



# **SNS COLLEGE OF TECHNOLOGY**

## **(AN AUTONOMOUS INSTITUTION)**

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Accredited by NBA & Accredited by NAAC with 'A+' Grade,  
Recognized by UGC saravanampatti (post), Coimbatore-641035.



## **Department of Biomedical Engineering**

Course Name: 19BMB301 Diagnostic & Therapeutic Equipment

III Year : V Semester

### **Unit 5- Application of Ultrasonic and Thermography**

**Topic : Application of Ultrasound in Obstetrics**



# Basics of Ultra sound



- Ian Donald & Co –workers (1958 )
- Two dimensional
- Doppler
- Three Dimensional
- Four Dimensional



# Basics of Ultrasound

## Physics:

- Piezoelectric crystals
- 40 frames/ second
- Real time
- High Frequency
- Low frequency
- Frequency 2-10 mHz



# Basics of Ultrasound

## Safety :

- Indication
- ALARA principle  
( AIUM 2003 )
- Safe: No confirmed damaging biological effects in mammalian tissue demonstrated in the frequency range of Medical Ultrasound ( AIUM 1991)



# Equipments

- Real time equipments.
- Abdominal / Vaginal US examination.
- Choice of the transducer frequency is a balance between penetration and resolution.
- For abdominal examination 3 – 5Mhz transducers, for vaginal scanning 5 – 7.5Mhz transducers.
- Doppler technology and Doppler flow should be used whenever needed.



# Basics of Ultrasound

## Clinical Applications :

- Dating of Pregnancy
- Improve in pregnancy outcome
- Prevention of Post-term deliveries
- Reduction in Induction of Labor
- Decrease in maternal morbidity and mortality
- Improve Neonatal Outcome --- decrease in perinatal loss
- Identification of fetal anomaly
- Depends on the skill of the Sonologist



# Who should do it ?

- A physician who has completed the residency Programme in Radiology or Obstetric & Gynecology with a minimum of 3 months experience in Obst. & Gyn. USG evaluation.
- The training should include 1 month of supervised and documented training in established ultrasound unit.
- The training should include basic physics, technique, performances and interpretation.
- A physician should do at least 200 US examination during training, Before offering services as a physician competent in diagnostic US examination.



# Documentation



- It is most essential for quality patient care
- Permanent record of the ultrasound images is must.
- Identification of normal structures for retrospective evaluation and comparison.
- If pathology is identified, the follow up scan will help the clinician to decide the course of the disease and response to the management.
- Standard terminology should be used to avoid confusion.





# Indication First Trimester



- To confirm site of pregnancy
- To confirm viability of pregnancy
- Define causes of vaginal bleeding
- Evaluate pelvic pain
- Estimate Gest. Age
- Diagnose or evaluate multiple pregnancy
- Confirm cardiac activity
- Assist to chorionic villus sampling, embryo transfer, and localization and removal of IUCD
- Evaluate maternal pelvic masses or uterine abnormalities
- Evaluate gestational trophoblastic diseases



# Indication Second and Third Trimester

- Estimation of Gest. Age
- Growth profile in 2<sup>nd</sup> & 3<sup>rd</sup> Trimester
- Vaginal bleeding
- Abdominal and pelvic pain
- Incompetent cervix
- Determination of fetal presentation
- Suspected multiple gestation
- Adjunct to amniocentesis
- Clinical discrepancy in uterine size
- Pelvic mass
- Suspected molar pregnancy
- Adjunct to cervical cerclage
- Suspected ectopic pregnancy
- Suspected fetal death
- Suspected uterine abnormality



# Indication Second & Third Tr



- Evaluation of fetal well being
- Fetal environment oligo or poly hydramnios
- Suspected abruptio placenta
- Adjunct to external cephalic version
- Preterm premature rupture of membrane or preterm labor
- Abnormal biochemical markers
- Follow up observation of identified anomaly
- Follow up evaluation of placental location or suspected placenta previa
- H/O Previous congenital anomaly
- Serial evaluation of fetal growth in multiple gestation
- Evaluation of fetal condition in late registrants for prenatal care
- Rule out Congenital malformations
- Biophysical , modified biophysical profile
- Doppler velocity to know the fetus at risk Umbilical A , Middle cerebral A , Fetal Aorta Ductus Venosus , Uterine A



# Guidelines for Obstetric Ultrasound

- 1<sup>st</sup> trimester sonography
- 2<sup>nd</sup> trimester sonography
- Basic ultrasound or level I ultrasound
- Targeted ultrasound or level II ultrasound (18 – 20Wks)





# Components of standard ultrasound examination

## First trimester

- GS Location , embryo or
- Yolk sac identification
- CRL
- Cardiac activity
- Fetal number, including
- Number of amnions and chorions of multiples when possible
- Uterus, adnexa and culdesac evaluation

## Second Trimester

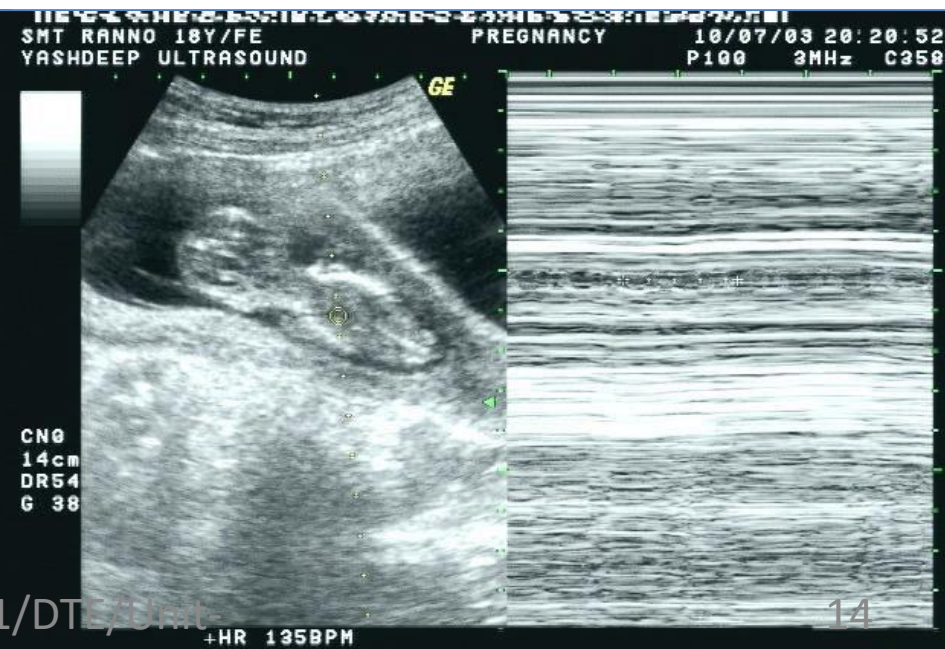
- Fetal number, presentation
- Fetal heart motion
- Placental location
- Amniotic fluid volume
- Gestational age assessment
- Fetal Weight estimation
- Evaluation for maternal pelvic masses
- Fetal anatomic survey



## Rule of Three

Every ultrasound examination should be done as per “Rule of Three.”

