



The Second Trimester Obstetric Scan (7 + 3 = 10): A Rational Approach (Including the “Rule of Three”)

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Abstract The second trimester targeted scan is done between 18 and 20 weeks. The primary objective of this scan is to do a detailed anatomical evaluation of the fetus and to maximize the detection of anomalies that may be present at this stage. A systematic method of ultrasound scanning of the fetus will ensure that a reasonably complete examination of the fetus is accomplished. A “rule of three” approach helps in ensuring that no major structures are missed out during the scan. It is a simple “checklist” approach which can be easily remembered. It not only helps in standardized training and performance but also helps in a systematic audit when anomalies are missed.

Keywords Second trimester · Targeted scan · Rule of three · Checklist · Anomalies

Introduction

The single most important scan during pregnancy is the second trimester targeted scan, which is done between 18 and 20 weeks. Since this scan is primarily meant for exclusion or diagnosis of fetal anomalies it is important that a thorough examination of the fetus is done during this period. The second trimester targeted scan is a head to toe clinical examination of the fetus. A thorough and a detailed study should be done to fulfill the following objectives.

- To predict with confidence, the structural normalcy of the baby within reasonable limits of expectation
- To identify severe and lethal abnormalities
- To raise the suspicion of an abnormality, which would warrant further testing or serial scans

To fulfil the above objectives, a high-level of expertise is required, which can be attained by

- Continuous training,
- A systematic method of examination and
- Audit

The 7 + 3 = 10 Concept

The numbers 7, 3 and 10 aptly describe the second trimester scan. The number “7” is the number of steps to be followed. The number “3” is the number of anatomical structures to be seen in each plane and “10” is the outer limit of normal for measurements of lateral ventricles, cistern magna and renal pelvis.

The “Rule of Three” Concept

The “rule of three” concept was evolved in the year 1995 by the authors. It is a systematic method of examination of the fetus designed to achieve maximum yield from the ultrasound examination in the least possible time. It is easily reproducible and is useful for audit. By following the “rule of three”, it is possible to say that all aspects of the fetus that are expected to be seen have indeed been imaged. This ensures that the examination has been done satisfactorily.

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The Second Trimester Targeted Scan

The second trimester ultrasound involves a seven step process as listed below:

- History
- Survey
- Biometry
- Targeted imaging
- Fetal activity
- Fetal environment
- Reporting

Each of the above steps gives us specific information about the fetus and all the steps are performed in the same order.

It is important to understand that even if an obvious anomaly like anencephaly is identified immediately after starting the scan, a systematic examination of the fetus should be done as described above without skipping any of the steps.

Importance of Each Step

Every step of the obstetric scan will yield specific information which is finally collated in the seventh step which is “reporting”.

I. History

The primary objective of history taking is to decide whether the pregnancy is “high risk” or “low risk”. The GA can be calculated either by the last normal menstrual period (LNMP) or by early scans if the information is available. At the end of this exercise, we can decide whether we need to extend our examination beyond the “rule of three”. For example, if the previous child was diagnosed as a harlequin fetus, measurement of the foot length in this pregnancy would be needed in addition to routine biometry.

II. Survey

It is the second step on the obstetric scan. The survey scan is meant to have a global picture of the gravid uterus (Fig. 1) much akin to us visiting a new house or building. The information we would like to gather from the survey scan are:

- Number of fetuses
- Lie and position of the spine
- The viability
- The location of placenta
- The available space around the baby amniotic fluid

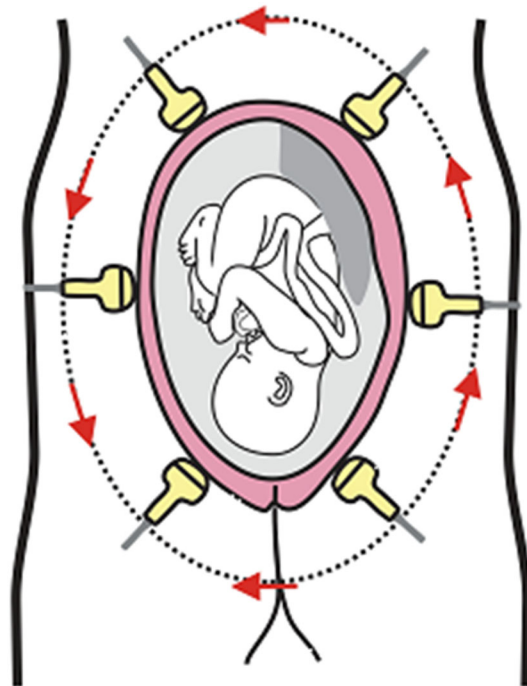


Fig. 1 Longitudinal plane of section demonstrating the fetal body in cephalic presentation with long axis of fetal spine to maternal left

Identifying the long axis of the spine of the baby will help us to locate all the major anatomical fetal parts.

III. Biometry

It is the third step. Fetal biometry is done to assess fetal age and “size for the age”. Though a large number of biometric parameters have been described, the minimum parameters that must be measured are BPD/OFD/HC/AC and FL. It is also wise to include transcerebellar diameter (TCD) in the biometric protocol.

For assigning the gestational age (GA) of the fetus the following steps are followed:

- Calculate GA and estimated date of delivery (EDD) by LNMP
- Calculate GA by biometric parameters
- Decide whether the EDD is to be corrected according to biometry. This is done if there is a significant discrepancy between the menstrual age and the ultrasound age

In the second trimester a difference of >10 days between last menstrual period (LMP) GA and USG GA between 14 and 21 weeks and >14 days between 20 and 28 weeks. The EDD has to be recalculated.

If a first trimester scan has been done, it would be appropriate to assign the gestational age by the first trimester parameters and use the second trimester biometry to predict the interval growth and size of the baby.

IV. Targeted Imaging

This is the fourth and the most crucial step during the second trimester scan. A detailed examination of the fetus is done in a systematic and reproducible manner. The “rule of three” approach entails visualizing three anatomical landmarks in each part or plane of section of the fetus and its environment. At the end of the examination, one must be able to declare with confidence, the following three aspects:

- The fetus is structurally normal for this period of gestation
- Major abnormalities have been detected or excluded
- A suspicion of an anomaly is raised

Targeted scan synonyms

TIFFA (Targeted imaging for fetal anomalies) Anomaly scan

Please note: The word “routine” scan is preferably avoided

Anatomical Planes and Structures to be Examined

Head The head is examined in three planes

1. Transthalamic plane
2. Ventricular plane
3. Transcerebellar plane

1. Transthalamic Plane is the plane which has been traditionally used to measure the biparietal diameter (BPD) and head circumference (HC) (Fig. 2). The three structures to be looked for in this plane are:

- i. Falx, which is interrupted by
- ii. Cavum septum pellucidum
- iii. Thalami, forming an arrow pointing to the occiput

The cavum septum pellucidum can be seen in the transthalamic and in the lateral ventricular plane.

2. Ventricular Plane The three structures to be identified in this plane are:

- i. The lateral ventricles
- ii. Choroid plexes and
- iii. Cavum septum pellucidum

The occipital horn of the lateral ventricle must be imaged clearly. Measurement of the atrium is done at the level of the glomus of choroid plexus. The far field lateral ventricle is better seen, as the near hemisphere is obscured by reverberation artifacts. To see both lateral ventricles, a coronal view of the head is ideal (Fig. 3a, b).

