Structured Notes According to

GYNAECOLOGY & OBSTETRICS

Revision friendly **Fully Colored Book/Structured Notes**

For Best results, watch the video lectures along with reading notes

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(Author)

CONTENTS

Gynaecology & Obstetrics Vol-2

NORMAL LABOR

ABNORMALITIES OF LABOR

OBSTETRIC HEMORRHAGE & OBSTETRIC EMERGENCIES

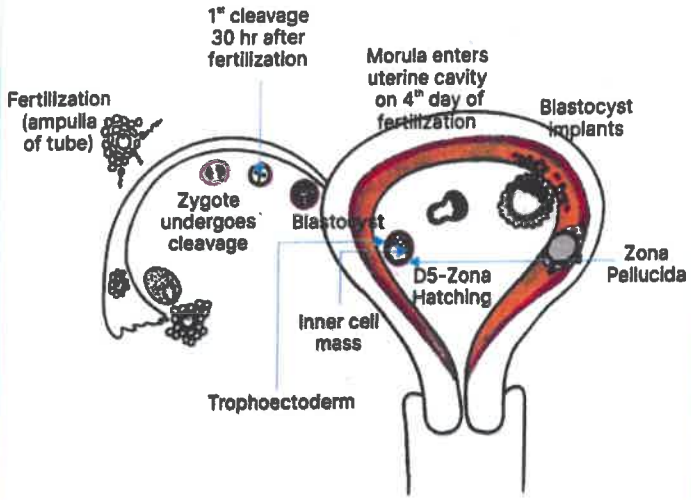
HIGH RISK PREGNANCY

PUERPERIUM

SPECIAL TOPICS IN OBSTETRICS

1. IMPLANTATION & PLACENTATION

FERTILIZATION



- Fertilization → occurs on the same day of ovulation → to form zygote
  - Site : Ampulla of fallopian tube / Junction of ampulla & isthmus
- Division of zygote → Cleavage
  - 1st cleavage → 30 hours after fertilization
- Tubal secretions (rich in pyruvate) provide nutrition to the zygote (secretory phase) → "provide nourishment to conceptus" → Zygote becomes morula
- Morula enters uterine cavity on 4th day of fertilization → becomes blastocyst (fluid filled cavity)
- Blastocyst has an
  - Inner cell mass → becomes embryo proper
  - Trophectoderm → becomes placenta and fetal membranes
  - Covered by zona pellucida → prevents it from implanting
    → Zona pellucida is lysed by proteases from secretory phase endometrial glands
  - Blastocyst emerges from zona pellucida → Zona hatching → occur on 5th day of fertilization
  - Blastocyst is implanted

IMPLANTATION

- Secretory phase → corpus luteum is present
- Corpus luteum secretes progesterone → secretory changes → makes endometrium receptive for implantation
- Timing of implantation → Day 6 - Day 10 of fertilization
- Window of Implantation → Day 20 - Day 24 of cycle
- Trophoblast layer is differentiated into 2 (By the time the implantation is taking place - Day 8 of fertilization)
  - **Outer Syncitiotrophoblast**

    Secretes hCG

    ↓

    Entering the maternal blood (as early as Day 8)

    ↓

    Supports corpus luteum

    ↓

    Decidualization of endometrial lining

    ↓

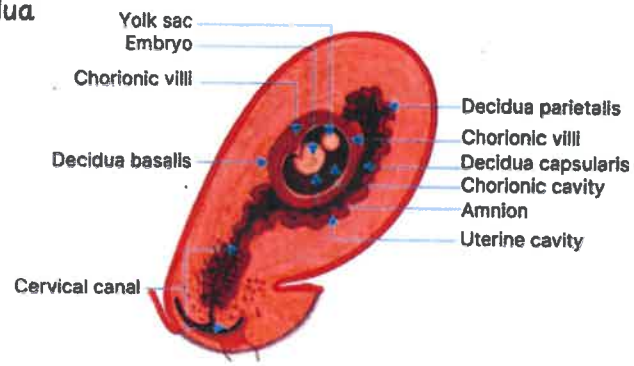
    More secretion of progesterone
  - **Inner cytotrophoblast**
- **Steps of Implantation**
  - Apposition →
    → Invasiveness of the trophoblasts → responsible for implantation
  - Human implantation (type of Interstitial implantation) → Blastocyst is within endometrium