1. Pregnancy or no pregnancy
2. Intrauterine or extra uterine
3. Living or non living.



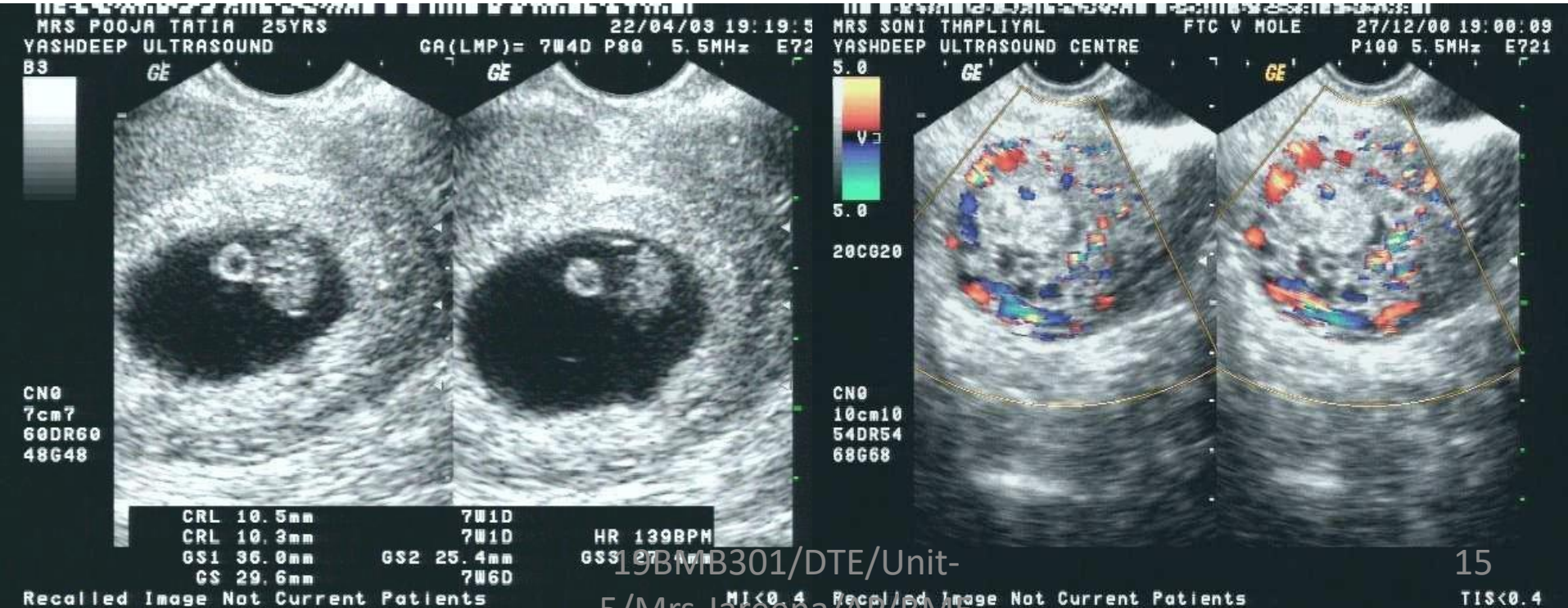




# Intra Uterine Pregnancy – “Rule of Three”



1. Fetus – Single or multiple
2. Placenta – Single or more
3. Environment
4. – Fluid – Oligo – polyhydramnios.





## Rule of Three

- Gestational sac – 5Wks      single or multiple
- Double decidual sac sign
- Yolk sac – 5.5Wks

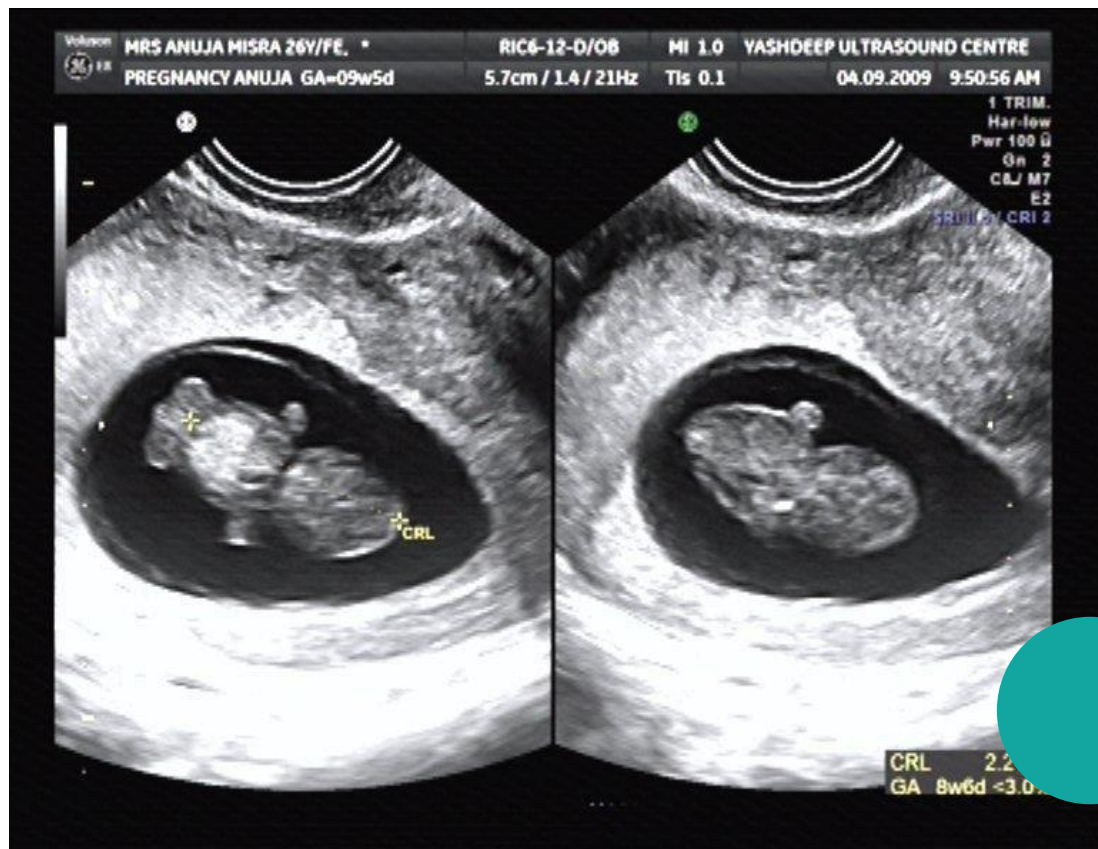


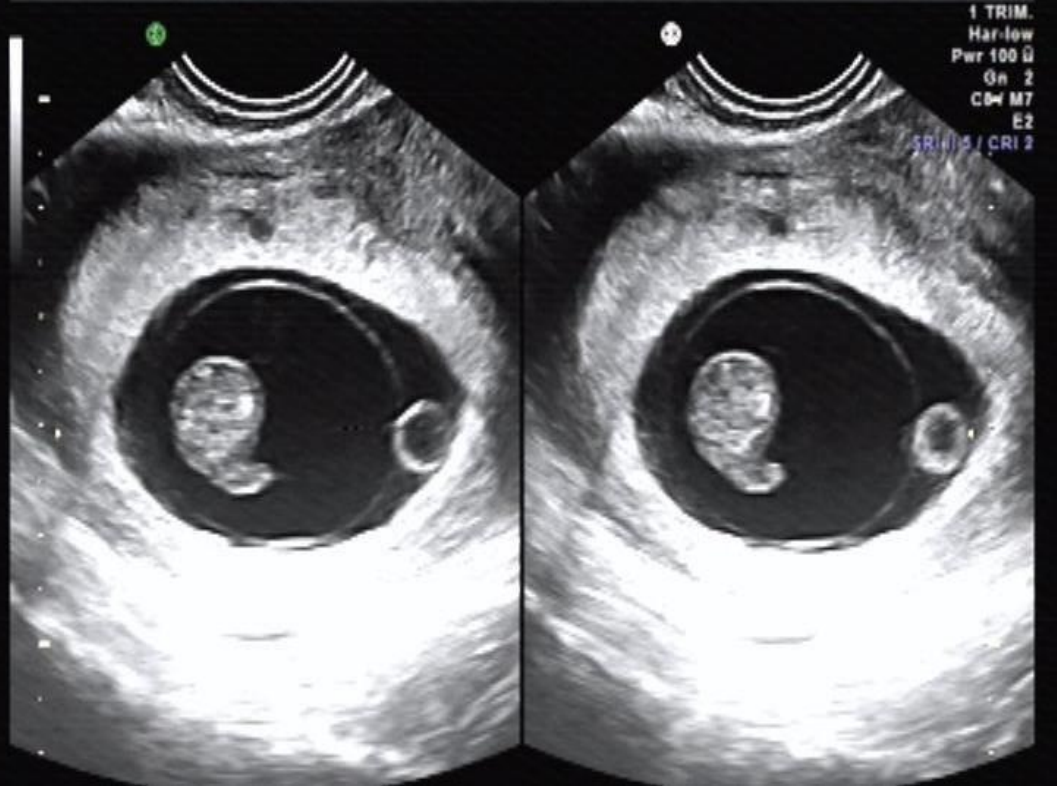




## Rule of Three

- Mean Sac Diameter (MSD) – 5Wks
- CRL – 5.5Wks
- Cardiac Activity – 5.5Wks
- $\text{MSD in mm} + 30 =$   
Gestational age in days
- $\text{CRL in mm} + 42 =$   
Gestational age in days  
between 6 to 9.5Wks.



