EAMBRYOLOGY

It is the science dealing with development of an organism from zygote stage to full establishment of the definitive organ &systems in prenatal life.

Prenatal life

It can be divided into:

- **Pre-embryonic period**: The 1st two weeks of pregnancy
- **Embryonic period:** From beginning of 3rd week to the end of 8th week.
- **Fetal period**: From beginning of 3rd month to the time of delivery.

Gametogenesis

Def: production of the mature gametes (sperms or ova) from primitive sex cells which called primordial germ cells.

Primitive Sex cells

What are the primitive sex cells?

Primordial germ cells

The cells that appear in the wall of yolk sac at end of 3rd week then migrate to gonads (ovary or testis) where they arrive at the end of 5th week.

Gametogenesis is classified into 2 processes:

Spermatogenesis: production of mature sperms from primitive sex cells in the testis.

Oogenesis: production of mature ova from primitive sex cells in the ovaries.

Spermatogenesis

1-Spermatocytogenesis

- **Def**: production of mature sperms from primitive sex cells(spermatogonia)
- **Site**: testis
- **The time of spermatogenesis:** From puberty and continues for life

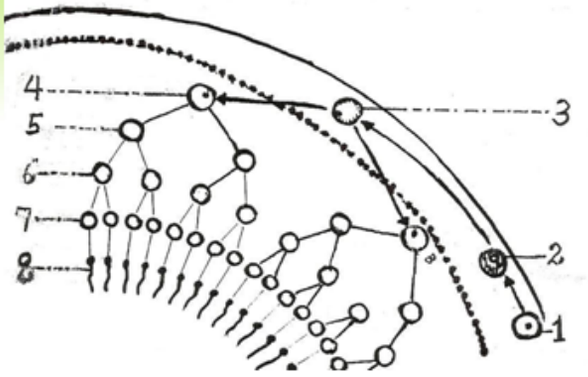
Steps of spermatocytogenesis:

primitive sex cells (46 XY)→ mitosis → **dark A spermatogonia** (46 XY) → mitosis (4-5 times for continuous supply) → → **pale A spermatogonia** (46 XY) → mitosis some of them differentiate → **type B Spermatogonia** (46 XY) →

PSC ↓mit dark A (46,xy) ↓mit Pale A (46,xy) ↓mit Type B (46,xy) ↓mit Primary spermatocyte ↓mt "1" secondary (1 (23,x or y)) ↓ mt "2" spermatides (23,x or y)

1. Spermatogonium (primordial germ cell).
2. Dark A spermatogonium.
3. Pale A spermatogonium.
4. Type B spermatogonium.
5. Primary spermatocyte.
6. Secondary spermatocyte.
7. Spermatid.

Spermatozoon



mitosis → **primary spermatocytes** (46 XY)→ 1st meiotic division → **2 secondary spermatocytes** (23X or Y) → 2nd meiotic division → **4 spermatids** (23 X or Y). The spermatids contact sertoli cells for spermiogenesis.

2- Spermiogenesis:

Def: metamorphic changes in the spermatid transforming it into sperm.

These Changes include:

1- Formation of the sperm head from the nucleus.
2- Formation of the acrosomal cap from Golgi apparatus.
This cap covers anterior 2/3 of sperm head & Contains enzymes needed in penetration of ovum during fertilization.
3- Formation of the axial filament through elongation of one of the two centrioles. The proximal part of this filament is called middle piece while its distal part is called the sperm tail.
4- Formation of mitochondrial sheath through spiral condensation of mitochondria around the middle piece.

Duration: Two months (64 days). (From spermatogonia till mature sperm).

The motility of sperms begins after ejaculation (tail of epididymis) & in female genital tract.

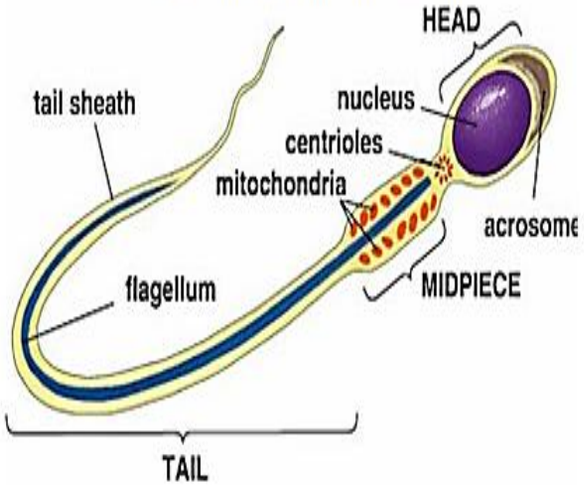
SPERM

Types: either carry X or Y chromosome.

Parts:

1- **Head:** formed of nucleus & acrosomal cap.
2- **Neck**: constriction between the head and middle piece.
3- **Middle piece**: proximal part of axial filament + mitochondrial sheath.
4- **Tail**: distal part of axial filament.

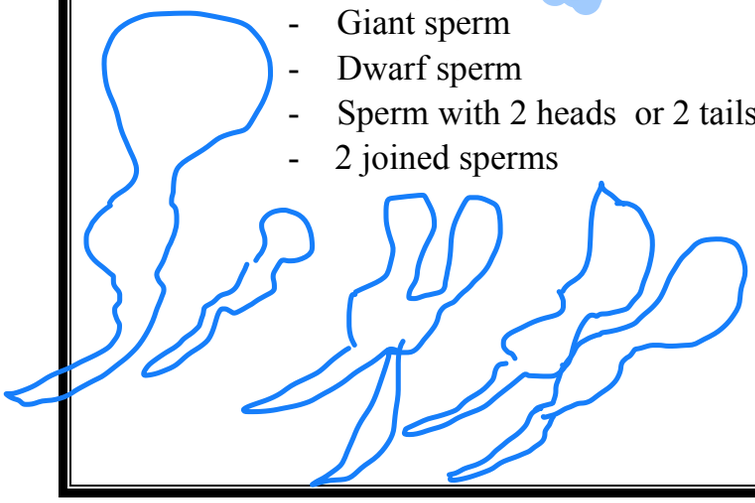
Fig. 5 :-Structure of normal sperm



Abnormal sperms:

1- Abnormality in shape:

- Giant sperm
- Dwarf sperm
- Sperm with 2 heads or 2 tails
- 2 joined sperms



2- Abnormality in number:

- **Oligospermia:** Decrease number of sperms less than 25% of normal number.
- **Aspermia:** no sperms.
- **Necrospermia:** dead sperms.
- **Athenospermia:**non-motile

Seminal fluid:

Composition:

1- **Sperms:** -100 million per 1 ml.