- M/c site of implantation → Upper posterior wall of uterus
- Most prominent histological finding in endometrium at the time of implantation → Stromal edema.
- Thickness of endometrium → 10 - 14 mm
- Hormone that prepares the endometrium for implantation → Progesterone

DECIDUA FORMATION

00:13:35

- Specialized endometrium for pregnancy → Decidua
- Main Hormone responsible (for decidualization) → progesterone
- Completed by Day 10 of fertilization
- ↑sed secretory activity
- Decidual cells → enlarged stromal cells which became polygonal/round cells
- Gestational sac → Chorionic cavity
- **Parts of decidua**



Beneath the implanted embryo (away from the cavity)	Covering the implanted embryo (like a capsule)	Covering the rest of the uterine cavity
↓	↓	↓
Decidua basalis	Decidua capsularis	Decidua parietalis

- Embryo grows → decidual space obliterates → Decidua parietalis & capsularis fuse → forms Decidua vera → Occurs at 14 - 16 weeks of gestation

PLACENTAL DEVELOPMENT

00:18:14

- Develops from 2 sources

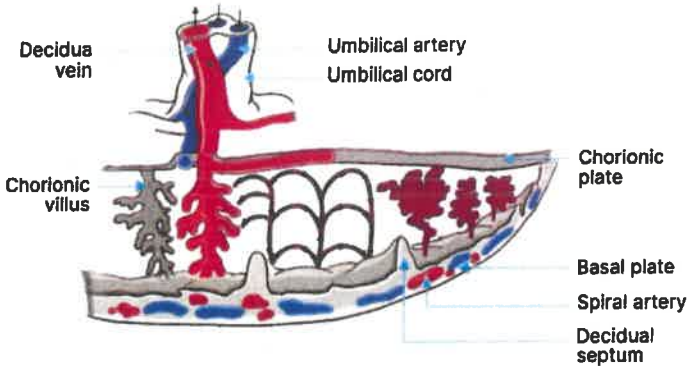
FETAL COMPONENT (BULK OF THE PLACENTA)	MATERNAL COMPONENT
Chorionic villi / Chorion frondosum	Decidua basalis

PLACENTA

00:18:54

- Umbilical cord has 3 vessels
  - Left umbilical vein → [redacted]
  - 2 Umbilical arteries → carrying deoxygenated blood to the placenta
- Chorionic plate → Chorionic villus arises
- Decidua basalis → Basal plate is formed
  - Projects inside at places (like the Decidual septum)

- Fetal vessels, i.e chorionic vessels (branches of umbilical vein and umbilical arteries)
  - Traveling inside chorionic villus → Fetoplacental circulation
- Spiral arteries & veins → in the region of decidua basalis
  - Push maternal blood into intervillous spaces (between various chorionic villi)
- **At term** → about [redacted] into intervillous spaces



EARLY INVASION OF TROPHOBLASTS

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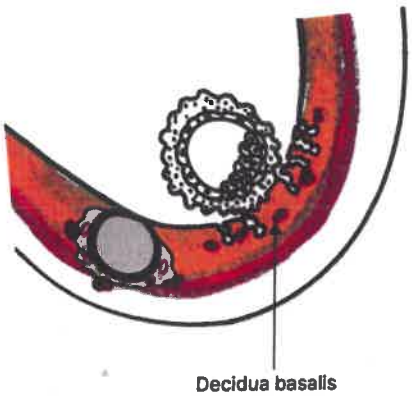
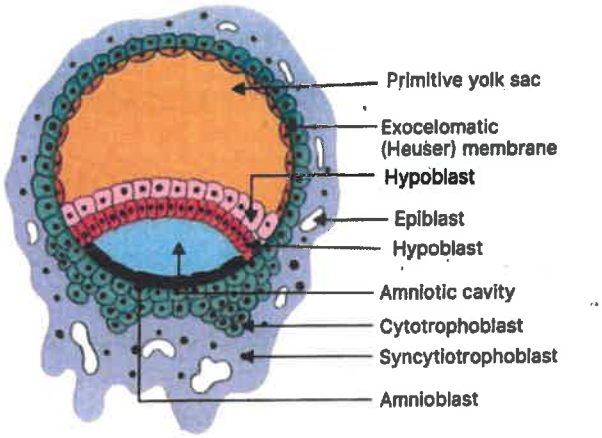




