



Fundamentals of Obstetrics

SEX DETERMINATION

• Genes

Sex is decided by SRY gene

↓
Distal end of short arm of Y chromosome (Yp 11)

↓
Present

↓
Male

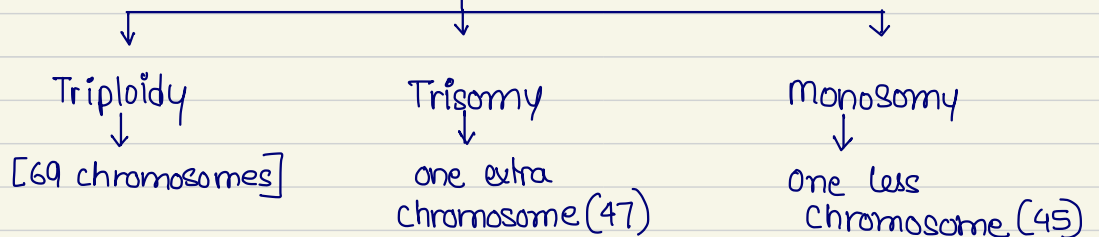
↓
Absent

↓
Female

- Genes that favour
 - Testis differentiation - SOX-9
 - Ovary diff. - RSP0-1
WNT-4

- Best method of sex determination - karyotyping

- Karyotyping is also best investigation to detect defect in chromosome number (Aneuploidy)



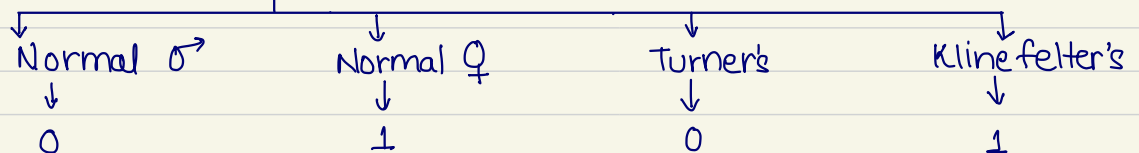
• Genitalia

MC method of sex determination - looking at external genitalia

- Can't be used in cases of ambiguous genitalia

• Barr Body

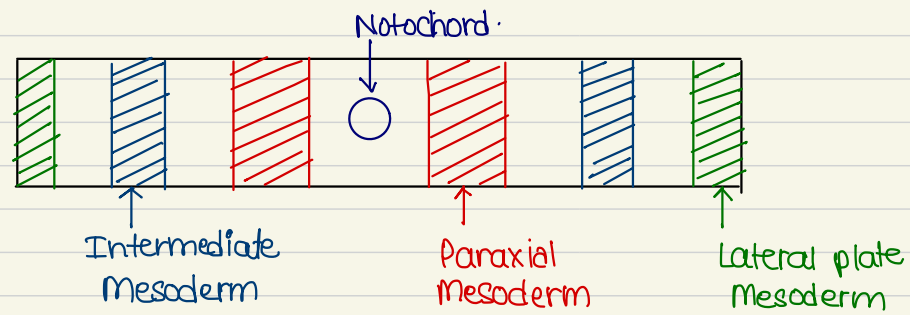
No. of barr bodies = No. of X chromosomes - 1



- Turner's Syndrome - 45 XO → No Y chromosome → female

- Klinefelter's syndrome - 47XXY → Y chr. present → male.

EMBRYOLOGY



- Most of the urogenital system is **Mesodermal** in origin.
 - ↳ Except Urogenital sinus → **Endodermal**
- Intermediate mesoderm
 - ↓
 - urogenital ridge (5 wks of gestation)
 - ↓
 - **Gonads** Renal System
 - **Ducts**
- Lateral plate mesoderm → Dorsosomatic part → **Genitalia**.
- **Germ cells** originate from **Epiblast**.

DEVELOPMENT OF GONADS

Till 6 weeks → Bipotential

↓
Derived from Genital Ridge

(In cases of mullerian agenesis, ovaries will be normal)

↓
Differentiation depends on **SRV gene**

↓
If SRV gene present

↓
medulla of gonads
form Testis

[formed by 7wks]

↓
If SRV gene absent

↓
cortex forms ovaries.

