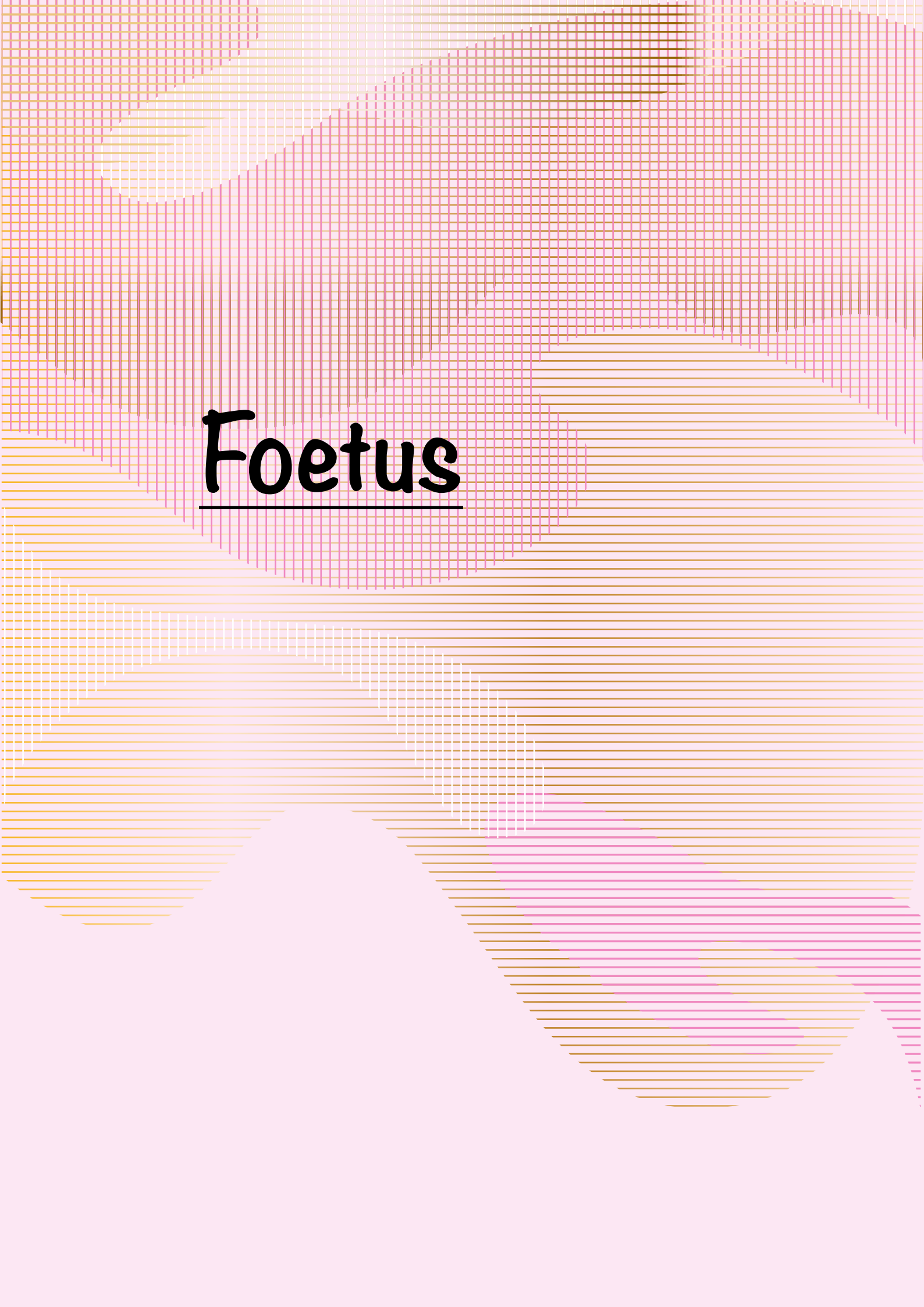
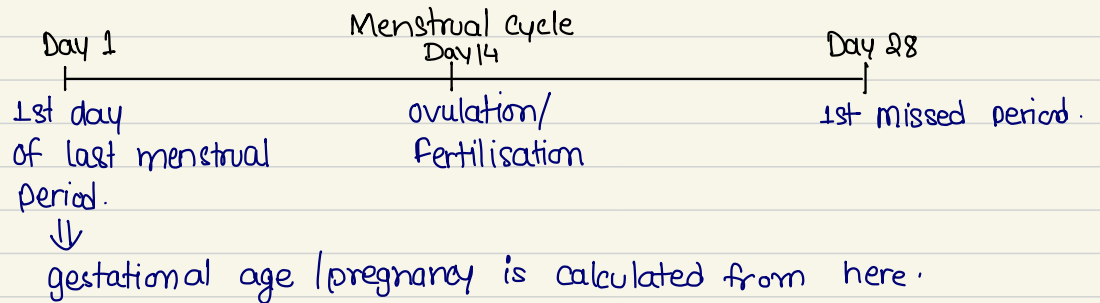




