II Trimester obstetric scan (7+3=10)

A Rational approach (includes the "Rule of Three")

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Acknowledgements

We are deeply indebted to the following persons
for making this booklet possible.

- Mrs.Vijayalakshmi Raja, Senior Sonographer, MediScan who described the “Premaxillary Triangle Sign” and incorporated it into the “Rule of Three”

- Mrs.Devaki Gopish, Senior Sonographer, MediScan

- The MediScan team who made sure that the “ Rule of three” is followed in our centre which has helped to improve the detection rate of anomalies.

- Dr.Chitra Ganesh who co-ordinated the editing and completion of the book.

- Ms. Mageshwari for the DTP graphics and her absolute commitment to bring this publication on time

The II Trimester Obstetric scan

The single most important scan during pregnancy is the II trimester targeted scan, which is done between 18-20 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 II 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, 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 fulfill 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 describes the II trimester scan. "7" is the number of steps to be followed. "3" is the number of anatomical structures to be seen in each plane "10" is the outer limit of normal for measurements of lateral ventricle, cisterna magna and renal pelvis.

THE "RULE OF THREE" CONCEPT

The "Rule of Three" concept was evolved in the year 1995 .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.

THE SECOND TRIMESTER TARGETED SCAN

The II trimester ultrasound involves a 7 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"**

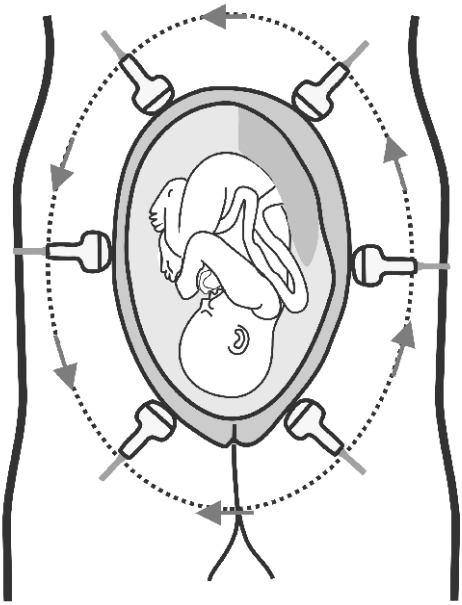
1. History : The primary objective of history taking is to decide whether the pregnancy is 'high risk" or " low risk". The gestational age can be calculated either by the LNMP or by early scans if the information is available. At the end of this exercise, we can decide whether we need to extend our examination beyond the "Rule of Three".

For eg : 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.

2. Survey : is the the second step on the obstetric scan.The survey scan is meant to have a global picture of the gravid uterus 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**

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



3. Biometry : 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 GA of the fetus the following steps are followed:

- Calculate GA & 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 II trimester a difference of > 10 days between LMP GA and USG GA between 14 - 21 weeks and > 14 days between 20-28 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 I trimester parameters and use the II trimester biometry to predict the interval growth and size of the baby.

4. Targeted Imaging 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 3 anatomical land marks 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.

1. The fetus is structurally normal for this period of gestation
2. Major abnormalities have been detected or excluded
3. 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:

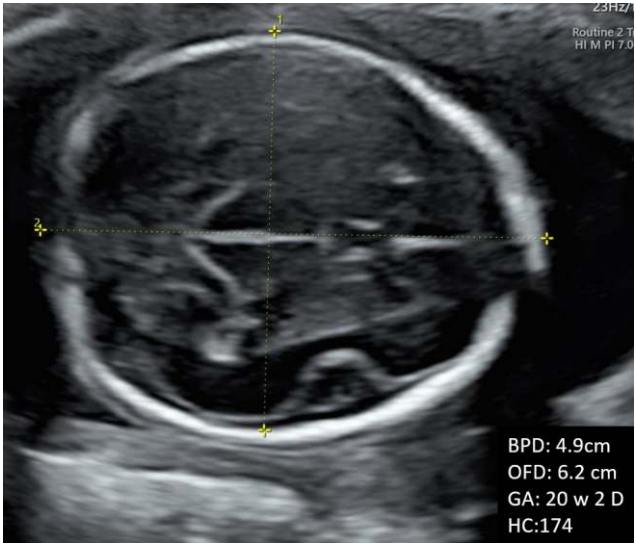
HEAD: The head is examined in 3 Planes

1. Trans thalamic plane
2. Ventricular plane
3. Trans cerebellar plane

1. **TRANS THALAMIC PLANE** is the plane which has been traditionally used to measure the BPD & HC. The 3 structures to be looked for in this plane are

> 1.Falx, which is interrupted by
> 2.Cavum septum pellucidum.
> 3.Thalami, forming an arrow pointing to the occiput.