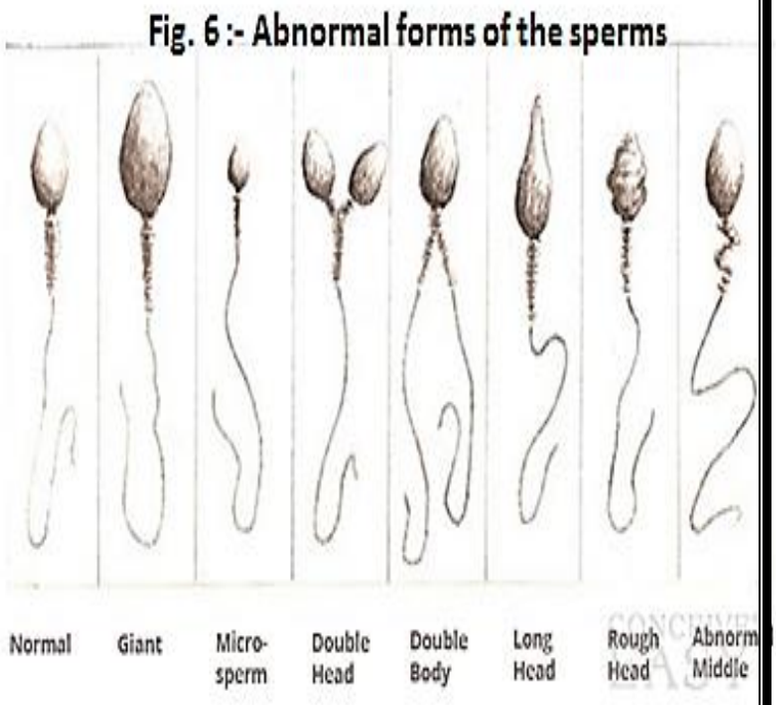
2- **Seminal Secretions**: from

- **prostate** (milky)
- **seminal vesicles** (main bulk, make semen mucoid)
- **Bubo urethral glands.**

- Contains: vitamin C and fructose.

Volume: 3-4 ml (normal ejaculate)

Reaction:- alkaline.



Viability of sperms:

DEF: period during which sperms are able to fertilize the ovum.

Duration: 1-2 days.

N.b: Spermatogenesis need temperature lower than body temperature.

OOGENESIS

Def: production of mature ova from primitive sex cells

Site: Ovary.

The time of oogenesis: From intrauterine to menopause

Purpose of oogonesis :-

1-To reduce the number of chromosomes from 46 to 23.

2-To increase the size of the ovum from 30 microns to 120 microns. 4 times

PHASES (STEPS):

A- Prenatal maturation phase.

- **At 4 months**: the oogonia are grouped in clusters in the cortex of the ovary. Some show mitosis, others have already differentiated into primary oocytes (in the prophase of 1st. meiotic division),
- **During the 5th month**: the germ cells (oogonia and 1ry oocyte) reach 7 millions and then degeneration (atresia) occurs.

- **At birth:** oogonia are absent (all the oogonia are transformed into primary oocytes) and each primary oocyte is surrounded by a single layer of follicular cells, thus forming **primordial follicle.** The number at birth about one million of primordial follicles**.**

B- Postnatal maturation phase:

- **After birth**: (most of primordial follicles) become atretic so at puberty there are only 400,000 primordial follicles.

IN THE OVARIAN CYCLE: - the following changes occur.

The primordial follicles start maturation to be primary follicle as follows:

1- Flat follicular cells become cuboidal & by mitosis they ↑ in number to be stratified epithelium called granulose cells.

2- Zona pellucida is secreted between the oocyte and granulose cells. Formed by 1ry oocyte and granulose cells.

Now the structure of primary follicle is:

1- Primary oocyte (in the prophase of 1st. meiotic division):
2- Granulosa cells: stratified cuboidal epithelium arises from follicular cells.
3- Zona pellucida.

Then maturation of 1ry follicles starts to be 2ry follicle as follows.

- Stroma cells of ovary form theca folliculi
  - Theca interna cells →secretes estrogen
  - Theca externa → formed of connective tissue
- Crescentic shaped cavity (called antrum) filled with fluid (called liquor folliculi) appear between granulose cells.

Now the secondary follicle consists of:

1- Primary oocyte (in the prophase of 1st. meiotic division).
2- Zona pellucida.
3- Granulose cells.
4- Cumulus oophorus.
5- Antrum filled with liquor folliculi.
6- Theca interna.
7- Theca externa.