3. Transcerebellar Plane is imaged by rotating the probe posteriorly from the BPD plane till a clear view of the posterior fossa and the occipital bone is obtained

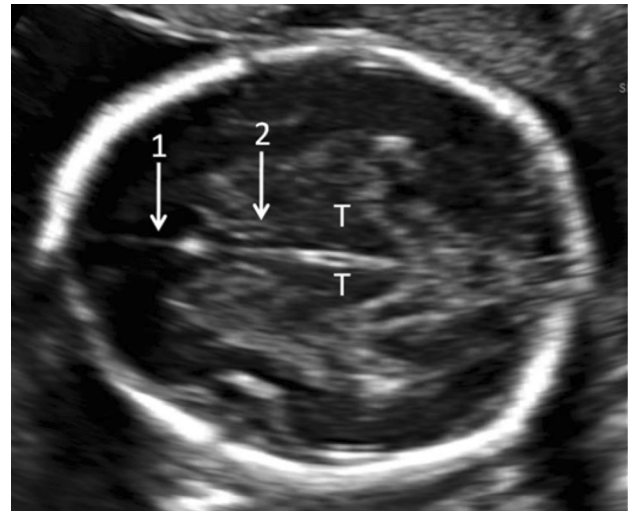


Fig. 2 Transverse axial scan of fetal head at the level of Thalami. (1) Falx cerebri (2) Cavum septum pellucidum. T Thalami

(Fig. 4). The three structures to be identified in the posterior fossa are:

- i. Rounded cerebellar hemispheres (dumb-bell shaped).
- ii. Vermis of the cerebellum. (there should be no space in between the two cerebellar hemispheres).
- iii. Cisterna magna (seen as a clear space between the cerebellum and the occipital bone).

The transcerebellar plane imaging helps to exclude open neural tube defects with Arnold–Chiari malformation in addition to a number of posterior fossa abnormalities. The nuchal fold thickness is measured from the occipital bone to the outer aspect of the skin at the level of the occipital bone. In the second trimester, the upper limit of normal of the nuchal fold thickness is 6 mm.

Spine The spine is imaged in three axes, namely

1. Sagittal
2. Transverse
3. Coronal

Of these, the sagittal and transverse axes are essential.

In the sagittal axis, we look for three aspects of the spine.

- i. Cervical widening
- ii. Parallel thoracic and lumbar spine
- iii. Sacral tapering

In the sagittal section of the spine, the typical “three line appearance” is identified which consists of the skin line, the lamina and body of the vertebra in that order (Fig. 5a, b). In the transverse axis, the three ossification centers forming a triangular shape is identified (Fig. 6).

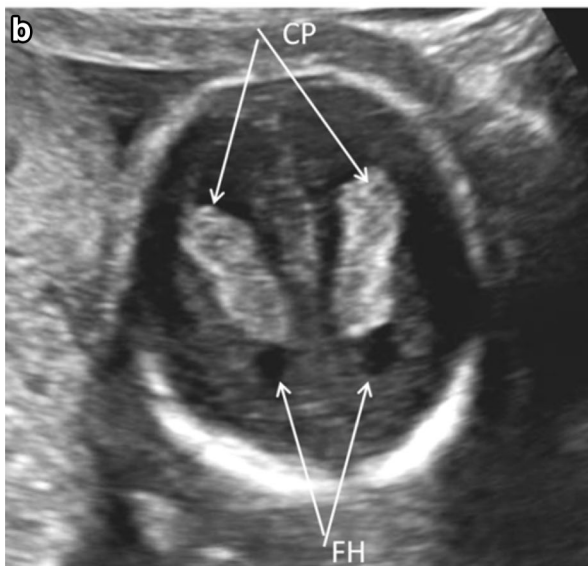
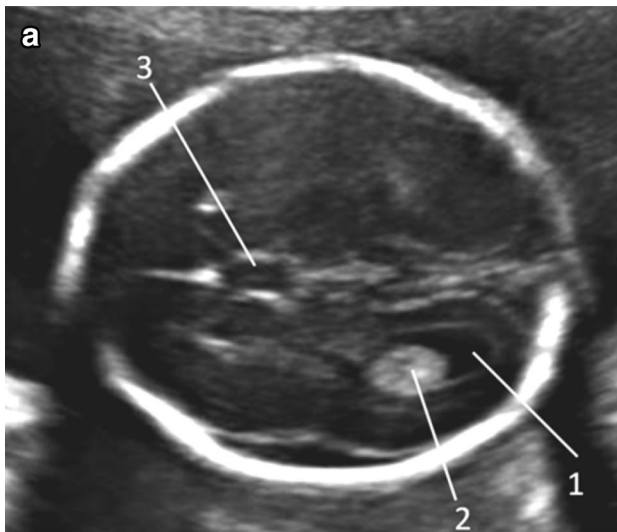


Fig. 3 **a** Transverse axial scan at the level of lateral ventricles. (1) Lateral ventricles (2) Choroid plexus (3) Cavum septum pellucidum. **b** Coronal view of fetal lateral ventricles through, posterior fontanel, CP choroid plexus, FH frontal horns

The coronal view of the spine is not compulsory during targeted scan. However one should remember that the minimal widened appearance of lumbar vertebra in this view is normal and should not be mistaken for spina bifida (Fig. 7).

Thorax The thorax comprises three structures

- Heart
- Right lung
- Left lung

The two lungs and heart occupy equal space in the thorax (1/3) each. The upper limit of the normal sized heart is 50 % of the thoracic size.

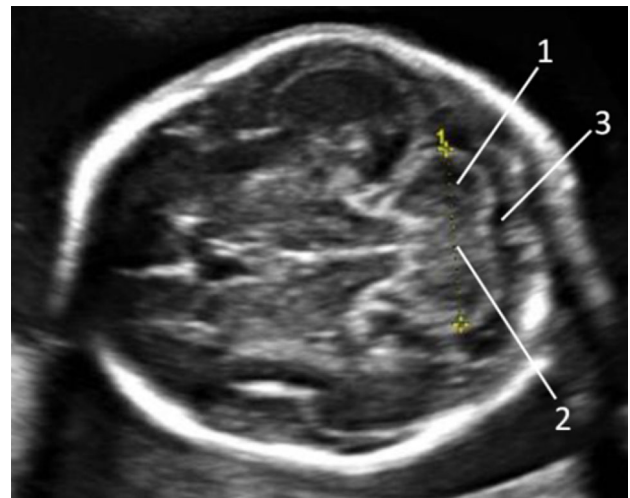


Fig. 4 Transverse axial view posterior fossa. (1) Cerebellar hemisphere (2) Cerebellar vermis (3) Cisterna magna

