

Placenta

• Introduction

Human Placenta is

Discoid - disc like shape

Deciduate - shed off during delivery

Hemichorial - Lies directly in contact with maternal blood.

At term,

Weight of Placenta = 500gms

Ratio of weight of Placenta and fetus = 1:6

* Weight of placenta = weight of fetus at 17 weeks of pregnancy.

• Named Cells

1) Hofbauer Cells - Placenta

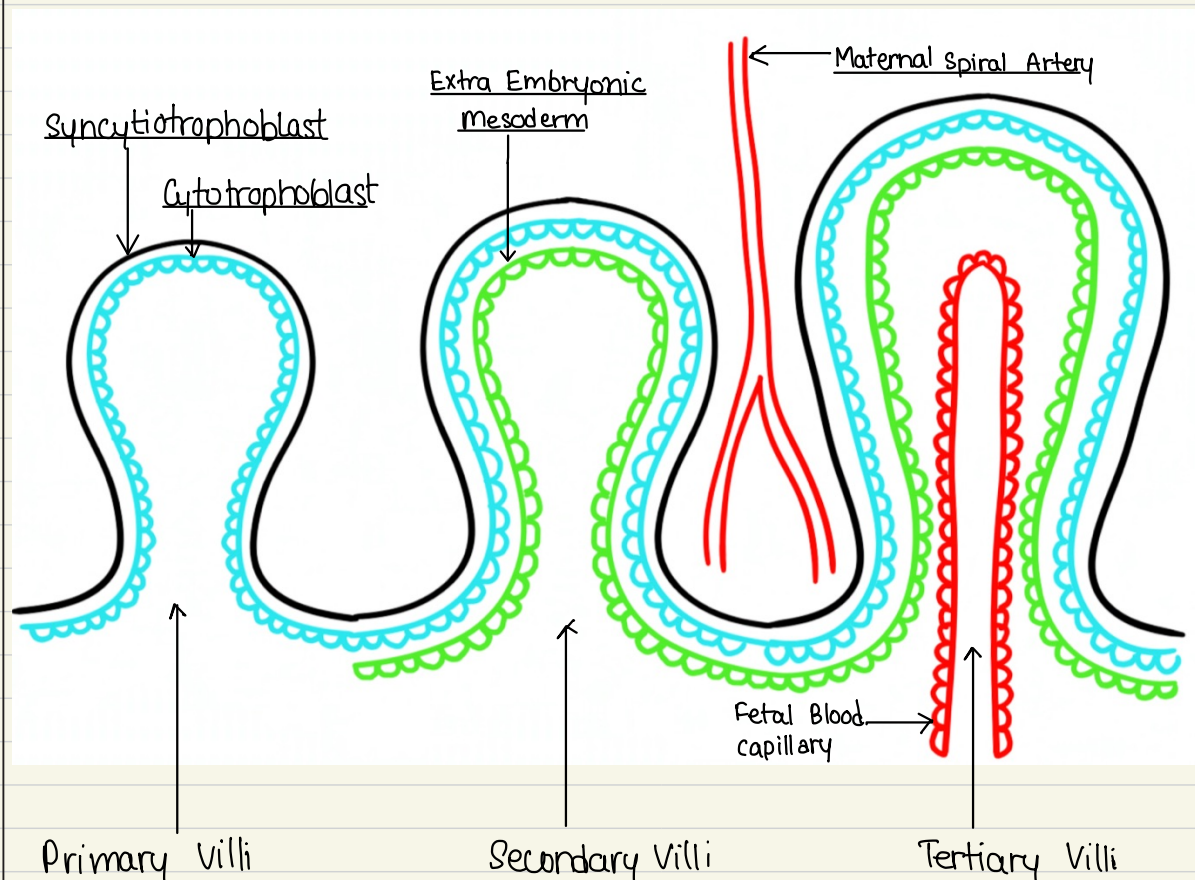
2) PEG cells - Fallopian tube

3) Langhan cells - Cytotrophoblast.

4) Nitabuch's layer - Fibrinoid degeneration b/w chorion & Decidua.

* Zika Virus can infect Hofbauer cells.

• Placenta formation



• Trophoblastic Shell

• Mesodermal core

• vascular

• Day 12

• Day 12-16

• Day 17

• Placental Barrier/ Membrane

Structures separating fetal blood from maternal blood.