The completion of first miotic devision before ovulation

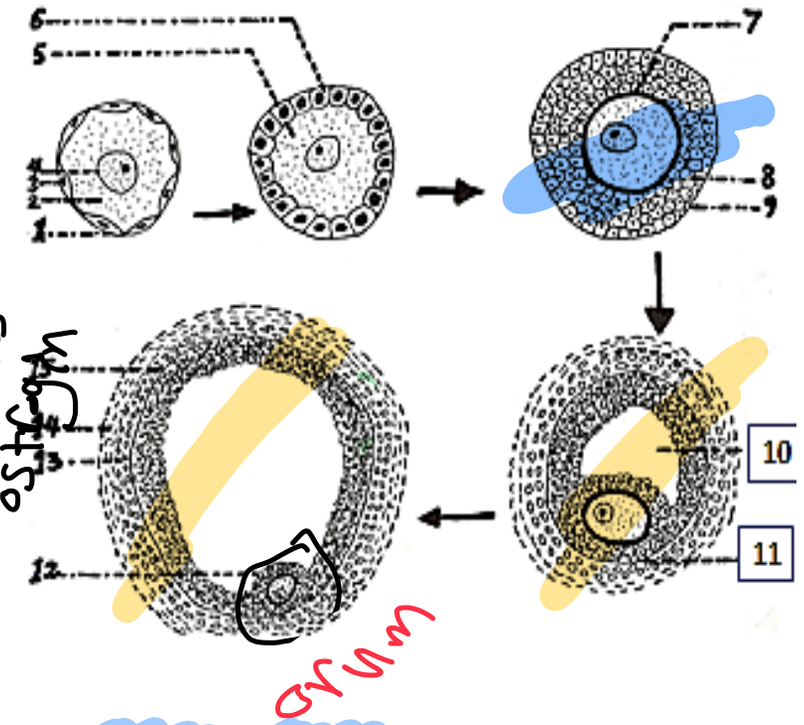


Fig.7: Oogenesis (postnatal maturation phase) showing:
1.Primordial follicle.
2.Primary oocyte.
3.Flat follicular cells.
4.Nucleus of primary oocyte.
5.Growing follicle.
6.Cuboidal follicular cells.
7.Zona pellucida.
8.Granulosa cels.
9.Primary follicle.
10.Follicular antrum.
11.Secondary follicle.
12.Cumulus oophorus.
13.Theca interna.
14.Theca externa.
15.Mature Graafian follicle.

secrates estrogen

ovum

Then the 2ry follicles become vesicular or Graafian which is formed due ↑ liquor folliculi several times so its structure is the same as secondary follicle but with expanded antrum. One follicle matures & others become atretic.

Just before ovulation: primary oocyte completes 1st meiotic division → 2 haploid daughter cells, each has 23 chromosomes (22+x)

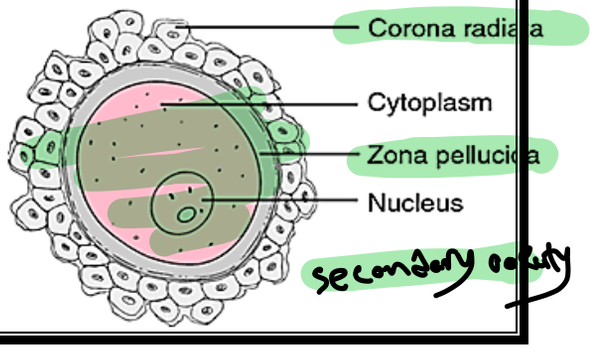
Secondary oocyte	**1st polar body**
Large in size as it takes all cytoplasm. Then at the moment of ovulation it starts 2nd meiotic division & arrested in its metaphase till fertilization.	Small in size. It divides by 2nd meiotic division into 2 polar bodies which degenerate

Ovulation:

At the 14th day of the ovarian cycle.

Def: Shedding of ovum formed of (secondary oocyte) surrounded by Zona pellucida & corona radiate (previous cumulus oophorus) from Graafian follicle, then fimbriae guide ovum to enter the uterine tube.

Fig. 11 :- coverings of the ovum



-:Mechanism of ovulation

The stimulus for ovulation is the luteinizing hormone (LH) which is secreted from the anterior lobe of pituitary gland .

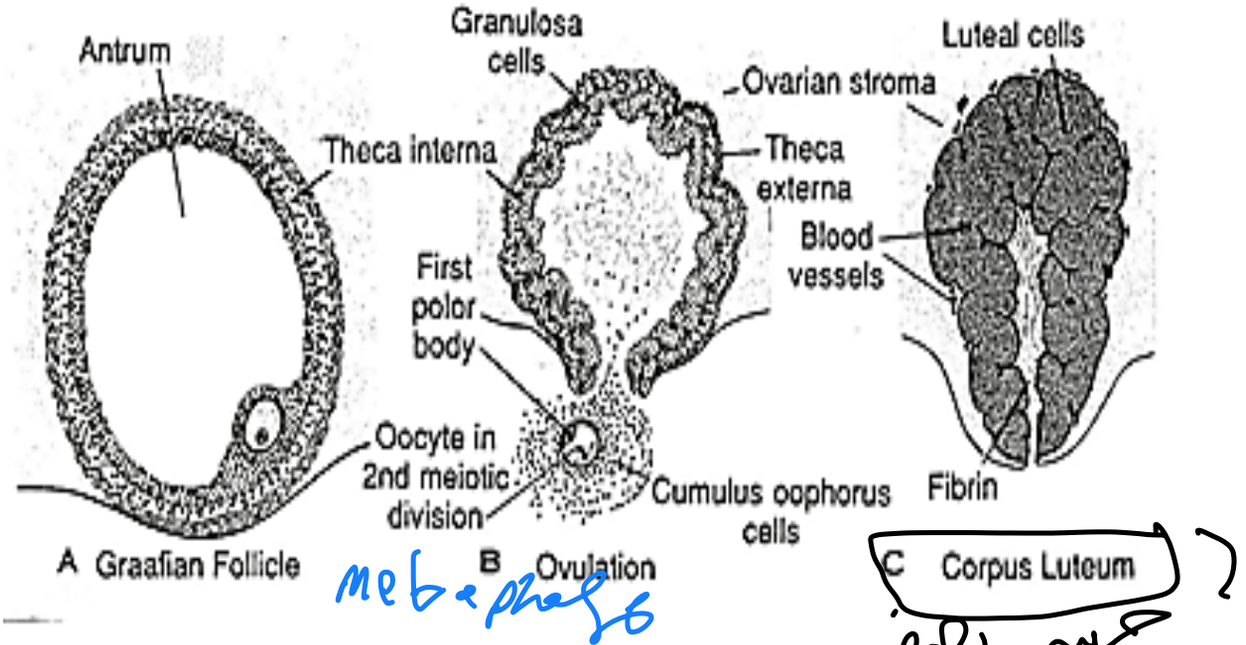
Viability of ovum:

The 2nd meiotic division is completed if oocyte is fertilized, otherwise if no fertilization, it degenerates in 24 hours after ovulation.

Luteinization :(Under LH hormone effect)

Following ovulation the ruptured Graafian follicle undergoes Luteinization (deposition of yellow pigment in the cells of the follicle) and formation of Corpus luteum that secrete progesterone hormone.

