



ISUOG Basic Training

Distinguishing between normal and
abnormal fetal anatomy

Learning objectives

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

- Compare the differences between the ultrasound appearances of normal fetal anatomy & of the more common structural fetal abnormalities
- Incorporate all this knowledge into your 20+2 planes scanning approach to the mid trimester & third trimester scans
- Combine this knowledge with your assessment of the fetal biometry & of the amniotic fluid

Key questions

1. Which abnormalities can be excluded by obtaining normal HC/BPD, AC & FL sections in the 2nd or 3rd trimester fetus?
2. What are the principal differences in ultrasound appearances between a structurally normal fetus and a fetus with one or more of the more common structural abnormalities ?

The 20 + 2 planes

Anatomical area	Plane	Description
Overview 1	Sweep 1	Longitudinal head & body for initial orientation
Spine	1	Sagittal complete spine with skin covering
	2	Coronal complete spine
	3	Coronal section of body
Head	4	Transventricular plane*
	5	Transthalamic plane*
	6	Transcerebellar plane*
Thorax	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

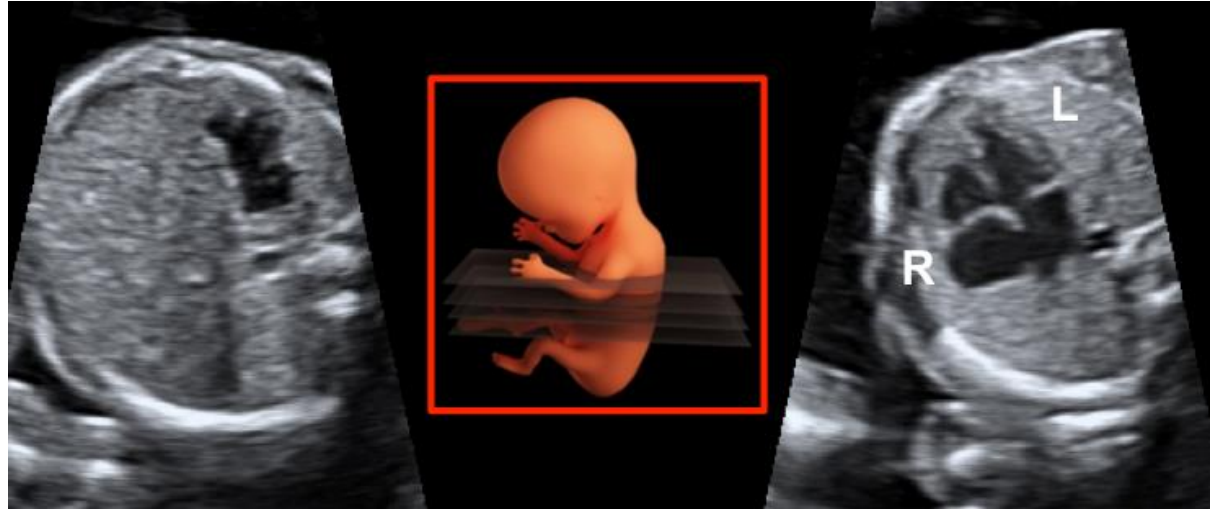
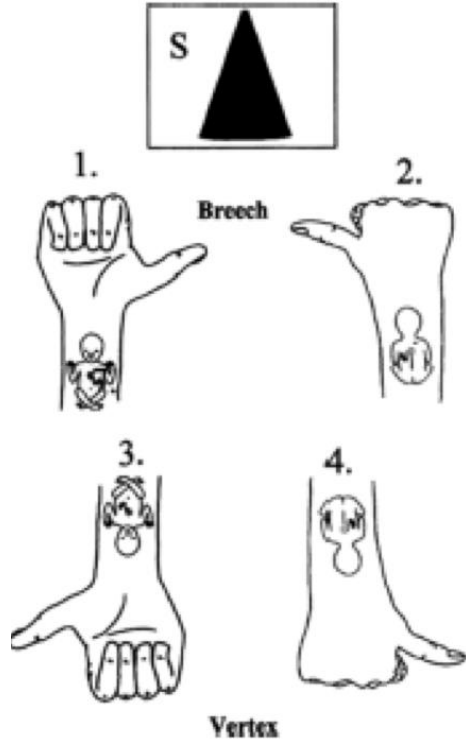
* measurement required

The 20 + 2 planes

Anatomical area	Plane	Description
Abdomen	11	Transverse section of abdomen with stomach & umbilical vein*
	12	Transverse section of abdomen at cord insertion
	13	Transverse section(s) of left kidney & pelvis, right kidney & pelvis
Pelvis	14	Transverse section of pelvis, bladder, both umbilical arteries
Limbs	15	Femur diaphysis length*
	16	3 bones of both legs, both feet & normal relationships to both legs
	17	3 bones of both arms, both hands & normal relationships to both arms
Face	18	Coronal view of upper lip, nose & nostrils
	19	Both orbits, both lenses
	20	Median facial profile
Overview 2	Sweep 2	Transverse sweep of body from neck to sacrum, one vertebra at a time

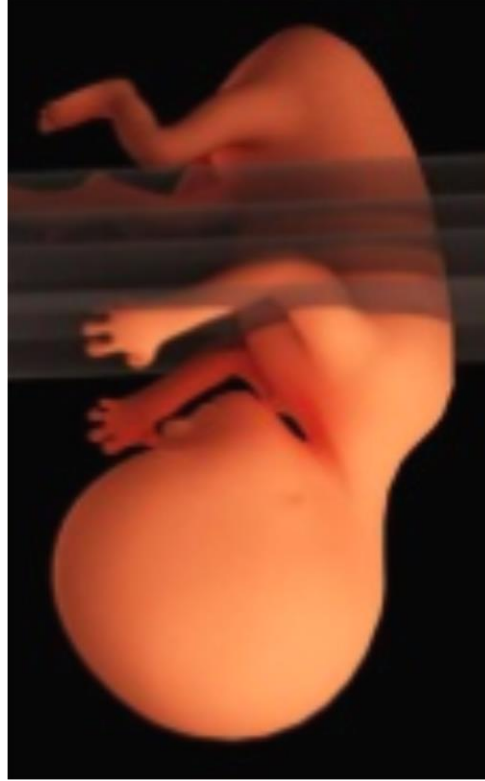
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Establishing fetal position & situs (overview 1)



Abuhamad & Chaoui. Practical Guide to Fetal Echocardiography: Normal and Abnormal Hearts. 2nd Edition, 1997.