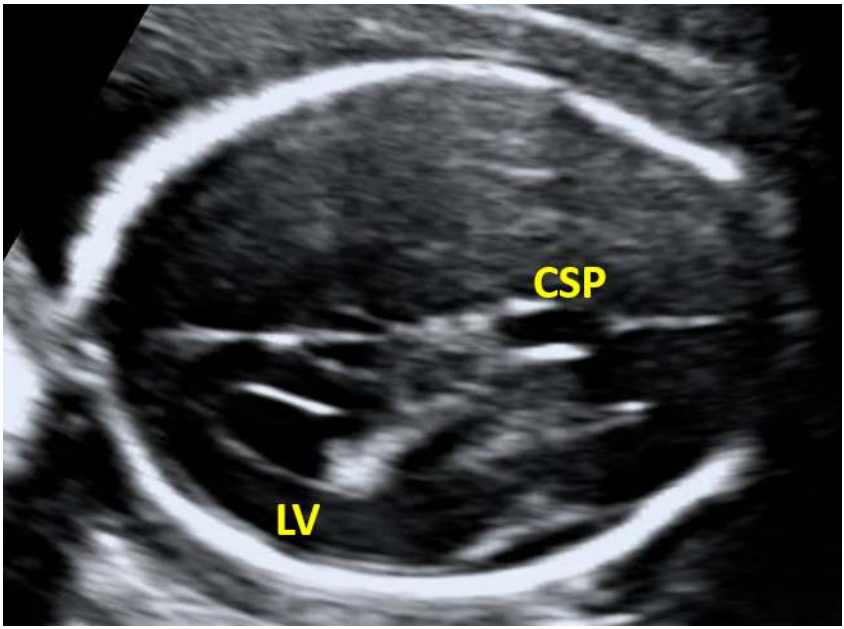
The cavum septum pellucidum can be seen in the trans thalamic and in the lateral ventricular plane.



2. VENTRICULAR PLANE :

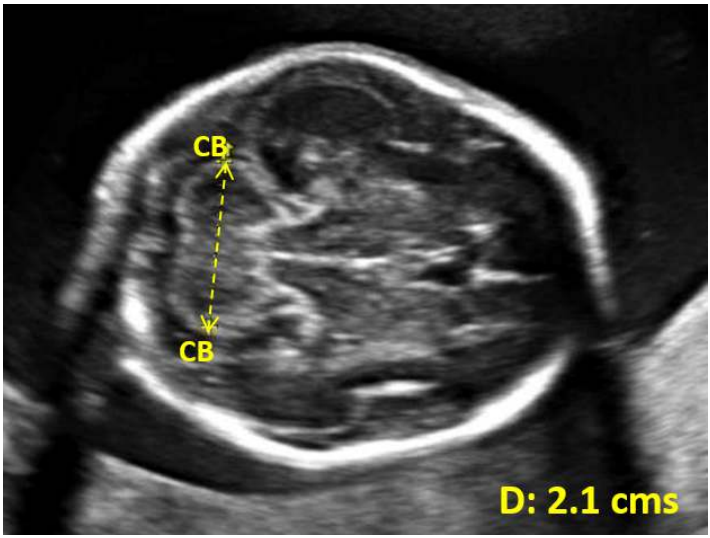
1. The lateral ventricles,
2. Choroid plexes and
3. Cavum septum pellucidum are the three structures to be identified in this plane.

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.



3. TRANS CEREBELLAR 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. 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 2 cerebellar hemispheres)
iii. Cisterna magna (seen as a clear space between the cerebellum and the occipital bone)



The trans cerebellar 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 II trimester, the upper limit of normal of the nuchal fold thickness is 6mm.