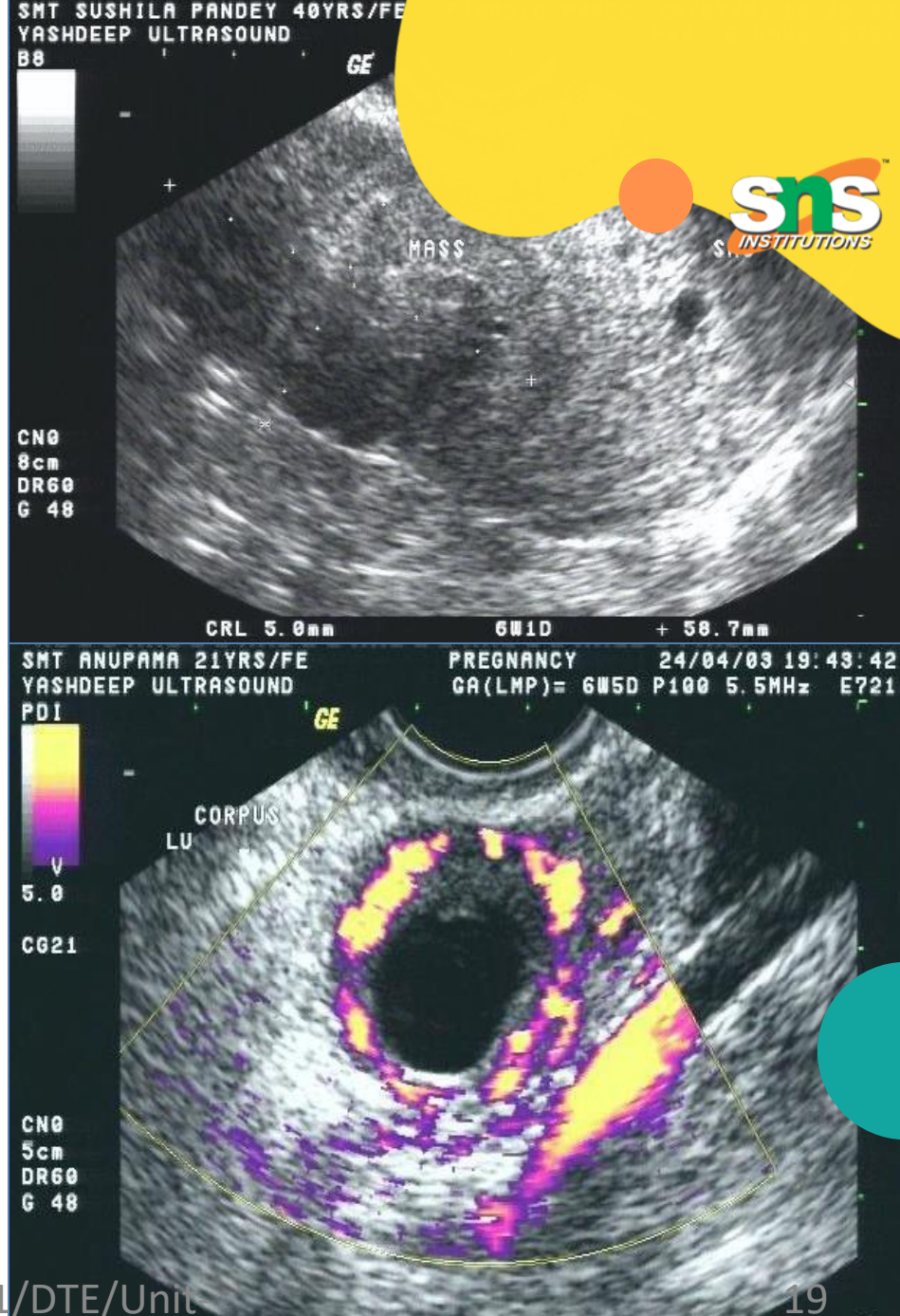


# AMNION CHORIONCAVITY



# Adnexa

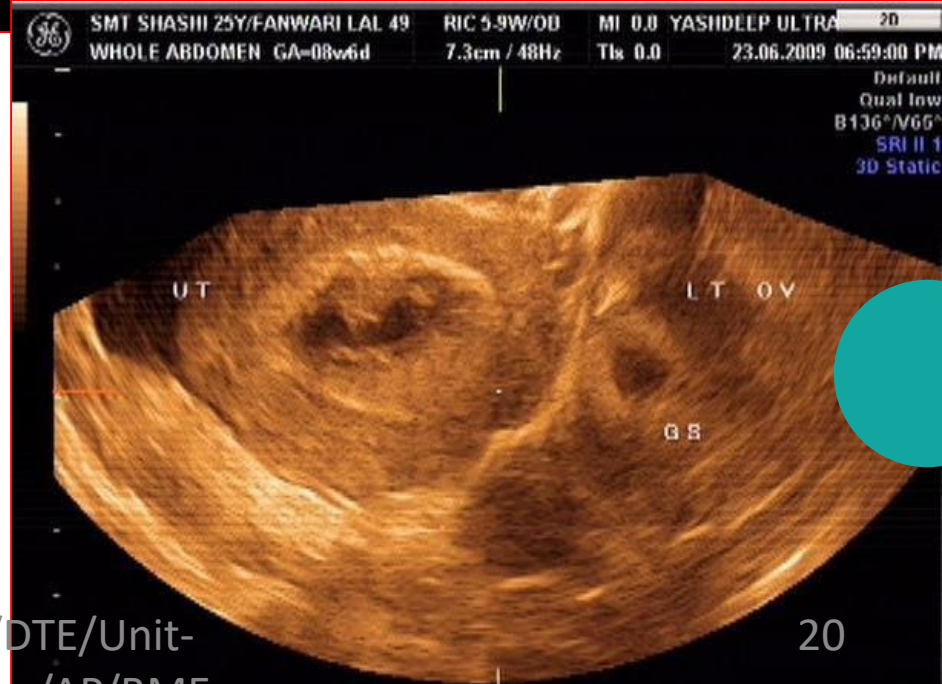
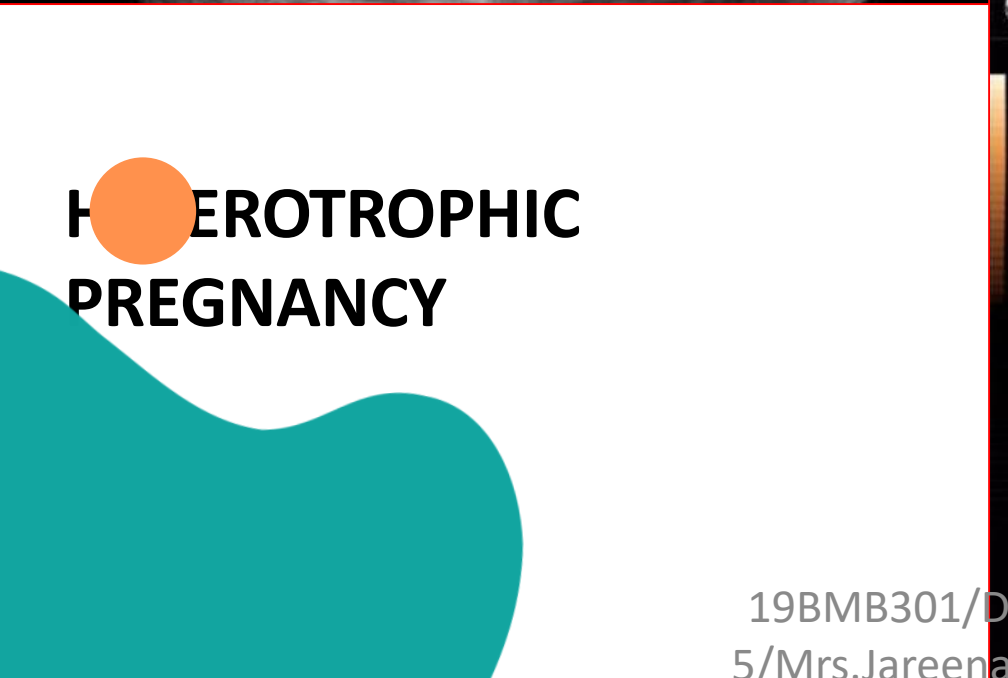
- Corpus luteum
- Presence of pelvic tumors, myoma, ovarian tumor or any other mass.
- Fluid in Cul-de-sac.