[formed by 8 wks]

• Ovaries

• **formation** depends on **absence of Y chromosome.**

• **Development** depends on **presence of both X chromosomes.**

↓
Turner's Syndrome

↓
45X0

↓
Y chr. absent → ovaries

↓
Only 1 X chr.

↓
Poorly developed ovaries
(Streak gonads)

↓
Klinefelter's syndrome

↓
47XXY

↓
Y chr. present → Testes

• DEVELOPMENT OF GERM CELLS

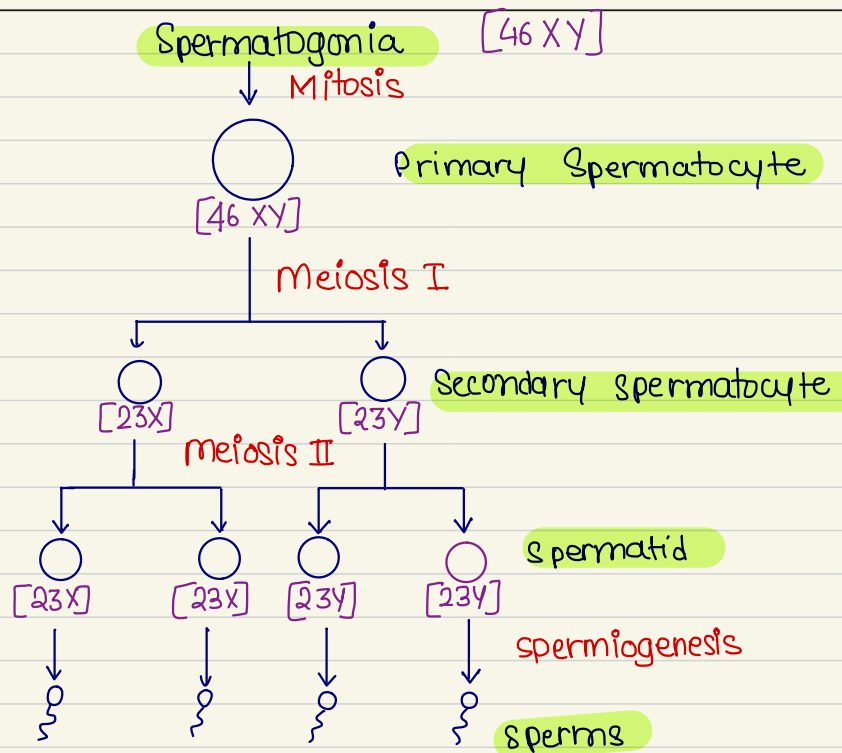
• Y chromosome +nt → Spermatogonia

• Y chromosome -nt → Oogonia

• First feature which distinguishes b/w testis and ovaries - **formation of Testicular Cords**

GAMETOGENESIS

• SPERMATOGENESIS



• **Spermatogenesis** : Spermatogonia → sperms

• Begins at puberty

• 1 Spermatogonia = 16 primary spermatocytes
 1 primary spermatocyte = 4 sperms.
 1 Spermatogonia = 64 sperms