SPINE:

The spine is imaged in three axes, namely

1. Sagittal
2. Transverse
3. Coronal

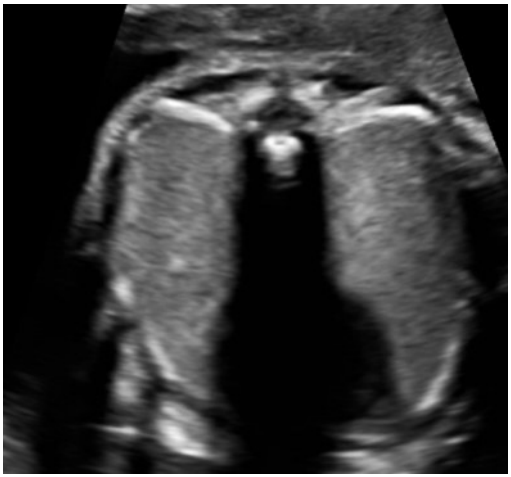
of these, the sagittal and transverse axes are essential.

In the sagittal axis, we look for 3 aspects of the spine

1. Cervical widening
2. Parallel thoracic and lumbar spine
3.. Sacral tapering

In the sagittal section of the spine the typical “3 line appearance” is identified which consists of the skin line, the lamina & body of the vertebra in that order.

In the transverse axis, the three ossification centres forming a triangular shape is identified.



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.

Thorax: The thorax comprises of 3 structures

١.Right Lung
٢.Left Lung
٣.Heart

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.

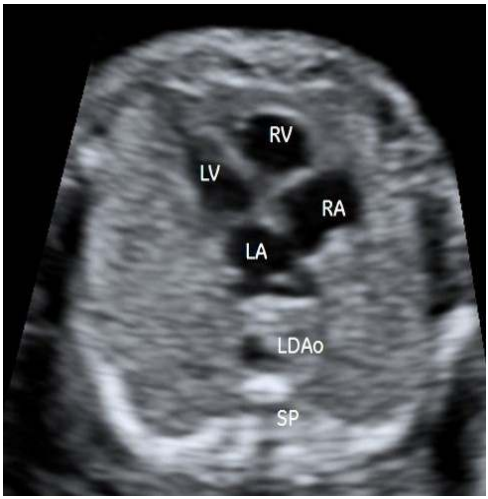
Heart : The 3 views of the heart that should be seen are

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

i. 4 Chamber view :

In the 4 chamber view the 3 structures to look for are

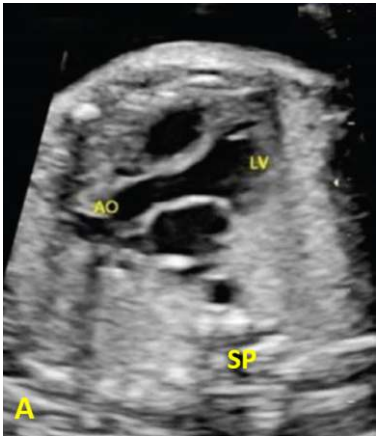
1.The crux of the heart formed by the IVS, Atrioventricular septum and interartrialseptum
2.Chamber symmetry
3.Movements of mitral and tricuspid valves in real time.



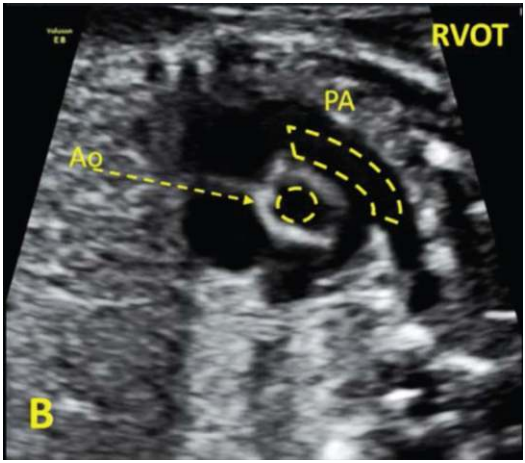
ii. Outflow tracts : At the origin, the outflow tracts are seen crossing each other with pulmonary artery anterior and aorta posterior.

The anterior aortic root should be continuous with the Interventricular septum and the posterior aortic root with the mitral valve. The bifurcation of the pulmonary artery must be 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.