Establishing fetal position & situs (overview 1,2)



Exclusion of structural abnormalities

When performed correctly the 20 + 2 approach has the potential to exclude 50 abnormal fetal appearances:

Plane	Anatomical area	Abnormal appearances
Sweep 1		1
1-3	Spine	6
4-6	Head	8
7-10	Thorax	16
11-13	Abdomen	8
14	Pelvis	3
15-17	Limbs	3
18-20	Face	5
Sweep 2	all	all
TOTAL		50

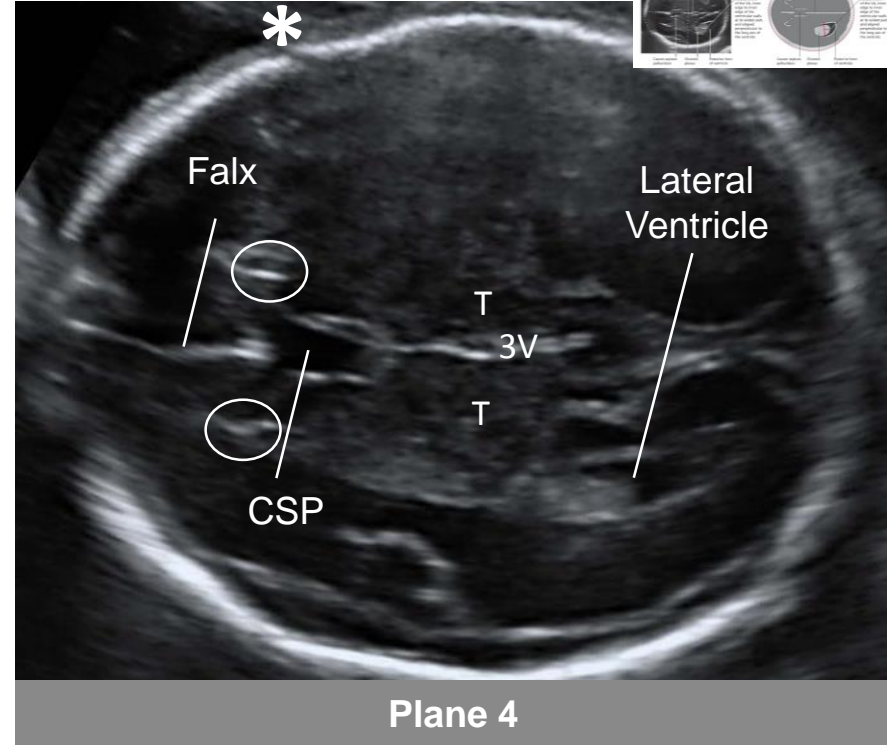
20 + 2 planes & abnormal appearances

Plane	Area	Abnormal appearances {50+intrauterine death (IUD)} excluded by the correct 20+2 approach
Sweep 1		Anencephaly, Intrauterine death
1-3	Spine	Abnormal abdominal situs, left sided diaphragmatic hernia, meningocoele, Open spina bifida, sacral agenesis, sacral coccygeal teratoma,
4-6	Head	Alobar holoprosencephaly, banana shaped cerebellum, cystic hygroma, large posterior fossa cyst, lemon shaped skull, occipital encephalocoele, skin oedema, ventriculomegaly
7-10	Thorax	atrioventricular septal defect (AVSD), congenital pulmonary airway malformation (CPAM), double aortic arch, ectopia cordis, overriding aorta, persistent left vena cava*, right aortic arch, severe aortic stenosis, coarctation & pulmonary stenosis, significant pericardial effusion (>4 mm) & pleural effusion (>4 mm), situs inversus/ambiguous, tetralogy of Fallot, transposition, univentricular heart, ventricular septal defect (VSD) (moderate/large)
11-13	Abdomen	Ascites, bilateral renal agenesis, duodenal atresia, echogenic bowel*, gastroschisis, omphalocoele, renal pelvic dilatation (>7 mm anterior posterior/AP), small/absent stomach
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15-17	Limbs	Fixed flexion deformities wrist, severe skeletal dysplasia (some), talipes
18-20	Face	Anophthalmia, cataract*, cleft lip, proboscis*, severe micrognathia

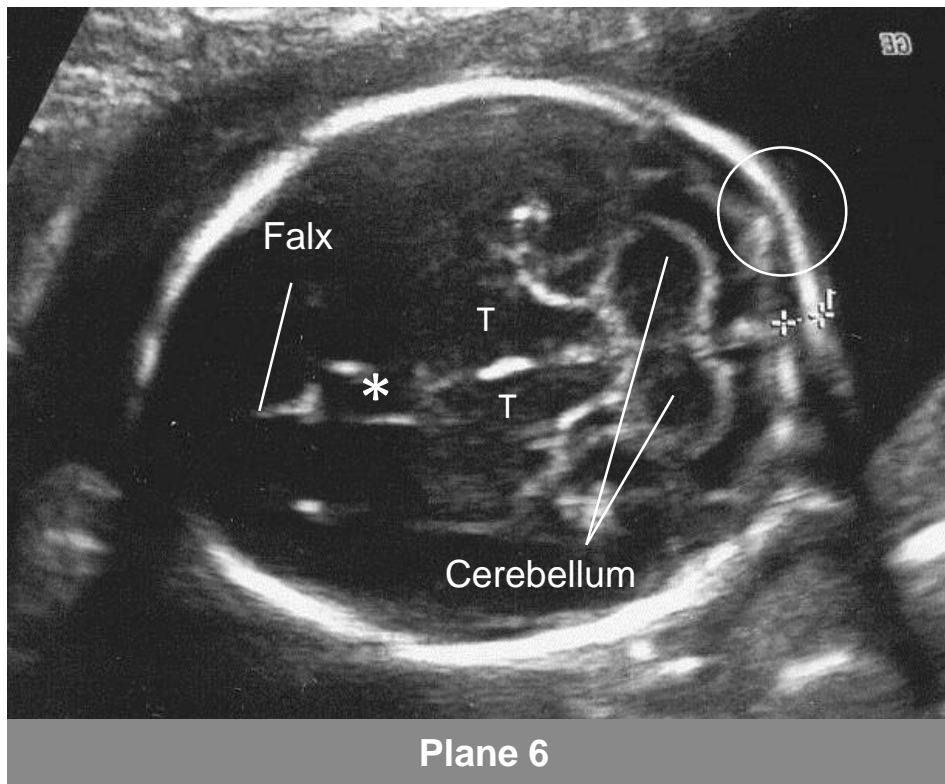
* optional, for local decision as to whether or not included