CHORION	• Arises from cytotrophoblast, syncytiotrophoblast and Extraembryonic mesoderm
LACUNA (Later Develops into Intervillous Spaces)	• Empty spaces which appear in invading syncytiotrophoblast layer o Appear by Day 12 of fertilization o Spiral arteries are present nearby; they are invaded o Lacuna gets filled by maternal blood; uteroplacental circulation is established by Day 15 of fertilization

DEVELOPMENT OF CHORIONIC VILLI

00:26:40

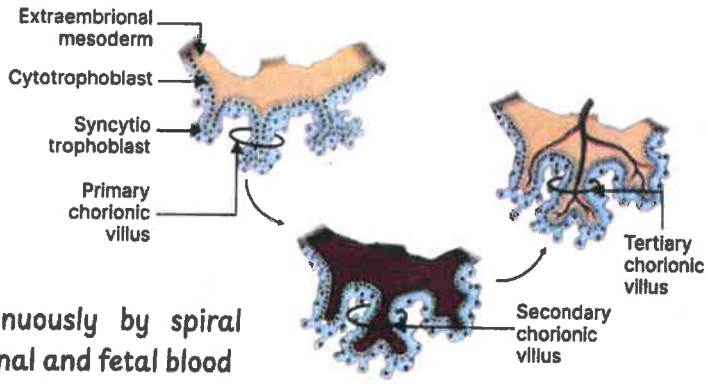
CHORIONIC VILLI
(Extraembryonic Mesoderm + Cytotrophoblast + Syncytiotrophoblast)

Primary Chorionic villus
Only Cytotrophoblast + Syncytiotrophoblast

Secondary Chorionic villus
Extraembryonic mesoderm enters core of the chorionic villi

Tertiary Chorionic villus
Fetal vessels/chorionic vessels → develop and enter the core of the chorionic villus (fetal blood vessels extend into the vessels)

- Fetal vessels in chorionic villi → functional by about Day 17 of fertilization (tertiary villi)
- Feto-placental circulation → by Day 21 of fertilization
- Functional unit of placenta → Lobule (Cotyledon)
  - Area of placenta supplied by one primary stem villi
- Maternal blood enters intervillous spaces continuously by spiral arteries → exchange of gases occurs between maternal and fetal blood



Trophoblast invasion of spiral arteries occurs
↓
Spiral arteries becomes dilated and wide
↓
Consistent increased blood supply to the intervillous spaces
↓
Facilitate exchange of gasses
↓
Amount of blood in the intervillous space (at term) → [redacted]

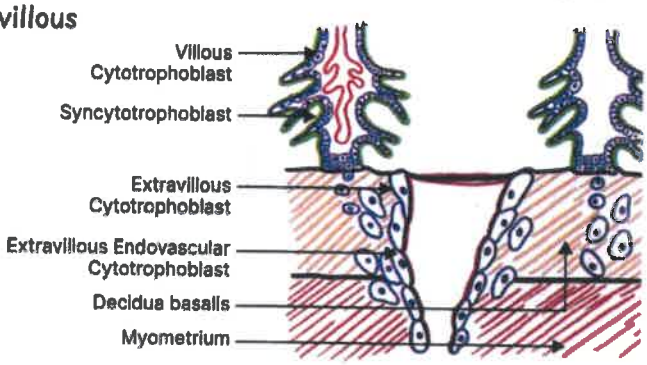
- Small narrow caliber spiral arterioles → not enough for ↑sed blood supply

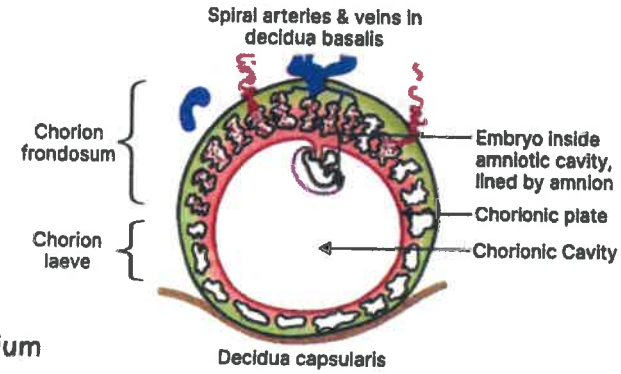
Trophoblast invasion of spiral arteries

- Certain cytotrophoblast → leave chorionic villi → Extravillous cytotrophoblast

Invading decidua basalis & spiral arterioles → Extravillous endovascular cytotrophoblast
↓
Cause vascular remodeling of spiral arterioles
↓
Extravillous endovascular cytotrophoblast lines spiral arterioles
↓
Fibrinoid material replaces smooth muscles & connective tissue of vessel wall
↓
Becomes loose, dilated vascular channels
↓
More blood reach intervillous space