Outflow tract
Pulmonary artery

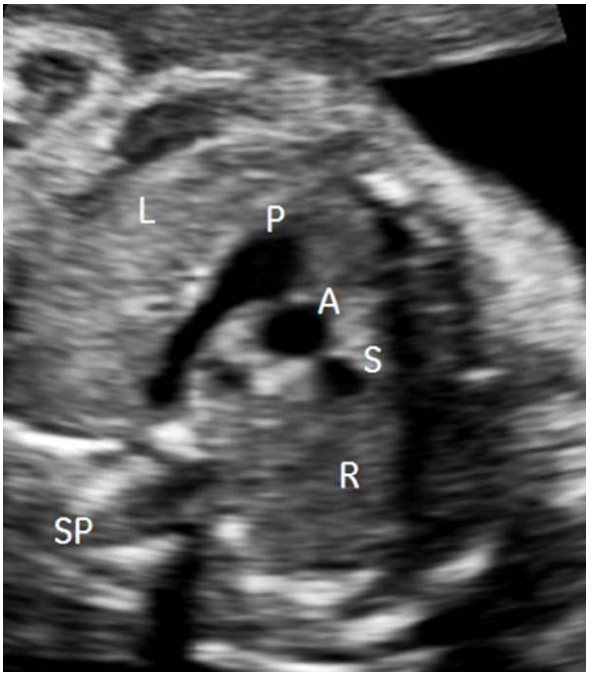


Outflow tract
Aorta

iii. 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 view at a plane superior to the cardiac chambers . The chambers are not visulaised in this plane. The 3 vessels seen from left to right are Pulmonary artery, Aorta and SVC. (PAS)

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

١. Number
٢. Alignment / Arrangement and
٣. Size of the three vessels



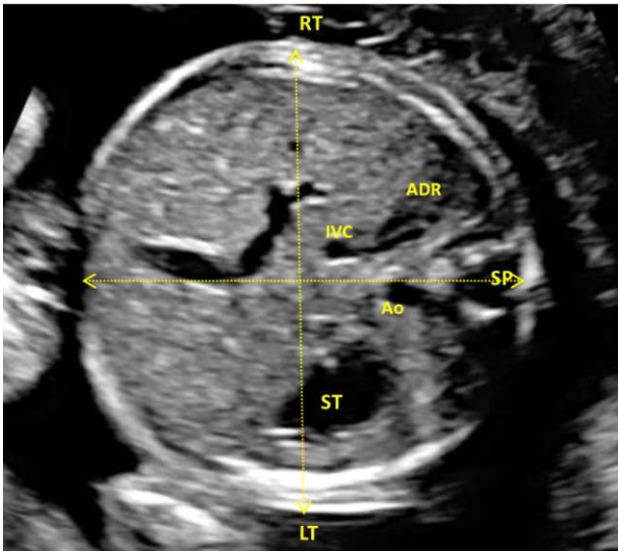
ABDOMEN - The abdomen is divided into 3 levels for convenience.

1. Upper abdomen
2. Mid abdomen
3. Lower abdomen

Upper abdomen : The 3 structures to be identified are

١. Stomach
٢. Portal vein and
٣. Liver

The gall bladder may be seen as a cystic space in the right side of abdomen within the liver echoes. 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.



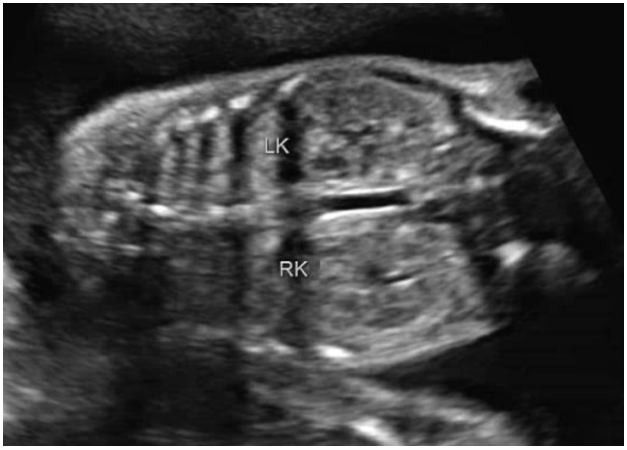
Mid abdomen : In the mid abdomen, the 3 structures to be identified are

1. Right kidney
2. Left kidney and
3. Small bowel.

The kidneys should be visualized in the transverse and coronal axis. The small bowel is identified by its peristalsis. The AP diameter of the renal pelvis is done in the tranverse section.