# HETEROTROPHIC PREGNANCY

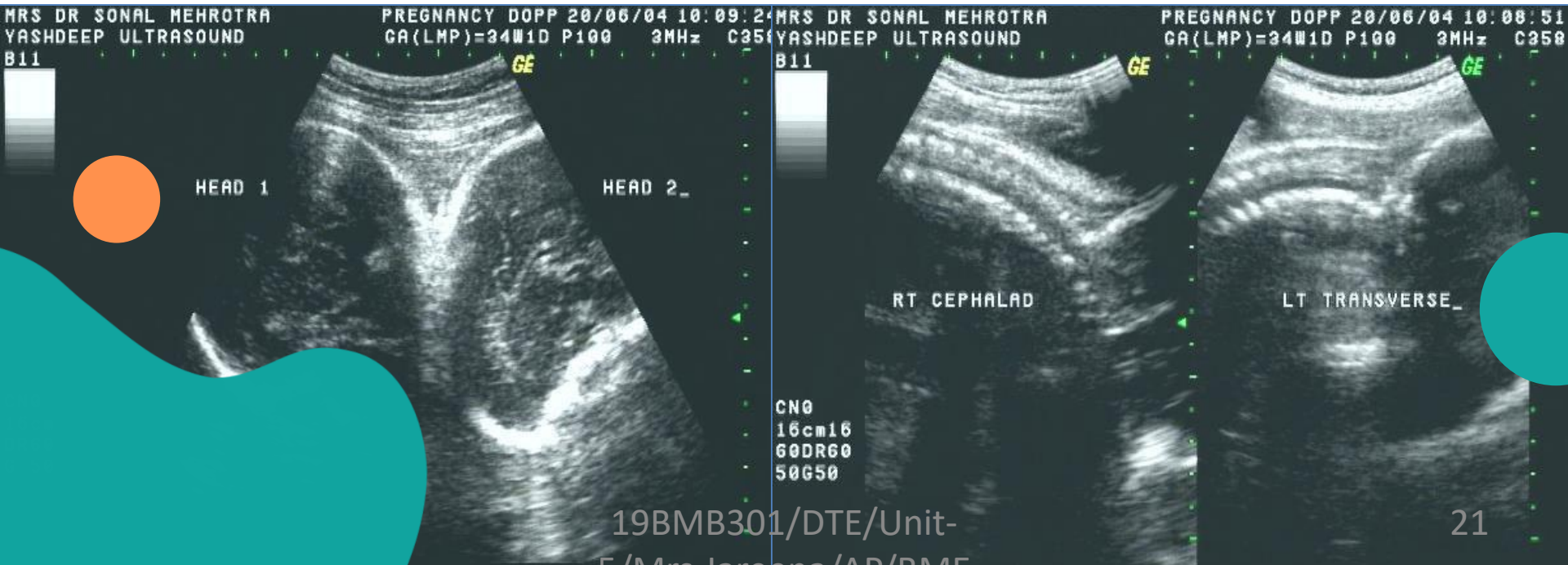




# Guideline for II<sup>nd</sup> and III<sup>rd</sup> trimester ultrasound

## 2<sup>nd</sup> trimester USG – 15 – 24Wks.

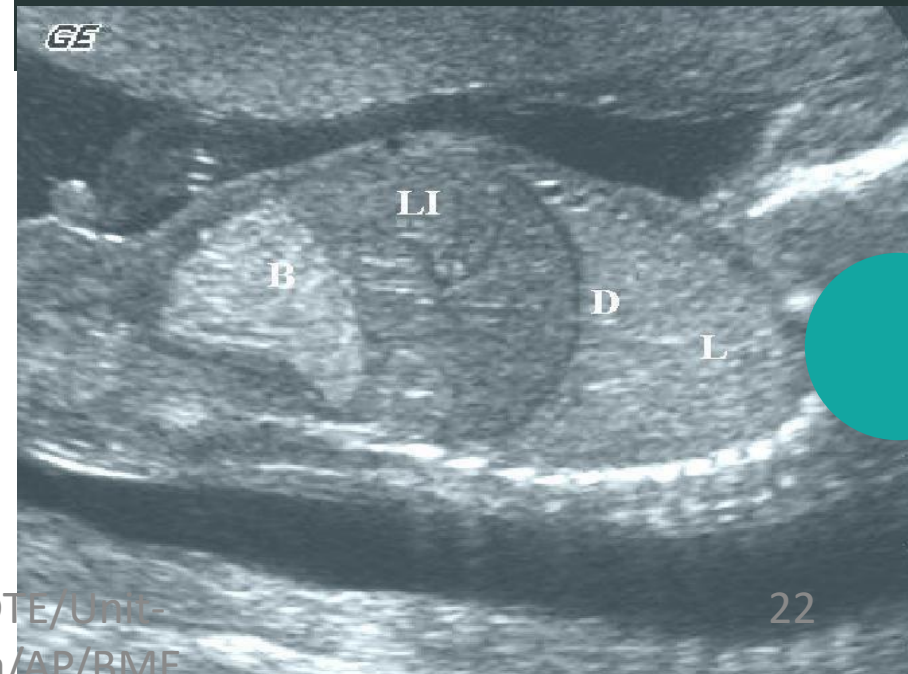
- Confirm fetal number
- Fetal presentation
- Fetal growth
- Fetal anatomy
- Placenta
- Environment
- – Fluid – Oligo – Polyhydramnios





## Ground Work

1. Systemic approach for examination.
2. Fetus examined from 'Head to Toe'.
3. Highest frequency optimized for fetal age.
4. Transverse & longitudinal scanning complete assessment of amniotic cavity, placental localization and fetal position.







# Pregnancy – “Rule of Threes”



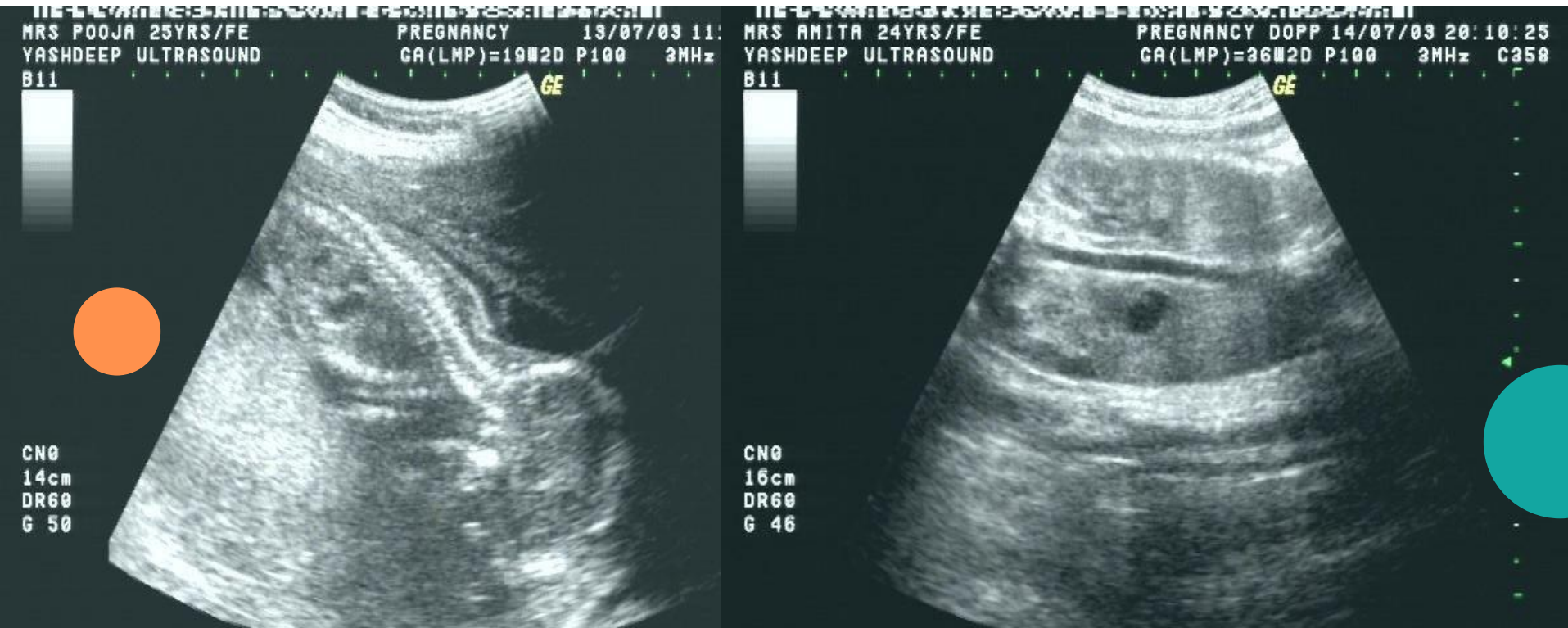
Fetus: Total examination from head to toe.

