendicular to the long axis of the ventricle



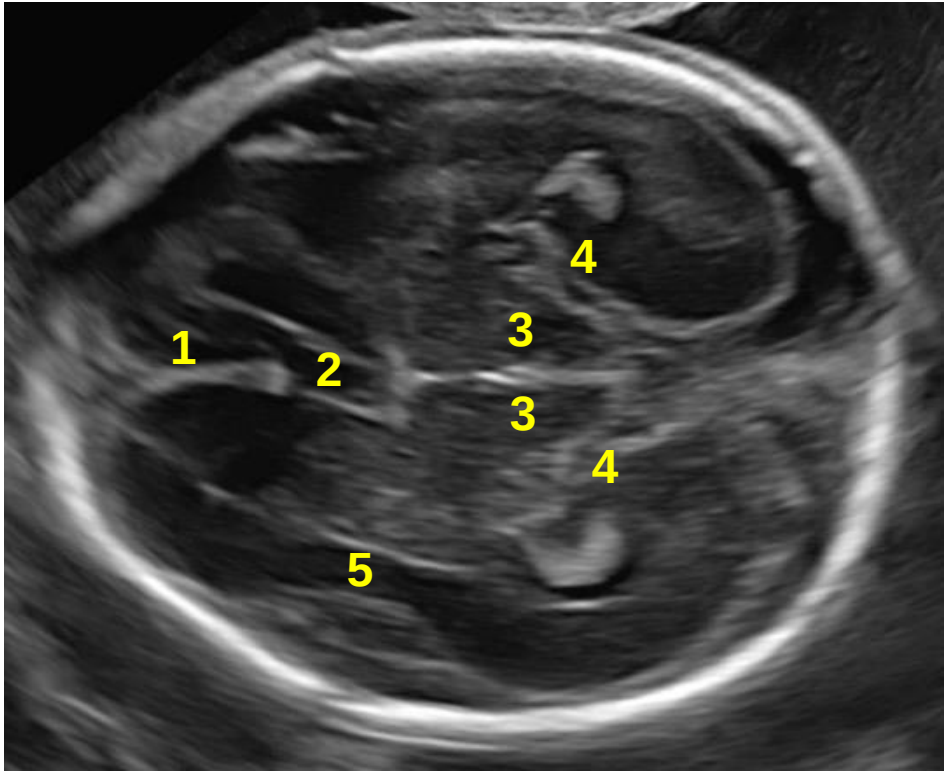


Measurement of the lateral ventricles



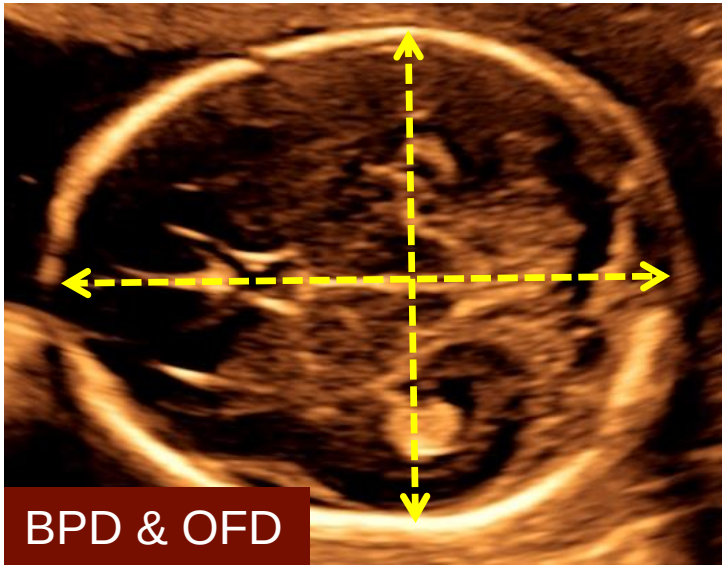
- Normal occipital horn of lateral ventricle < 10.0mm
- Refer if LV measurement > 10.0mm