• Time taken for Spermatogenesis = 72-74 days

• Average No. of Sperms produced = 100 million / day

• **Spermiogenesis** : Spermatid → sperms

- No mitosis / meiosis

• Time taken = 12-24 days

★

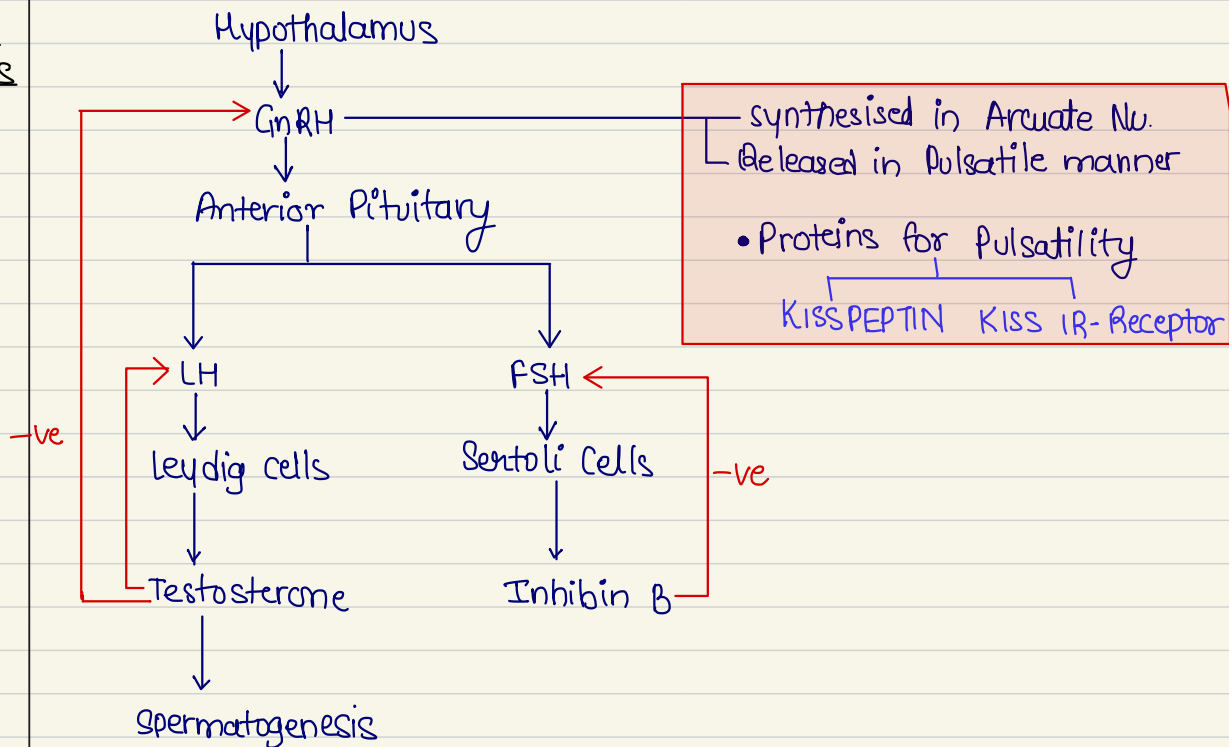
Part in Spermatid	In sperm
Nuclear material	Head
Golgi body	Acrosomal cap
Mitochondrion	Middle piece
Microtubule/centriole	Tail / Axial filament (a+a)

★ Sperm lacks Endoplasmic reticulum (specially RER)

• Sperm

- Length - 55 microns
- Fertilizable span : 48 - 72 hrs
- Attain motility & mobility in caudal end of epididymis.
- Gene for motility **CATSPER**
- Ion for motility **Ca^{2+}**
- Remain motile in female genital tract for **12 hrs**
- Time taken to reach ampulla of tube **30 mins**

• Hormonal control for Spermatogenesis



- Due to -ve feedback on GnRH, Testosterone also uses production of FSH.

* 1st stimulus for Leydig cells to release testosterone : **HCG**.

- Hormones needed for spermatogenesis: ① Testosterone - **main**
② LH
③ FSH

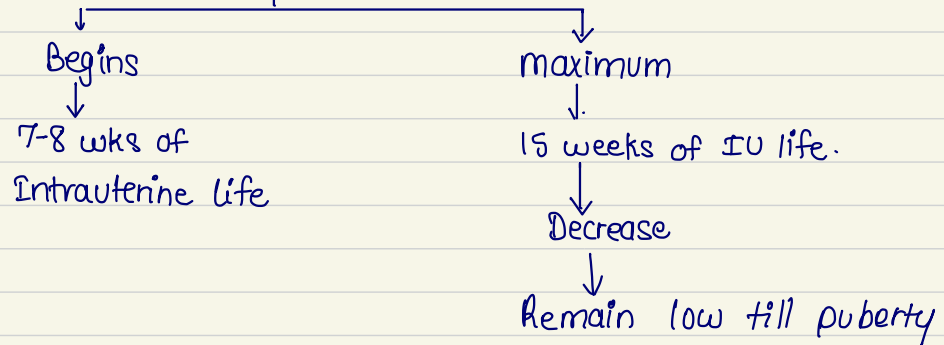
- LH receptors on Leydig cells . FSH receptors on Sertoli cells in σ .

- Blood Testis Barrier - formed by Sertoli cells.