1. Head
2. Trunk
3. Extremities



# Timings: -

- Second trimester examination from 15 – 18Wks.
- Maximum useful information about structural and chromosomal anomalies.







# FETAL BRAIN

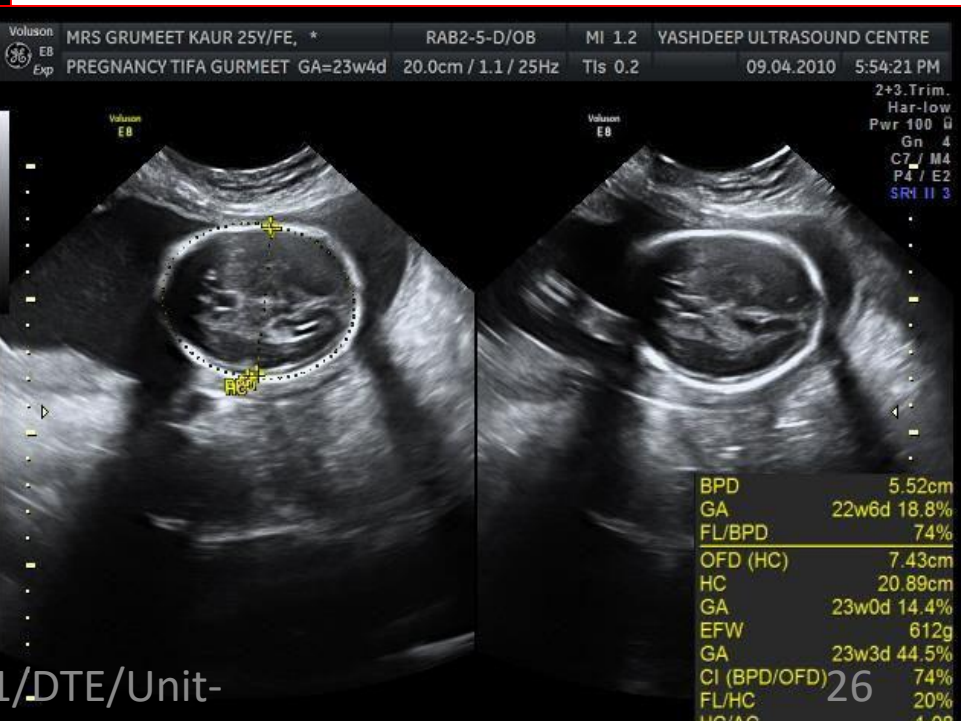
## RULE OF THREE

- Transventricle View
- Transthalamic View
- Transcerebellar View





# RULE OF THREE HEAD

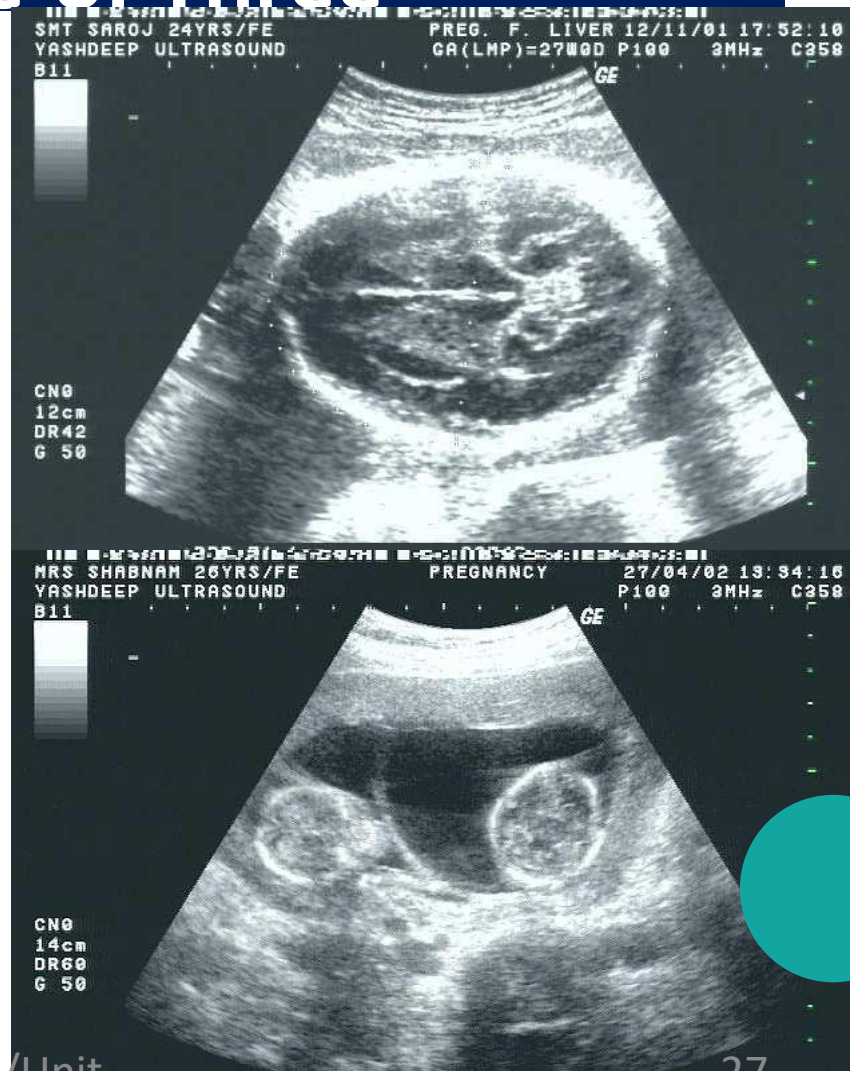




# Normal fetal anatomy

## Fetal Head – “Rule of Three”

- Cranium
- Brain structures
- Space O.L.
- Normal view – Axial plane



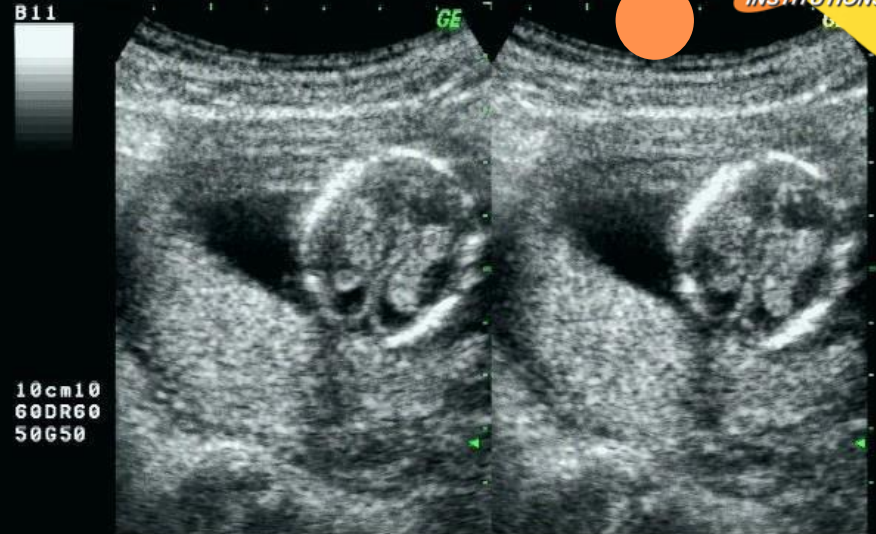


# Fetal Head



MRS YAS... SRIVASTAVA 27Y/FE PREGNANCY 17/07/03 20:00:42  
YAS... ULTRASOUND GA(LMP)=14W6D P100 T4.5 C358  
B11

MRS PREETI SRIVASTAVA 27Y/FE PREGNANCY 17/07/03 20:00:42  
YASHDEEP ULTRASOUND GA(LMP)=14W6D P100 T4.5 C358  
B11



MI=0.6  
DR MRS JUGNU PREGNANCY 07/07/03 20:10  
YASHDEEP ULTRASOUND GA(LMP)=31W3D P100 3MHz C  
B11

MI=0.6  
MRS RUBY CHAUDHARY 26YR/FE ANENCEPHALY 20/07/02 18:52:42  
YASHDEEP ULTRASOUND GA(LMP)=26W0D P100 3MHz C358  
B11





# Fetal Spine – “Rule of Three”



- Parasagittal
- Coronal
- Transverse

Three ossification centers: -

1. Anterior – Vert. Body
2. Posterior – lamina & pedicle

Any widening in posterior centers suggest neural tube defect.