00:33:35



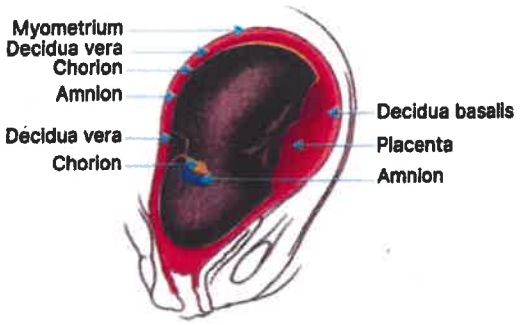


- Remodeling → extends to the superficial layer of myometrium (to some extent)
- Extravillous cytotrophoblasts remaining in the decidua basalis → Extravillous interstitial cytotrophoblast → persists as Placental bed giant cells

- Vascular remodeling occurs only in the spiral arteries (not veins)
  - Only in the region of Decidua basalis
- 1st wave of remodeling → [redacted]
- 2nd wave of remodeling → completed between 12-16 weeks

CHORION FRONDOSUM	CHORION LAEVE
• Vascularized chorionic villus • Towards the embryonic end • Takes part in the formation of placenta (along with decidua basalis)	• Avascular layer of Chorion • Completely flattens out

- Fetus is growing → amnion will fuse with the chorion → Final chorionic plate is formed
  - Around 8 - 10 weeks



AMNION

Part of fetal membranes
- Chorion Laeve + Amnion = Fetal membranes
- Protective in nature

1st identified on Day 7 / Day 8 of embryonic development

Derived from Fetal ectoderm

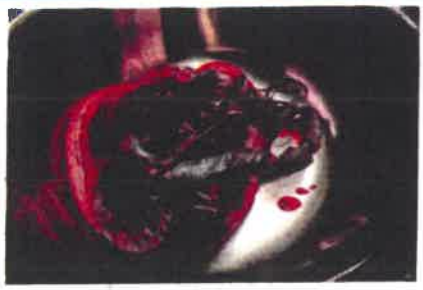
Avascular layer, rich in collagen

Responsible for the tensile strength of fetal membranes

Synthesizes PGE2, FFN (Fetal Fibronectin)

TERM PLACENTA

00:42:43

MATERNAL SURFACE OF PLACENTA	FETAL SURFACE OF PLACENTA	
		
• Rough looking • Reddish in color • Divided into lobes (not same as Cotyledons) • Some portion of decidua basalis	• Shiny and glistening appearance ○ Cause : covered by amnion and chorion • Umbilical cord is attached at the center of placenta	Fetal membranes

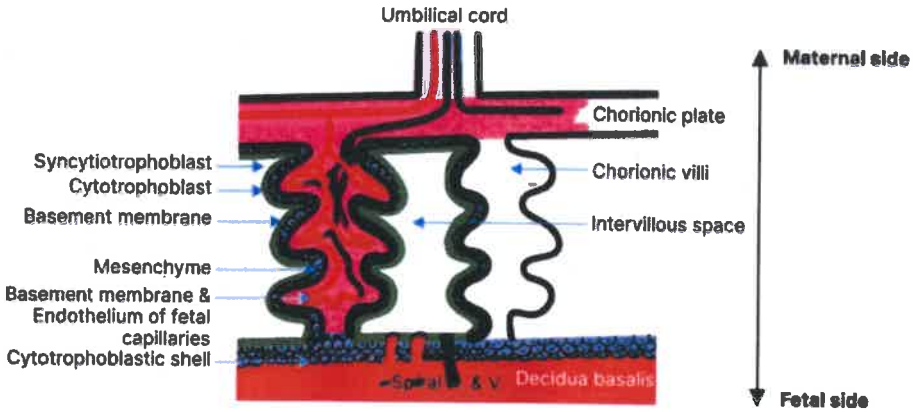
SHAPE	• Discoid in shape
WEIGHT	• 500g
CONTENT - BLOOD	• 500 ml of blood o 150 ml → in intervillous spaces o 350 ml → in chorionic villus
PLACENTAL WEIGHT : FETAL WEIGHT	• 1 : 6 (Placental weight = Fetal weight at 17 weeks)
UTEROPLACENTAL CIRCULATION AT TERM	• 700 - 900 ml/min
FETOPLACENTAL CIRCULATION AT TERM	• 400 ml/min