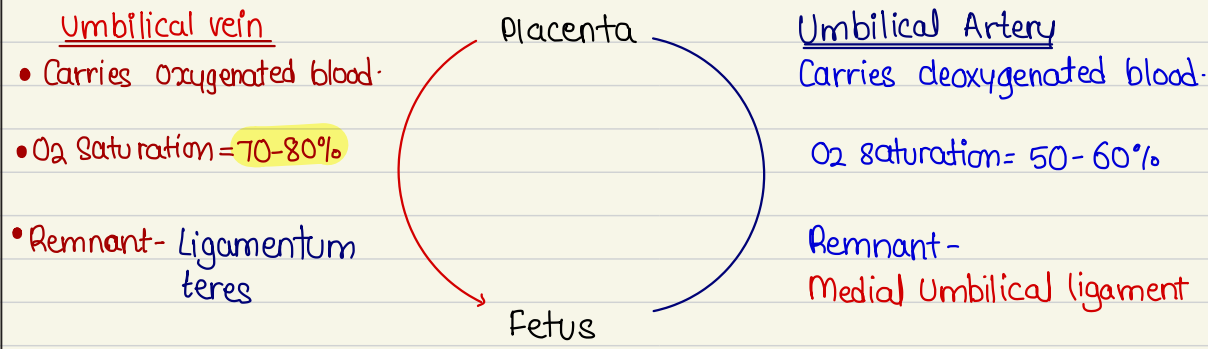
- | | |
|------------------------|---|
| outside
↓
Inside | <ul style="list-style-type: none"> • Syncytiotrophoblast • Cytotrophoblast • Extra embryonic mesoderm • Fetal capillary endothelium |
|------------------------|---|

* maternal spiral artery endothelium not included in barrier because extravillous cytotrophoblast replaces lining of maternal arteries during trophoblastic invasion.

• Placental Circulation

<u>Uteroplacental</u>	<u>Fetoplacental</u>
• In intervillous space (ivs)	• In villi
• Established on day 15	• Established on day 17 after fertilisation
• No. of spiral arteries opening in IVS - 120	• fetoplacental circulation at term ↳ 400 ml/min
• Partial pressure in IVS: 35-45 mmHg	• fetal blood flow at term. ↳ 125 ml/min
• O ₂ saturation in IVS : 65-75%	Rate of O ₂ delivery to fetus → 8 ml / kg / min
• Uteroplacental blood flow at term ↳ 500 - 750 ml/min	
• Uterine blood flow at term ↳ 750 ml / min	

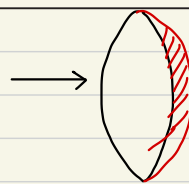
• Umbilical artery & vein :



- * Remnant of urachus - Median Umbilical Ligament
- * Remnant of umbilical artery - medial umbilical ligament
- * Remnant of Epigastric artery - Lateral umbilical ligament.

• Anatomy at Term

Fetal Side



Maternal Side

Formed by Chorion frondosum /
Cytotrophoblast / trophoblast

Comprises 4/5 of placenta

Shiny grey in colour.

fetal membranes & umbilical cord
is attached

Formed by decidua basalis.

Comprises 1/5 of placenta.

Dull red in colour.

Lobes (Polygonal areas) presents
↓
lobules / Cotyledons.

Note:

Functional unit of placenta → Cotyledons.

The area is supplied by main stem villi and all its branches.

USG for localization of placenta - 3rd trimester

Thickness of placenta-

a) at term - 2.5 cms

* Thickness ↑ 1mm every week.

b) At 40 weeks - 4 cm (40 mm) → Maximum thickness.

