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

<table>
<thead>
<tr>
<th>Anatomical area</th>
<th>Plane</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview 1</td>
<td>Sweep 1</td>
<td>Longitudinal head &amp; body for initial orientation</td>
</tr>
<tr>
<td>Spine</td>
<td>1</td>
<td>Sagittal complete spine with skin covering</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Coronal complete spine</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Coronal section of body</td>
</tr>
<tr>
<td>Head</td>
<td>4</td>
<td>Transventricular plane*</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Transthalamic plane*</td>
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<tr>
<td></td>
<td>6</td>
<td>Transcerebellar plane*</td>
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<tr>
<td>Thorax</td>
<td>7</td>
<td>Lungs, 4 chamber view of heart</td>
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<tr>
<td></td>
<td>8</td>
<td>Left ventricular outflow tract (LVOT)</td>
</tr>
<tr>
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<td>Right ventricular outflow tract (RVOT) &amp; crossover of LVOT</td>
</tr>
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<td>10</td>
<td>3 vessel trachea (3VT) view of heart</td>
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</table>

* measurement required
### Requirements from each plane

<table>
<thead>
<tr>
<th>Plane</th>
<th>Description</th>
<th>Structures to be evaluated$^{2,3,4}$</th>
<th>Measurement$^{1,2}$ &amp; criteria for referral</th>
<th>Abnormalities that can be excluded from the normal appearances of the section</th>
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</thead>
<tbody>
<tr>
<td>4</td>
<td>Transventricular plane</td>
<td>Skull shape, size, integrity &amp; bone density Cavum septum pellucidi (CSP) Frontal/anterior horns of both lateral ventricles Posterior horn (PH) of lower lateral ventricle</td>
<td>PH, Refer if PH &gt;10mm</td>
<td>Anencephaly Lemon shaped skull (open spina bifida) Ventriculomegaly Alobar holoprosencephaly</td>
</tr>
<tr>
<td>5</td>
<td>Transthalamic Plane</td>
<td>Frontal horns of both lateral ventricles CSP Thalami Hippocampal gyruses</td>
<td>BPD HC, refer if outside normal range of size chart</td>
<td></td>
</tr>
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<td>6</td>
<td>Transcerebellar Plane</td>
<td>Frontal horns of both lateral ventricles CSP Thalami Cerebellum Cisterna magna (normal range 2.0 – 10.0mm)</td>
<td>TCD</td>
<td>Banana shaped/absent cerebellum (open spina bifida) Large cyst in posterior fossa Occipital encephalocele Cystic hygroma Skin oedema</td>
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ISUOG Education Committee recommendations for basic training in obstetric & gynecological ultrasound, UOG, 2014, 43(1): 113-116
Sonographic examination of the fetal central nervous system, UOG, 2007, 29(1): 109-116
## Moving through the 20 planes

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From plane 1 or 2 to 4 - **rotate** through 90°
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° & identify the cranial vault
3. Gently angulate probe to identify plane 4 (transventricular) & plane 5 (transthalamic)
4. Gently rotate probe towards occiput for plane 6 (transcerebellar) – ensure CSP is also seen anteriorly
From plane 1 or 2 to 4 – Identify junction of cervical spine & occiput

Rotate through 90°
Plane 4 (transventricular)
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
Atria of the 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 atria of the lateral ventricles

- Normal ventricle atrium (VA) < 10 mm
- Refer if VA measurement > 10 mm
Plane 5 (transthalamic) - anatomical landmarks

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

1. Transventricular plane
2. Angle of insonation 90° to midline echoes
3. Symmetric hemispheres
4. Falx with CSP & thalamus

Cerebellum should **NOT** be visualised

Use appropriate charts
Cranial biometry – BPD & HC

- Cephalic index = BPD (outer to outer) / OFD \times 100
- Normal = 75-85
- < 75 - dolichocephaly
- > 85 - brachycephaly
### HC chart

- Use standard reference charts
- Refer if HC outside normal range for period of gestation

<table>
<thead>
<tr>
<th>Gestational Age (Weeks)</th>
<th>Head Circumference (mm) by Percentile</th>
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<tr>
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<td>2.5</td>
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<td>14</td>
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<td>319</td>
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</tbody>
</table>
Cranial biometry – cerebellar diameter
Key points

• Ensure complete visualisation of cerebellum
• Ensure anatomical landmarks – avoid steep angulation
Plane 6 (transcerebellar)

1. Frontal horns of both LV
2. CSP
3. Thalami
4. Cerebellum
5. Cisterna magna
Plane 6 (transcerebellar) biometry

- TCD – maximum diameter in the correct plane
- Cisterna magna – outer edge of vermis to inner edge of occipital bone (normal range 2-10 mm)

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 (tranventricular), 5 (transthalamic), & 6 (transcerebellar)
The cranial vault - anencephaly
The cranial vault
‘lemon’ sign of open NTD
Other head shapes

- Dolicocephaly
- Brachycephaly
- Strawberry
- Clover leaf
Poor mineralisation of skull – reduced bone density
Osteogenesis imperfecta

Normal skull

Poor near field visibility
The cranial vault, skull integrity
- encephaloceles

- Can occur anywhere
- Most commonly occipital
- Meningocele / meningo-encephalocele
- Vary in size
Transthalamic & ventricular planes - ventriculomegaly

Refer if:

- Atrium of the lateral ventricle >10 mm
- Ventricular “tear drop” shape (colpocephaly) in agenesis of the corpus callosum (ACC)
Holoprosencephaly

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

- Banana shaped cerebellum in open spina bifida
- Mega cisterna magna = cisterna magna > 10 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
- Biometry: BPD, OFD, HC
- Anencephaly
- Encephalocele
- Alobar holoprosencephaly
- Ventriculomegaly

**Plane 5**
- Transthalamic
- Biometry: TCD Cerebellum/cerebellar vermis
- Post fossa cyst
- Mega cisterna magna
- Cystic hygroma
- Scalp oedema

**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 mm, cisterna magna > 10 mm – refer
5. HC < 5th centile / > 95th centile – refer
6. TCD < 5th centile, or altered shape – refer
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