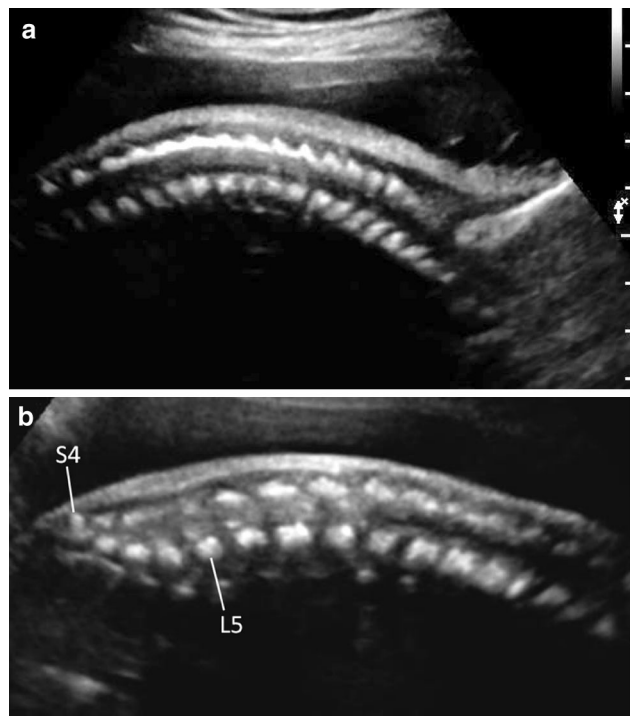


Fig. 5 **a** Sagittal section of the cervico-thoracic spine. (1) Skin line (2) The lamina (3) Body of the vertebra. **b** Sagittal section of the lumbosacral spine

Heart The three views of the heart that should be seen are:

1. Four chamber view
2. Outflow tracts
3. Three vessel view

1. Four Chamber View In a four chamber view (Fig. 8, 9), the three structures to look for are:

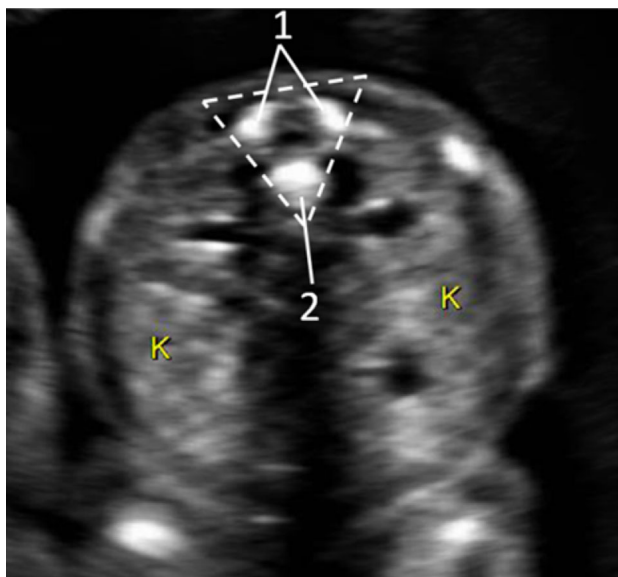


Fig. 6 Transverse axial sonogram of spine showing (1) Ossification centers in laminae (2) Ossification centers in vertebral body

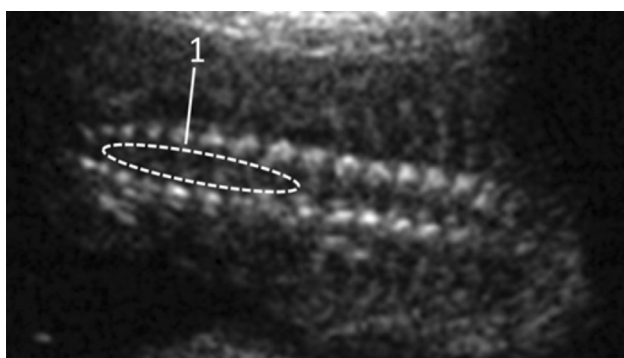


Fig. 7 The coronal view of the spine. (1) Minimal lumbar widening appearance of vertebra in this view is normal

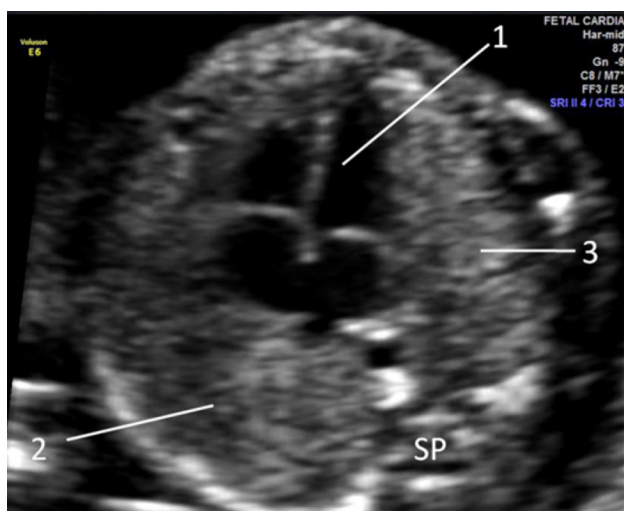


Fig. 8 Transverse axial sonogram of thorax. (1) 4 chamber Heart (2) Right lung (3) Left lung

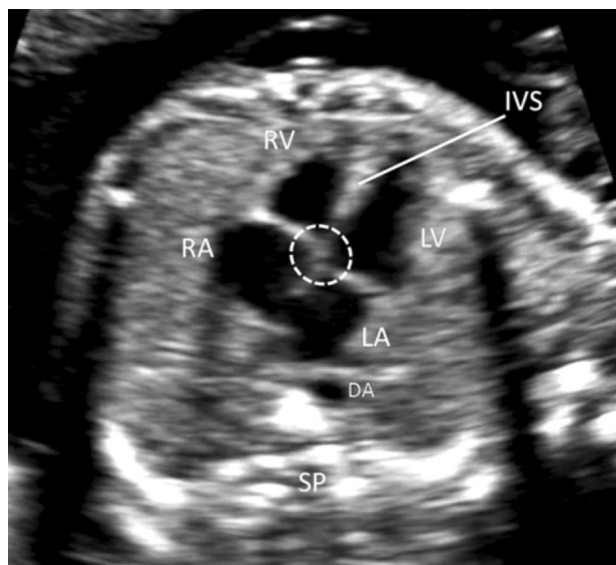


Fig. 9 Transverse axial sonogram of thorax showing 4 chamber fetal heart at 20 weeks scan. *SP* spine, *DA* descending aorta; *RA* right atrium, *RV* right ventricle, *LA* left atrium, *LV* left ventricle, *IVS* interventricular septum, Dotted circle- crux of the heart

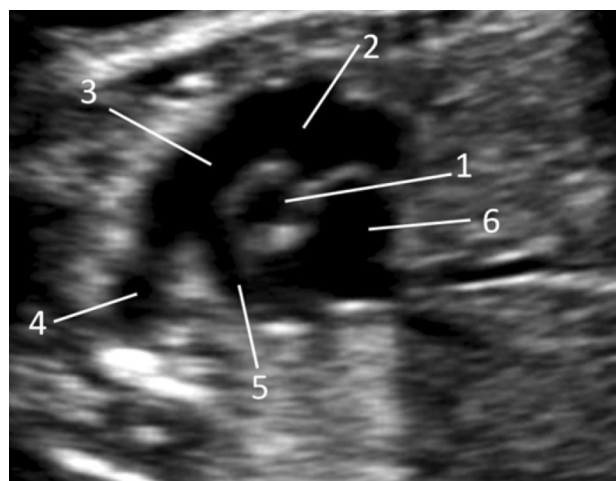


Fig. 10 Basal short axis view of right ventricular outflow tract. (Circle and sausage view). (1) Cross section of the ascending aorta root (2) Right ventricle (3) Main pulmonary artery (4) Left pulmonary artert (5) Right pulmonary (6) Right atrium