The transthalamic plane - anatomical landmarks - plane 5/20



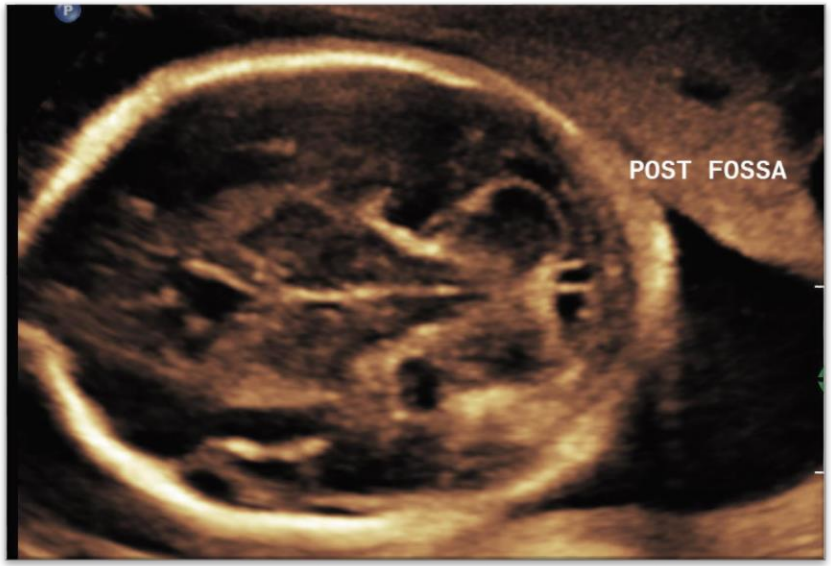
1. Midline falx
2. CSP
3. Both thalami in apposition & separated by falx
4. Hippocampal gyri
5. Lateral sulcus

Cephalic index



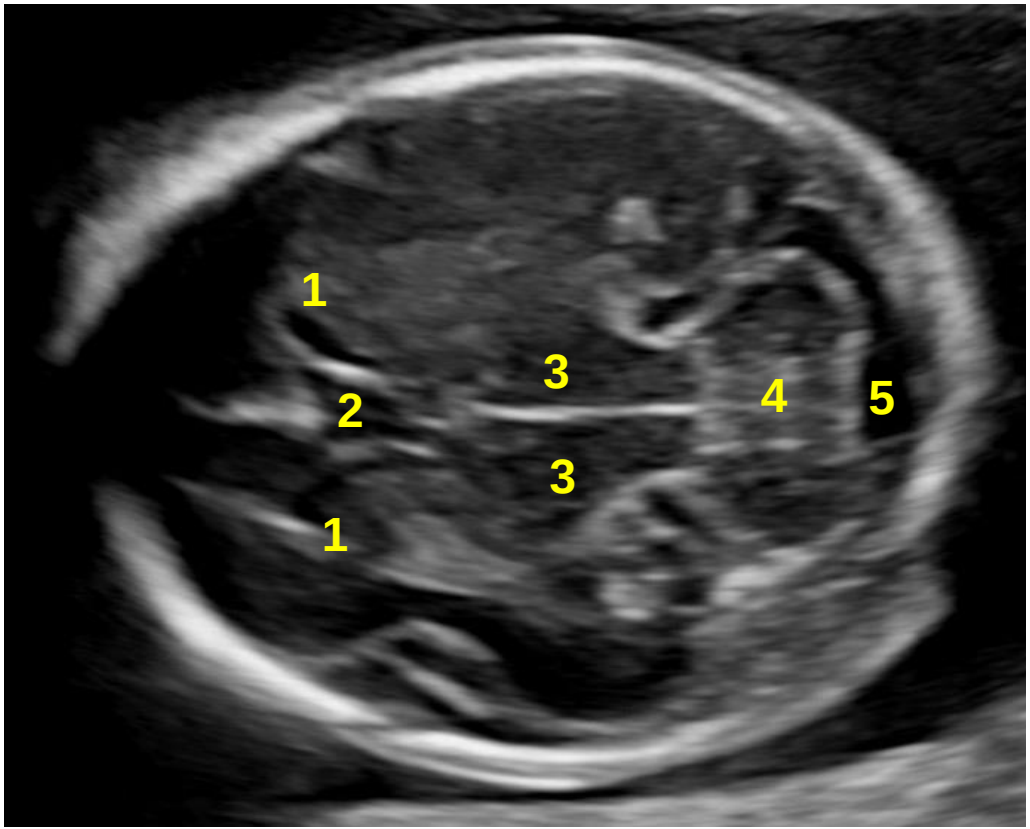
- Cephalic index = BPD (outer to outer) /OFD X 100
- Normal = 75-85
- < 75 - dolichocephaly
- >85 - brachycephaly