• Thickness > 4cm - Placentomegaly

Causes

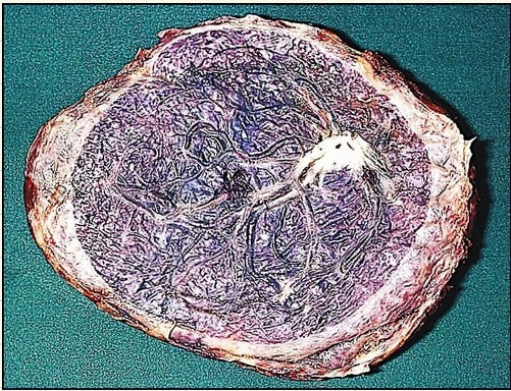
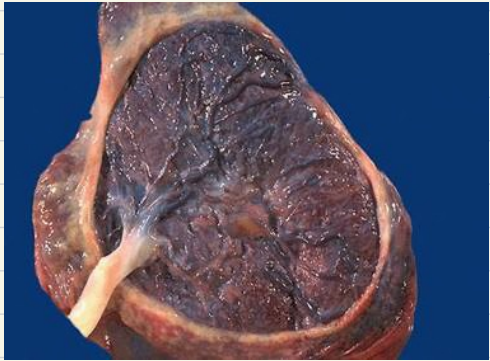
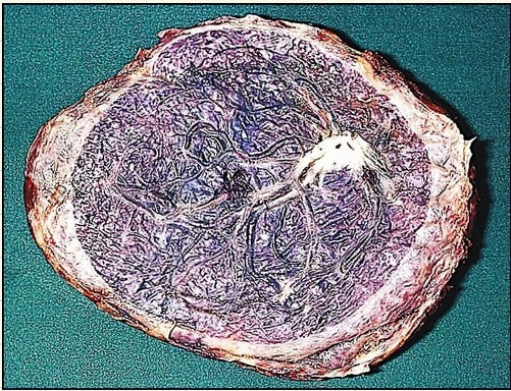
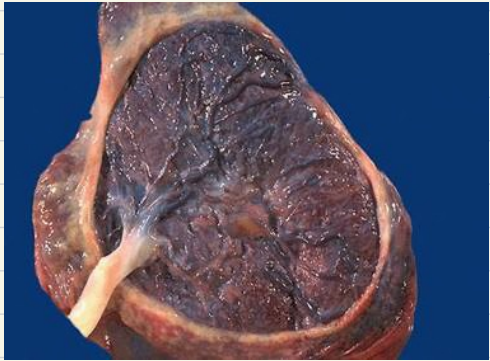
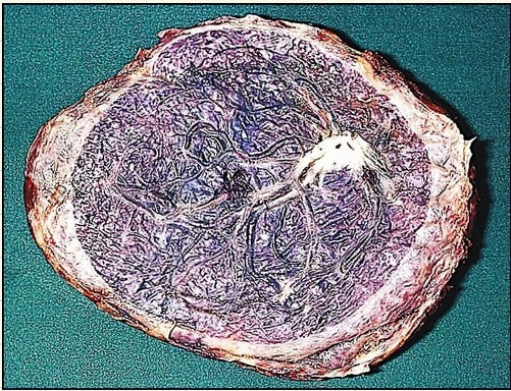
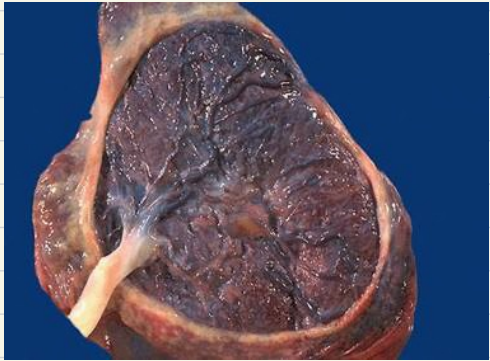
Maternal