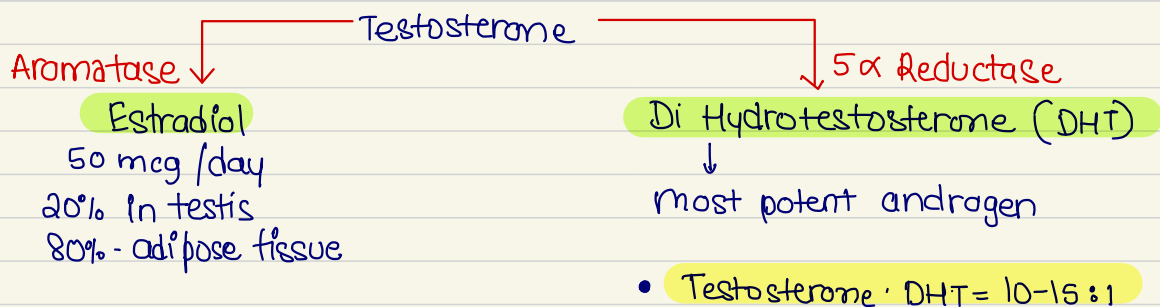
* Leydig cells lie outside the barrier.

• TESTOSTERONE

Testosterone production



- At 17 years, testosterone level in boy = level in adult male
- Testosterone production = 5-7 mg/day
- Free testosterone = 0.5 to 3%
- Best bound to Sex hormone Binding Globulin (SBGH) & Albumin.

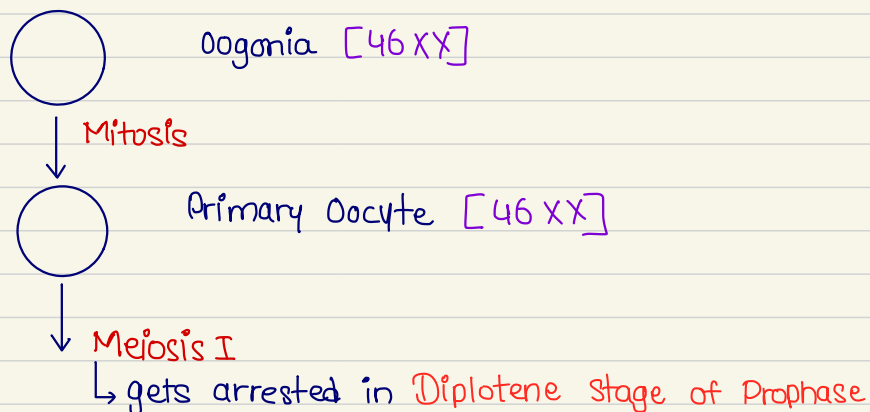


Role of estrogen in males.

- ① ↑ bone density
- ② Closure of epiphysis of long bone
- ③ maintain body fat
- ④ Sexual function

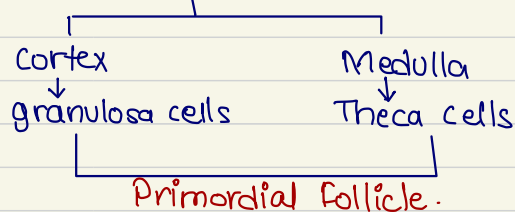
* Excessive estrogen in ♂ → Gynaecomastia.

- OÖGENESIS
- Begins in intrauterine life

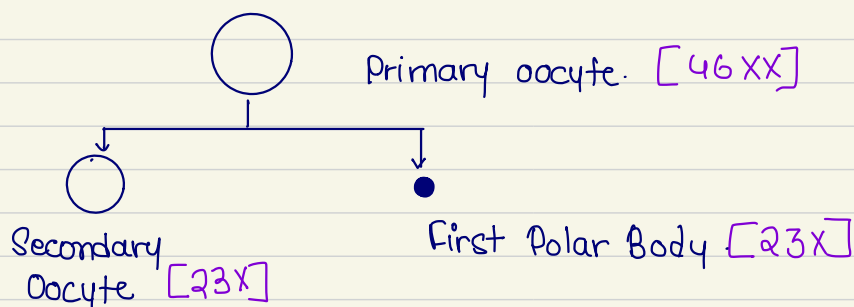
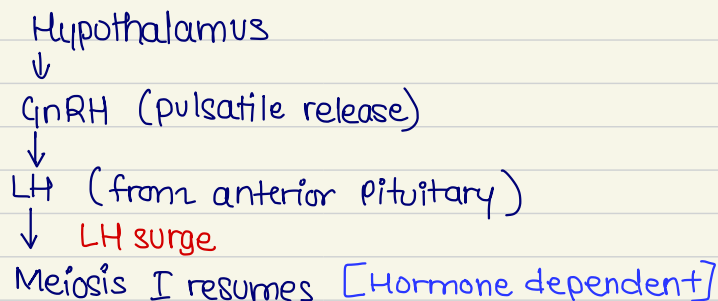