- i. The crux of the heart formed by the IVS, atrioventricular septum and interatrial septum
- ii. Chamber symmetry
- iii. Movements of mitral and tricuspid valves in real time

2. Outflow Tracts At the origin, the outflow tracts are seen crossing each other with pulmonary artery anterior and aorta posterior. The anterior aortic root should be continuous with the interventricular septum and the posterior aortic root with the mitral valve (Fig. 11). The bifurcation of the pulmonary artery must be



Fig. 11 Short axis view of left ventricular outflow tract



Fig. 13 Transverse axial sonogram of fetal abdomen. *SP* spine, *PV* portal vein, *ST* stomach

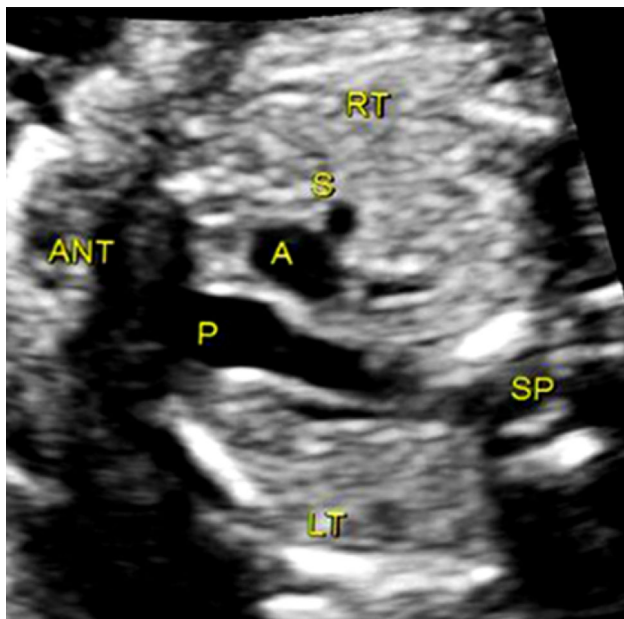


Fig. 12 3 vessel view. *P* pulmonary artery, *A* aorta, *S* superior vena cava

documented. The crossing of the outflow tract can be appreciated in the transverse view (circle sausage view) which shows the cross-section of the aorta and long section of the pulmonary artery (Fig. 10).

3. Three Vessel View This is the most important view for identifying outflow tract anomalies. This view is obtained by doing a cephalad tilt from the four chamber

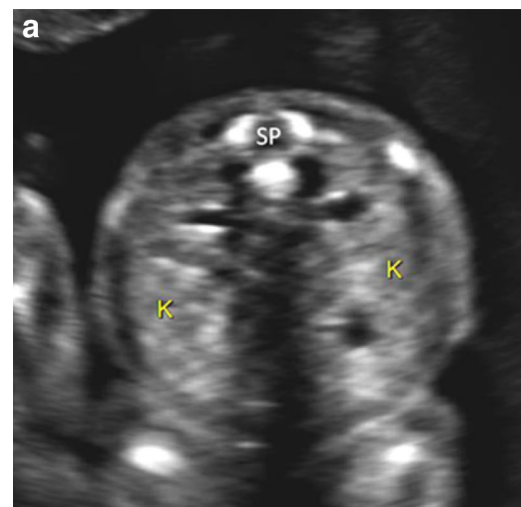


Fig. 14 **a** Transverse scan of kidneys. *SP* spine; *K* kidney **b** Coronal sonogram of the fetal kidneys. *K* kidneys

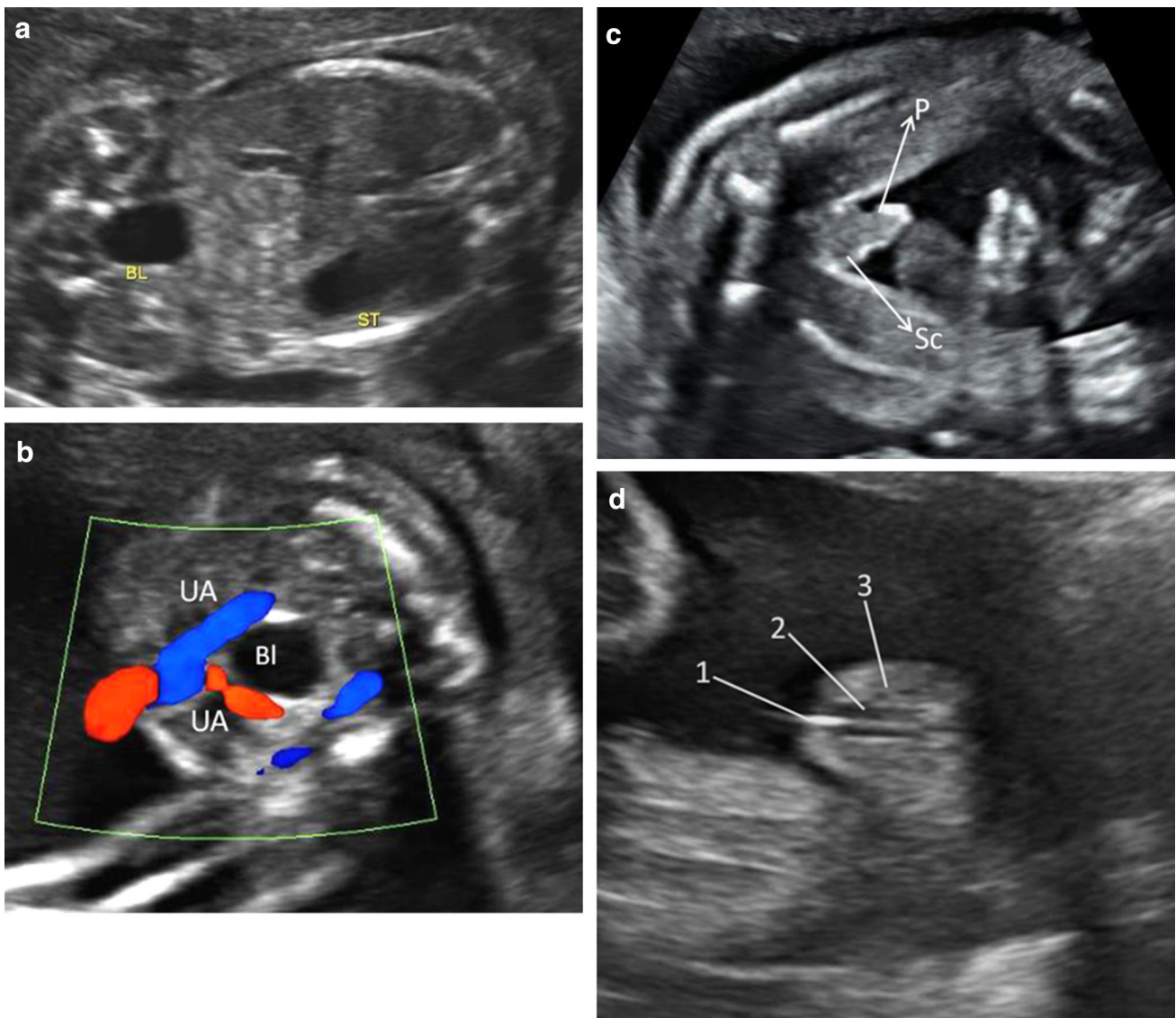


Fig. 15 **a** Anterior coronal sonogram of the fetal abdomen showing the stomach, small bowel and the bladder. **b** Umbilical cord insertion into the fetus. Umbilical arteries (UAs) are seen on either side of the