Kidney - Transverse

Kidney - Coronal

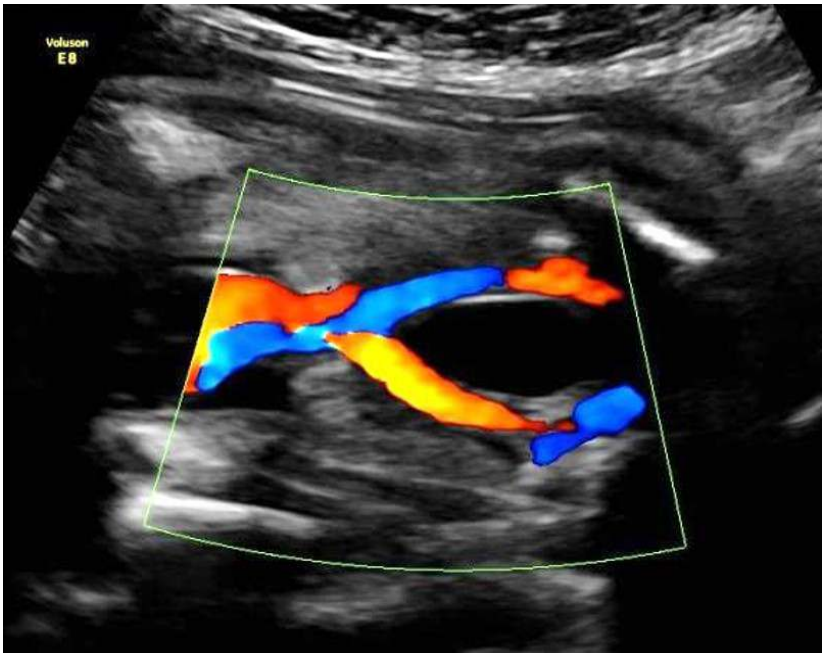


Lower abdomen: In the lower abdomen, the 3 structures to be identified are the

١.Bladder
٢.Two umbilical arteries
٣.Genitalia

The parabladder location is the best site for the identification of single umbilical artery and is done using color Doppler.

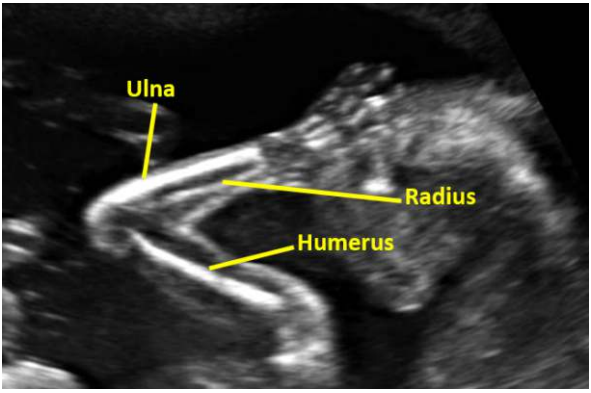
Two umbilical arteries

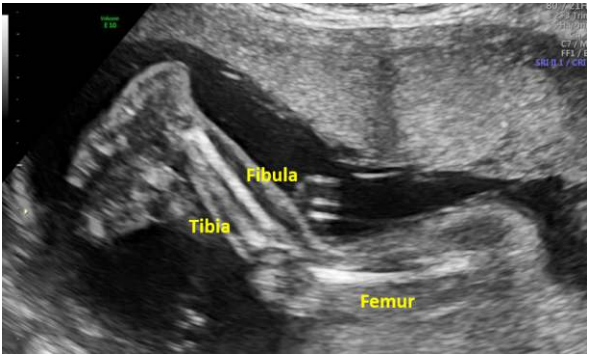


THE EXTREMITIES - Imaging the extremities is an essential component of the targeted scan and all the 4 extremities must be identified.

In each extremity we look for

1. The three segments - proximal, mid, distal.
2. The three features - length, echogenicity and shape.
3. Subjective assessment of the muscle mass.