Dictyate State- Primary oocyte remain arrested in meiosis I till puberty. (Absent in Spermatogenesis).

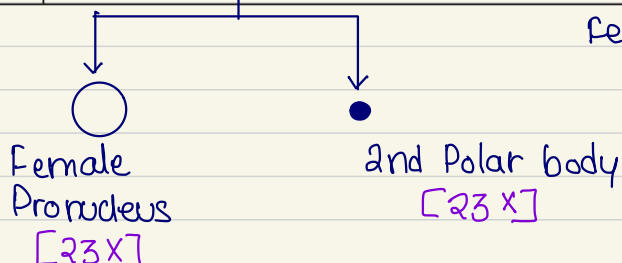
- 1° Oocyte gets surrounded by follicular cells



- At puberty,



Meiosis II → gets arrested in Metaphase.
↓
Resumes at the time of fertilisation.



• Ovulation

Release of secondary oocyte from primary oocyte.

- Occurs due to LH surge.
- Time b/w LH surge and ovulation 32-36 hrs > 24-36 hrs.
- 1st Polar body is released at the time of Ovulation.
- 2nd Polar body is released at the time of Fertilisation.

• Important Points

- Oogenesis begins in intrauterine life.
- Ova is largest cell in body = 120 microns.
- Size of Resting follicle - 0.02 mm.
- Size of follicle just before ovulation: 18-20 mm.
- Fertilizable span of ovum: 12-24 hrs.

• Time Table

- Germ cells reach yolk sac : 3 weeks.
- Germ cells reach gonads : 6 weeks
- Oogonia formed : 9 weeks
- Primary oocyte formed : 12-16 wks.
- Follicle formation begins : 15-20 wks
- Follicle formation completes : 22-24 wks.

• Number of follicles

- Max at 20 wks of IUL (5 months) : 6-7 millions
- At Birth : 1-2 millions
- At Puberty : 4-5 lakhs.
- Only 500 follicles mature in entire lifetime.
- 1000 follicles undergo atresia every month.
- Initial recruitment of follicle is Hormone independent.
- When number of follicles in ovaries becomes zero
↓
Ovarian Failure / Menopause.

FERTILISATION

Steps

- When sperm reaches female reproductive tract.

① Capacitation - Ability of sperms to fertilise ova

Begins in **Cervix**
Majority in **Fallopian tubes**.

- Sperms become **motile** in **caudal end of epididymis**.
- Sperms become **hypermotile** in **Fallopian tubes**.

- Sperm reaches fallopian tubes in 30 mins.

2) Acrosomal Reaction -

Sperm attaches to zona pellucida (layer around 2° oocyte)

↳ Facilitated by receptors

	ZP ₁
	ZP ₂
	ZP ₃ main

3) Cortical Reaction -

Sperm penetrates zona pellucida and reaches cortex of 2° oocyte.

↓
With help of **ZP₂, Ca²⁺ ions & enzymes from cortex**.

4) Zona Reaction

The enzymes make zona **impermeable to other sperms**.

- function of zona pellucida - Prevent Polyspermy

• Zygote formation

Sperm unites with secondary oocyte

↓
Fertilisation - occurs in Ampulla of Fallopian Tube.

↓
Zygote is formed.

↓ ← After 20-30 hrs

2 cell stage

↓
4 cell stage

↓
8 cell stage

↓
16 cell stage - Morula → Mulberry Shaped.

- Zygote remains in Fallopian Tube for 3 days after fertilisation.