Fig. 9 :- Ovulation of Graafian follicle and formation of corpus luteum



Fate of corpus luteum:

If fertilization occurs	If no fertilization
- **Corpus luteum of pregnancy**. - Corpus luteum enlarges & continues to secrete progesterone till 4th month when placenta is full formed.	- **Corpus luteum of menstruation.** - Corpus luteum continues to secrete progesterone for 14 days for endometrial growth. Then the corpus luteum begins to degenerates & decreases in size & transformed into functionless corpus albicans → ↓ progesterone → menstruation.

RESULTS of oogenesis: - one 1ry Oocyte gives 1 mature ovum and 3 polar bodies.

1st week of pregnancy

important !!!

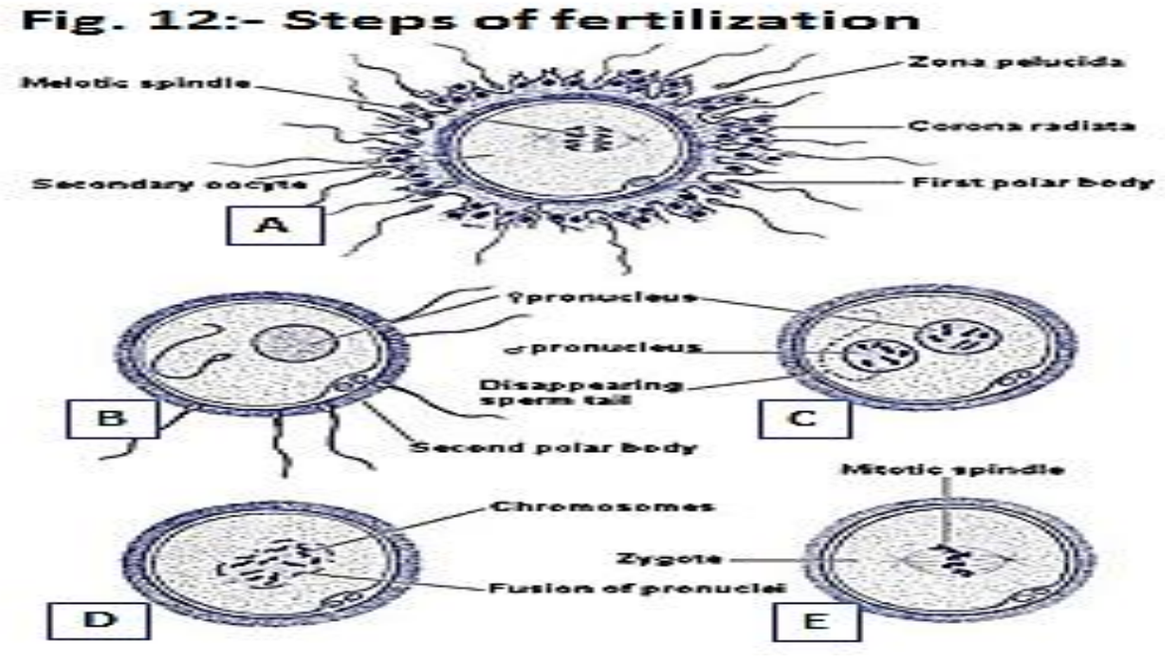
1- Fertilization and zygote formation in 1st day
2- Cleavage & morula formation 1st- 4th day
3- Blastula formation.
4- Implantation in 6th to 7th day.

Fertilization:

Def.: Fusion of sperm (male gamete) & ovum (female gamete) to form zygote.
Site: ampulla of uterine tube.
Steps: from 300-500 million sperms ejaculated in vagina only 500 reach Fertilization site & they must undergo 2 processes to be able for fertilization.

A-Capacitation: الاثارة

- Removal of glycoprotein coat & seminal plasma proteins that cover the acrosomal region to permits acrosomal reaction to occur.
- **Site**: - In female genital tract (uterine tube).
- **Duration**: - 7 hours.



B- Acrosomal reaction:

Release of the enzymes from acrosomal cap which are:

1- Hyaluronidase: to penetrate corona radiate.
2- Acrosin & trypsin – like substances: to penetrate zona pellucida.

Site: - (uterine tube) very close to secondary oocyte.

Phases of Fertilization:

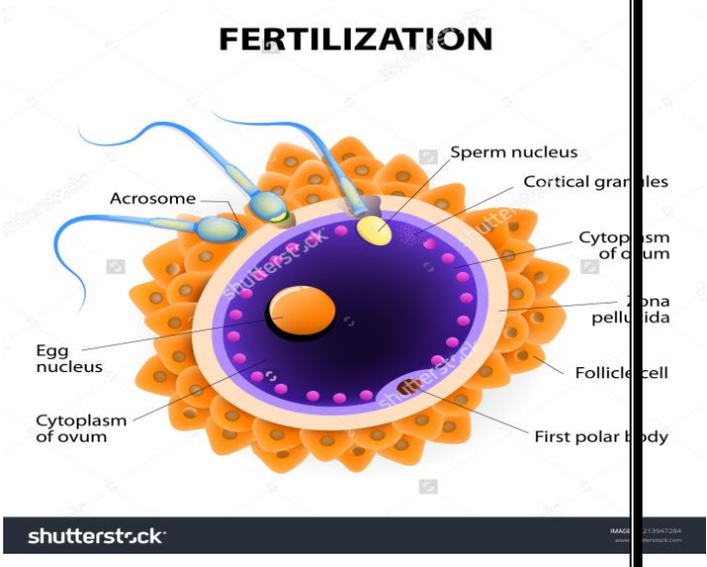
1- Penetration of corona radiate by:

- Hyaluronidase enzyme (from 300-500 sperms) reach the fertilization site

2- Penetration of zone pellucida by:

- Acrosin & trypsin like substance released from acrosomal cap of sperms
- The oocyte responds by.
- Formation of fertilization cone to engulf one sperm (once the head of sperm touches the oocyte membrane).
- Cortical & zona reaction: means release of cortical oocyte granules containing lysosomal enzymes from oocyte. These enzymes change the properties of zona pellucida to make it impermeable to other sperms.

