

**LATEST 2024 MARROW
NEET-SS NOTES**



**UPDATED
OBSGYNE RESIDENCY
NOTES**

**REPRODUCTIVE
MEDICINE**

DEVELOPMENT OF UTERUS AND OVARY

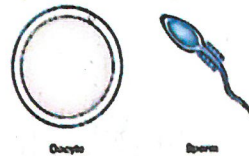
Embryogenesis

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Fertilisation :

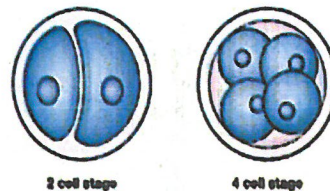
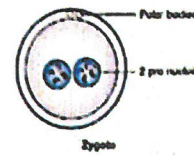
Oocyte :

- Largest cell of the human body.
- Covered by zona pellucida : Role in sperm-oocyte interaction and prevention of fallopian tube implantation.
- Arrested in prophase of meiosis-I.
- Just before ovulation : meiosis I → meiosis II, release of 1st polar body.



Sperm-oocyte interaction :

- The acrosome (Tip of sperm) fuses with oocyte membrane.
- Sperm membrane disintegrates and its nucleus goes inside the oocyte.
- Earliest sign of fertilisation : 2 pronucleus.
- After fertilisation, 2nd polar body from oocyte is released.



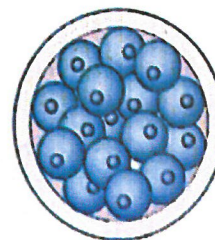
Embryo :

Day 1 after fertilisation (1 celled stage) : 2 pronucleus + 2 polar bodies.

Day 2 : 2-4 celled stage.

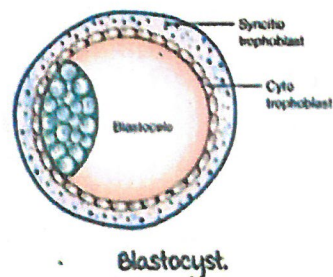
Day 3 : 8 celled stage.

Day 4 : 16 celled stage (morula).



morula (mulberry shape) :

- Enters the uterine cavity in a normal cycle.
- Covering : Zona pellucida.



Blastocyst :

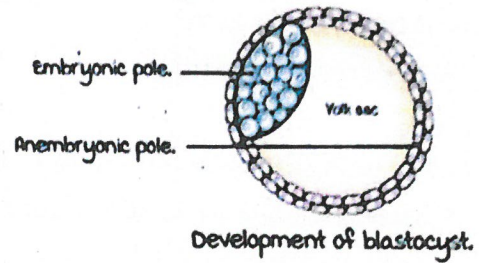
- 256 celled stage.
- Fluid accumulation → Blastocoele → Later forms the yolk sac.

----- Active space -----

- majority cells arrange at one embryonic pole : Embryoblasts.
- Cells at the margin : Trophoblasts.

Trophoblasts differentiate into :

1. Syncytiotrophoblasts : Acellular layer.
2. Cytotrophoblasts : Cellular layer.



Zona pelluca breaks → Embryo is released → Implantation.

Pre implantation genetic testing (PGT) :

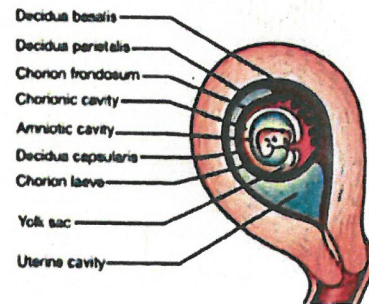
- Day 5 of embryo.
- Cells from trophoectoderm biopsied.
- Assessed for genetic analysis.
- Limitation : mosaicism can be missed.

Implantation :

Blastocyst is implanted into decidua at the embryonic pole.

Decidua (Endometrium during pregnancy) :

1. Decidua basalis : Related to embryonic pole.
2. Decidua capsularis : Encapsulating the embryo.
3. Decidua parietalis : Remaining part of decidua.



Decidua.

Chorion : bhatipreeti411@gmail.com

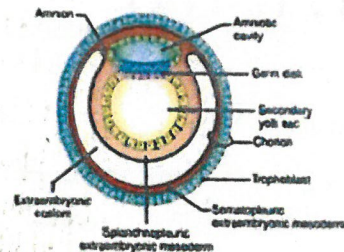
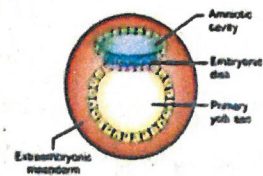
- Chorion frondosum : Related to decidua basalis.
- Chorion laeve : Surrounding chorion.