Key features of HC section: plane 4 (transventricular)

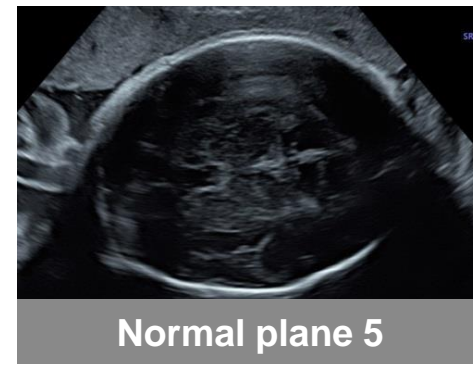
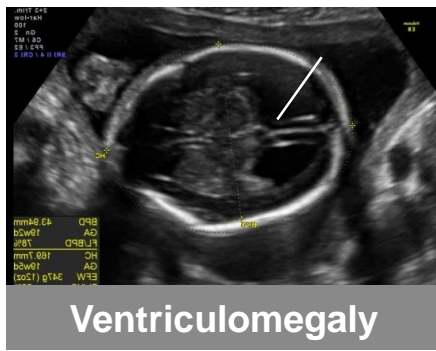
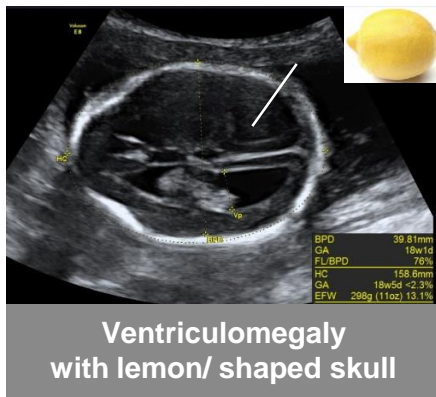
1. Midline (**falx** cerebri)
2. **Cavum septum pellucidum**
3. Rugby football shape, rounded at back, more pointed at front
4. Skull contour regular
5. **Atrium of lateral ventricle** <10 mm
6. **Anterior horn(s)** slit-like



Key features of plane 6 (posterior fossa)



NTD - abnormal appearances of plane 4 (transventricular), 5 (transthalamic)



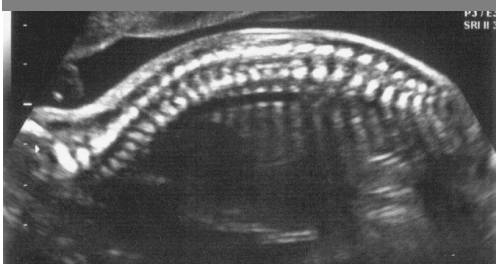
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18-20	Face	Anophthalmia, cataract*, cleft lip, proboscis*, severe micrognathia

* optional, for local decision as to whether or not included

NTD - abnormal appearances: planes 1 (sagittal spine), 2 (coronal spine), 4 (transventricular), & 6 (transcerebellar)

Normal appearances



Plane 1



Plane 4

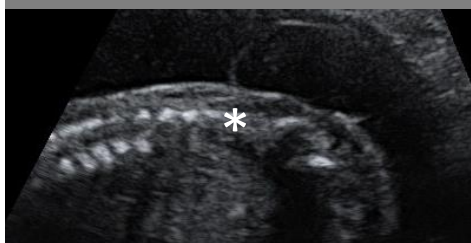


Plane 6

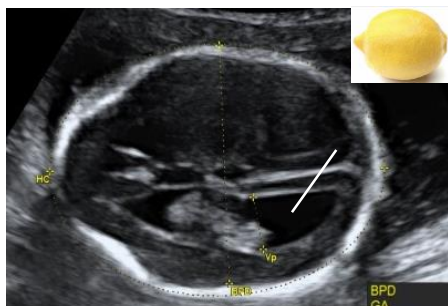


Plane 2

Abnormal appearances



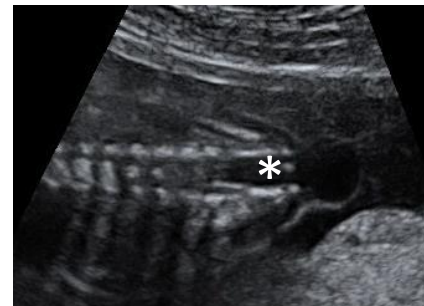
Plane 1



Plane 4



Plane 6



Plane 2

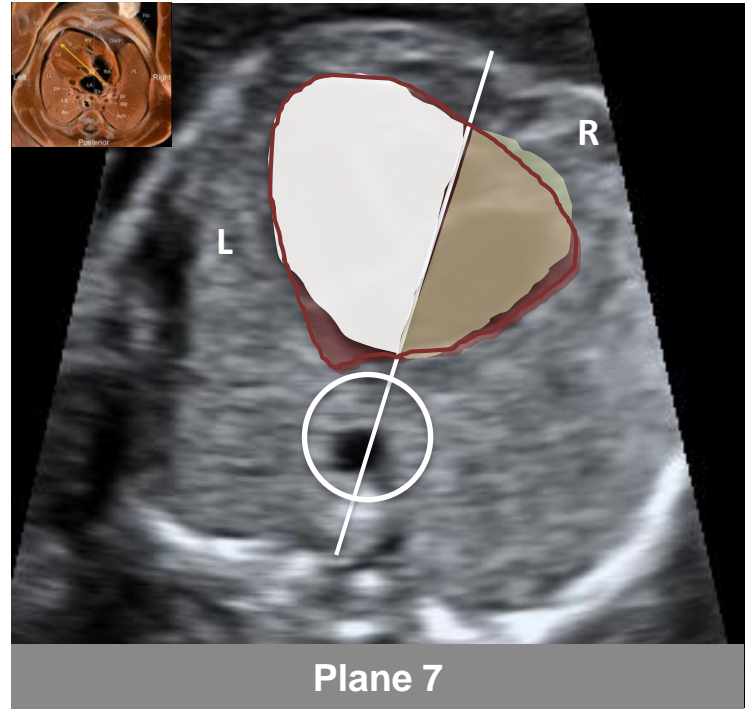
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Normal appearance of plane 4 (lungs & 4 chamber view)