Acrosin & trypsin



3- Fusion of sperm & ovum to form zygote:

- Immediately after entry of sperm, the secondary oocyte completes 2nd meiotic division → formation of female pronucleus (mature ova) & 2nd polar body.
- Sperm moves to become close to the female pronucleus.
- Middle piece & tail are then disappear.
- Sperm nucleus swells →form male pronucleus .
- The 2 pronuclei fuse in the center of the ovum forming zygote.

Results of fertilization:

1- Formation of the zygote (46 chromosomes) with restoration of diploid number of chromosomes.
2- Determination of sex of embryo.
3- Start of cleavage.

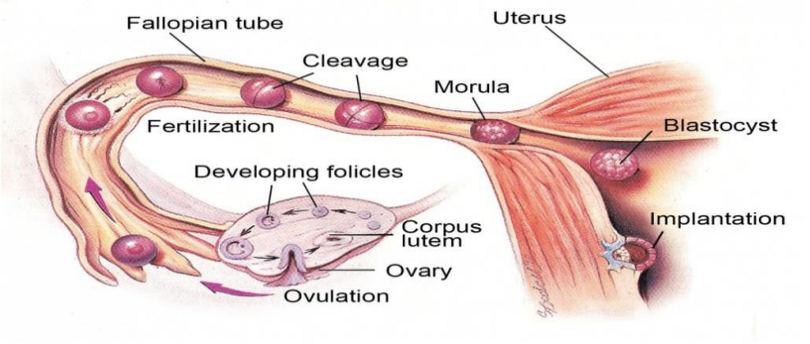
الانقسام المتساوي في قناة فالوب

In Vitro Fertilization (IVF) of Human Ova:

-In this technique, oocytes are collected with an aspirator from the ovarian follicles by laparoscopy & sperms added. Then the fertilized ovum placed in uterus.

Cleavage (segmentation)

Def: Rapid successive mitotic divisions results in production of smaller cells called blastomeres.



Steps: zygote → 2 cell stage in 30 hours → 4 cell stage → 8 cell stage → 16 cell (morula) stage in 3 days → 32 cell stage (morula)& so on.

Site: in uterine tube

Morula:

Def. 16 cell stage, formed & enter uterine cavity at 3rd day after fertilization.

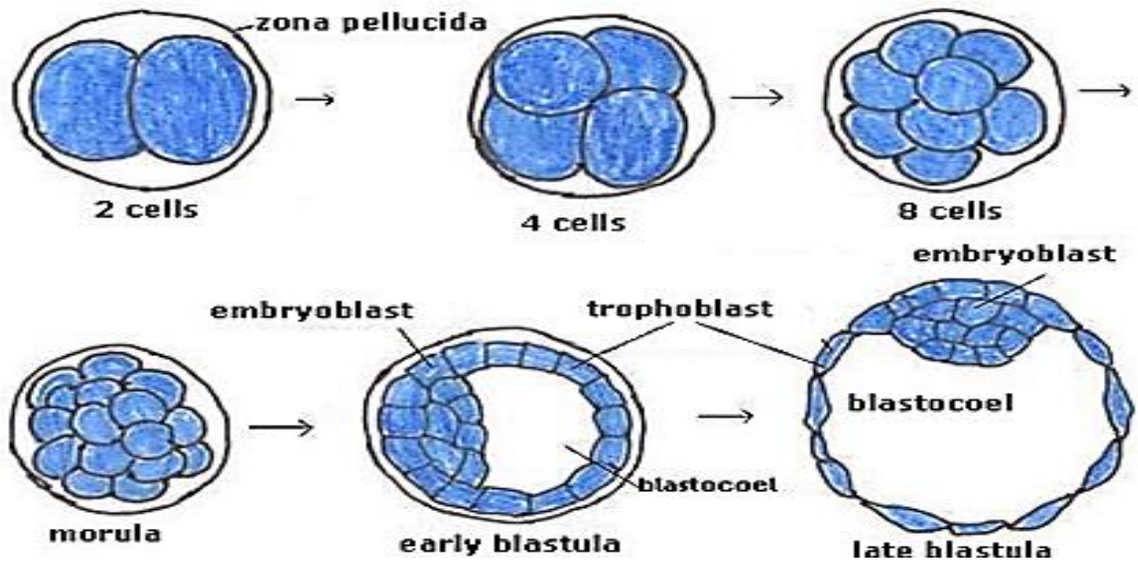
Structure:

1-**Outer cell mass (trophoblast).** Outer layer of blastomeres will form placenta.

2-Zona pellucida

3- Inner cell mass. Centrally placed blastomeres will form tissues of embryo

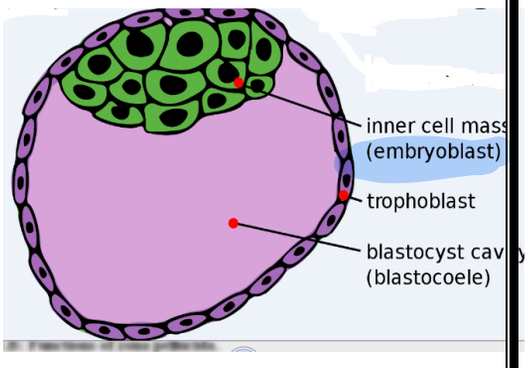
Fig.15 :- Change of zygot to morula and blastocyst



Blastocyst

Formation:

- In uterine cavity at 5th day after fertilization.
- Fluid pass from uterine cavity through Zona Pellucida & outer cell mass of morula to



spaces between outer & inner cell mass & these spaces unite → single cavity called blastocele.

Structure: a vesicle formed of

1- Outer cell mass (trophoblast):- single layer of flat cells which will form the placenta.
2- Inner cell mass: at one pole of outer cell mass called embryonic pole.
3- Blastocele (a cavity filled with fluid).

N.B: Functions of zona pellucida.

1- Prevents penetration of ovum by other sperms by zona reaction.
2- Passes nutrients to embryo.
3- Keeps blastomeres together during cleavage.
4- Prevents adhesions of blastomeres to epithelium of uterine tube.