# SPINE RULE OF THREE



# Fetal Spine



MRS YASHEER 21YRS/FE PREGNANCY 16/07/03 17:45:33  
YASHDEEP ULTRASOUND GA(LMP)=19W1D P100 4MHz C358  
B11

MRS YASHEER 21YRS/FE PREGNANCY 16/07/03 17:45:33  
YASHDEEP ULTRASOUND GA(LMP)=19W1D P100 4MHz C358  
B11



MRS MAHIMA TANDON 23YRS/FE PREGNANCY 17/05/03 18:53:16  
YASHDEEP ULTRASOUND GA(LMP)=23W6D P100 3MHz C358  
B11

MRS MAHIMA TANDON 23YRS/FE PREGNANCY 17/05/03 18:54:20  
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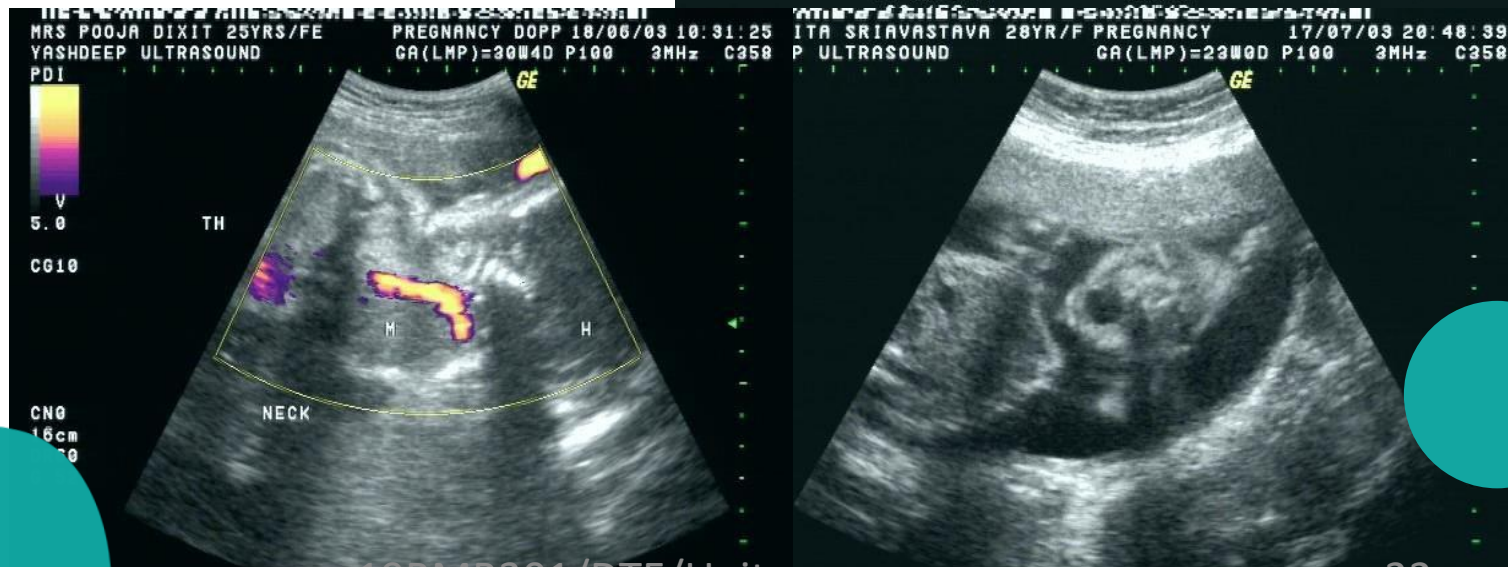




# Fetal Face – “ule of Three

Not a part of ‘Basic Examination’ planes

- Coronal
- Sagittal
- Axial







# Fetal Face



# Fetal Thorax – “ule of Thr



- Heart
- Lung
- SOL/FLUID





# Fetal Abdomen – “ule of T



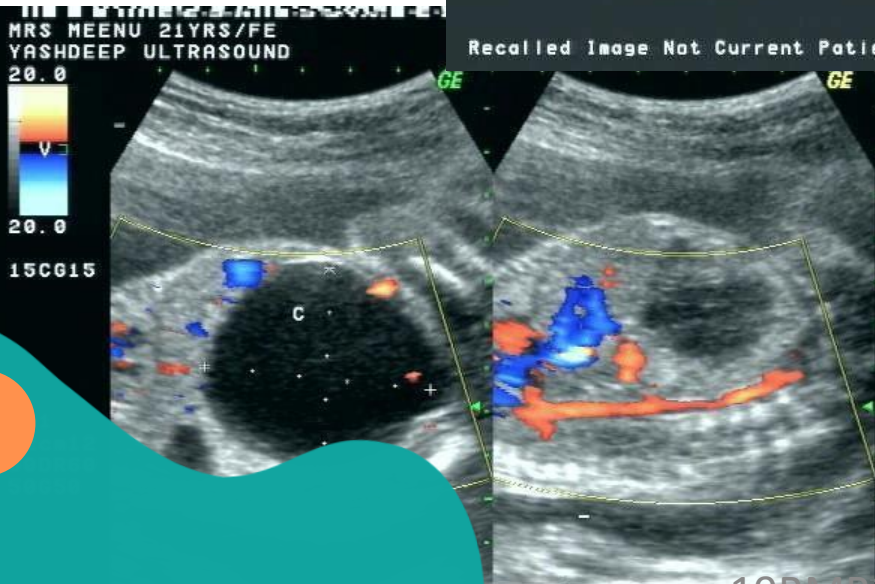
- Organs
- Vessels
- Fluid / mass



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2YRS/FE FETAL AORTA 15/02/03 19:47:09  
GA(LMP)=20W0D P100 3MHz C358





# Fetal Urinary Tract

- Evaluation of urinary tract is important as common site of fetal anomalies.
- Kidneys bilateral hypoechoic para spinal organs with echogenic central renal sinus.
- Renal arteries can be seen on color doppler.
- Urinary bladder fluid filled shadow located low in the pelvis anteriorly.







# Anterior abdominal wall

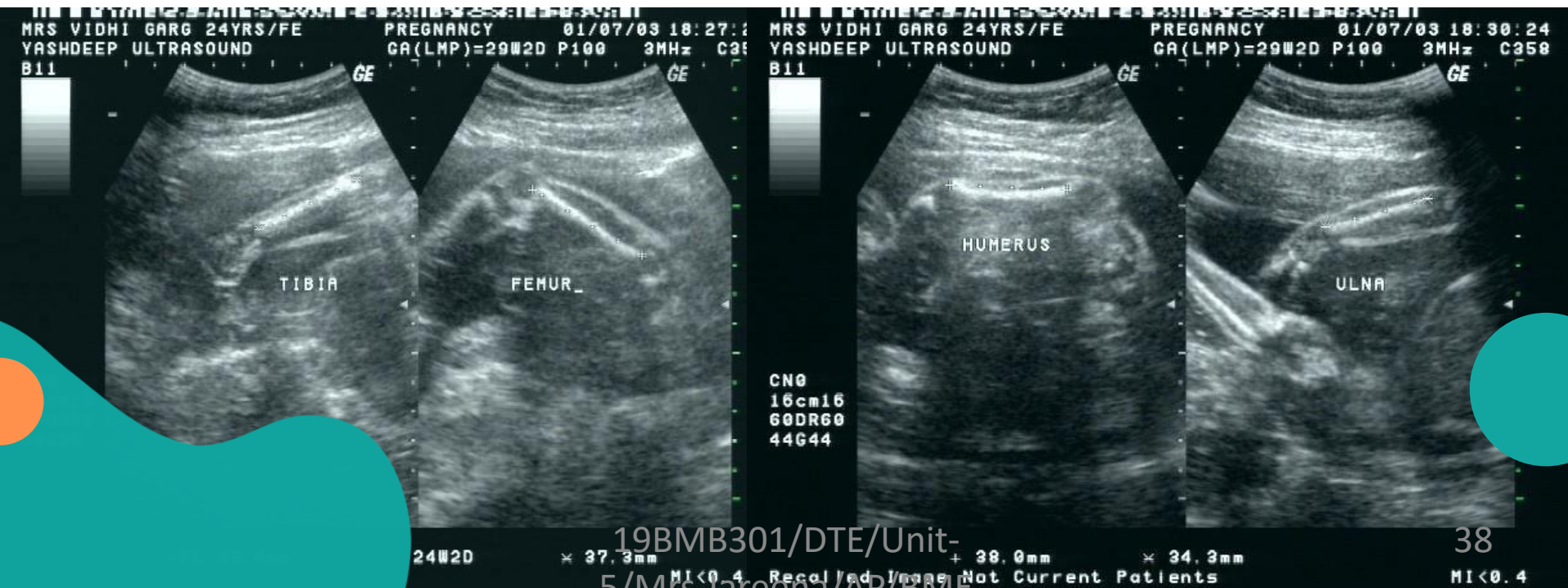
- The site of the umbilical cord insertion is important to confirm a normal size cord.
- Visualization of normal cord insertion and anterior abdominal wall excludes ventral wall defects.