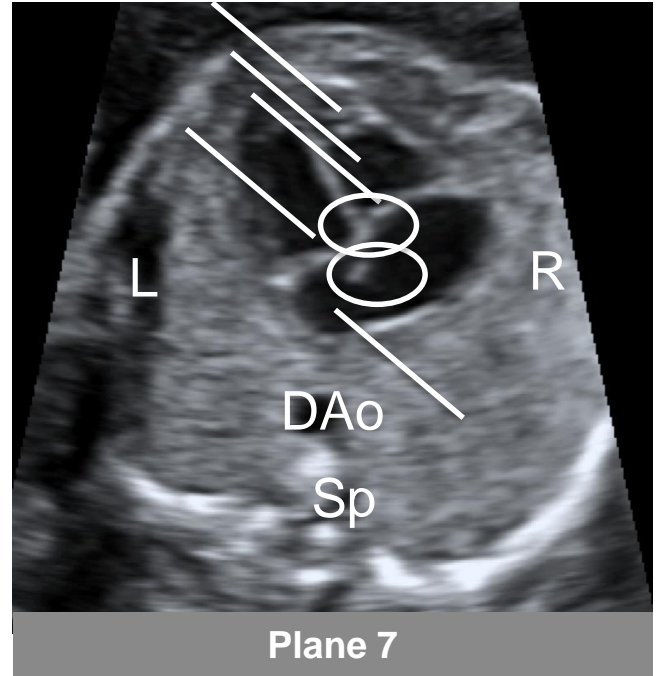
- Sits to the **left of the chest**
- **Area** 1/3 chest
- **Circumference** ½ chest
- **Aorta** is just anterior to the spine and to the left



Abuhamad & Chaoui. A Practical Guide to Fetal Echocardiography: Normal and Abnormal Hearts. 3rd Edition, 1997.

Normal appearance of plane 4 (lungs & 4 chamber view)

- **Right ventricle** is the most anterior, below the sternum
- **Left atrium** is closest to the spine and the most central structure in the chest
- **Tricuspid valve** is more apical than the mitral valve
- Flap of the **foramen ovale** is in the left atrium
- **Moderator band** is in the right ventricle
- **Crux** seen

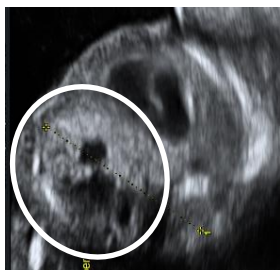


Abnormal appearances of plane 4 (lungs & 4 chamber view)

4 chamber view (4CH)



Plane 7

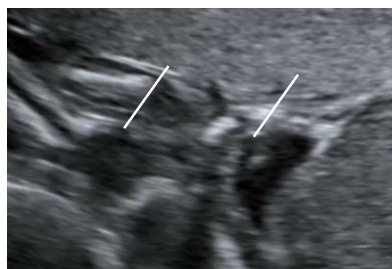


Plane 7

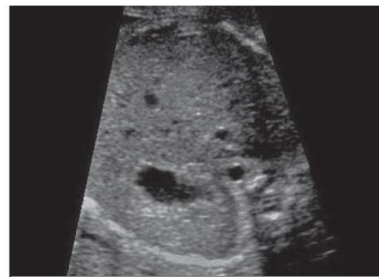


Plane 7

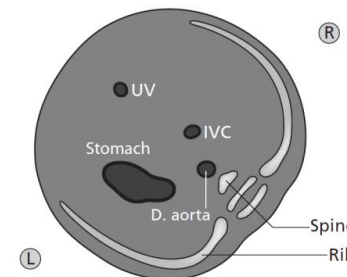
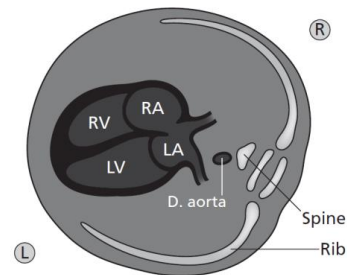
Visceral situs/laterality



Plane 7



Plane 11



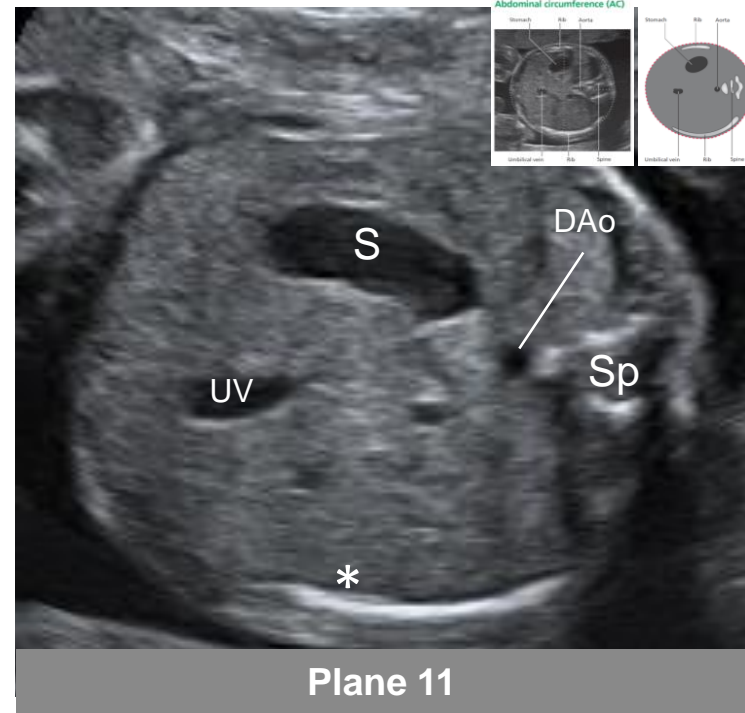
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Key features of AC section plane 11 (abdomen)