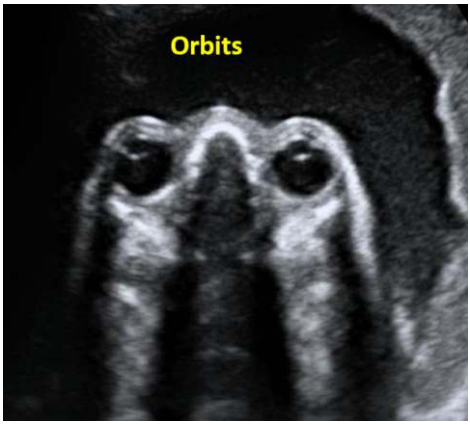
It is important to note that the foot and leg are at right angles to each other. In a low risk patient,counting of fingers is not essential, but it would be wise to look for opening and closing of hands.

FACE : The three planes of examination of the fetal face are axial, sagittal & coronal .

The three major structures to be visualized are

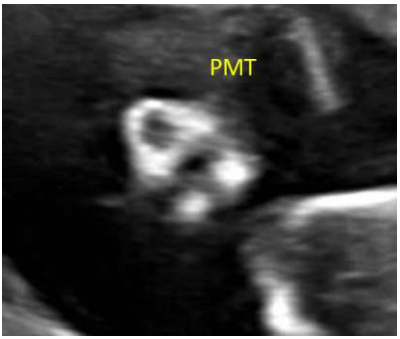
١ . Orbits
٢ . Nose and
٣ . Mouth.

The orbits are ideally visualized in the axial view.

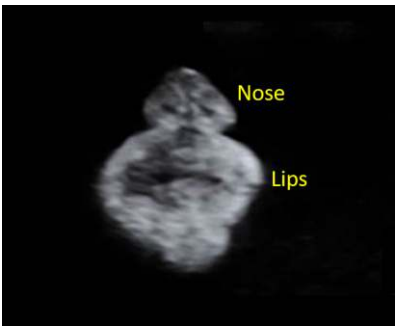


Nose and the nasal bone in sagittal view

In the coronal view the probe is angulated moved from anterior part of face to the orbits.



Premaxillary Triangle (PMT)



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 2 nasal bones as the 2 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 preferrable for imaging the orbits

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

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

FETAL ENVIRONMENT is the sixth step and includes the imaging of the

1. Placenta
2. Liquor
3. Umbilical cord

1. Placenta : The 3 aspects of the placenta to be studied are

a. Location with specific reference to the lower edge of the placenta to the internal OS and the major site of implantation.
b. Assessment of placental substance.
c. Identification of the sub placental complex of veins which is visualised as a hypoechoic area, behind the placenta.

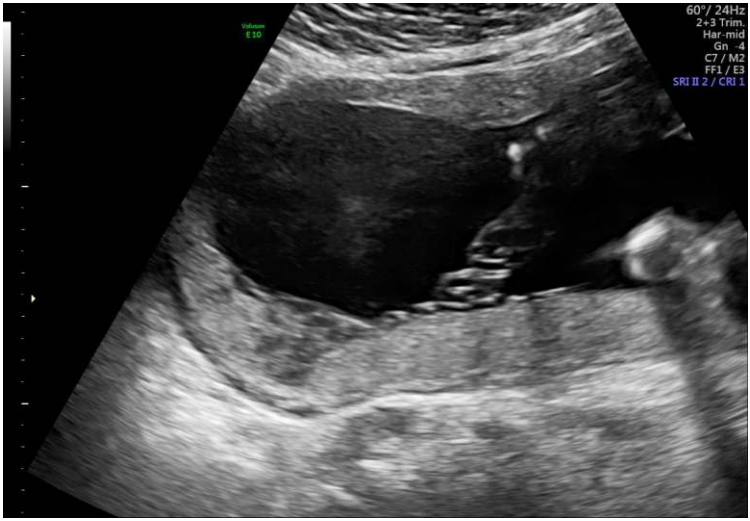
2. Liquor : The liquor can be assessed by 3 methods during pregnancy.