Foetus

- Gestational age / fetal age / Period of pregnancy:



* On the day of missed period, patient will be considered 4 weeks pregnant (even when fertilisation occurred 2 weeks back).

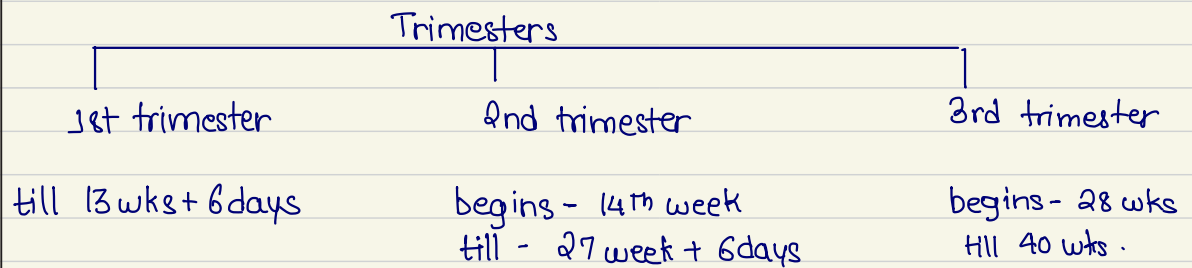
* If an event occurs x days after fertilisation.
Then it will be $(x \text{ days} + 2 \text{ weeks})$ days of pregnancy.

Fetal Growth Periods

- fetal growth periods are defined from day of fertilisation & not from day 1 of LMP.

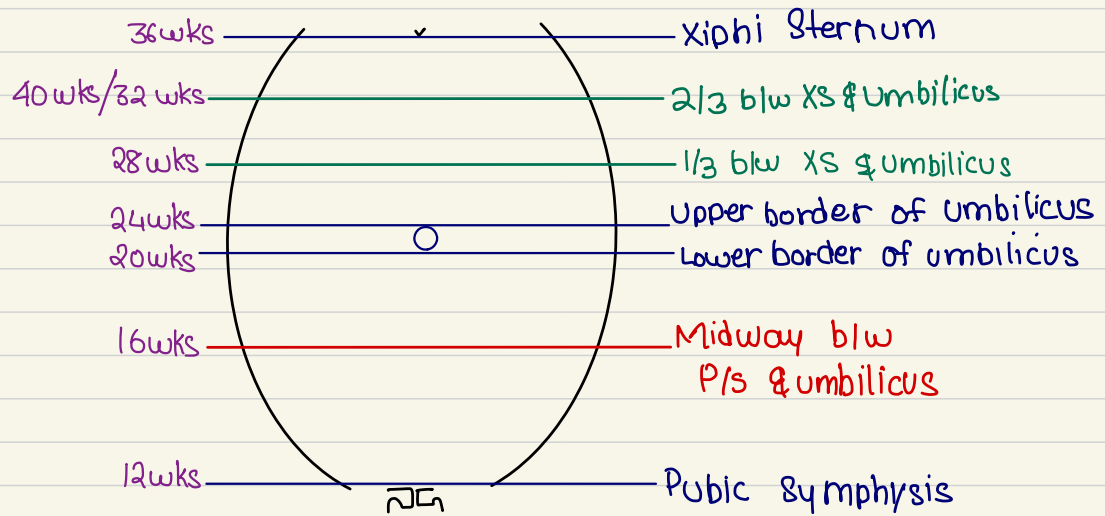
<u>Growth Periods</u>	<u>Definition</u>	<u>Definition As per gestational age</u>
1) Fertilised ova	Day of fertilisation till week 2.	Up till 4 weeks
2) Embryonic period (most teratogenic)	3 wks after fertilisation till 8 wks after fertilisation.	From 5 weeks of pregnancy till 10 weeks of pregnancy.
3) fetal period	≥ 9 wks after fertilisation till delivery	≥ 11 wks till delivery

- Trimesters Total duration of pregnancy = 280 days / 9 month + 7 days / 40 wks.