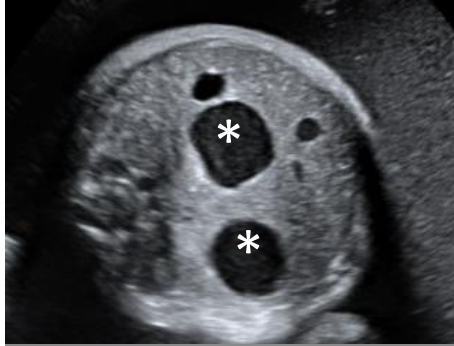
1. Short length of **umbilical vein**, opposite spine
2. Single **stomach** 'bubble', on left side
3. Remaining echotexture homogeneous
4. Gall bladder to right of umbilical vein (UV)



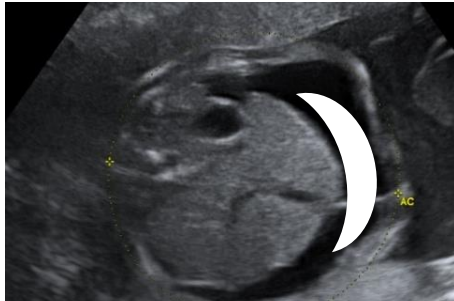
Measure AC



Abnormal appearances of plane 11 (abdomen)



Plane 11



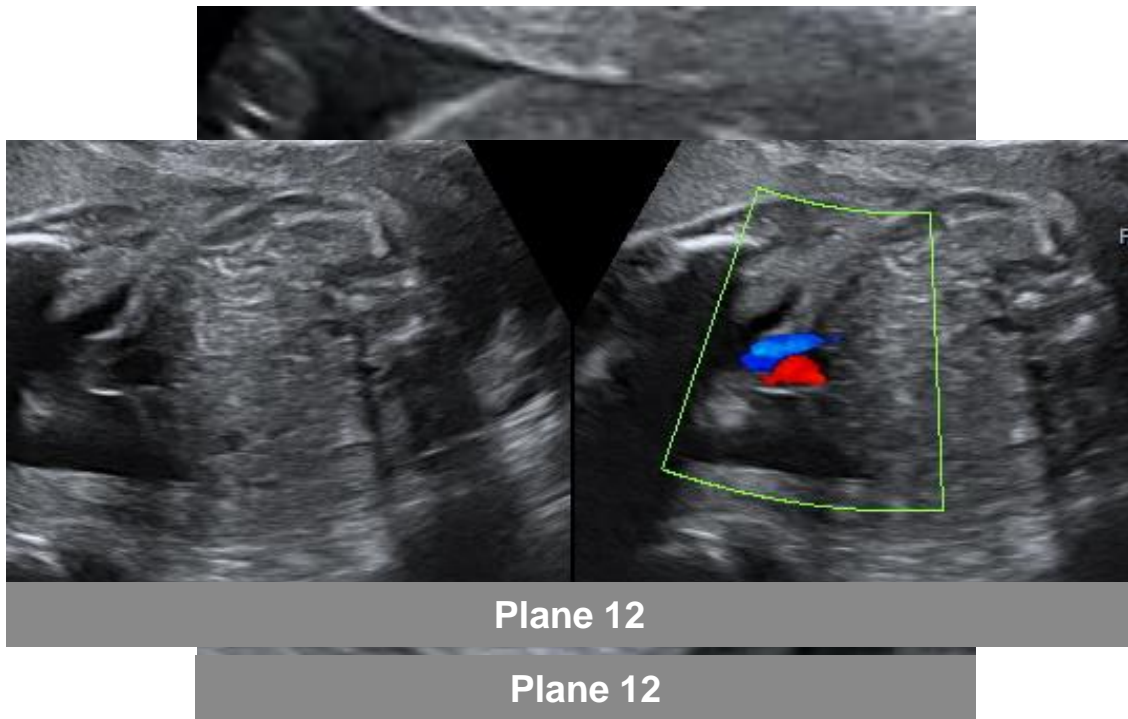
Plane 11



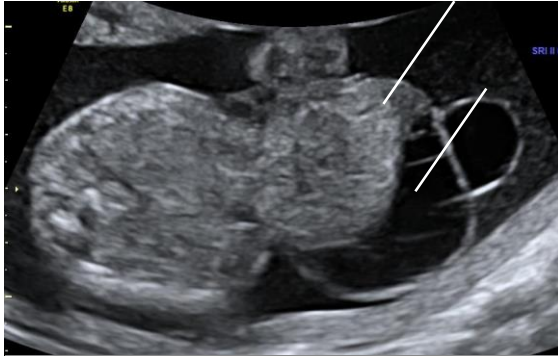
Plane 11

Normal appearances of plane 12 (cord insertion)

1. Slide inferiorly from AC to sacrum
2. Maintain cross sectional approach
3. Cord inserts superior to bladder



Abnormal appearances of plane 12 (cord insertion) Abdominal wall defects



Plane 12



Plane 12

Omphalocele – abnormal cord insertion

- Cord inserts into apex of defect
- Contains liver +/- bowel etc
- Membrane covered

Gastroschisis – normal cord insertion

- Defect below & to right of cord insertion
- Contains bowel only
- Free floating

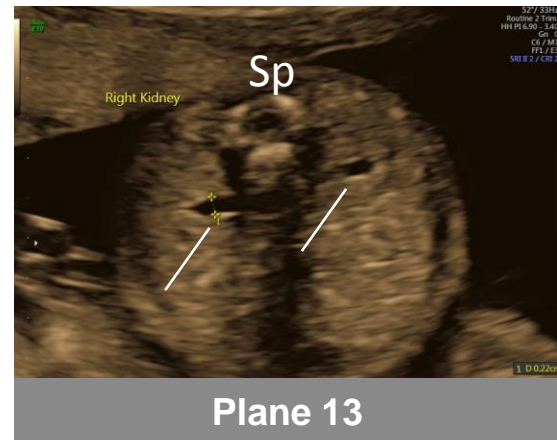


Plane 12

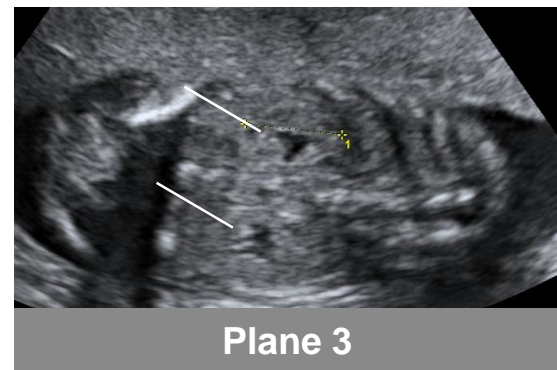
Normal appearances of plane 13 (transverse kidneys) and 3 (coronal body)