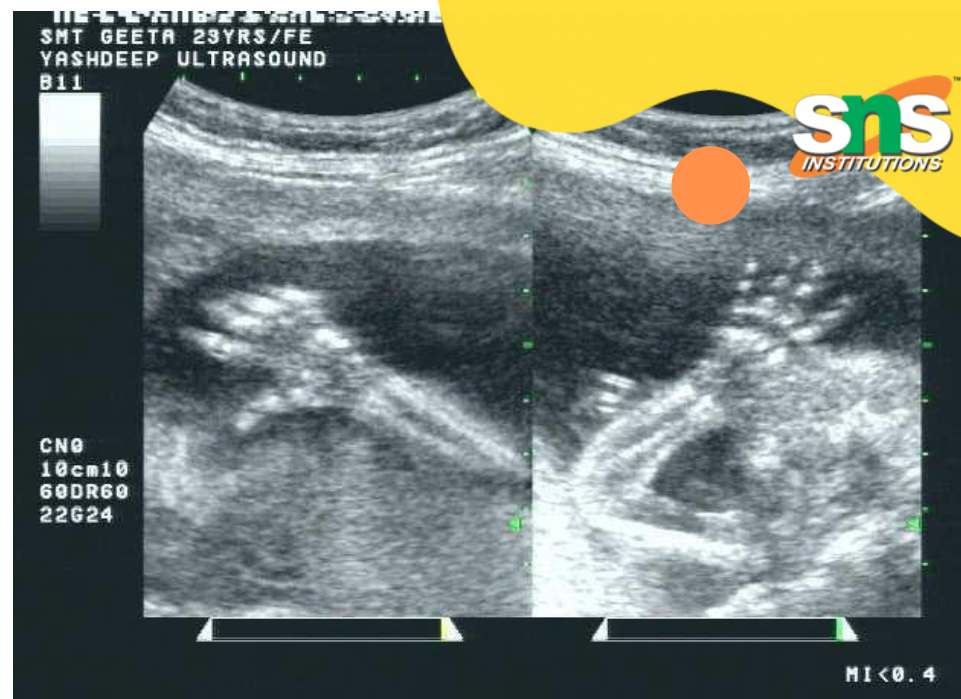
# Extremities

- The bones of the extremities are easily seen.
- Femur is routinely measured for biometry. However, humerus, ulna, radius and fibula and tibia are also look for in skeletal dysplasia.





# Extremities



# Extremities





# Umbilical vessels

- Normal three vessel cord may be confirmed by direct imaging of the cord.
- Two umbilical arteries and one umbilical vein.
- Arteries are smaller than vein.
- Single umbilical artery suggest chromosomal anomaly.

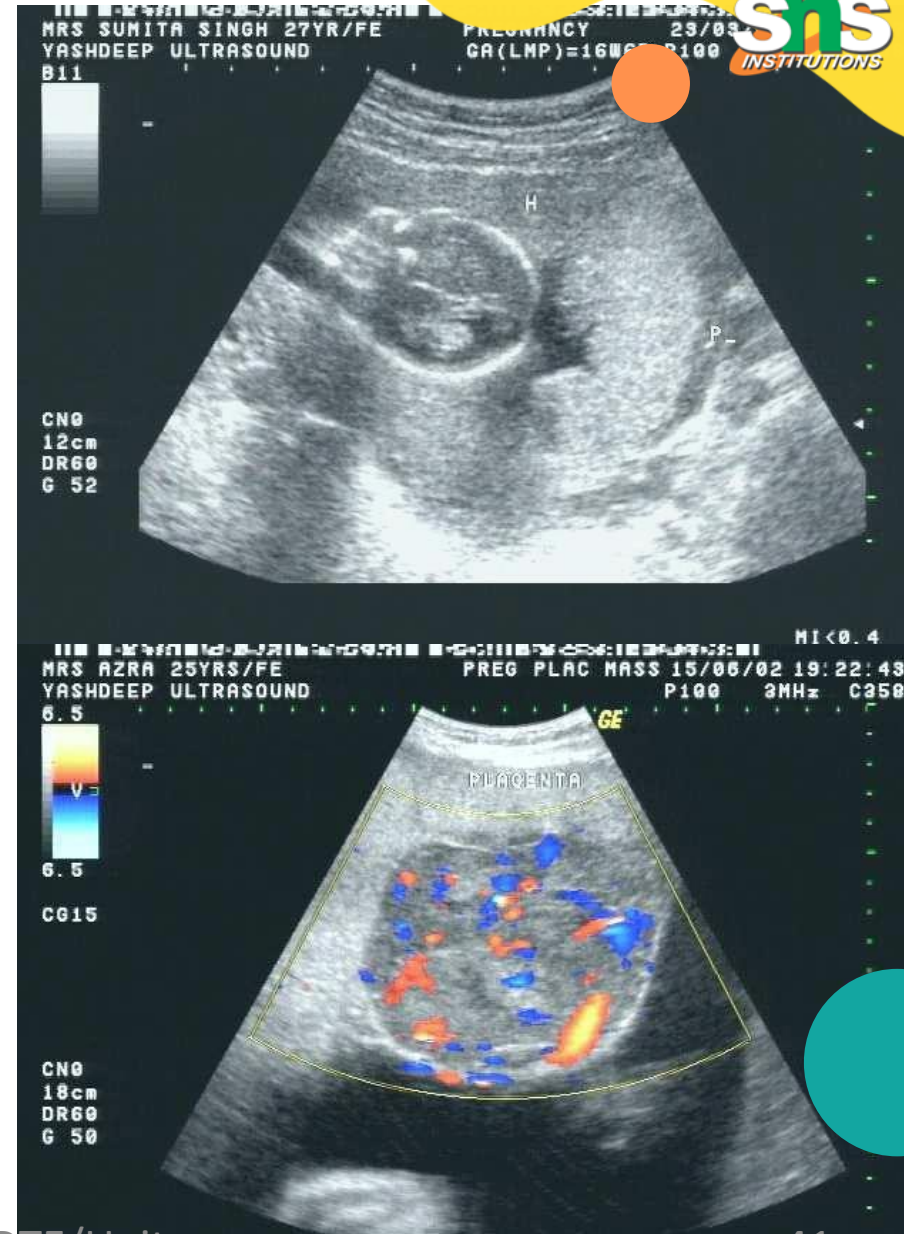






# Placenta

- Evaluation of placenta is
- Part of routine examination.
- Site of placenta
- Type of placenta.
- Placental infarcts.
- Placental mass
- Placental abruption.