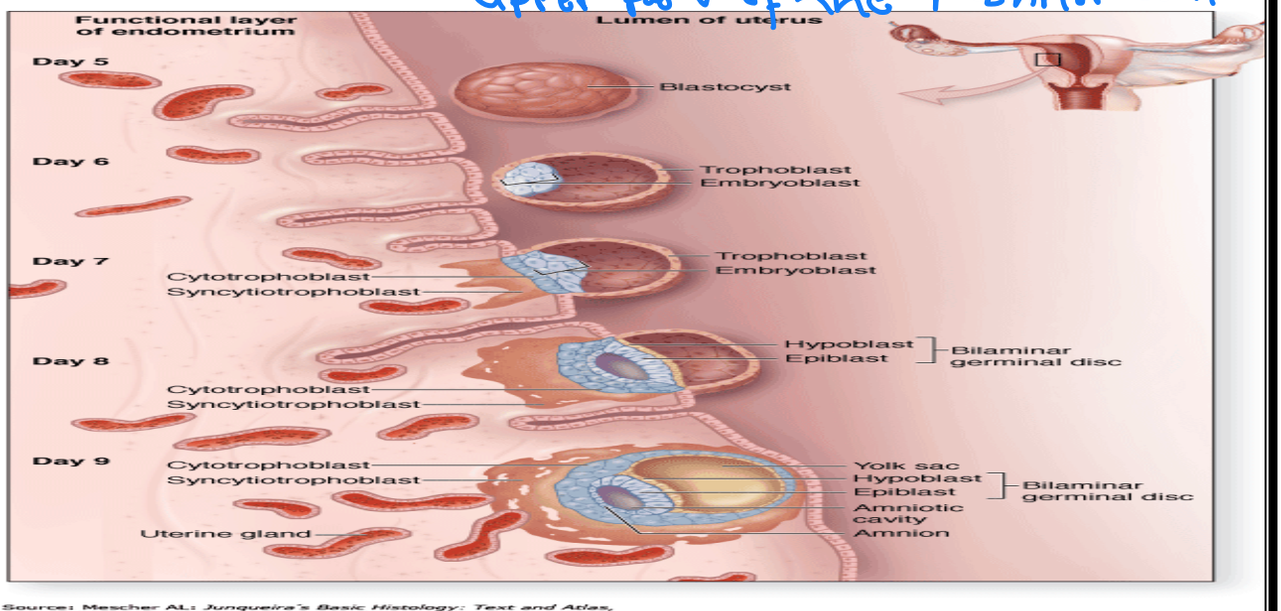
2nd week of pregnancy

1- Implantation is completed.
2- Formation of bilaminar embryonic disc
3- Formation of amniotic cavity,1ry yolk sac& connecting stalk.
4- Formation of chorion & chorionic coelom.

Implantation:

Def: embedding of fertilized ovum (blastocyst) in endometrium.

Normal site: upper part of posterior wall of uterus near fundus.



Mechanisms of implantation:

3 mechanisms under the effect of progesterone.

1- Muscular: Transport of blastocyst & placed it in the area of implantation.

2- Adhesive:

By which the blastocyst is attached to localized part of endometrium.

3- Invasive:

By which the blastocyst penetrate the endometrium.

Start of implantation: by the 7th Day after fertilization.

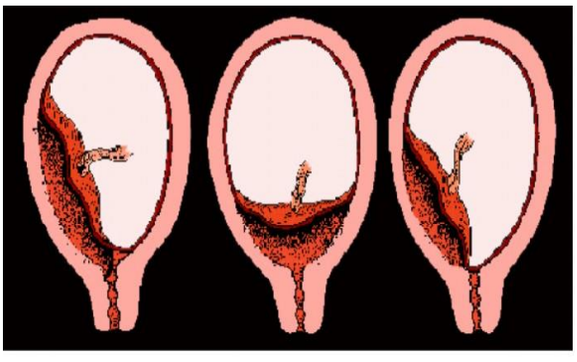
Steps:-

1- Attachment of the blastocyst to the endometrium at embryonic pole).

2- The trophoblastic cells at these projections differentiate into:

- Outer syncytiotrophoblast (has finger like projection) which erode the Stroma of endometrium
- Inner cytotrophoblast (has intact cell boundaries) called Langhans layer.

3- **End of implantation:** By the 11th. Day the blastocyst is completely embedded in the endometrium.



Partial Complete Marginal

Abnormal sites of implantation:

A-Uterine implantation(placenta praevia)

In Lateral wall of uterus close to internal OS.

Types:

1- **placenta praevia marginalis**: partially covers internal OS.

2- **placenta praevia centralis:** completely covers internal OS.

3- **placenta praevia lateralis:** at margin of internal OS.

Extra-uterine implantation:

(ectopic pregnancy)

Pregnancy outside the uterus.

Types:

1- (tubal pregnancy)In uterine tube

2- (ovarian pregnancy) On ovary

3- (abdominal Pregnancy)

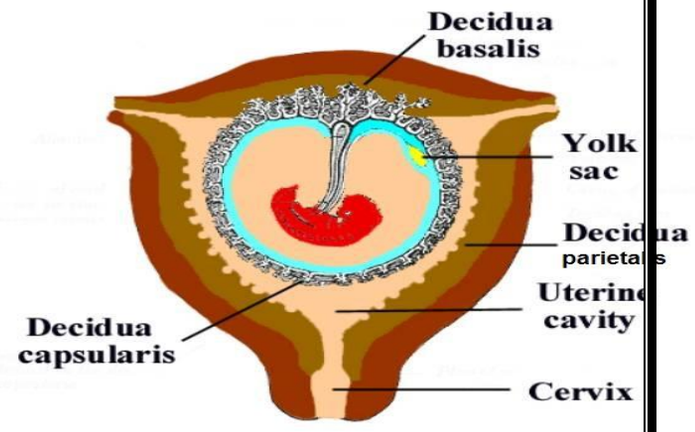
endometrium before implantation

Decidua:

Def.: endometrium after implantation of blastocyst.