Kidneys

- Lateral to spine
- Posterior to stomach
- Normal renal tissue similar echogenicity to bowel, liver etc
- Coronal view allows easier comparison
- Cortex homogenous echopattern
- Renal pelvis, centrally positioned, <7.0mm AP



Plane 13



Plane 3

20 + 2 planes & abnormal appearances

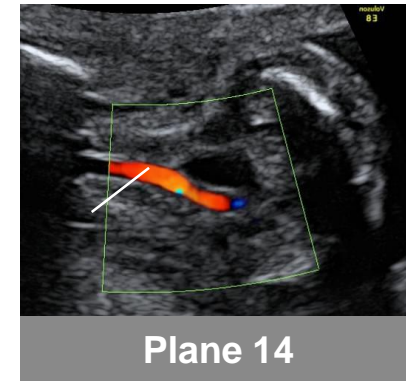
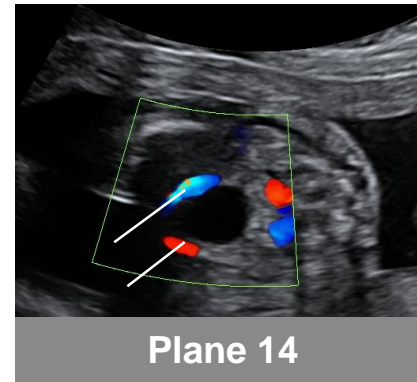
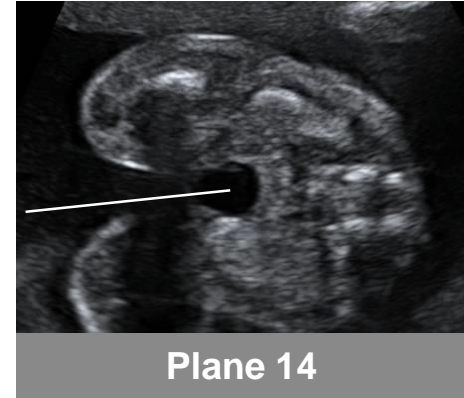
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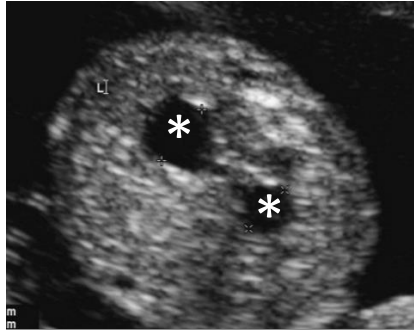
Normal appearance of plane 14 (bladder)

Bladder

- **Central position** in fetal pelvis
- **Thin walled**
- No internal content
- Size varies (~30 minute cycle)
- **Umbilical artery** on each side



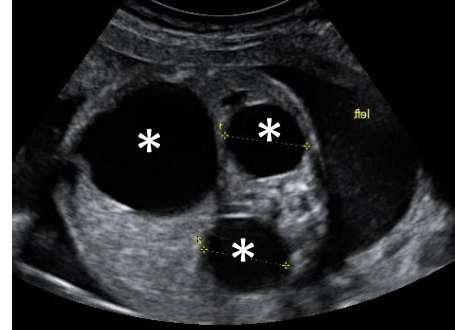
Urinary tract obstruction – abnormal appearances of planes 13 (transverse kidneys) & 14 (transverse bladder)



Plane 13



Sweep 1



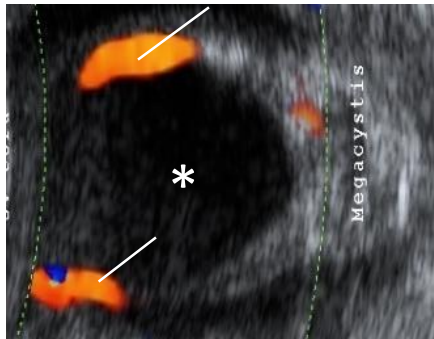
Plane 13



Plane 13



Plane 13



Plane 14



Sweep 1



Plane 14

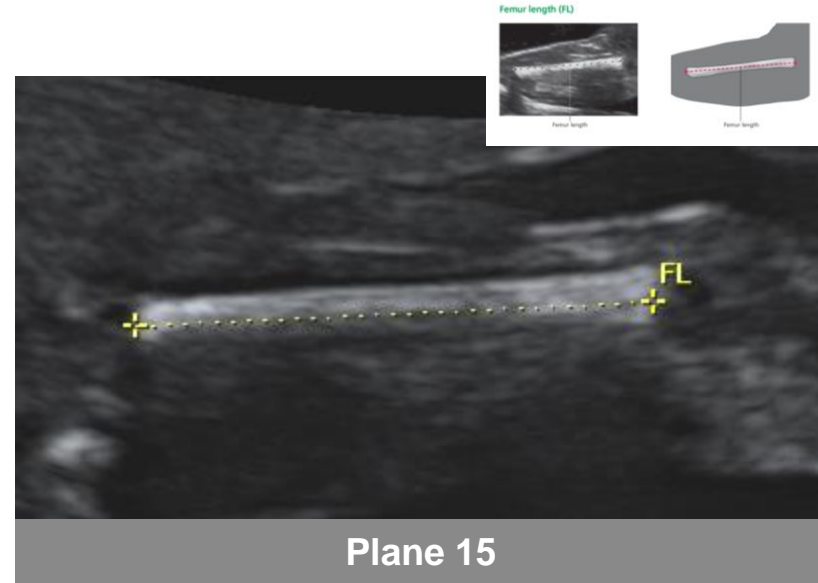
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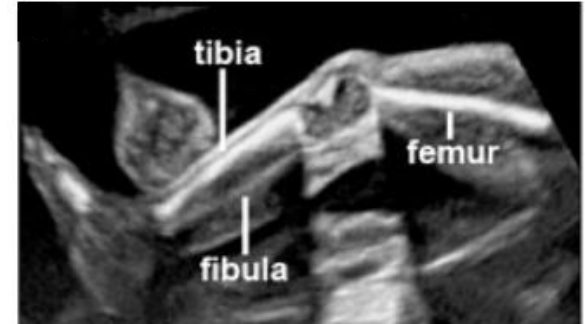
Key features of FL section: plane 15 (femur)