# Placenta



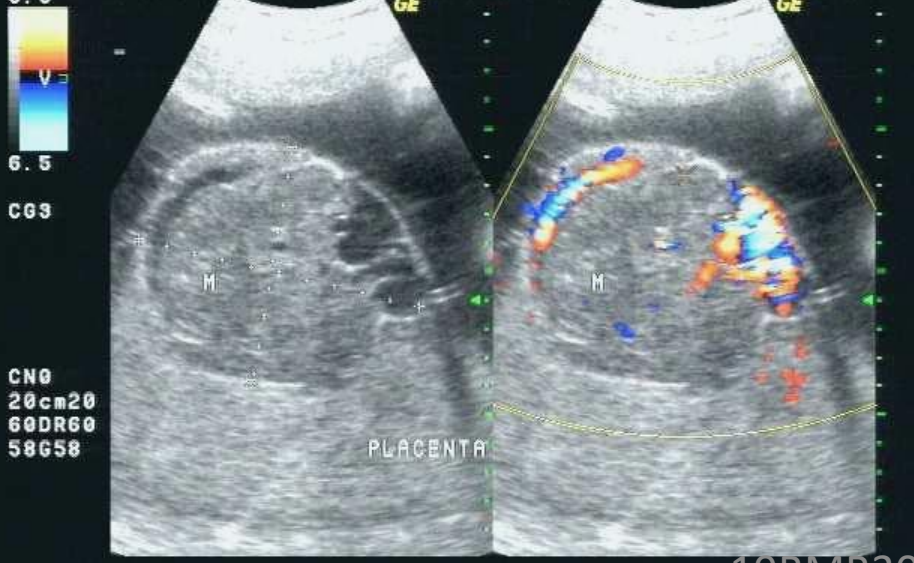
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 YASHDEEP ULTRASOUND P100 3MHz C358  
 B11



MRS KAVINI 25YRS/FE PREGNANCY DOPP 17/07/03 08:46:29  
 YASHDEEP ULTRASOUND GA(LMP)=38W1D P100 3MHz C358  
 B11



MRS AZRA 25YRS/FE PREG PLAC MASS 15/06/02 19:42:37  
 YASHDEEP ULTRASOUND GA(LMP)=32W5D P100 3MHz C358  
 6.5



MRS AZRA 25YRS/FE PREG PLAC MASS 15/06/02 19:42:37  
 YASHDEEP ULTRASOUND GA(LMP)=32W5D P100 3MHz C358  
 6.5



+ 100mm × 82.5mm × 58.9mm  
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# Amniotic fluid

- Amniotic fluid is important for fetal environment
- Abnormality of amniotic fluid known as oligoamnios and polyhydramnios.
- Oligoamnios – fluid pocket  $< 2\text{cm}$ , AFI  $< 5$
- Polyhydramnios- Fluid pocket  $> 8\text{cm}$ , AFI  $> 20$
- Abnormality of amniotic fluid suggest inherent maternal or fetal abnormality.





# Fetal Biometry

○ Fetal biometry is important for fetal growth assessment.

○ The important biometric parameters are:

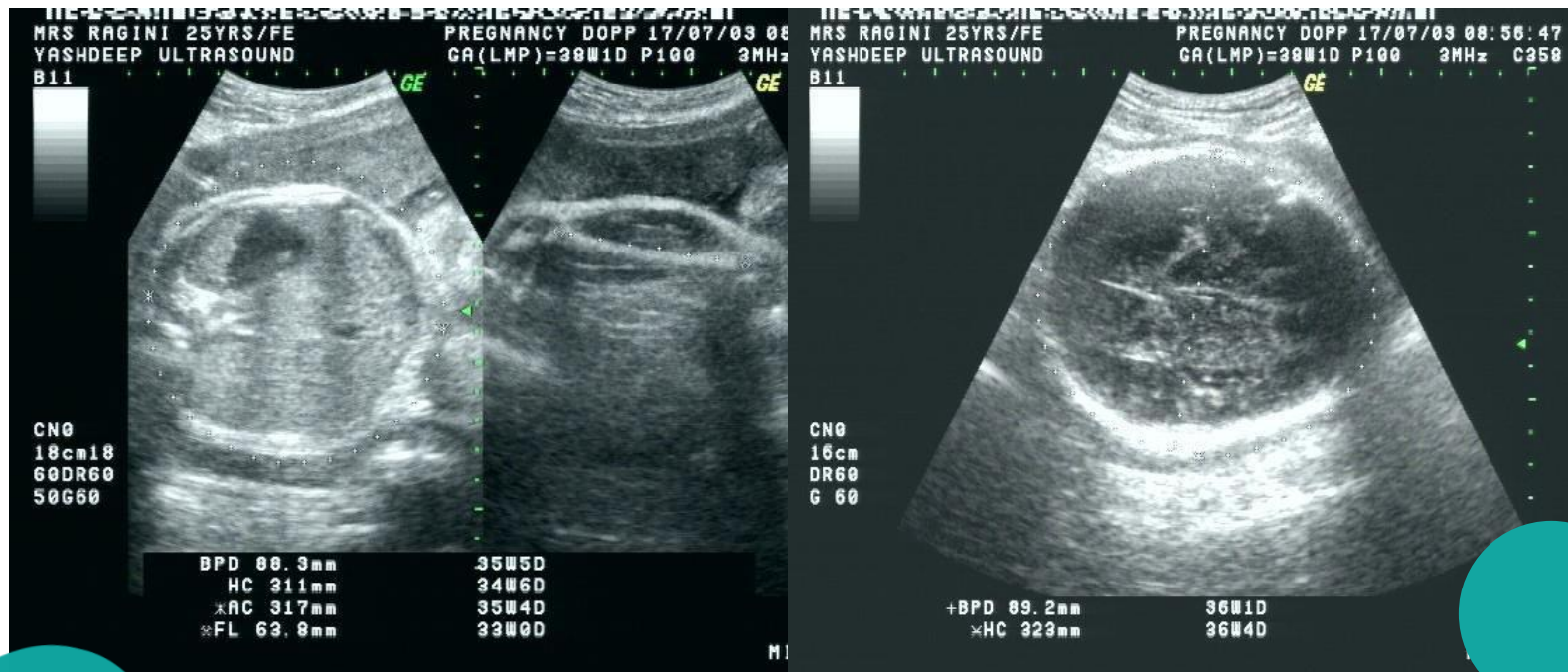
• CRL

• FL

• AC

• BPD

• HC







# Limitations: -

- Maternal obesity
- Incomplete filling of UB.
- Early Gestational Age.
- Quality of Equipment.
- Experience of Sonologist.
- Fetal Position.
- Amount of Liquor.



# Transabdominal (TA) Scanning



- Locating the ovaries in relation to the uterus, particularly those sited laterally
- Demonstrating large masses such as fibroid uterus, adnexal masses or pelvic collections
- Demonstrating iliac fossae, bladder & any associated renal pathology
- Demonstrating uterine anomalies, such as bicornuate uterus, which may be more difficult to appreciate on a TV scan



# Indication of USG in gynecology



- Uterus –
  - Fibroids
  - Adenomyosis
  - Endometrial pathology
  - Hyperplasia
  - Polyp
  - Carcinoma
  - Pelvic inflammatory disease (PID)
  - Chronic endometritis
  - Oestrogen producing ovarian tumour
  - Postmenopausal atrophic endometritis



- Cervix –
  - Chronic cervicitis
  - Polyp
  - Carcinoma





# Q1

**sns**  
INSTITUTIONS

On Transvaginal Ultrasound ,the definite diagnosis of pregnancy is made by visualizing all except

- a. Gestational sac
- b. Beta hCG
- c. Double decidual sign
- d. Yolk Sac



## Q2

The criteria for viable pregnancy on the T.V.S are all except

- a. Gestational Sac  $\geq 18$ mm
- b. Yolk sac
- c. Embryo  $\geq 5$  mm in size
- d. Absent Cardiac activity



## Q3

The presence of cystic hygroma on ultrasound in fetus is suggest all except

- a. Rh Isoimmunization
- b. Turner Syndrome
- c. Chromosomal aneuploidy
- d. Noonan Syndrome



## Q-4

The all of the following features of Meckel – Gruber Syndrome except

- a. Cephalocele
- b. occipital midline defect
- c. Associated hydrocephalus
- d. Spina bifida





## Q5

- On USG the diagnosis of Anencephaly can be made as early as gestational age in weeks
  - (a) 10
  - (b) 14
  - (c) 16
  - (d) 18



# Q-5

The following are the features of Arnold-Chiari II Syndrome except

- a. Spina bifida
- b. Banana Sign
- c. Lemon Sign
- d. hydrocephalus



# Thanks