1. Diabetes
2. Severe anaemia
3. d- thalassemia

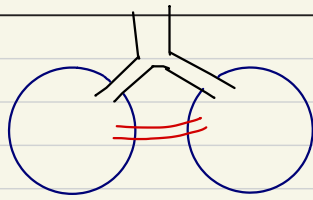
Fetal

1. Hydrops fetalis
2. Infections [Syphilis, TORCH]
3. Triploidy.

Placental Anomalies

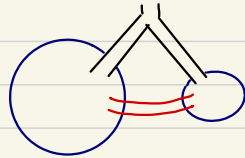
1) <u>Battledore Placenta</u>	Marginal insertion of Umbilical cord. • Normal placenta - Cord attached to centre of placenta. <u>Complications</u> • Abortion • Preterm delivery • Hydrorrhoea gravidarum • Antepartum Haemorrhage		
2) <u>Extrachorial Placenta</u>	Normally, area of fetal side = area of maternal side. → Fetal side < maternal side → fetal side is surrounded by maternal side in form of a ring. <table border="0"><tr><td data-bbox="371 947 930 1695"> <u>Circummarginate</u> • fetal side is surrounded by maternal side smoothly. </td><td data-bbox="938 947 1580 1695"> <u>Circumvallate</u> • fetal side surrounded by maternal side with valve like thickening in between. </td></tr></table> • <u>Complications</u> • Intrauterine Growth Retardation (IUGR) • Antepartum Haemorrhage • PPH • Retained Placenta.	<u>Circummarginate</u> • fetal side is surrounded by maternal side smoothly. 	<u>Circumvallate</u> • fetal side surrounded by maternal side with valve like thickening in between. 
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3) Placenta Bilobata



- 2 equal parts of placenta separated from each other.
- Connecting blood vessels present.
- aka Placenta duplex / Bipartite.

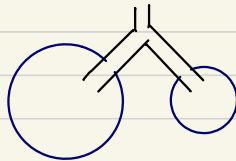
4) Placenta Succenturiata



- Small part of placenta detaches from main part.
- Connecting blood vessels present.



5) Placenta spuria



- Small part detaches from main part.
- No connecting blood vessels.

Complications of above anomalies.

- 1 part of Placenta retained → Secondary post partum haemorrhage [>24 hrs - <12 weeks of delivery]

Mx - Curettage

- Vasa previa

* Curettage is most common cause of Asherman Syndrome in case of post partum women.

6) Fenestrated Placenta

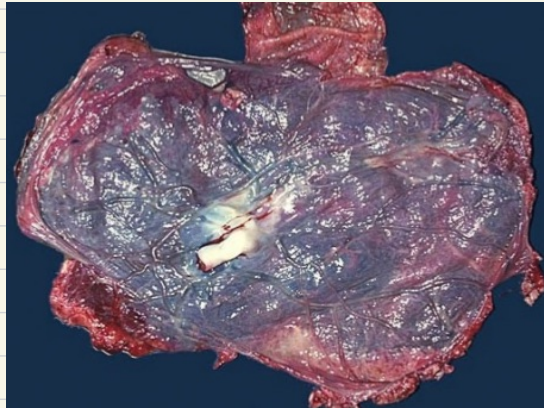
Central portion of discoid placenta is missing
ie missing chorionic plate & villi.

7) Placenta Membranacea

Placenta develops as thin membranous structure
Occupies the entire periphery of chorion.

All fetal membranes covered by functioning villi

✳ Serious haemorrhage due to associated **Placenta previa / accreta**.

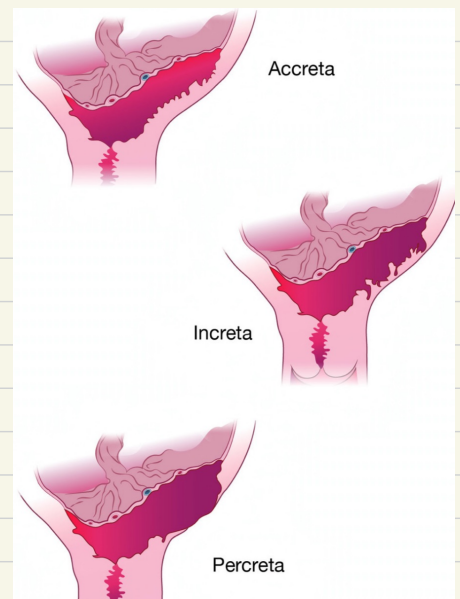
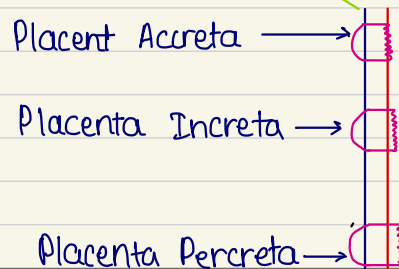
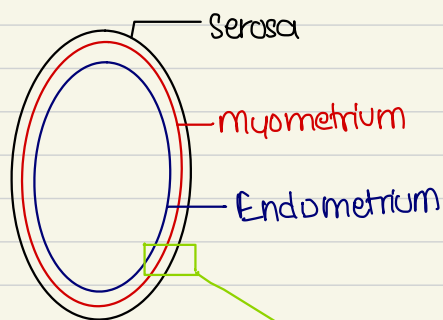


Morbidly Adherent Placenta

Nitabuch's layer

- Layer of fibrinoid degeneration present b/w placenta & decidua.
- Limits penetration of blastocyst
- Absence of nitabuch's layer leads to morbidly adherent placenta.