Note : Decidua basalis + chorion frondosum → Formation of placenta.

Extra embryonic mesoderm (EEM) :

Develops around the embryo.

Between the embryonic disc and trophoblast.



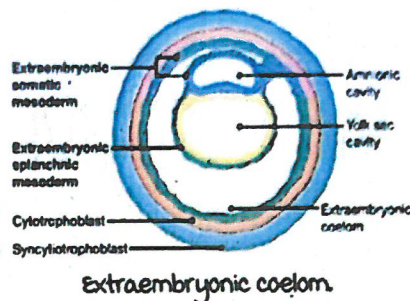
Extraembryonic mesoderm.

Fluid collected within the EEM divides it into 2 layers :

1. Somatopleuric EEM.
2. Splanchnopleuric EEM.

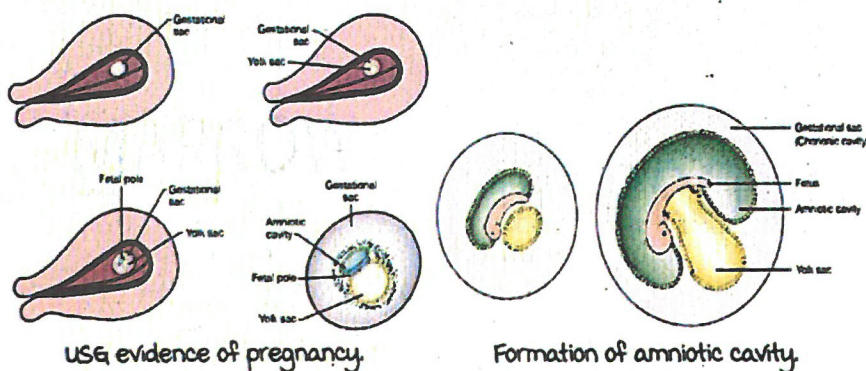
Extra embryonic coelom/chorionic cavity :

- Develops inside extra embryonic mesoderm splitting it into 2 except at connecting stalk.
- First fluid filled structure seen on ultrasound : Seen as gestational sac at 5 weeks of gestation.



Implantation and embryonic disc : USG correlation.

- 5 weeks : Gestational sac from extra embryonic coelom.
- 5 weeks + 3/4 days : Yolk sac from blastocele.
- 6 weeks : Embryonic disc, cardiac activity.
- Decidua parietalis and capsularis : Double decidual sac sign.



Further embryo development, folding and amniotic fluid expansion :

Amniotic cavity :

- Between ectoderm and trophoblasts.
- Enlarges and surrounds the embryo.
- Embryo is folded on itself.
- Yolk sac is compressed and seen as a small sac adjacent to fetal pole.

Yolk sac :

- Transformed structure of blastocele.
- Resorbed by 12 weeks.
- Normal diameter : 2-5 mm.
- Small yolk sac < 3 mm, large yolk sac > 6 mm.

----- Active space -----

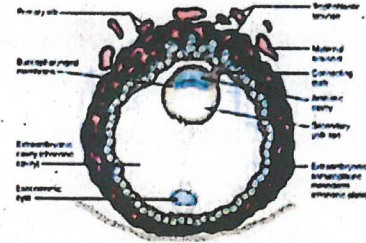
Formation of placenta

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Connecting stalk :

- Fetal vessels reach the maternal vessels via the connecting stalk.
- Later, forms the umbilical cord.

Cytotrophoblasts, syncytiotrophoblasts, mesoderm
: Form placenta.

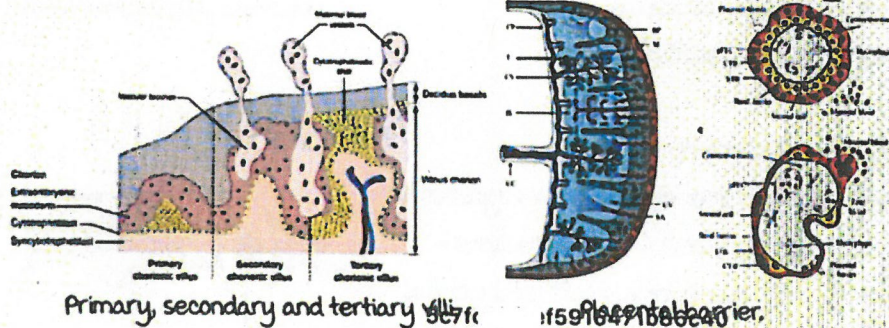


Connecting stalk.

villi :

Syncytiotrophoblast erode into maternal vascular sinuses/lakes.