Fetal Age Assessment

• Clinically



After 36 wks, head of fetus goes down into pelvis & Height of uterus decreases.



Hence, Respiratory distress mother was feeling at 36 wks due to pushing of diaphragm decreases.

↳ This is called **Lightening / welcome sign**.

- 32 weeks - Fetal head felt abdominally
- 40 wks - fetal head shifts into pelvis & not palpated P/A

• On USG

<u>Trimesters</u>	<u>Best Parameter</u>
1st	Crown Rump length (CRL)
2nd	Biparietal Diameter (BPP) Head circumference (2nd best)
3rd	Femur length.

The earlier the USG done in pregnancy, the more accurate is prediction of fetal age.

- Suboptimally dated on USG - If a female has no USG done before 22 wks of pregnancy.
- EDD should not be changed based on USG except in cases of IVF.

• Crown Rump Length measurement from vertex of fetus to coccyx of fetus.

• $CRL + 6.5 =$ Gestational age in wks.

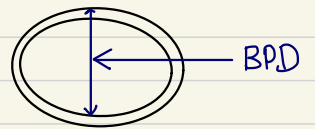
• $CRL + 42 =$ Gestational age in days

• CRL increase by 1mm/day.

• Smallest CRL at which embryo is visible = 4-5 mm

• If $CAL \geq 7mm$ + No cardiac activity $\Rightarrow$ Missed Abortion

• Biparietal Diameter measured from outer table of fetal skull on one side to the inner table of other side.



• Hasse's Rule

< 5 months pregnant



$\sqrt{\text{Fetal length}} = \text{Gestational age}$



Fetal length = vertex to coccyx



Crown Rump length

> 5 months pregnant



$\frac{\text{Fetal length}}{5} = \text{Gestational age}$



Fetal length = vertex to heel



Crown heel length.

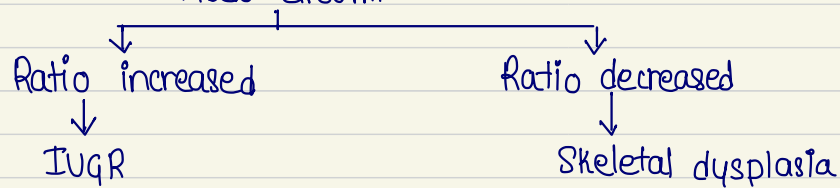
Assessing Fetal Weight

• Clinical • Johnson's formula

• USG • Hadlock formula
• Shepherd formula

Assessing Fetal Growth

- Done by USG
- Only one parameter used - Abdominal circumference of the fetus.
- ✖✖ Abdominal circumference should be measured in a plane where P, U & S are visible.
 - P - Portal sinus
 - U - Umbilical vein
 - S - Fetal stomach
- Abdominal parameter is only parameter to determine growth of fetus (IUGR & macrosomia).
- If $AC \geq 35\text{cm}$ - Macrosomia
- Normally, $\frac{\text{Femur length}}{\text{Abdo. circum.}} = 20 - 40\%$



Fetal Haematopoiesis

<u>Site</u>	<u>Time of pregnancy</u>	<u>Main Hb formed</u>
• Yolk sac	Till 6 wks of pregnancy	Gower 1 Gower 2 Portland Hb
• Liver	Till 20 weeks	Fetal Hb
Bone Marrow	After 20 weeks	Hb A