Types



Accreta - Superficially attached to myometrium

Increta - Deep inside myometrium

Percreta - Chorionic villi attached to serosa.

• <u>Pathogenesis</u>	• Absent Nitabuch's layer • Absent decidua basalis
• <u>C/F</u>	Undiagnosed case presents as case of Refractory PPH .
• <u>Risk factors</u>	• Placenta previa in present pregnancy. (Highest Risk). • Previous History of C-section. • History of uterine curettage • History of uterine surgeries - Myomectomy, Hysterectomy
• <u>Diagnosis</u>	• IOC - Transvaginal USQ USQ shows (i) Subplacental sonolucent area which represents decidua basalis - Absent (ii) Heterogenous appearance of Placenta. (iii) Placental lakes present. • Gold Standard - MRI
• <u>Management</u>	Elective Caesarean Section [Classical C-section] ↓ Because Placenta accreta is common with placenta previa Hence to prevent excessive bleeding. Hysterectomy ↓ If refused by patient. ↓ Remove as much placenta as possible & Leave the placenta which can't be removed for Autolysis + Methotrexate (Prevent Gestational Trophoblastic Neoplasia)

Placental function

1) <u>Respiratory</u>	Intake of O_2 and output of CO_2 takes place by Simple diffusion. O_2 supply to fetus - 8 ml/kg/min - Cord blood flow - $165-330\text{ ml/min}$.
2) <u>Excretory</u>	Waste products as Urea, uric acid, creatinine excreted in maternal blood by simple diffusion.
3) <u>Nutritive</u>	- Glucose - facilitated diffusion by GLUT-1 proteins ↳ located in syncytiotrophoblast. - Lipids - Dual origin. - Triglycerides & fatty acids transferred in early pregnancy and synthesised in fetus later. - Cholesterol is capable of direct transfer. - Amino Acids - Active transport. - Water, Sodium, potassium, chloride - Simple Diffusion - Calcium, Phosphorus, Iron - Active transport. - Water soluble vitamins - Active transport. Fat soluble vitamins are slowly transported. - Hormones Parathormone & Calcitonin do not cross placenta.
4) <u>Enzymatic</u>	Oxytocinase, phospholipase A_2, Diamine oxidase
5) <u>Barrier</u>	Substances with $M_w > 500$ Daltons are held up. TORCH, malarial Parasite and certain other microbes & drugs may cross Placental barrier.
6) <u>Immunological</u>	- Fetus has paternal genes, yet there is no rejection due to immunological protection from Placenta. - Placental hormones, proteins (sPI) are immunosuppressive.

7) Endocrine

Hormones produced by Placenta

- a) Progesterone
- b) Estrogen
- c) hCG
- d) hPL

* Main site for production in placenta - **Syncytiotrophoblast**

• Progesterone

- Released from corpus luteum (early pregnancy)

- At 7-9 weeks this function is taken over by Placenta
↳ **Luteal Placental shift**.

- > 8 wks - Progesterone is released from placenta.

- Life span of corpus luteum of pregnancy = 10-12 weeks.

- Precursors of progesterone = **Maternal LDL & Cholesterol**

- Rate of production of progesterone = 250 mg/day.

↳ Twin pregnancy = up to 600 mg/day

- Leads to 2 reactions in pregnancy:

- 1) **Decidual Reaction** - Conversion of endometrium to decidua

- ↳ Glands become hypersecretory

- ↳ Stroma becomes oedematous & rich in glycogen.

- 2) **ARIAS STELLA Rxn** -

- Glands become hypersecretory + changes in nuclei.

- Also seen in **Ectopic & molar pregnancy**.

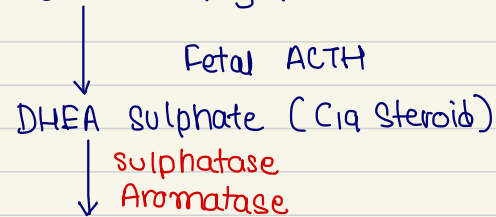
- Progesterone relaxes smooth muscles during pregnancy.