Cranial biometry – cerebellar diameter – key points



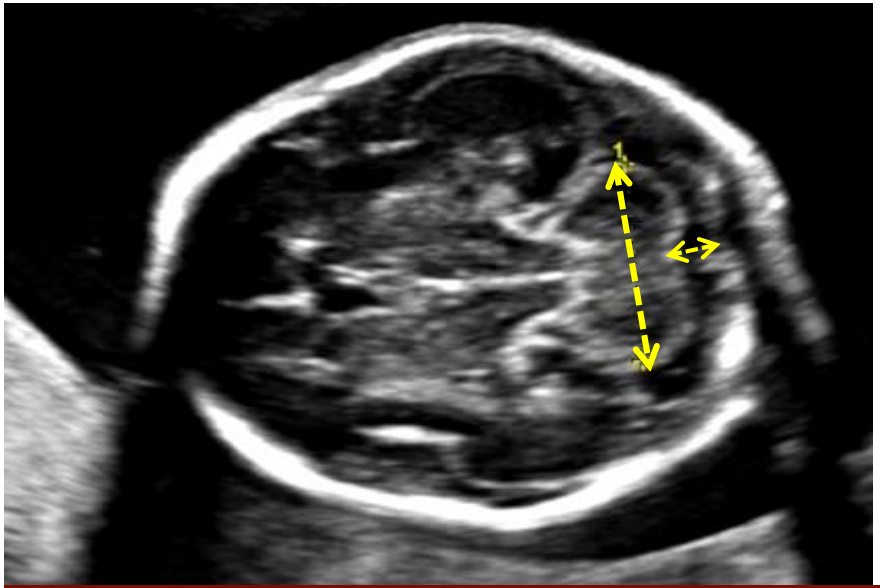
- Ensure complete visualisation of cerebellum
- Ensure anatomical landmarks – avoid steep angulation

The transcerebellar plane – plane 6/20



1. Frontal horns of both LV
2. CSP
3. Thalami
4. Cerebellum
5. Cisterna magna

Transcerebellar plane biometry



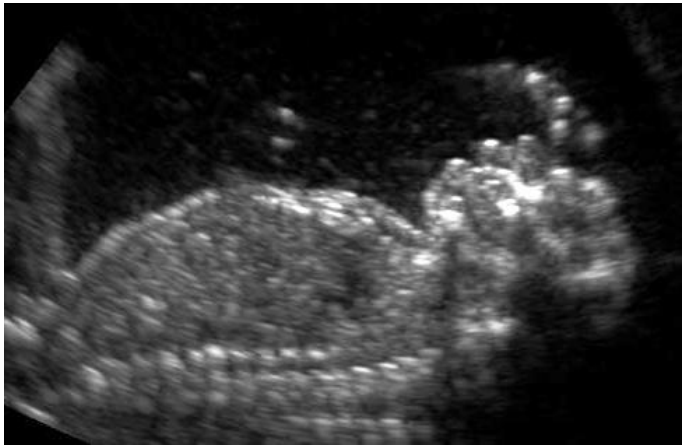
- TCD –maximum diameter in the correct plane
- Cisterna magna – outer edge of vermis to inner edge of occipital bone (normal range 2.0-10.0mm)

Refer if:

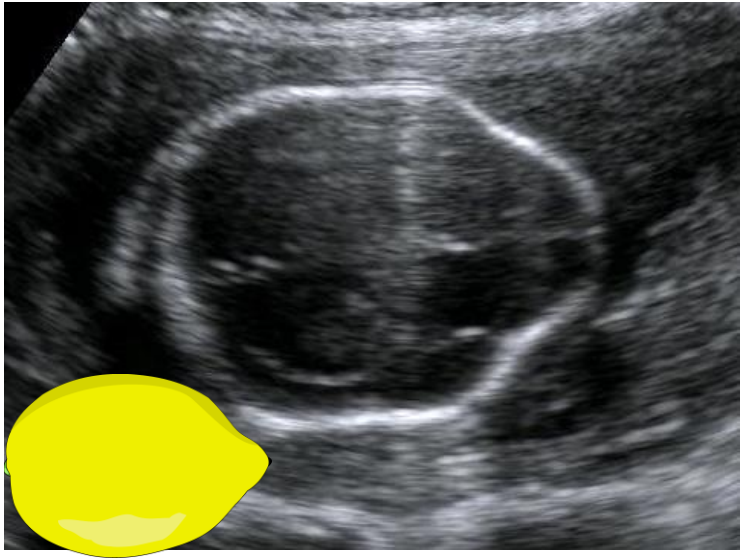
- TCD < 5th centile for period of gestation
- cisterna magna > 10.0mm
- cerebellar hemispheres appear separated