• <u>Fetal RBCs</u> Early intrauterine life - Nucleated & macrocytic (MCV=180 fL) ↓ * Does not happen in Aneuploid fetus ↓ Later, size ↓ ⇒ MCV = 105 fL • fetal RBC is larger than adult RBC & has a shorter life span (90 days). * At birth, Hb = 16-18 gm/dl <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">75-80%</td> <td style="text-align: center;">20-25%</td> </tr> <tr> <td style="text-align: center;">HbF</td> <td style="text-align: center;">HbA</td> </tr> </table> • By 6 months, HbF < 1% <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><u>HbF</u></th> <th style="text-align: center;"><u>HbA</u></th> </tr> </thead> <tbody> <tr> <td>• Has less of 2,3 Diphosphoglyceric Acid</td> <td>• Has more of 2,3-DPG</td> </tr> <tr> <td>• Less Carbonic Anhydrase</td> <td>• More Carbonic Anhydrase</td> </tr> <tr> <td>• Higher affinity for O₂</td> <td>• Lower affinity for O₂</td> </tr> <tr> <td>• Resistant to acid & alkali</td> <td>• Sensitive to acid & alkali</td> </tr> </tbody> </table>	75-80%	20-25%	HbF	HbA	<u>HbF</u>	<u>HbA</u>	• Has less of 2,3 Diphosphoglyceric Acid	• Has more of 2,3-DPG	• Less Carbonic Anhydrase	• More Carbonic Anhydrase	• Higher affinity for O ₂	• Lower affinity for O ₂	• Resistant to acid & alkali	• Sensitive to acid & alkali
75-80%	20-25%													
HbF	HbA													
<u>HbF</u>	<u>HbA</u>													
• Has less of 2,3 Diphosphoglyceric Acid	• Has more of 2,3-DPG													
• Less Carbonic Anhydrase	• More Carbonic Anhydrase													
• Higher affinity for O ₂	• Lower affinity for O ₂													
• Resistant to acid & alkali	• Sensitive to acid & alkali													

* Resistance of HbF to acids/alkali forms basis of -

- a) Apt test / Singer's Alkali Denaturation test
- b) Kleihauer Betke test / Acid Elution Test

	<u>Apt Test</u>	<u>Kleihauer Betke test</u>																												
• <u>Use</u>	• Differentiate b/w Placenta previa & vasa previa.	• Calculate dose of Anti D in Rh negative female.																												
• <u>Reagents</u>	• 1% NaOH / KOH	• Citric acid phosphate buffer																												
• <u>Nature</u>	• Qualitative	• Quantitative																												
	• Differentiates b/w fetal blood from maternal blood	• Differentiates b/w fetal RBC & maternal RBC.																												
	<table><tr><th><u>Major Events</u></th><th><u>Seen at</u></th></tr><tr><td>• Fetal gross body movement</td><td>7wks</td></tr><tr><td>• Gonad formation Testis ovaries </td><td>7wks 8wks</td></tr><tr><td>• Glucagon synthesis</td><td>8wks</td></tr><tr><td>• Internal genitalia (♂ & ♀)</td><td>10wks</td></tr><tr><td>• Breathing movements</td><td>11wks</td></tr><tr><td>• External genitalia ♀ ♂ </td><td>12 wks 14 wks</td></tr><tr><td>• Production of insulin</td><td>12 wks</td></tr><tr><td>• Hypothalamic Pituitary axis</td><td>12 wks</td></tr><tr><td>• Production of urine</td><td>12 wks (3rd month)</td></tr><tr><td>• Production of meconium</td><td>16 wks (4th month)</td></tr><tr><td>• Ig G transferred to fetus</td><td>16 wks</td></tr><tr><td>• Ig M production</td><td>20 wks</td></tr><tr><td>• Surfactant production present in Amniotic fluid </td><td>20 wks 28 wks</td></tr></table>		<u>Major Events</u>	<u>Seen at</u>	• Fetal gross body movement	7wks	• Gonad formation Testis ovaries	7wks 8wks	• Glucagon synthesis	8wks	• Internal genitalia (♂ & ♀)	10wks	• Breathing movements	11wks	• External genitalia ♀ ♂	12 wks 14 wks	• Production of insulin	12 wks	• Hypothalamic Pituitary axis	12 wks	• Production of urine	12 wks (3 rd month)	• Production of meconium	16 wks (4 th month)	• Ig G transferred to fetus	16 wks	• Ig M production	20 wks	• Surfactant production present in Amniotic fluid	20 wks 28 wks
<u>Major Events</u>	<u>Seen at</u>																													
• Fetal gross body movement	7wks																													
• Gonad formation Testis ovaries	7wks 8wks																													
• Glucagon synthesis	8wks																													
• Internal genitalia (♂ & ♀)	10wks																													
• Breathing movements	11wks																													
• External genitalia ♀ ♂	12 wks 14 wks																													
• Production of insulin	12 wks																													
• Hypothalamic Pituitary axis	12 wks																													
• Production of urine	12 wks (3 rd month)																													
• Production of meconium	16 wks (4 th month)																													
• Ig G transferred to fetus	16 wks																													
• Ig M production	20 wks																													
• Surfactant production present in Amniotic fluid	20 wks 28 wks																													