- Estrogen

- Placenta can't synthesis estrogen using precursors from mother as placenta lacks **17-hydroxylase**.

- 17-Hydroxy progesterone (C21 steroid) $\xrightarrow{17\text{ hydroxylase}}$ Androstenedione (C19 steroid)
↓
Needed for estrogen synthesis

- Fetal Adrenal glands



Placenta uses this to form estrogen.

- Function of this estrogen is to give contraction signals to uterus at term.
[Low levels lead to post term pregnancy].

- **Most common** estrogen during pregnancy = **E₂** (Estradiol)

- **Most Specific** estrogen during pregnancy = **E₃** (Estriol)

- Conditions in which estrogen levels are decreased -

- 1) Adrenal glands of fetus are absent or hypoplastic - **Anencephaly**
- 2) Placental sulphatase or aromatase deficiency
- 3) Fetal demise
- 4) Down's syndrome
↳ Overall production of C19 steroids reduced in fetus.

- Conditions in which estrogen levels are increased -

- 1) Erythroblastosis fetalis

↓
↑ placental tissue

↓
High levels of estrogen.

- hCG Human Chorionic Gonadotrophin

- Glycoprotein.

- Hormone with max glycogen content.

- 2 subunits

α - subunit

β - subunit.

- Non specific

- Similar for LH, FSH, TSH

- Gene present on chromosome 6

- Specific

- Gene present on chromosome 19.

- Anatomically similar to LH, FSH & TSH.

- Most anatomically and functionally similar to LH.

- Earliest detection of hCG in blood - 8 days after fertilisation (or) Day 22 of menstrual cycle.

- hCG can be detected approximately 5-6 days before 1st missed period.

- Most sensitive test for detection [Fluorescent Immunoassay
Radio Immunoassay (and choice)

- Levels of hCG

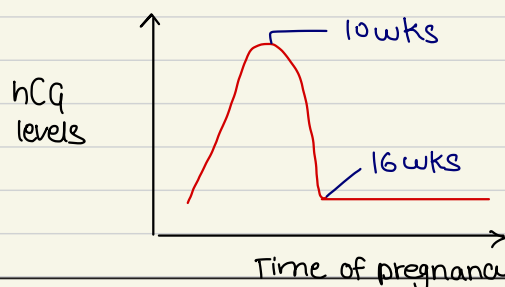
- Early pregnancy, nearly double (↑ by 55-65%) every 48 hrs.

- * Maximum levels → 10th wk (60-80 days) of pregnancy

↓ ↳ levels = 50000 IU/L - 10⁵ IU/L

levels decrease

- * Minimum at 16 weeks → continues throughout pregnancy at low levels.



- * hCG levels become normal,

a) delivery : 1-2 wks

b) Abortion : 2-4 wks

c) Partial mole evacuation : 7wks

d) Complete mole evacuation: 9wks

$T_{1/2}$ of hCG = 36 hrs [$T_{1/2}$ of LH = 2 hrs]

Function

- 1) Helps to maintain corpus luteum of pregnancy.
- 2) Acts as initial stimulus for Leydig cells to produce testosterone.
- 3) Prevents rejection of fetus.

* Increased hCG levels

- ① Twin pregnancy
- ② Molar pregnancy
- ③ Choriocarcinoma
- ④ Down's syndrome
- ⑤ Erythroblastosis fetalis

* hCG levels less than normal

- ① Ectopic pregnancy
- ② Abortion
- ③ All trisomies except Down's.

Urine Pregnancy test

Based on Sandwich ELISA test

Sensitivity - detects hCG with 20 IU/L

Can't detect pregnancy before missed period.