PLACENTAL BARRIER

00:46:43

EXTRA-POINTERS

- Intervillous spaces → lined by syncitiotrophoblast
- **Cytotrophoblastic shell** → Formed by Cytotrophoblast cells invading into the region of decidua basalis
- **Zone of fibrinoid necrosis / NITABUCH LAYER** → Region where Cytotrophoblast shell & decidua basalis meet
  - **Function** : prevents deeper penetration of placenta
  - Absent in Morbidly adherent placenta



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FUNCTIONS OF PLACENTA

Respiratory
Gaseous exchange between maternal blood & fetal blood

Excretory
Excretory waste from the baby excreted via placenta

Nutrition
All requirements; (eg:- Electrolyte, water requirements) met by the placenta

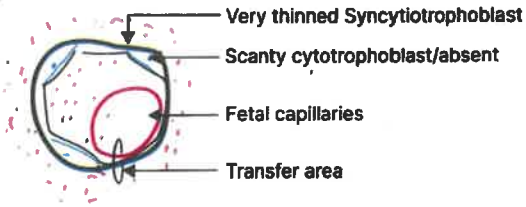
Hormone production

Barrier function
- Incomplete barrier
- Placental barrier keeps maturing physiologically throughout pregnancy → placenta keeps thinning

TERM PLACENTAL BARRIER

00:51:38

- Very thinned out Syncytiotrophoblast
  - Chorionic villi keeps on branching → becomes thinner
- Absent / scanty cytotrophoblast
  - Continuity lost (because of rebranching)
- Presence of mesenchyme
- Presence of Fetal capillary → [redacted]
- **Transfer area** → consists of endothelium & basement membrane of fetal capillaries
  - Very thinned out



Important Information

- Smoking, bleeding, fibrin deposition of placenta → Thick placental barrier
  - Interferes with gaseous exchange & nutrient exchange across placenta
- O_2 diffusion occurs continuously → across intervillous space from maternal side to the fetal side → 8 ml/min/kg fetal weight
- Oxygen saturation in Intervillous space → 65 - 75 %
- PaO_2 in Intervillous space → 30 - 35 mmHg
- Oxygen saturation in the umbilical veins → similar to Oxygen saturation in Intervillous space
- PaO_2 in the umbilical veins → little bit lower to PaO_2 in Intervillous space
- Transfer of O_2 from the maternal to the fetal side
  - Cause
    → Low PaO_2 in the umbilical veins
    → Fetal HbF has greater affinity for O_2

PREVENTION OF FETAL REJECTION

00:57:18

- Villous trophoblasts have no MHC expression
- Extravillous cytotrophoblasts express Class Ia HLA
  - HLA-G → [redacted]
- Pregnancy hormones - Progesterone and hCG contribute to immune tolerance
- Decidual Natural Killer cells are not cytotoxic
  - Secrete substances that favor trophoblastic invasion
- Immunomodulated state of pregnancy
  - Cytotoxic immunity i.e, Th1 immunity is ↓sed
  - Antibody mediated immunity i.e Th2 immunity is ↑sed
  - Th2 response >>> TH1 response

Important Information

- MHC expression is important in identifying cells as foreign

MCQ's

Q. Decidual reaction is completed by
a. Day 10 of fertilisation
b. Day 7 of fertilisation
c. Day 14 of ovulation
d. Day 10 of ovulation

Ans: (a)

Q. A 30 year g2p2 delivered by normal vaginal delivery with no complications. The placenta was examined after delivery. The normal human placenta is?
1. Discoid
2. Hemochorial
3. Deciduate

a. 1 & 2
b. 2 & 3
c. 1 & 3
d. 1, 2 & 3

Ans: (d)

Q. A 28 year old pregnant woman who just delivered after an uncomplicated pregnancy. What would be the anticipated weight of her placenta at the time of delivery?
a. 200 grams
b. 500 grams
c. 700 grams
d. 1000 grams

Ans: (b)