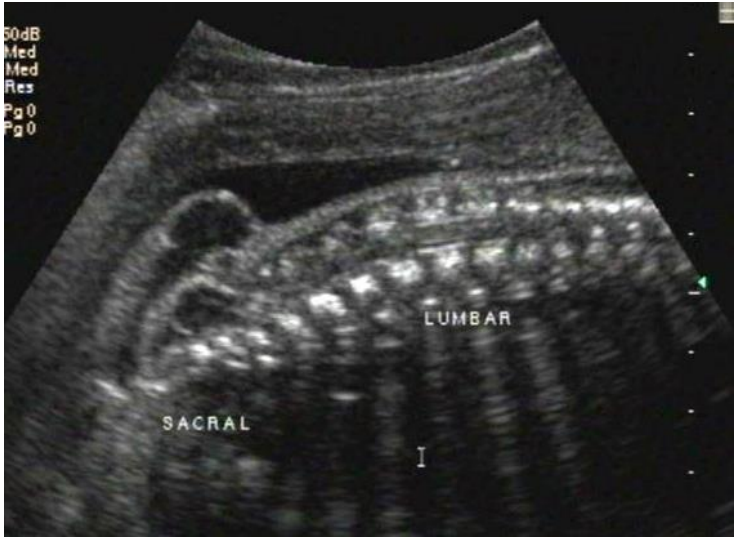
Common abnormalities that can be excluded from planes 4, 5 & 6