1.Subjective
2.Single pocket measurement
3. Amniotic fluid index AFI

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

3. Umbilical cord : The umbilical cord is imaged in three locations namely, and we look for 3 vessels in the cord. The three locations are

١.Placental attachment,
٢.The free loop and
٣.Cord entry into abdomen

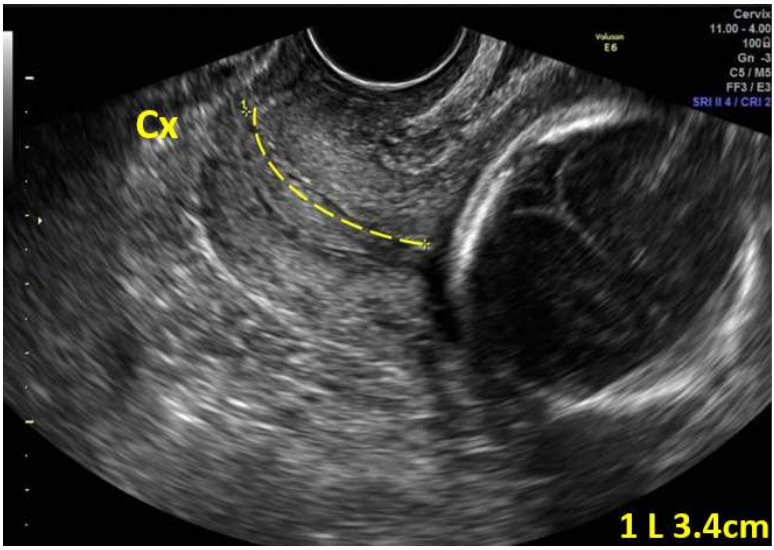


REPORTING is the seventh and final step. A good structured report can be obtained by documenting by findings of each of the above steps in a simple and understandable language.

EVALUATION OF THE CERVIX:

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

TVS - Cervix



CONCLUSION

The 7 steps of the obstetric scan including the "Rule of Three" in targeted imaging can be done in most cases within 20 minutes and is the most effective way of 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 III 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.

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Check list for Targeted Scan - Rule of three

HEAD	
BPD plane	☐ Interrupted falx ☐ Thalamus ☐ Cavum Septum Pellucidum
LV plane	☐ Atria of lateral ventricles ☐ Choroid plexes ☐ Cavum Septum Pellucidum
Posterior Fossa plane	☐ “Dumb Bell" shaped cerebellum ☐ Vermis ☐ Cisterna Magna
SPINE	
Sagittal view	☐ Contour ☐ "Three" lines ☐ Sacral tapering
Transverse view	☐ Three ossification centres
Coronal view	☐ Not compulsary
THORAX	
TS at level of 4ch view	☐ Right lung ☐ Left Lung ☐ Heart (4 chamber view)
HEART	
4 chamber view	☐ Chamber symmetry ☐ Crux ☐ AV valve movements
RVOT / LVOT	☐ Crossing at root
Three vessel view (PAS) **Pulmonary artery** **Aorta** **SVC**	☐ Number ☐ Alignment ☐ Size