fetal bladder (BI). **c** Coronal section of fetal external male genitalia. *Sc* scrotum, *P* penis **d** Coronal section of fetal external female genitalia, (1) Major labium (2) Minor labium (3) Vaginal cleft

view at a plane superior to the cardiac chambers. The chambers are not visualized in this plane. The three vessels seen from left to right are pulmonary artery, aorta and superior vena cava (SVC) [PAS] (Fig. 12).

The pulmonary artery is largest in diameter and SVC the smallest in diameter. We look for

- i. Number
- ii. Alignment/arrangement and
- iii. Size of the three vessels

Abdomen: The abdomen is divided into three levels for convenience.

- (1) Upper abdomen; (2) Mid-abdomen; (3) Lower abdomen

1. Upper Abdomen The three structures to be identified are:

- i. Stomach
- ii. Portal vein and
- iii. Liver

The gall bladder may be seen as a cystic space in the right side of abdomen within the liver echoes (Fig. 13). But it is not necessary to identify and document the gall bladder in all cases. However, if the gall bladder is to the left of the portal vein, it indicates persistent right umbilical vein. In this plane, the adrenals may be seen as a thin streak paravertebrally. No other cystic structures should be seen in the upper abdomen.

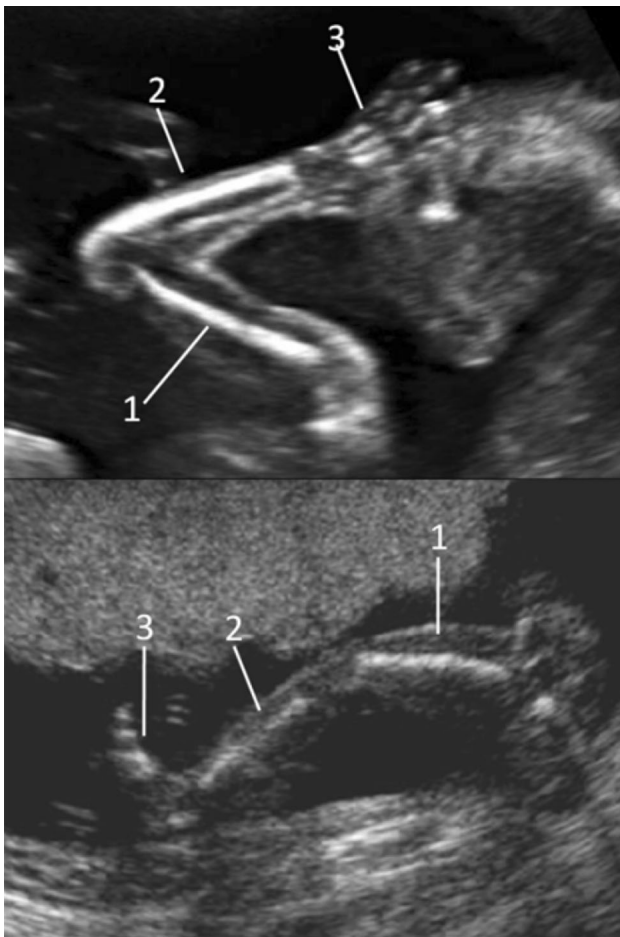


Fig. 16 The three segments of upper and lower limb. (1) Proximal (2) Mid (3) Distal segments

2. Mid-abdomen In the mid abdomen, the three structures to be identified are:

- i. Right kidney
- ii. Left kidney and
- iii. Small bowel

The kidneys should be visualized in the transverse and coronal axis (Fig. 14a, b). The small bowel is identified by its peristalsis. The AP diameter of the renal pelvis is done in the tranverse section.

3. Lower Abdomen In the lower abdomen, the three structures to be identified are the

- i. Bladder
- ii. Two umbilical arteries
- iii. Genitalia

The parabladder location is the best site for the identification of single umbilical artery and is done using color Doppler (Fig. 15a, b, c, d).

The Extremities Imaging the extremities is an essential component of the targeted scan and all the four extremities must be identified. In each extremity we look for:

- i. The three segments—proximal, mid, distal.
- ii. The three features—length, echogenicity and shape
- iii. Subjective assessment of the muscle mass

It is important to note that the foot and leg are at right angles to each other (Fig. 16). In a low risk patient, counting of fingers is not essential, but it would be wise to look for opening and closing of hands.

Face The three planes of examination of the fetal face are axial, sagittal and coronal. The three major structures to be visualized are:

- i. Orbits
- ii. Nose and
- iii. Mouth

The orbits are ideally visualized in the axial view (Fig. 17a, b, c, d). Nose and the nasal bone in sagittal view (Fig. 18a, b). In the coronal view the probe is angulated moved from anterior part of face to the orbits.

Lips/Nose

- In the anterior coronal view nose and lips are identified.
- In the mid-coronal view the premaxillary triangle (PMT) is identified which is formed by the two nasal bones as the two sides of the triangle and the premaxilla as the base of the triangle.
- The completion of the triangle ensures that there is no cleft hard palate.
- The posterior coronal view shows the orbits.
- The far orbit will not be visualized due to shadowing from the nasal bones. Hence an axial view is preferable to im

The targeted scan is considered complete at the end of the above mentioned steps.

V. Fetal Activity

It is the fifth step in the obstetric scan. Fetal activity can be observed while performing the targeted scan. In this step, we specifically look for flexion, extension movements of