Formation: - by progesterone through **decidual reaction:** as follows:

1- Stroma cells filled with glycogen & lipids and are called decidua cells.
2- Endometrium become thick & edematous.



Parts of decidua:

1- **Decidua basalis:** between implanted blastocyst & uterine wall.
2- **Decidua capsularis**: between implanted blastocyst & uterine cavity.
3- **Decidua parietalis:** The remaining decidua, lines wall of uterine cavity.

Formation of bilaminar germ layers (embryonic disc)

- At 8th day after fertilization amniotic cavity appears within inner cell mass.
- Inner cell mass differentiate into 2 germ layers.
  - Hypoblast: - Ventral layer of cuboidal cells close to blastocele.
  - Epiblast: - dorsal layer of columnar cells.
- These 2 layers together form bilaminar embryonic disc.
- Epiblast cells spread to line inner surface of cytotrophoblast are called amnioblast & together with the rest of epiblast forming amnion that line amniotic cavity.

Fig.21 : - Appearance of amniotic cavity in blastocyst

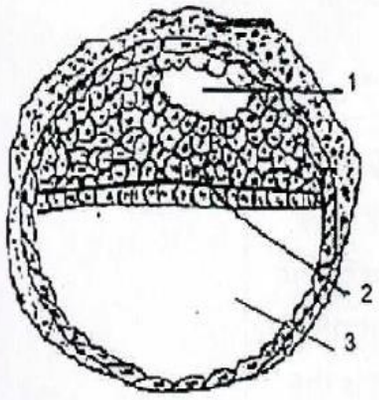
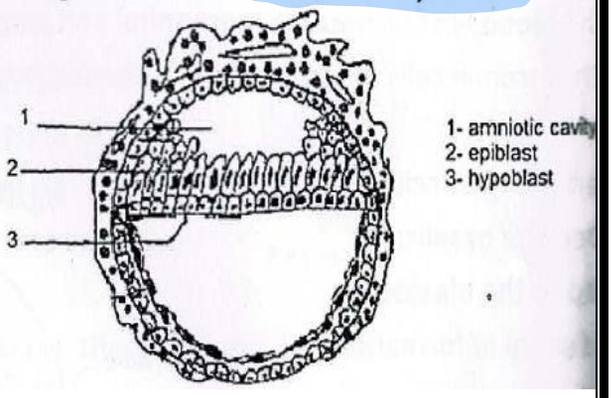


Fig.22 :- Formation of bilaminar embryonic disc



- Hypoblast cells spread to line inner surface of cytotrophoblast at ab. embryonic pole forming a membrane called exocoelmic (Heuser's) membrane. This membrane with hypoblast form lining of 1ry yolk sac.

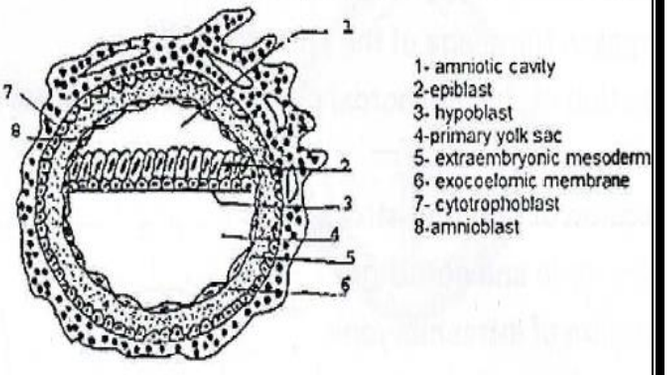
Formation of extra embryonic mesoderm:

- At 11^{th} – 12^{th} day after fertilization. From hypoblast.
- Cells appear between cytotrophoblast externally & exocoelmic membrane & amnion internally.

Formation of extra embryonic coelom:

Spaces appear in extra embryonic mesoderm, then unite to form C-shaped cavity called extra embryonic coelom that surrounds amniotic cavity & 1ry yolk sac except at small area called connecting stalk that connects bilaminar embryonic disc to trophoblast.

Fig.23 :- Formation of primary yolk sac and extraembryonic mesoderm

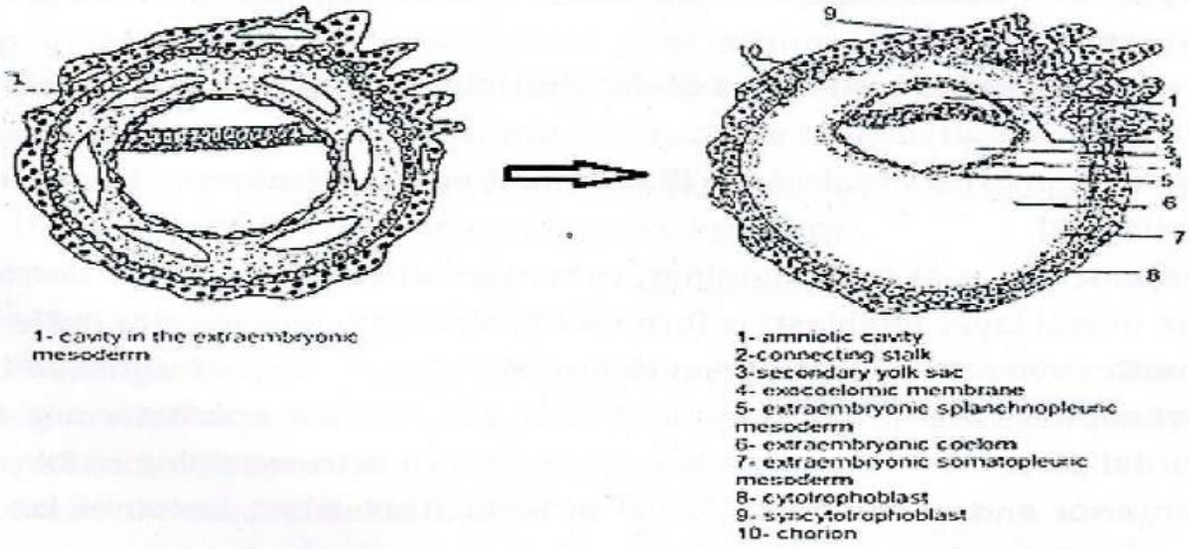


Fate of extra embryonic mesoderm:

- **Extra embryonic somato – pleuric mesoderm:**
  Line cytotrophoblast & covers amniotic cavity.
- **Extra embryonic splanchno – pleuric mesoderm**: covers 1ry yolk sac.