Check list for Targeted Scan - Rule of three

ABDOMEN

Upper abdomen

- ☐ Stomach
- ☐ Portal V
- ☐ Gall Bladder

Mid abdomen

- ☐ Right kidney (TS / LS)
- ☐ Left Kidney (TS / LS)
- ☐ Small Bowel

Lower abdomen

- ☐ Bladder
- ☐ 2 Umbilcal arteries

EXTREMITIES

Three segments

- ☐ All 4 limbs to be seenLength
- ☐ Echogenicity
- ☐ Shape

FACE

Three views for Orbits, Nose & Mouth

- ☐ Axial
- ☐ Coronal
- ☐ Sagittal

- ☐ Orbits
- ☐ PMT
- ☐ Nose with nasal bone
- ☐ Lips
- ☐ Chin

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

- ☐ Done by TVS

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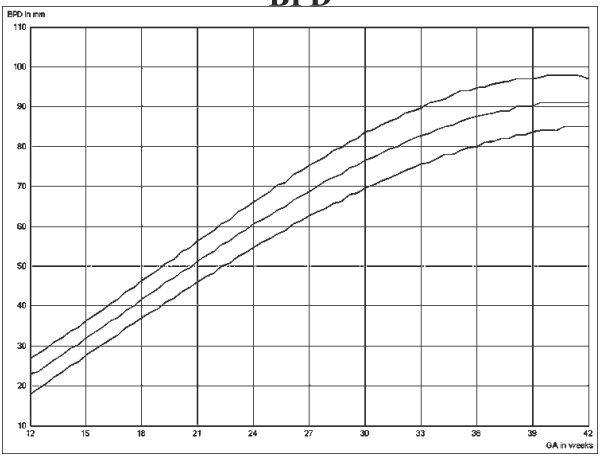
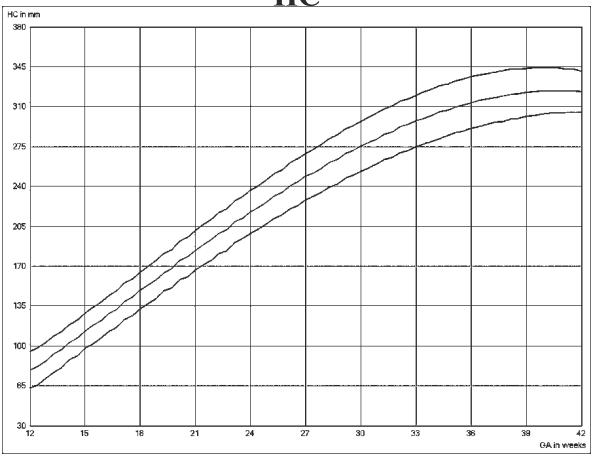
Standard Biometry Graphs - (Data from MediScan)

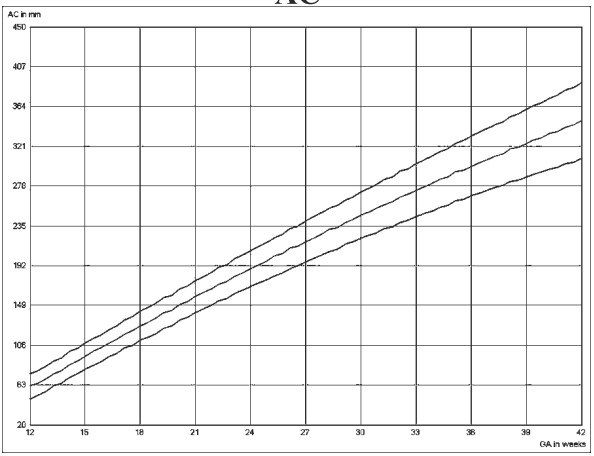
BPD



HC

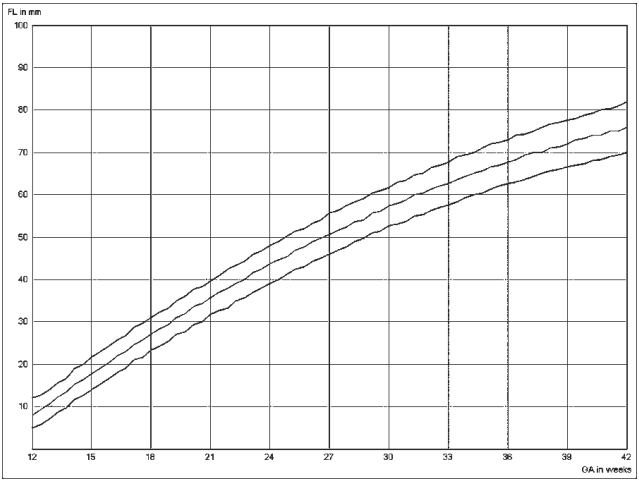


AC

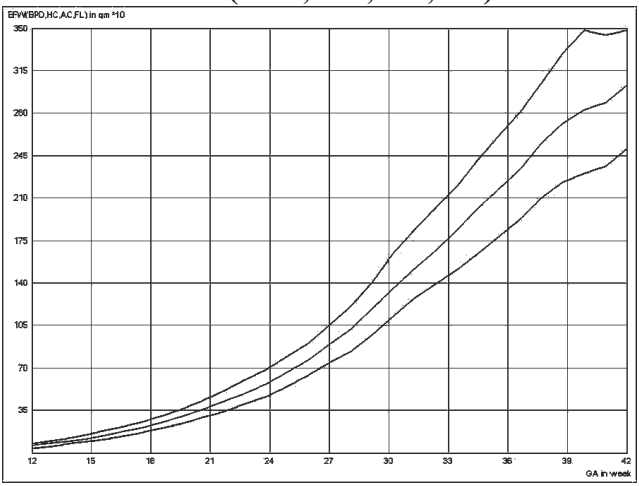


Standard Biometry Graphs - (Data from MediScan)

FL



EFW (BPD, HC, AC, FL)



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