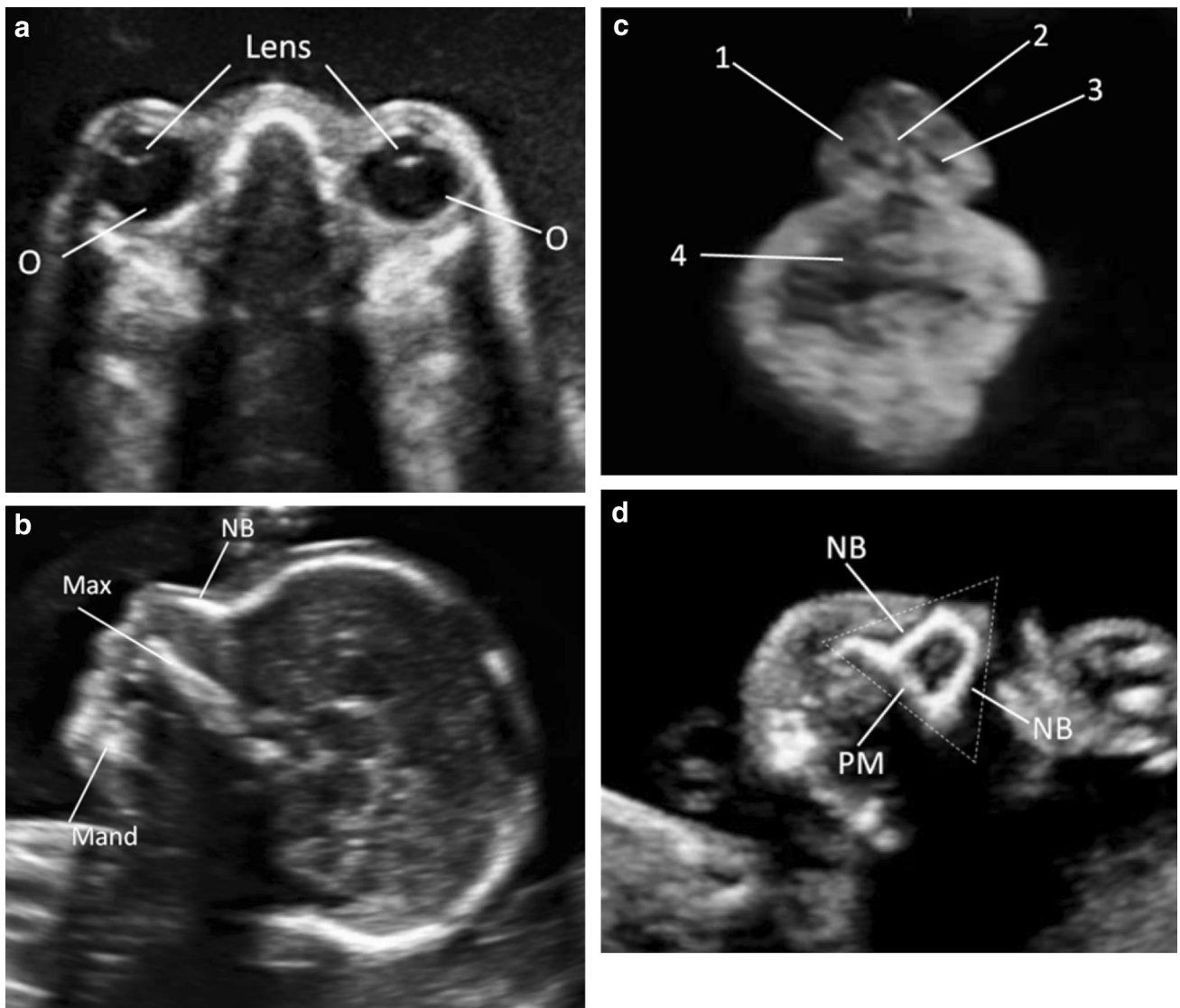


Fig. 17 **a** Axial view of fetal orbits. *O* orbits. **b** Mid-sagittal view of the fetal face (“profile” view). **c** Anterior coronal sonogram of the nose and mouth. (1) Ala (2) Column (3) Nostril (4) Lips. **d** Mid-coronal view—the premaxillary triangle (PMT)

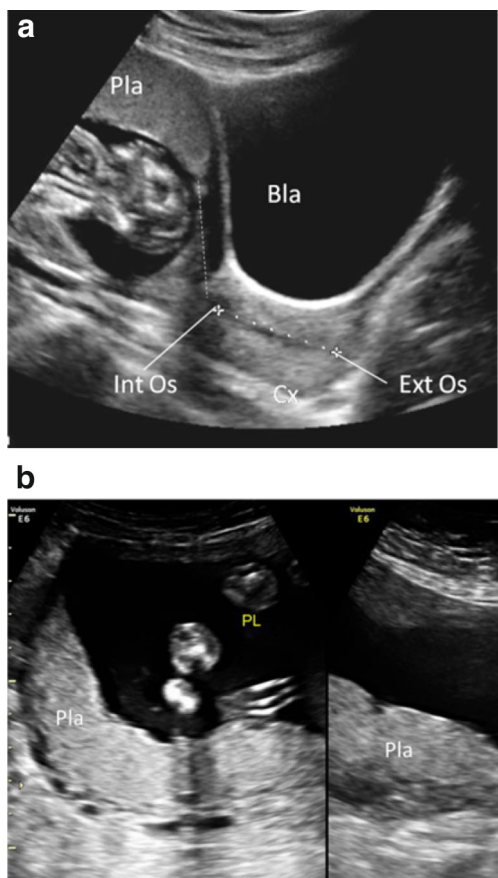


Fig. 18 **a** Second trimester transabdominal ultrasound of placenta in relation to Cervix. Pla placenta, *Int Os* internal Os, *Ext Os* external Os, *Cx* cervix, *Bla* bladder. Dotted line – distance between the lower edge of placenta in relation to internal os. **b** Second trimester transabdominal ultrasound of placenta

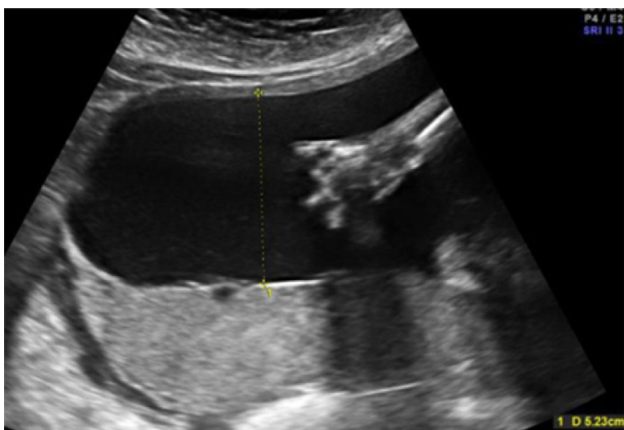


Fig. 19 Normal amniotic fluid volume assessment by measuring the largest single pocket of fluid

the limbs including opening and closing of fingers. An actively moving fetus is reassuring.

VI. Fetal Environment

This is the sixth step and includes the imaging of the

1. Placenta
2. Liquor
3. Umbilical cord

1. Placenta The three aspects of the placenta to be studied are:

- i. Location with specific reference to the lower edge of the placenta to the internal OS and the major site of implantation (Fig. 19)
- ii. Assessment of placental substance
- iii. Identification of the sub placental complex of veins which is visualized as a hypoechoic area, behind the placenta

2. Liquor The liquor can be assessed by three methods during pregnancy.

The three methods are:

- Subjective
 - Single pocket measurement
 - Amniotic fluid index (AFI)
-

Of these, subjective assessment is used in the second trimester and is highly reproducible. In case a suspicion of increased or decreased liquor, single vertical pocket may be measured (Fig. 19). The AFI is not done in the second trimester.

3. Umbilical Cord The umbilical cord is imaged in three locations and we look for three vessels in the chord (Fig. 20a, b, c). The three locations are:

- i. Placental attachment,
- ii. The free loop and
- iii. Cord entry into abdomen

VII. Reporting

This is the seventh and final step. A good structured report can be obtained by findings of each of the above steps in a simple and understandable language.