The cranial vault - anencephaly



The cranial vault
‘lemon’ sign of open NTD





Other head shapes

Dolicocephaly

Brachycephaly

Strawberry

Clover leaf

Poor mineralization of skull – reduced bone density
Osteogenesis imperfecta

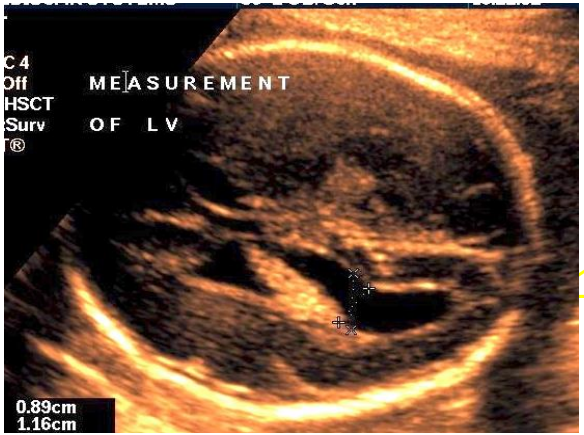
Normal skull

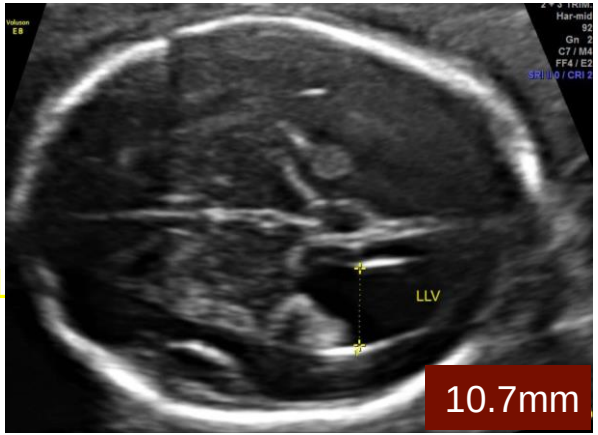
Poor near field visibility

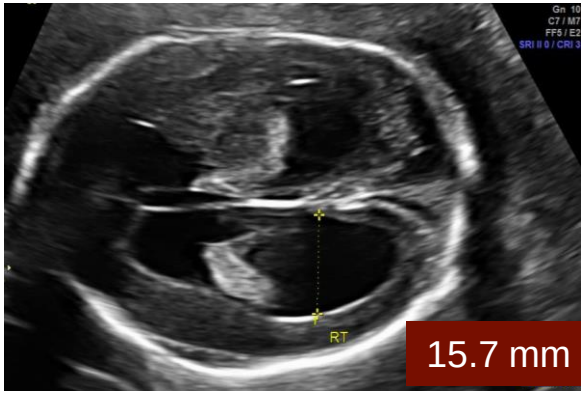
The cranial vault, skull integrity - encephalocoeles

- Can occur anywhere
- Most commonly occipital
- Meningocele / meningo-encephalocele
- Vary in size

Trans thalamic & ventricular planes - ventriculomegaly



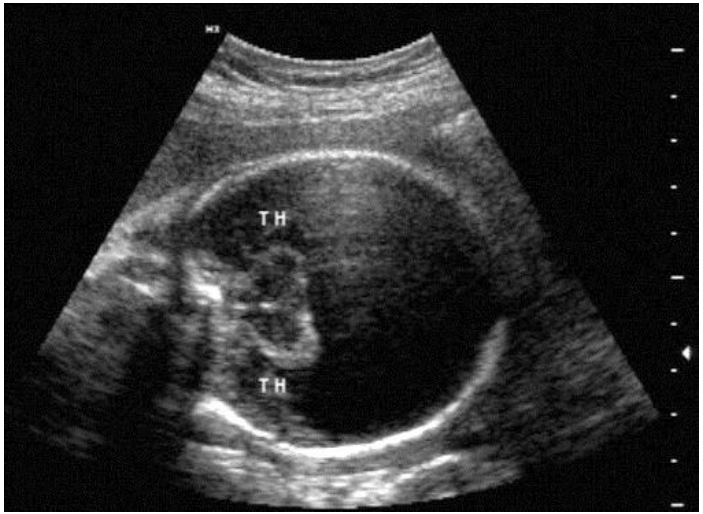


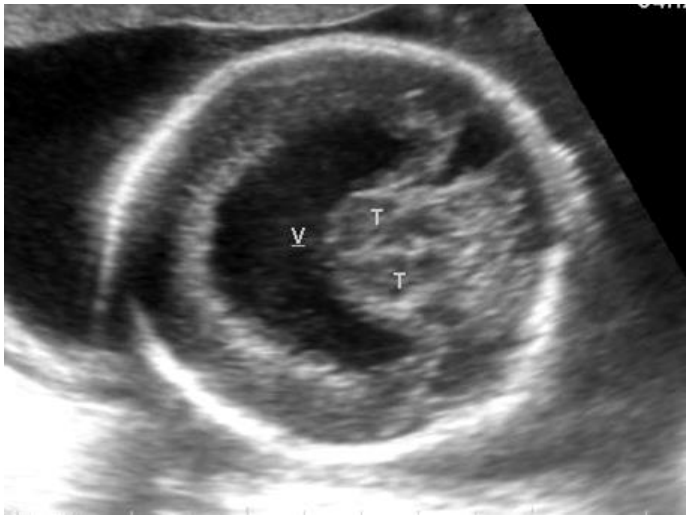


Refer if:

- Posterior horn of lateral ventricle >10.0mm
- Ventricular shape “tear drop” in ACC