- Cytotrophoblast grow into syncytiotrophoblast : Primary villi (2 weeks).
- mesoderm grows into the cytotrophoblast : Secondary villi (2 weeks).
- Blood vessels inside mesoderm : Tertiary villi (3 weeks).



Primary, secondary and tertiary villi

Placental barrier.

Placental barrier :

Between maternal vascular sinuses/lakes and fetal blood inside vessels.

Formed by :

1. Syncytiotrophoblasts.
2. Cytotrophoblasts.
3. Basement membrane.
4. Endothelium of vessels.

Ultimately, the placental barrier thins out.

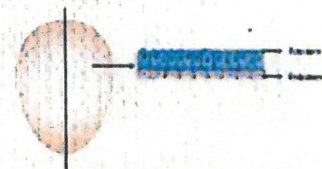
Further development of embryo

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Development of embryonic disc :

a layered embryonic disc at 2 weeks :

1. Epiblast/ectoderm.
2. Hypoblast/endoderm.



a layered embryonic disc.

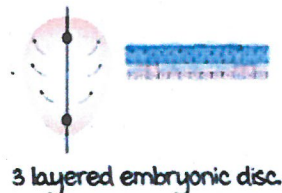
3 layered embryonic disc at 3 weeks :

Trilaminar disc.

Intra embryonic mesoderm (IEM) develops between ectoderm and endoderm.

Ectoderm and endoderm remains unseparated at 2 places :

- Procaudal plate.
- Cloacal plate.



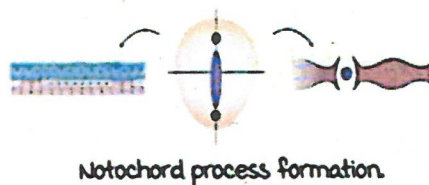
Notochord process formation :

Some ectodermal cells proliferate into IEM forming notochordal process.

It splits IEM into 2 halves.

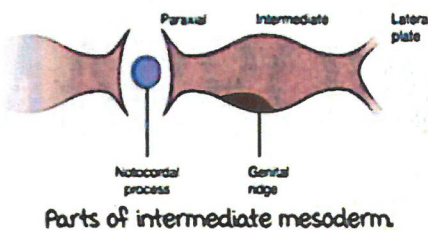
Each half of IEM is divided into :

- Paraxial mesoderm.
- Intermediate mesoderm.
- Lateral plate mesoderm.



Intermediate mesoderm :

- Cephalic end : Pronephros (Disintegrates).
- middle : mesonephros (Forms mesonephric/paramesonephric ducts and genital ridge).
- Caudal end : metanephros.
- medial part of intermediate mesoderm : Genital/gonadal ridge.



Genital/gonadal ridge formation :

- Formed from medial most part of intermediate mesoderm.
- Later forms the gonads.
- Bipotential gonad till 6 weeks of gestation.
- After 6 weeks, differentiates into testis/ovary depending on presence/absence of Y chromosome.

Note : Genital tubercle forms the external genitalia (Scrotal sac/labia majora).

Paraxial mesoderm :

Forms the somites.

Somites can be used to determine embryonic age.

Somites divided into 3 parts :

- Sclerotome : Develops skeletal system.
- Myotome : Develops muscles.
- Dermatome : Develops dermis.

Development of paramesonephric ducts

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Immediately lateral to the genital ridge, two duct systems extending from cranial to caudal end develop.

2 duct systems : mesonephric and paramesonephric ducts.



Both ducts coexist and the final fate is decided by the gonads.

Testis :

- Secrete testosterone and antimullerian hormone (AMH).
- AMH hormone abolishes development of mullerian duct/paramesonephric duct.
- Promotes formation of wolffian/mesonephric duct.

Ovary :

- No testosterone, AMH is released.
- Paramesonephric duct develops.

mullerian ducts :

"POTTS" the female internal genitalia.

Caudal ends of mullerian ducts fuse in midline.

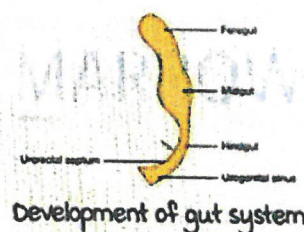
Tip of the fused ends is called mullerian tubercle.