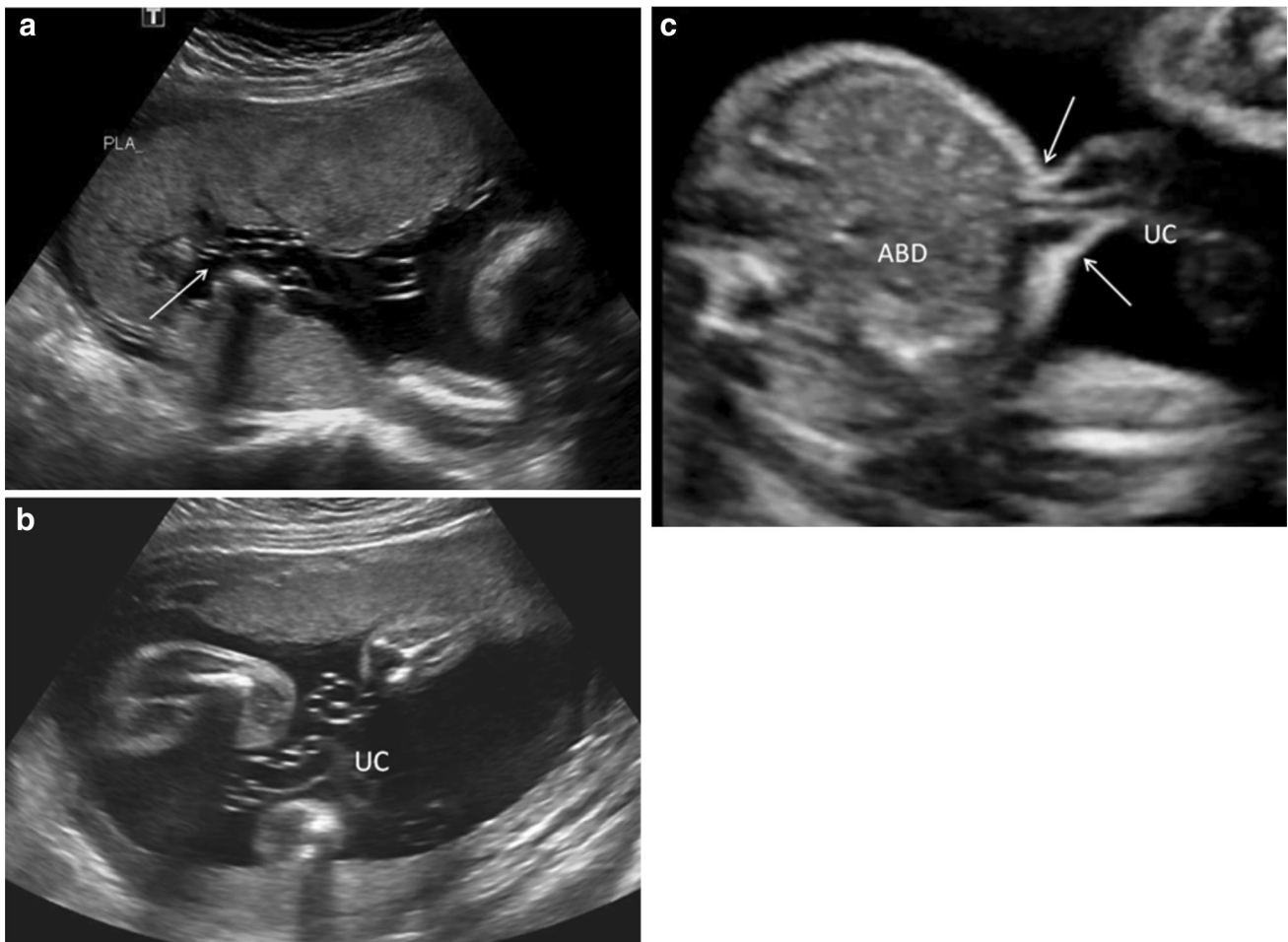


Fig. 20 a Sonogram of normal insertion of the umbilical cord into the anterior placenta. b Sonogram of free loop of umbilical cord. c Sonogram of umbilical cord entry into the fetal abdomen. UC umbilical cord, ABD abdomen

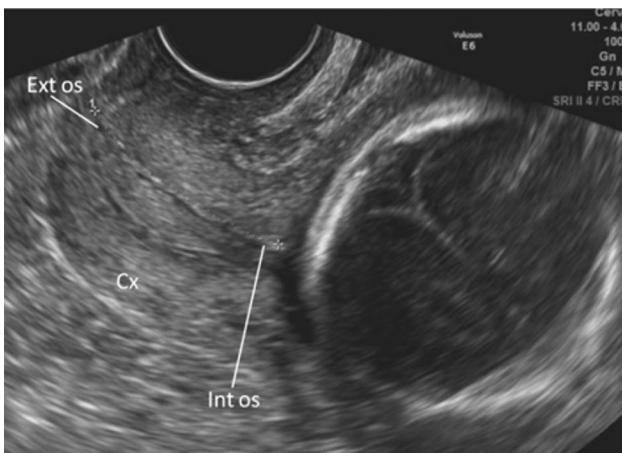


Fig. 21 Transvaginal sonogram of normal cervix in second trimester. Cx cervix, Ext os external os, Int os internal os

Evaluation of the cervix

The measurement of the cervical length is done to assess the risk of preterm labor. Cervical length is the distance between the internal and the external OS and is measured by the transvaginal scan (Fig. 21). The risk of preterm labor is predicted by using the appropriate likelihood ratio for a given length of the cervix. Routine screening for preterm labor by cervical length measurement has not yet been universally adopted in India at present.

Conclusion

The seven steps of the obstetric scan including the “rule of three” in targeted imaging can be done in most cases within 20 min and is the most effective way of