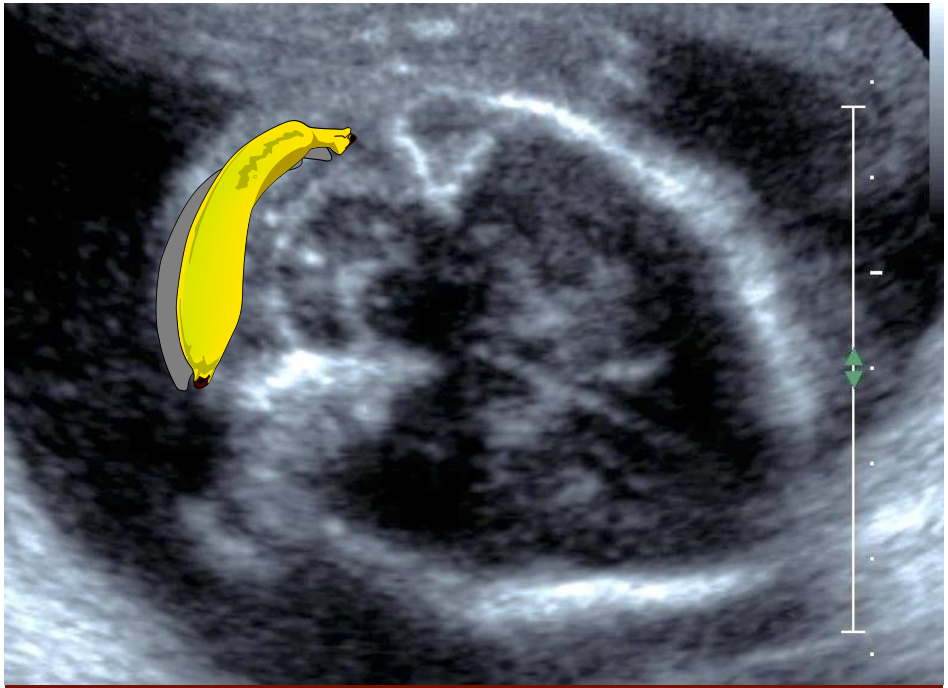
Holoprosencephaly





- Three types – alobar most severe
- Associated anomalies may be present
- Refer if midline falx not visualised & ventricles are fused

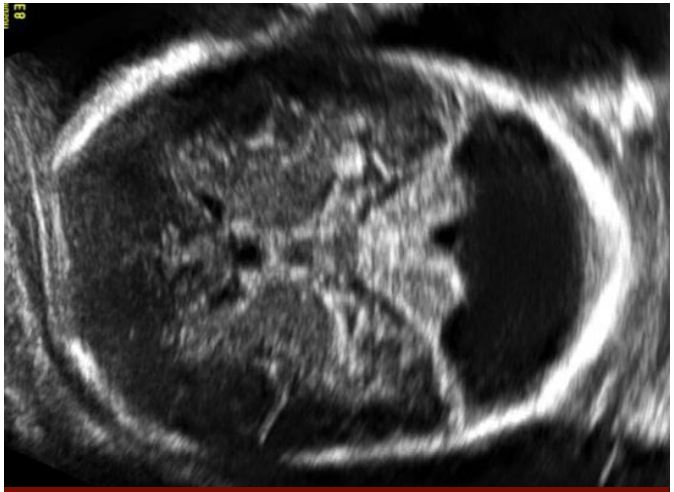
Trans cerebellar plane anomalies



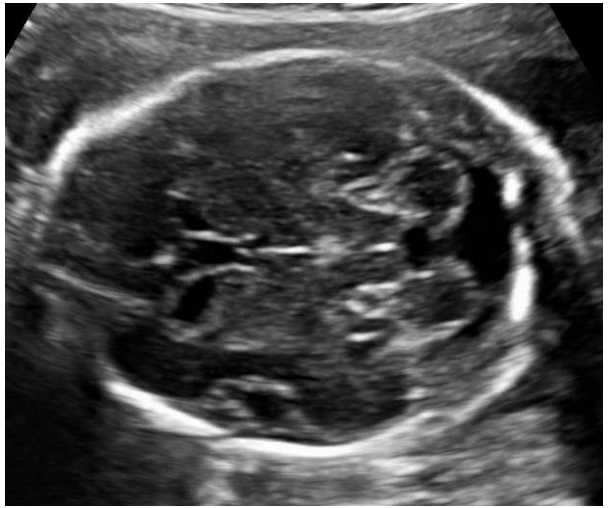
Banana shaped cerebellum in open spina bifida