- **Both ends** of ossified metaphysis clearly visible (*rotate + slide*)
- Distal femoral epiphysis if visible or spur artefacts **should not** be included
- **Angle of femur** to incident beam should correspond to technique of reference chart (*dip*)
- Recommend 0° - 15° to horizontal

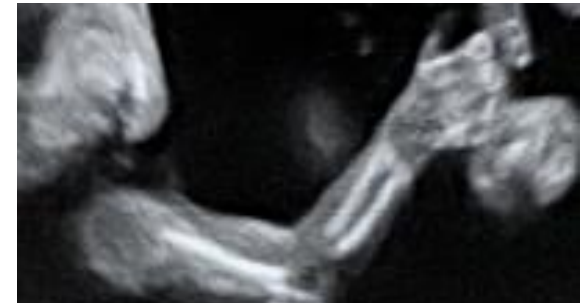


Planes 16 (lower limbs) & 17(upper limbs)

- Number of bones
- Length, FL + visual assessment
- Echogenicity
- Shape
- Position (hands & feet)
- Movements, flexion, extension

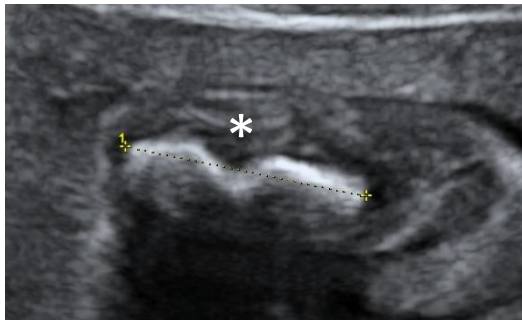


Plane 16

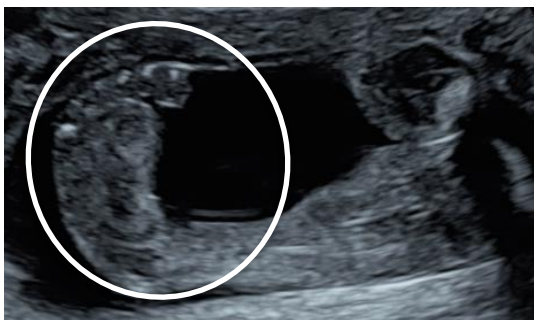


Plane 17

Normal & abnormal appearances of planes 15 (femur) -16 (lower limbs)



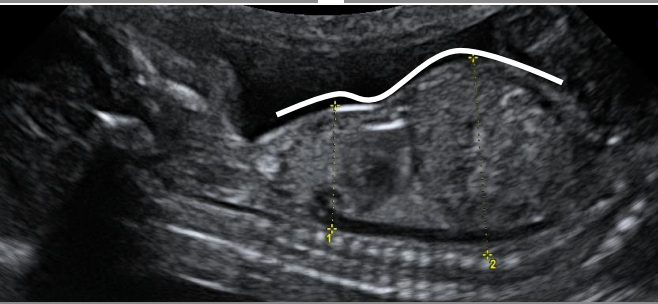
Plane 15



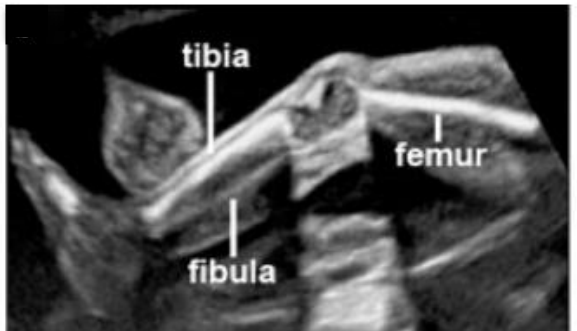
Plane 16



Plane 15



Sweep 1



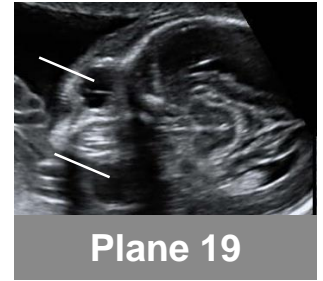
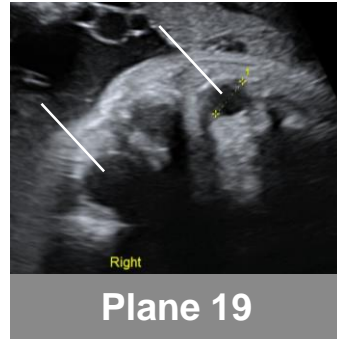
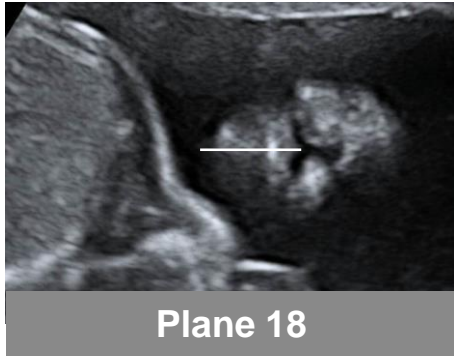
Plane 16