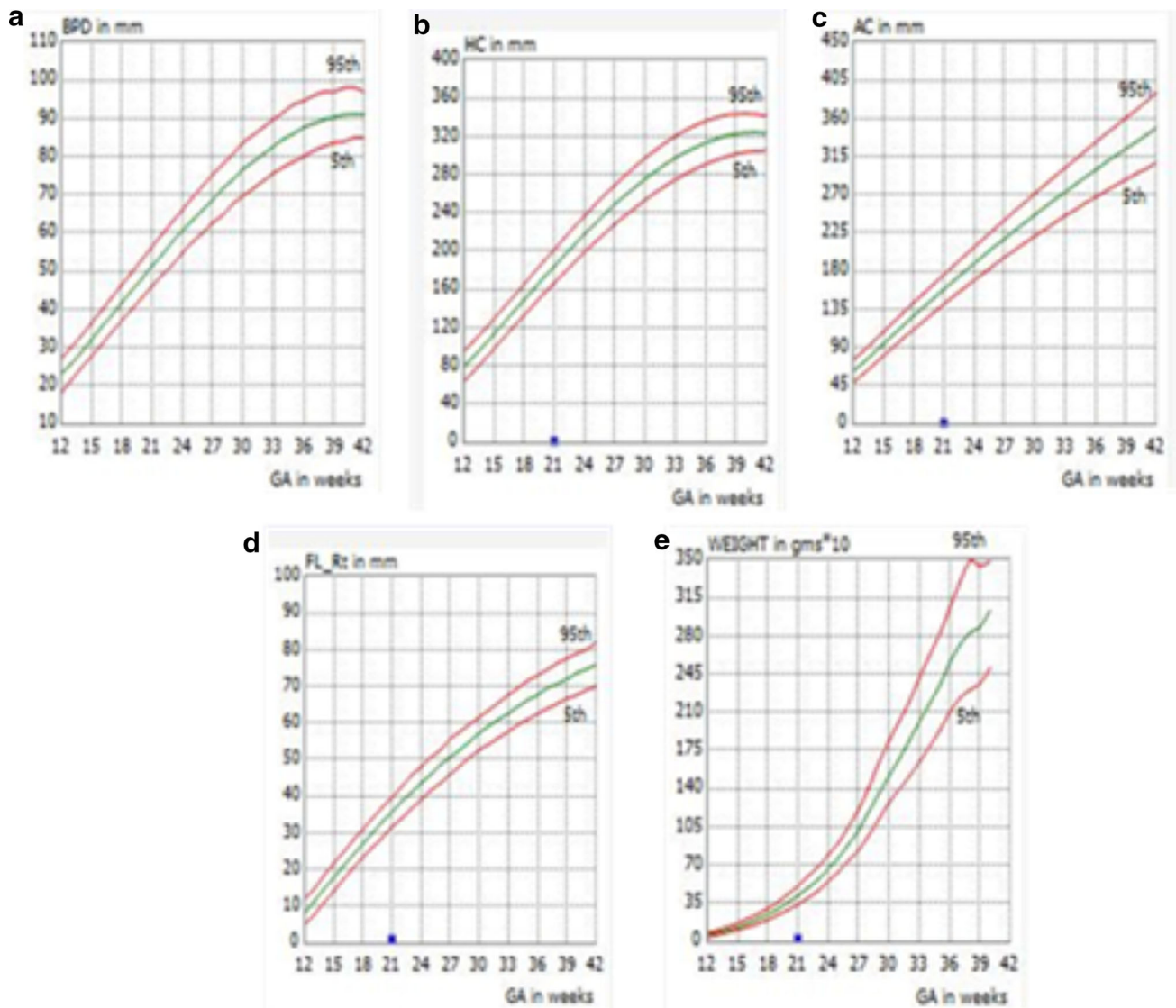


Fig. 22 Nomogram of BPD, HC , AC , FL and EFW depicting the 5th, 50th and the 95th %ile

achieving maximum yield from the scan. A reasonable amount of reassurance can be given regarding the absence of major structural abnormality in the fetus. It should be noted that there are several abnormalities which can evolve with advancing gestation and can be detected only in the third trimester and some anomalies may not be detected antenatally. Minor defects can sometimes be overlooked in low risk patients and they should be made aware of these limitations. Fig. 22 gives the nomograms for (a) BPD (b) Head

circumference (c) abdominal circumference (d) Femur length (e) Weight.

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Appendix 1: Checklist for Targeted Scan—Rule of Three

1. HEAD

- (a) BPD plane
- Interrupted falx
 - Thalamus
 - Cavum spetum pellucidum
- (b) LV plane
- Atria of lateral ventricles
 - Choroid plexes
 - Cavum septum pellucidum
- (c) Posterior fossa plane
- “Dumb Bell” shaped cerebellum
 - Vermis
 - Cisterna magna

3. THORAX

- (a) TS at level of 4 chamber view
- Right lung
 - Left lung
 - Heart (four chamber view)

5. ABDOMEN

- (a) Upper abdomen
- Stomach
 - Portal V
 - Gall Bladder
- (b) Mid-abdomen
- Right kidney (TS/LS)
 - Left kidney (TS/LS)
 - Small bowel
- (c) Lower abdomen
- Bladder
 - Two umbilical arteries
 - Genitalia

2. SPINE

- (a) Sagittal view
- Contour
 - “Three” lines
 - Sacral tapering
- (b) Transverse view
- Three ossification centers
- (c) Coronal view
- Not compulsory

4. HEART

- (a) Four chamber view
- Chamber symmetry
 - Crux
 - AV valve movements
- (b) RVOT/LVOT
- Crossing at root
- (c) Three vessel view (PAS)
- Number
- (d) Pulmonary artery
- Alignment
- (e) Aorta
- Size
- (f) SVC
-

6. EXTREMITIES

- (a) All four limbs to be seen
-
- (b) Three segments
- Length
 - Echogenicity
 - Shape

Checklist for Targeted Scan—Rule of Three

7. FACE

- (a) Three views for Orbits, Nose and Mouth
- | | | | |
|--------------------------|----------|--------------------------|----------------------|
| <input type="checkbox"/> | Axial | <input type="checkbox"/> | Orbits |
| <input type="checkbox"/> | Coronal | <input type="checkbox"/> | PMT |
| <input type="checkbox"/> | Sagittal | <input type="checkbox"/> | Nose with nasal bone |
| | | <input type="checkbox"/> | Lips |
| | | <input type="checkbox"/> | Chin |

8. FETAL ENVIRONMENT

- (a) Placenta
- | | | |
|--------------------------|----------------------|--|
| <input type="checkbox"/> | Location | |
| <input type="checkbox"/> | Placental substance | |
| <input type="checkbox"/> | Retroplacental space | |
- (b) Umbilical cord
- | | | |
|--------------------------|-----------------|--------------------------|
| <input type="checkbox"/> | Three vessels | |
| <input type="checkbox"/> | Three locations | <input type="checkbox"/> |
| | | Placental attachment |
| | | <input type="checkbox"/> |
| | | Entry into the abdomen |
| | | <input type="checkbox"/> |
| | | Free loop |
- (c) Liquor
- | | |
|--------------------------|-------------------------------|
| <input type="checkbox"/> | Subjective |
| <input type="checkbox"/> | Single pocket |
| <input type="checkbox"/> | AFI (only in third trimester) |
- (d) Cervix
- | | |
|--------------------------|-------------|
| <input type="checkbox"/> | Done by TVS |
|--------------------------|-------------|

Appendix 2: Sample of a Structured Report Documenting the Fetal Organs Imaged and Surveyed**Checklist for Fetal Anatomy****Head**

- Transthalamic plane : Midline Falx
 Cavum Septum Pellucidum
 Thalami
- Transventricular Plane : Cavum Septum Pellucidum
 Lateral Ventricles
 Choroid Plexus
- Transcerebellar Plane : Cerebellum
 Cisterna Magna

Abdomen

- Upper Abdomen : Stomach
 Portal vein
 Gall bladder
- Mid Abdomen : Right Kidney (LS/TS)
 Left Kidney (LS/TS)
 Small bowel
- Lower Abdomen : Bladder
 Two umbilical arteries
 Genitalia

Extremities

- Three segments : All 4 limbs to be seen
 Echogenicity
 Shape and length

Face

- 3 views : Axial
 Coronal
 Sagittal
- 3 Structures : Orbits
 Nose & mouth
 PMT view

Fetal Environment

- Placenta : Location
 Placental Substance
 Retroplacental space
- Umbilical cord : Three vessels
 Three Locations Placental attachment
 Entry into the abdomen
 Free loop
- Liquor : Subjective
 Single pocket
 AFI (Only in 3rd Trimester)
- Cervix : Sag. View done by TVS