• Critical Titre of hCG

The value of hCG at which 100% cases of intrauterine pregnancy has visible gestational sac

- Critical titre for
 - trans vaginal scan = >1500 IU
 - Abdominal scan = 6500 IU (>5000 IU)

Case Based

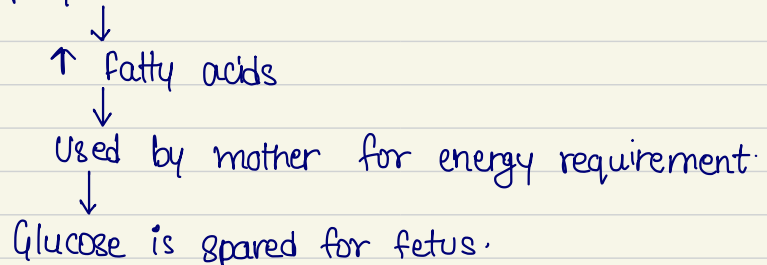
	<u>Patient 1</u>	<u>Patient 2</u>
Urine Pregnancy	+ve	+ve
hCG levels	1000 IU	2500
TVE	No gestational sac seen	No gestation sac seen
DDs	Early IU pregnancy ↓ Repeat hCG after 48 hrs ↓ Levels Double Ectopic ↓ Levels ↑ but not Double Abortion ↓ Levels ↓	Ectopic pregnancy.

hPL Human Placental Lactogen

- Aka hCS (Human Chorionic Somatotrophin).
- Single chain polypeptide hormone.
- Structurally similar to GH and Prolactin.
- Can be detected at 3 weeks of pregnancy.
- Levels continue to rise throughout and maximum at 36 wks of pregnancy.
- hPL is a marker used for checking Placental functioning.
- Hormone with highest production at term
↳ Production rate - 1g/day.
- $T_{1/2} \Rightarrow 20-30$ mins.

Function-

1) Promote lipolysis in mother.



2) Brings about insulin resistance

↳ Levels of glucose in mother ↑sed.

* Insulin resistance in pregnancy

- hPL (mainly)
- estrogen
- progesterone
- cortisol

Fetal Membranes

- | | |
|--------------------|---|
| • <u>Chorion</u> | <ul style="list-style-type: none">• Formed 8 days after fertilisation by Cytotrophoblast.• Outer layer. |
| • <u>Amnion</u> | <ul style="list-style-type: none">• Derived from ectoderm• Formed by 10 days after fertilisation• Innermost membrane.• Avascular• Maximum tensile strength. |
| • <u>Yolk Sac</u> | <ul style="list-style-type: none">• Site for Haematopoiesis in fetus. |
| • <u>Allantois</u> | <ul style="list-style-type: none">• Diverticulum derived from hindgut & grows in the connecting stalk. |
| | <ul style="list-style-type: none">• PGE_2 is the prostaglandin predominantly released by fetal membranes.• If fetal membrane is ruptured<ul style="list-style-type: none">↓PGE_2 released↓Accelerates the process of labour |

Umbilical Cord

• Introduction

- Derived from connecting stalk.
- Length : 30-100 cms (Average length = 55 cms)
- Short Cord = length < 30 cm
 $pH = 7.2$
- Connective tissue - **Wharton's Jelly**.
- Has folds known as folds of Hoboken.
- In early Intrauterine life, 4 vessels are present.
 - (i) Right Umbilical Artery (iii) Left Umbilical Artery
 - (ii) Right Umbilical vein (iv) Left Umbilical vein
- Later, Right umbilical vein disappears.
- At birth, there are 2 umbilical arteries & 1 umbilical vein.
- 2 umbilical arteries near insertion of cord to placenta are connected by **Hirtle's anastomosis**.
- Most common vascular anomaly of cord = single umbilical artery.

• Single Umbilical Artery

- More common in
 - [Diabetes
 - Twin Pregnancy
- Significant finding
- Increases chances of malformation [CVS + Renal]
- Single UA + malformations $\Rightarrow$ Increased chances of Trisomy

- Velamentous Insertion of Cord.
- Cord is attached to fetal membranes & then to placenta & before attaching to placenta it divides.

On the rupturing of membranes, cord will be damaged,

↓
Damage to UA & UV

↓
Fetal Blood loss

↓ known as

Vasa Previa

✱ Since there is PV bleeding it may be confused with Placenta previa:

- Vasa Previa
- Diagnosis

1) Singer's Alkali Denaturation test.

2) Antenatally (no Pv Bleed) : Doppler USG

- Mx - Caesarean Section

- Prognosis - ↑ Perinatal mortality

• Singer's Alkali Denaturation Test (Apt Test)