* Sex can be determined on USG by 14th week.

USG in pregnancy

- Uses
 - ① Confirm pregnancy
 - ② Differentiate b/w intrauterine & ectopic pregnancy
 - ③ Diagnosis of twin pregnancy
 - ④ Know the fetal age
 - ⑤ Growth assessment
 - ⑥ Detection of congenital anomalies.

- Frequencies
 - High frequency - Better resolution
 - Low frequency - Better penetration
 - Early pregnancy : 5-10 MHz
 - Late 1st trimester & 2nd trimester : 4-6 MHz
 - 3rd trimester : 2-5 MHz

- Modes
 - Routine USG - B mode
 - To see cardiac activity - M mode

- ALARA principle As Low AS Reasonably Achievable
↳ for radiations as well as USG.

Signs	Trans vaginal Sonography	Trans Abdominal Sonography
① <u>Gestational Sac</u>	4 weeks + 1 day to 4 weeks + 3 days	5 weeks
② <u>Yolk sac</u>	5 weeks	5½ weeks
③ <u>Cardiac activity</u>	5-6 weeks	6-7 weeks

- Time given is from 1st day of LMP (gestational age).
- Until mentioned, USG has to be considered TFS.
- If earliest detection on USG asked, consider TVS because signs appear earlier of TVS.

	<u>Intrauterine Pregnancy</u>	<u>Ectopic pregnancy</u>
	• True gestational sac is seen • True sac is located eccentrically. • True sac increases in size with time. • Double decidual sign +ve	• Pseudogestational sac is seen. • Sac located centrally • Pseudo sac does not grow. • Double decidual sign -ve.
	• 1st sign of pregnancy on USG - Gestational Sac • 1st sign of intrauterine pregnancy on USG - Yolk Sac	
• <u>Blighted Ovum</u>	Fertilised egg implants in uterus but does not develop into embryo. • On USG - Mean sac diameter ≥ 25 mm + No Fetal tissue / Yolk sac / Cardiac Activity	
• <u>Missed Abortion</u>	On USG $\Rightarrow$ CRL ≥ 7 mm + No cardiac activity	

Congenital malformations & USG

USG in pregnancy

Type I USG

- Routine USG
- Can detect only few congenital malformations.
- Anencephaly can be detected

Type II USG

- Targetted Imaging for Fetal Anomalies (TIFFA)
- Can detect all congenital malformations.
- Should be done in all pregnant females.
- Best time - 16-20 weeks.
[18-20 weeks]
↳ more precise.

• Spina bifida

On USG

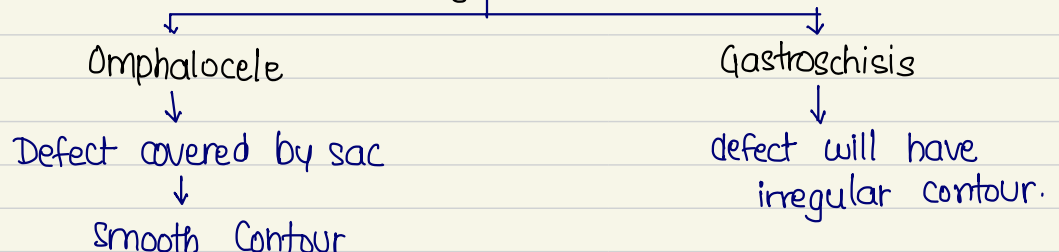
- small biparietal diameter.
- Ventriculomegaly
- Frontal bone scalloping - Lemon Sign
- Elongation and downward displacement of cerebellum - Banana Sign.