Q. The invasiveness of trophoblasts promotes the implantation of blastocyst into the uterine wall. All of the following statements are true regarding this except?
a. Invasion of spiral arterioles occur all over the decidual lining
b. Extravillous cytotrophoblasts invade the spiral arterioles
c. Human implantation is the interstitial implantation
d. Resistance in uteroplacental circulation decreases

Ans: (a)

Q. Zika virus can infect the fetal macrophages present in the maternal fetal interface of the placental barrier to allow fetal transmission. These cells are called as?

a. Langhans cells
b. Whartons cells
c. Hoffbauer
d. NK cells

Ans: (c)

2. PLACENTAL HORMONES

BASICS OF ENDOCRINOLOGY OF PREGNANCY

00:00:54

- Early pregnancy maintenance is by:
  - Implanting blastocyst: hCG
  - Corpus luteum of pregnancy: Progesterone
- Corpus luteum secretes:
  - Estradiol
  - Relaxin
  - Inhibin A
  - Progesterone

Inhibin A
↓
Suppresses FSH from pituitary
↓
Suppresses follicular growth

Increased levels of progesterone
↓
-ve feedback
↓
Decreased levels of LH
↓
Suppression of ovulation

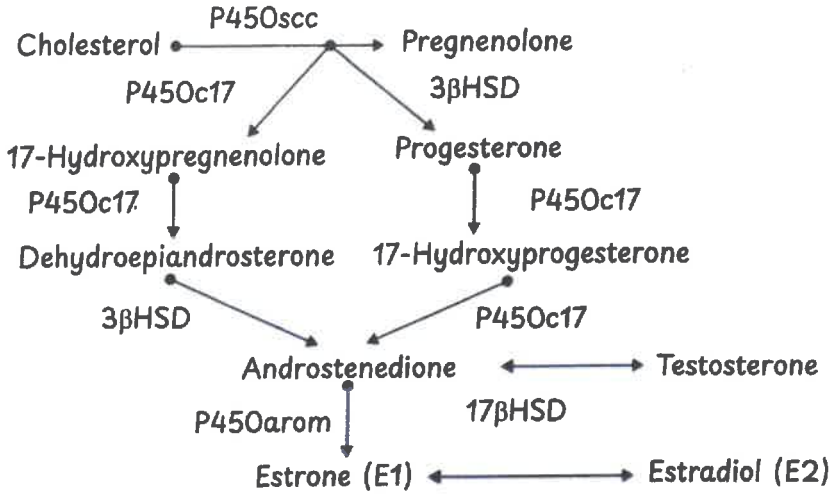
PROGESTERONE DURING PREGNANCY

- **Till 7 weeks**
  Exclusively from corpus luteum of pregnancy
- **After 10 weeks**
  Exclusively from placenta
- **Between 7 to 10 weeks**
  Luteal - placental transition
- **8 weeks**
  Placenta takes over progesterone production
- **If corpus luteum removed before 7 weeks**
  Early pregnacy loss or abortion
- **At term**
  Placenta produces 250 mg/day progesterone
- **Low progesterone levels:**
  Ectopic pregnancy, Abortion, Failing pregnancies