Development of urogenital sinus from endoderm :

Endoderm develops into gut system : Foregut, midgut, hindgut.

Part of hindgut distal to allantois diverticulum :

Primitive urogenital sinus.



Primitive urogenital sinus is divided by urogenital septum into :

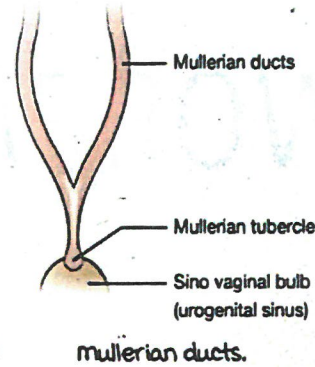
- Definitive urogenital sinus anteriorly : Forms part of urinary structures and urinary structures (Part of urethra; bladder except trigone).
- Anus/rectum posteriorly.

Part of urogenital sinus forming vagina : Sinovaginal bulb.

Tip of urorectal septum forms perineal body.

Mullerian tubercle opens into sinovaginal bulb :

- Fallopian tubes develop from the mullerian duct unfused part.
- Uterus, cervix and upper 2/3rd of vagina : Develop from the fused mullerian duct parts.
- Lower 1/3rd of vagina : Develops from sinovaginal bulb.
- Mesoderm around the sinovaginal bulb : Connective tissues and musculatures of the genital tract.
- The distally fused mullerian ducts then canalizes and the middle septum is resorbed from caudal part to cranial part at 20 weeks of gestation.



Mullerian duct anomalies :

No fusion of mullerian ducts : Didelphys uterus.

Partial fusion of mullerian ducts : Bicornuate uterus.

No resorption of septum : Septate uterus.

Development of only 1 mullerian duct : Unicornuate uterus.

No mullerian duct system development : Mullerian agenesis.

Associated anomalies with mullerian duct anomalies :

- 3% of renal anomalies.
- 12-15% of skeletal anomalies.

Development of urinary system

00:49:10

Ureteric bud :

- Diverticulum from mesonephric duct.
- Goes into the metanephros.
- Forms collecting system of urinary tract.
- Metanephros : Forms the kidneys.

Development of bladder :

- mesonephric ducts open into urogenital sinus.
- Part of distal ends of mesonephric ducts resorbed → Trigone of bladder.
- Remaining part of bladder : From endoderm (Urogenital sinus).

REPRODUCTIVE PHYSIOLOGY

Menstrual cycle

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Duration : 28 days (24-35 days).

Controlling hormones :

- FSH : First 14 days.
- LH : Second 14 days.

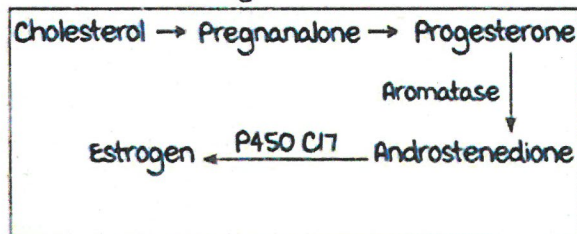
Cells in the follicle :

- Granulosa cell : Under control of FSH.
- Theca cells : Under control of LH.

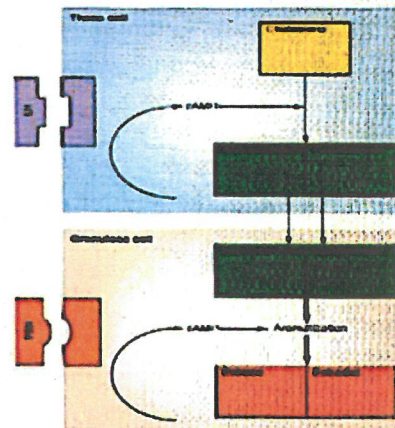
This is called the
"a cell a gonadotrophin theory".

Granulosa cells and theca cells are dependent on each other.

Production of estrogen :



Granulosa cells lacks P40 C17 → Provided by theca cells.



Ovarian steroidogenesis.

Follicular phase :

Primordial germ cells :

- 7 to 8 billion in fetal life.
- 1 to 2 million at birth.
- 1000 at menopause.

1. Recruitment :

- Process where a fixed fraction of primordial follicles are acted upon by FSH to develop in each cycle.
- Influenced by intracrine & paracrine factors :
Not by FSH, LH but possibly by GH & androgens.

2. Selection : Only one will get selected to grow prominently.