• Ventral Wall defects

If size of ventral defect $> 7\text{mm}$

+
defect continues after 12wks of pregnancy → Pathological defect.

Pathological defects



*** Best time to localise placenta on USG / Best time to detect Placenta previa on USG.

↓
3rd trimester

• <u>Anencephaly</u>	• Earliest time to detect on USG - 10 weeks • Best time for detection on USG - 14 weeks • Signs on USG : ① Frog eye sign ② Mickey mouse sign • Vault /skull is absent. • Adrenal glands - Absent or Hypoplastic ↓ ↓ DHEA sulphate ↓ ↓ placental estrogen ↓ Post term pregnancy • It can also cause polyhydramnios leading to pre-term labour. • Most common presentation in Anencephaly - Face presentation. • Chances of recurrence - After 1 baby with NTD (neural tube defect) - 4% - After 2 babies with NTD - 10% <u>Dx</u> • <u>Screening</u> - maternal Serum AFP (done routinely at 15-20 weeks) (Best time is 16-18 weeks) • * Most Sensitive Biochemical marker for Anencephaly - <u>Acetylcholinesterase</u> • <u>Diagnostic</u> • Earlier: Amniocentesis (Invasive) • Now: Level 2 scan (TIFPA) • <u>Prevention</u> Folic acid supplementation <u>Mx</u> MTP
--	--

- Anencephaly is more common in female fetuses.
- In ♂ fetus, most common - Macrosomia; Respiratory distress.

Folic Acid supplementation in pregnancy

• Advantages

- Prevents NTDs.
- Prevents Megaloblastic anaemia.
- Prevents IUGR.
- Prevents Abruption Placenta.

• Doses

① 400 mcg/day

- Prophylactic dose

- Given to

① All pregnant females (even with no history of NTD)

② All pregnant females with diabetes.

③ Pregnant females on antiepileptics which do not cause NTD (Lamotrigine)

★ 400 mcg folic acid is sufficient to prevent NTDs.

- Ideally, should be given 3 months before pregnancy and should be continued till 3 months after pregnancy.

- Tablet provided by govt. of India - 500mcg.

★ ∴ RDA for folic acid for pregnancy $\Rightarrow$ 500 mcg.

② 1mg/day

Indicated for -

① Pregnant female with megaloblastic anaemia

② If pregnant female has 2^o relative with H/o NTD.

③ Pregnant female on drugs that decrease folic acid absorption (Trimethoprim, Sulphasalazine)

③ 4mg/day

- Therapeutic dose

- Indicated for

① Pregnant female with H/o NTD in baby.

② Pregnant female on Antiepileptics that cause NTD (Valproate)

③ Pregnant female with sickle cell anaemia [5mg preferred]

- For females with previous history of NTD;

↓
4mg/day should be started at least 1 month before pregnancy and is continued till 3 months after pregnancy.

↓
After 3 months, 400 mcg/day continued through pregnancy.

Alpha Fetoprotein (AFP)

• Synthesis

- Early - by foetal Yolk Sac.
- Later - by foetal G.I.T and Liver.
- Major source - **Fetal Liver**.

• T_{1/2}

5-7 days

- Concentration of AFP is highest in
 - a) fetal serum - at 13 wks
 - b) Amniotic fluid - at 13 wks
 - c) maternal serum - at 32 wks

• Screening Test

- Maternal serum AFP used.
- AFP ≥ 2.5 multiples of median (MOM) $\Rightarrow$ +ve
- Twin pregnancy; AFP ≥ 3.5 MOM $\Rightarrow$ +ve
- AFP screening positive $\uparrow$ ses risk for neural tube defects.

$\uparrow$ AFP

- Neural Tube Defects
- Abdominal wall defects
- Pilonidal sinus

$\downarrow$ AFP

- Diabetes
- G**: • Gestational trophoblastic diseases
[Molar pregnancy;
Chorio Carcinoma]
- O**: • Maternal Obesity
- Overestimated gestational age.
- A**: • Abortion
- T**: • Trisomy