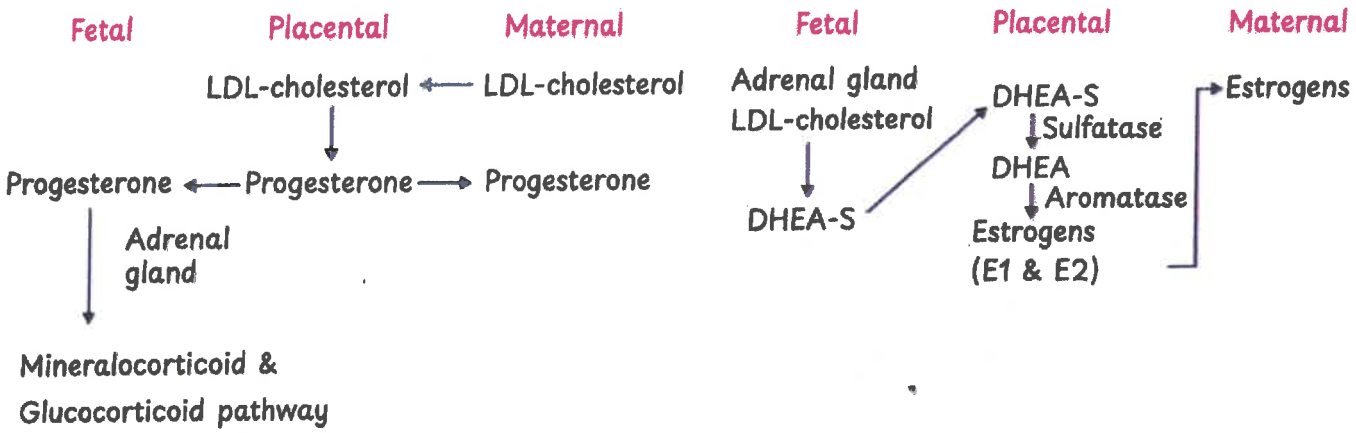
STEROID HORMONES FROM PLACENTA

00:07:53

- Production from
- Raw materials:
  - Maternal blood
  - Fetal blood
- Fetoplacental maternal unit produces steroid hormones



- Placenta has 3 β hydroxysteroid dehydrogenase activity (3 βHSD)
  - Fetal adrenal glands don't have 3 β HSD activity
  - Progesterone and hydroxyprogesterone enters the glucocorticoid and mineralocorticoid pathway
  - Fetal adrenal glands do not produce glucocorticoid and mineralocorticoid if no progesterone as raw material
- Placenta does not have 17 α hydroxylase activity which is needed for the production of androgens
  - Fetal adrenal glands have 17 α hydroxylase enzyme activity → can synthesize androgens which placenta uses to produce estrogen



- DHEA-S can get hydroxylated in the fetal liver
  - 'On aromatization : E3 & E4 (pregnancy)'

ESTROGEN DURING PREGNANCY

- Placenta produces:
  - Estradiol (E1)
  - Estrone (E2)
  - Estriol (E3) } exclusive to pregnancy
  - Estetrol (E4) }
- Estriol: Maximum amount produced (per day)
  - 1st detectable in maternal serum at 9 weeks
- Estradiol: [redacted]

ROLE OF PROGESTERONE	ROLE OF ESTROGEN
• Prepares endometrium for implantation • Decidualization of endometrium • Promotes uterine quiescence • Suppresses maternal immune response to fetal antigens • Substrate for fetal adrenal gland production of corticosteroids • Angiotensin refractoriness in pregnancy.	• Hypertrophy & hyperplasia of uterine myometrium • Development & hypertrophy of breasts (together with progesterone) • Sensitizes the myometrium to oxytocin & PGs • Along with progesterone - maternal adaptation to pregnancy

PROTEIN HORMONES FROM PLACENTA

00:22:03

They are:

- hCG
- hPL
- Produced from syncytiotrophoblast layer

hCG	hPL
Glycopeptide	Polypeptide
T½ = 24 hours	T½ = 15 mins
Alpha (similar to FSH, LH, TSH) and beta (specific) subunits	

ROLE OF hCG IN PREGNANCY

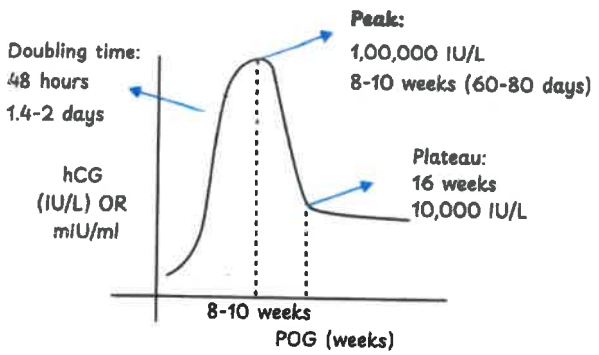
- Rescue & maintenance of corpus luteum
- Stimulation of fetal testes to produce testosterone
- Stimulation of maternal thyroid gland
- Uterine vascular dilatation & uterine smooth muscle relaxation
- Modulates maternal immune cell function in decidua

Q. When can hCG be first detected in maternal serum?

- 8 days after fertilization
- Day 22 of cycle
- 5 days prior to expected but missed periods

Trends of hCG in maternal serum

- 'hCG levels normalize by 2 weeks after delivery & 3-4 weeks after abortion'



Abnormal hCG levels:

HIGH	LOW
• Multiple pregnancy • Molar pregnancy • GTN (Gestational Trophoblastic Neoplasia) • Down's syndrome fetus • Erythroblastosis fetalis • Renal failure (hCG is cleared by kidneys)	• Failing early pregnancies • Ectopic pregnancy