↳ Nutrition is provided by secretory cells of fallopian tube

- Morula moves into uterine cavity with help of 2 factors

↓
Peristalsis in tube
[Main factor]

↓
Movement of cilia

- Factor that ↓ Peristalsis → ↑ risk of ectopic pregnancy.
eg - Progesterone, Cu-T, tubal Surgery.
- Fallopian tube has 3 types of cells.
 - a) Columnar cells
 - b) Secretory cells
 - c) PEG cells → function Unknown

• Implantation Day 4 after fertilisation / Day 18 of menstrual cycle.
↓
Morula enters uterine cavity

Day 5 → Zona pellucida is lost [Zona Hatching]

↓
Fluid enters Morula.

↓
Forms Blastocyst

↓
Attaches to endometrium of uterus — Implantation.

• Types a) Superficial Implantation- Blastocyst attaches superficially to endometrium.

b) Interstitial Implantation- Implanted deep inside endometrium.
↳ Occurs in humans.

• Important points • Implantation occurs in form of Blastocyst.

• Begins - 6 days after fertilisation [Day 20 of menstrual cycle]

• Implantation window - Day 20 to Day 21 of MC.

• Completion - 10 days after fertilisation (Day 24)

• M/C site - Upper Posterior Part of uterus.

• Implantation is eccentric (on one side)
↳ unequal growth of uterus - Piskacek sign.

True Gestational sac - eccentrically located

Pseudo gestational sac - Centrally located (whole decidua thickened)

• Type - Interstitial

• Sign on USG - Intradecidual sign.

✳ By convention, 14th day of menstrual cycle is assumed to be day of ovulation and fertilisation.

Hence, Day 1 after fertilisation = Day 15 of menstrual cycle.

- Hartman Sign / Placental sign

Bleeding at the time of implantation.

- Phases of Implantation

<u>Phase</u>	<u>Main Transmitter</u>
Apposition	Selectin
Adhesion	Integrin
Invasion / Penetration	Metallo Protease

- Thickness of Endometrium

- At the time of:

a) Implantation : 10-12 mm

b) After menstruation : 0.5 mm

c) Ovulation : 2-3 mm

d) Secretory Phase : 5-6 mm.

- Intracdecidual Sign

On USG - Normal Uterine Cavity appears as a white straight line.

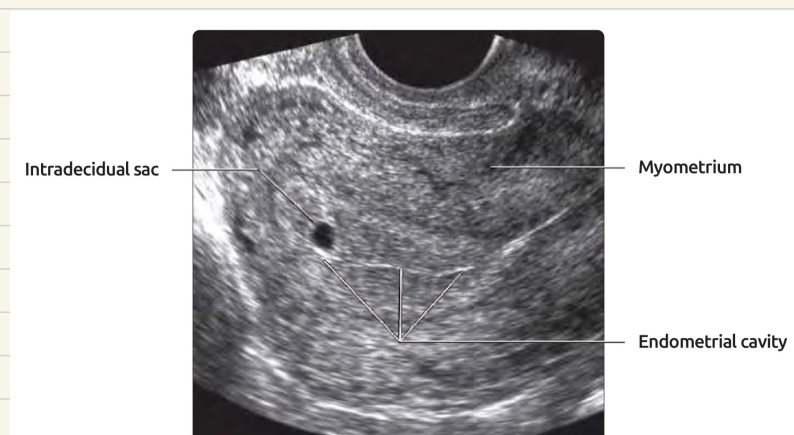
- The blastocyst does not disturb central cavity complex