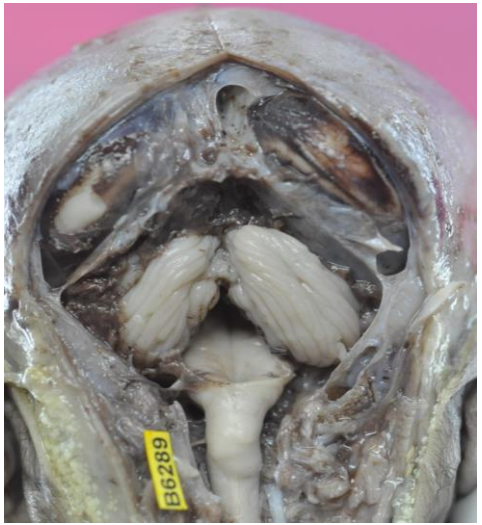
Mega cisterna magna = cisterna magna > 10.0 mm

Trans cerebellar plane anomalies



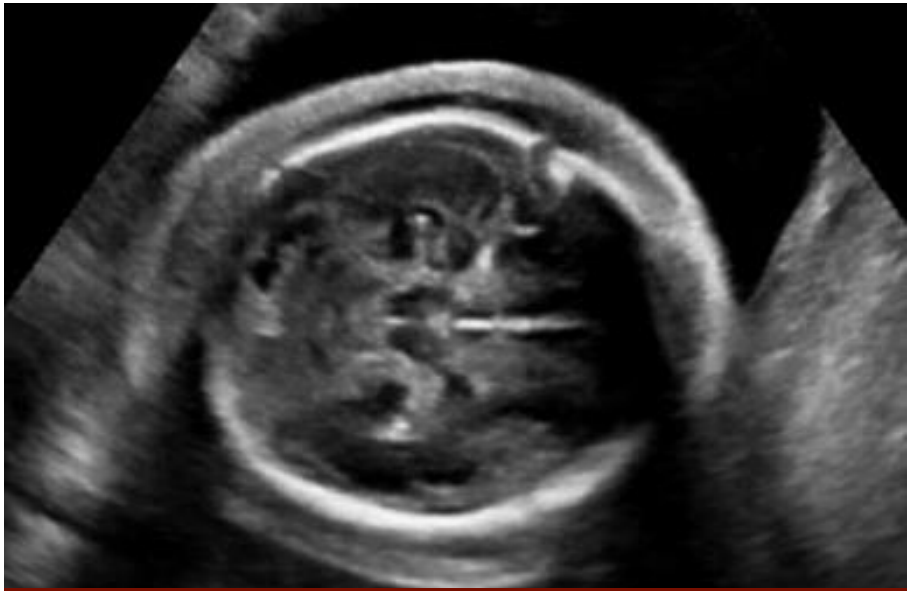
Dandy Walker malformation





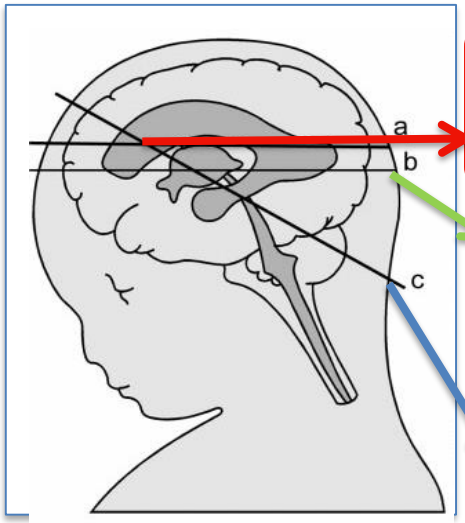
Trans cerebellar plane anomalies

Cystic hygroma



Oedema – hydrops

Key features of planes 4,5,6



Plane 4
Transventricular

Skull , Falx, CSP, LV
BPD, OFD, HC

Anencephaly
Encephalocele
Alobar holoprosencephaly
Ventriculomegaly

Plane 5
Transthalamic

Ventricles

Plane 6
Transcerebellar

Biometry:
TCD
Cerebellum/ cerebellar vermis

Post fossa cyst
Mega cisterna magna
Cystic hygroma
Scalp oedema

Key points

1. The head is imaged in three planes – transventricular, transthalamic plane & transcerebellar planes
2. It is important to identify the specific landmarks
3. Any variation in the appearances should raise suspicion of an anomaly
4. Lateral ventricle > 10.0mm, cisterna magna > 10.0mm – refer
5. HC < 5th centile / > 95th centile – refer
6. TCD < 5th centile, or altered shape – refer