HUMAN PLACENTAL LACTOGEN

- Human chorionic somatomammotropin
- Single chain polypeptide hormone; structurally similar to growth hormone
- T ½ = 15 min
- 1st detected in maternal serum:
- Levels rise through pregnancy & plateau in last 4 weeks
- Production rate at term: 1 gm/day
- Levels in maternal serum correlate with placental well being

Role of human placental lactogen

- Maternal adaptation to fetal energy requirements
- Promotes lipolysis to raise free circulating fatty acids
- Maintain insulin resistance during pregnancy

MCQ's

Q. A young woman is admitted to emergency with an acute abdomen in shock. She was operated for a right sided hemorrhagic corpus luteal cyst which was removed. She is also found to be 7 weeks pregnant with a healthy intrauterine pregnancy. What is she counseled about the pregnancy ?
a. There is no risk to pregnancy
b. There is risk of abortion
c. Counsel for MTP
d. The other side ovary will take over progesterone production

Ans (b)

Q. Which hormone is secreted by the human placenta exclusively?
a. hPL
b. hCG
c. GH
d. GnRH

Ans (a)

Q. What is the source of prolactin in the amniotic fluid?
a. Maternal pituitary
b. Placenta
c. Fetal pituitary
d. Decidua

Ans (d)

Q. Relaxin hormone can be demonstrated from the corpus luteum, placenta and decidua. It contributes to all of the following in pregnancy except?
a. Remodeling of reproductive tract connective tissue
b. Peripheral joint laxity
c. Increase GFR
d. Vasodilatation

Ans (b)

Q. Hormone responsible for the growth of fetus is?
a. Growth hormone
b. Insulin
c. Glucagon
d. Thyroxine

Ans (b)

3. AMNIOTIC FLUID

00:01:02

ROLE OF AMNIOTIC FLUID

- Maintains even temperature around the fetus
- Shock absorber
- Prevents cord compression
- Allows for fetal growth and movement
- Protective role
- No nutritive role

IMPORTANT CHARACTERISTICS 00:02:40

- Main content is water, replaced once in every 3 hours
- Osmolality : [redacted]
- Specific gravity : 1.007 - 1.010
- pH: 7.1 - 7.5 (alkaline)
- Color
  - At term: Straw colored
  - Preterm: Colorless
  - Post term: Saffron colored
  - Blood stained in placental abruption
  - Tobacco juice like with IUD
  - Rh affected fetus: Golden yellow (bilirubin)
  - Green colored: Meconium stained
    - → Fetal distress
    - → Breech in labor
    - → Maternal listeriosis
- Ferning: Amniotic fluid is rich in sodium and chloride
  - It dries in a fern like pattern, observed under microscope

MAIN SOURCE OF AMNIOTIC FLUID

- First 12 weeks: Ultrafiltrate from maternal plasma
- 12 to 20 weeks: Transudation of fluid across fetal skin
- Beyond 18 weeks: Fetal urine

Important Information

- Fetus starts forming urine from 12 weeks of gestation
- Fetal skin keratinization occurs between 22 to 25 weeks

AMNIOTIC FLUID VOLUME

00:09:18

- 10 weeks: 30 ml
- 12 weeks: 50 ml
- 16 weeks: 200 ml
- 32- 34 weeks (Maximum) : 1 litre
- Term (40 weeks): 800 ml
- Post term (> 42 weeks): 200 ml

REGULATION OF AMNIOTIC FLUID VOLUME

00:10:48

At term,

Fetal urination	+ 1000 ml/day
Fetal lung fluid secretion	+ 350 ml/day
Fetal swallowing (Begins around 10-12 weeks of gestation)	- 750 ml/day
Intramembranous flow across fetal blood vessels on placental surface	- 400 ml/day

MEASUREMENT OF AMNIOTIC FLUID

00:15:46

USG:

- Measurement of amniotic fluid pocket (vertical pocket) in centimeters

1. Amniotic fluid index (AFI)

- Uterine cavity is divided into 4 quadrants
- Amniotic fluid volume in the 4 quadrants are measured

2. Single deepest pocket

- Measured in centimeters
- Normal AFI = 5-25 cm
- Normal SDP = 2-8 cm
- Oligohydramnios: AFI < 5 cm OR SDP < 2 cm OR absolute amount < 200 ml
- Polyhydramnios: amount > 2000 ml