Intra Decidual Sign



1st Sign of Pregnancy

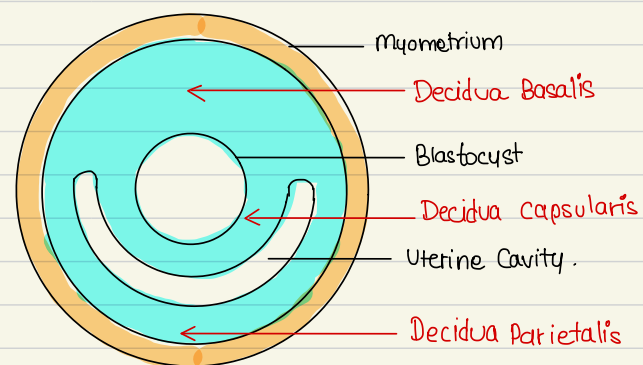
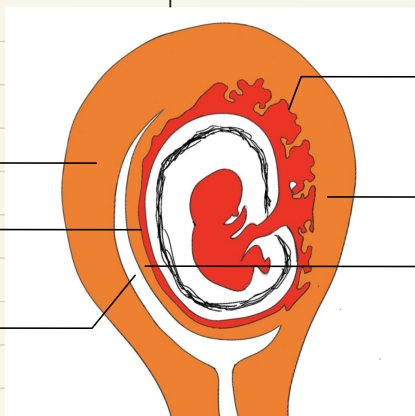
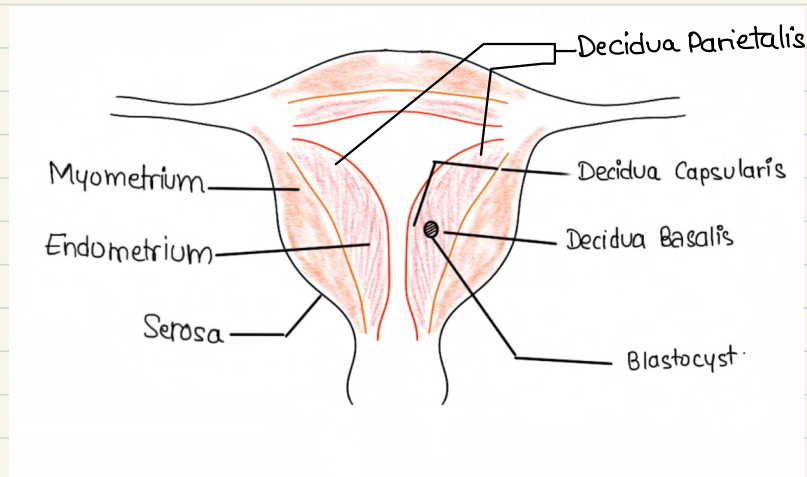


• Decidua Endometrium after implantation is called Decidua.

• Parts • Decidua Capsularis - Separates blastocyst from uterine cavity

• Decidua Basalis — Separates blastocyst from myometrium
— Site of formation of future Placenta
— Forms maternal side of Placenta.

• Decidua parietalis - Rest of decidua



• Blastocyst grows and occupies uterine cavity → Decidua capsularis & parietalis come close to each other.

✱ At 14-16 weeks of pregnancy → Decidua parietalis & Decidua capsularis fuse
↓
Uterine cavity obliterates.

* Twin Pregnancy

When 2 ova are fertilised by 2 sperms.

In Same Cycle

Superfecundation

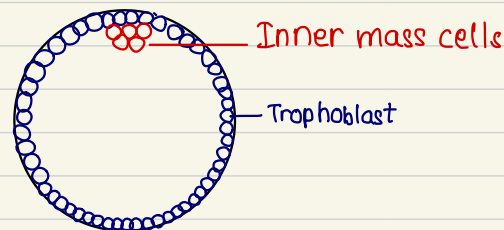
Seen in Human.

In different cycle

Superfetation.

- Superfetation is theoretically possible in human being only till 14 weeks because uterine cavity obliterates.

• Blastocyst



Number of cells = 58

Inner mass cells
(5 cells)

Form entire fetus

Trophoblast -
(53 cells)

8 days after fertilisation,

Trophoblast

Cytotrophoblast

Near
Decidua
Basalis

Form villi
like
structure

Chorion

Rest of
Chorion

Remain
Smooth

Chorion Laeve

Prevents
PIH

Synctiotrophoblast.

Hormone factory
of Placenta.

Frondosum

↳ forms fetal side of Placenta.

• Trophoblastic Invasion Extravillous Cytotrophoblast converts maternal arteries from High Resistance Vessels to low resistance vessels.

- Occurs in 2 phases
 - Phase I → at 12 wks
 - Phase II → at 16 wks
- This maintains uteroplacental blood flow.

- If trophoblastic invasion is absent.

Resistance in maternal blood vessels is high

Blood volume ↓

Utero-placental insufficiency

PIH

IUGR

Placenta accreta.

- Function of cytotrophoblasts is controlled by Natural Killer cells of decidua.

• Double Decidual Sign

Blastocyst grows and occupies uterine cavity



Indents central cavity complex.

- Decidua capsularis & parietalis forms 2 rings around blastocyst

↳ Double Decidual Sign.