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7-10	Thorax	AVSD, CPAM, double aortic arch, ectopia cordis, overriding aorta, persistent left vena cava*, right aortic arch, severe aortic stenosis, coarctation & pulmonary stenosis, significant pericardial effusion (>4 mm) & pleural effusion (>4 mm), situs inversus/ambiguous, tetralogy of Fallot, transposition, univentricular heart, VSD (moderate/large)
11-13	Abdomen	Ascites, bilateral renal agenesis, duodenal atresia, echogenic bowel*, gastroschisis, omphalocoele, renal pelvic dilatation (>7 mm AP), small/absent stomach
14	Pelvis	Cystic renal dysplasia, lower urinary tract obstruction, 2 vessel cord
15-17	Limbs	Fixed flexion deformities wrist, severe skeletal dysplasia (some), talipes
18-20	Face	Anophthalmia, cataract*, cleft lip, proboscis*, severe micrognathia

* optional, for local decision as to whether or not included

Planes 18 (upper lip), 19 (orbits), & 20 (profile)



Size and relative size



Plane 4

Small HC (below 5th centile)

- Microcephaly
- Spina bifida



Plane 11

Small AC (below 5th centile)

- Congenital diaphragmatic hernia (CDH)
- Abdominal wall defect
- Early fetal growth restriction (FGR)



Plane 15

Small FL (below 5th centile)

- Skeletal dysplasia
- Down's syndrome
- Early FGR ?

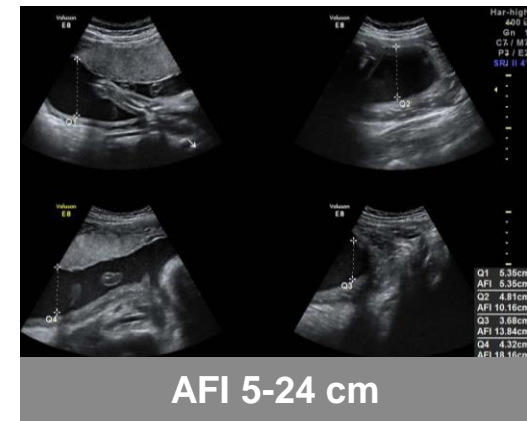
Amniotic fluid volume

Polyhydramnios

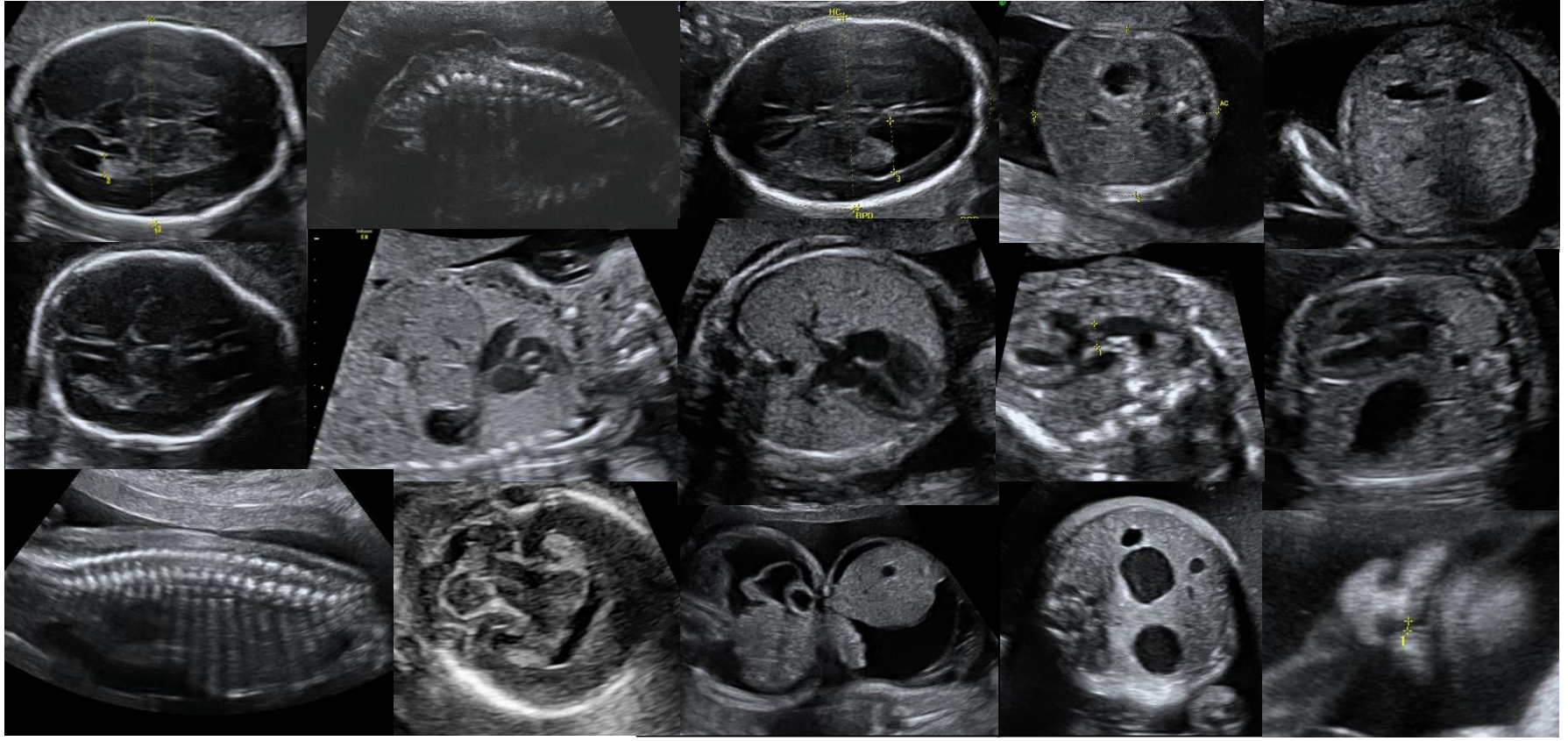
- Anencephaly
- Upper gastrointestinal tract (GIT) anomalies
- Skeletal dysplasias involving small chest

Oligohydramnios / anhydramnios

- Renal anomalies
- Fetal growth restriction
- Premature rupture of membranes



Normal or abnormal appearances? (planes 1-20, sweeps 1 & 2)



Key points

1. The key to identifying abnormalities is understanding the range of normal appearances at differing gestations
2. It is important to develop a consistent & logical approach to each scan, rather than scanning randomly. The 20+2 planes approach provides this consistent & logical approach
3. If you are unable to confirm that the appearance and/or size of the fetus is normal, seek a more experienced opinion



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