N.B: At this stage the blastocyst is called chorionic vesicle & the membrane formed by extra embryonic mesoderm & overlying syncytiotrophoblast and cytotrophoblast is called **chorion**.

Fig.24 :-Change of blastocyst into chorionic vesicle



Events in the 3rd week of pregnancy

1- Gastrulation & formation of the 3 germ layers.
2- Notochord formation.
3- Formation of cloacal & buccopharyngeal membrane.
4- Neurulation.
5- Allantois formation and 3 types of chorionic villi.

Gastrulation

Def.: the process by which the epiblast forms the 3 germ layers intra – embryonic (endoderm, mesoderm & ectoderm).

Time: 3rd week of development.

Steps:

1- **Formation of primitive streak & node. (at 15th – 16th day).**

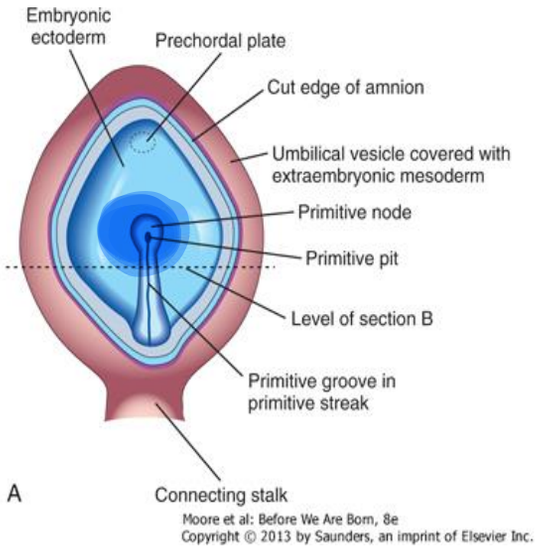
Primitive streak

Def.: Narrow groove on the surface of epiblast in the midline near the caudal end of the embryo.

Primitive node

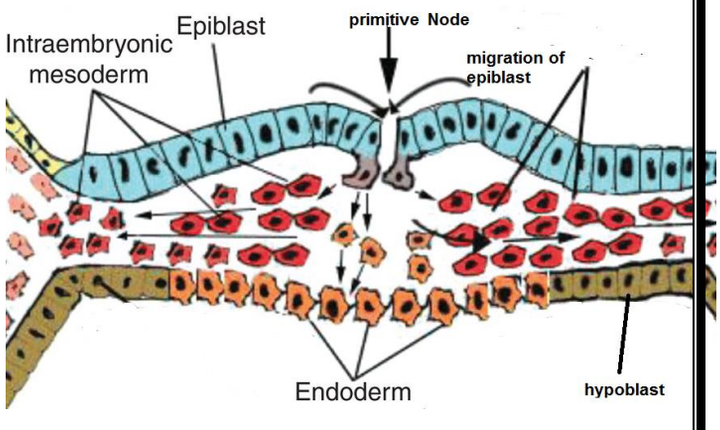
Def.: rounded elevation at the cephalic end of the primitive streak.

This elevation has a small pit called primitive pit



2-**Migration**: of epiblast cells toward the primitive streak & node. When the migrating cells reach the region of primitive streak they become flask shape & detach from epiblast.

3- Invagination of migrating cells below the epiblast leading to formation of the 3 germ layers as follows.



- First invaginated cells that displace hypoblast form→ intra embryonic endoderm.
- Next invaginated cells after formation of endoderm lie between epiblast & endoderm form → intra – embryonic mesoderm which spread in.
- Remaining cells in epiblast form → ectoderm.

Growth of the embryonic disc

In shape:-

Rounded then oval then pear shape with broad cranial end & narrow caudal end

.

Bilaminar: formed of two layers

- Epiblast: dorsal layer of columnar cells.
- Hypoblast: ventral layer of cuboidal cells.

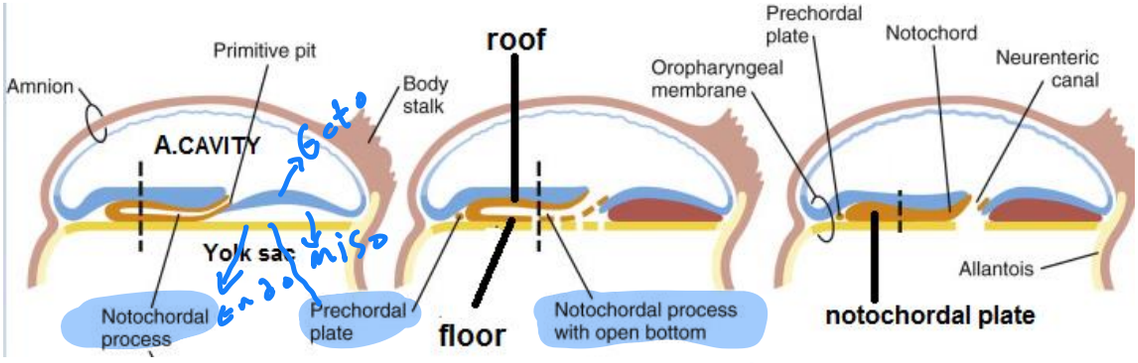
Trilaminar:

- Ectoderm, mesoderm & endoderm except at buccopharyngeal membrane cranially & cloacal membrane caudally, there is no mesoderm & the membranes formed of ectoderm & endoderm only.

Notochord

Def: Solid cord in axis of embryonic disc between ectoderm & endoderm. Around it vertebral column is formed.

Steps of formation:



1- Notochordal (head) process:

Cells invaginated through primitive pit move in cephalic direction till they reach (future buccopharyngeal membrane) →forming tube like process called notochordal (head) process.

2- Notochordal canal:-

Formed by extension of the primitive pit through the process.

3- Notochordal plate:

At 18th day of development the floor of notochordal canal fuses with underlying endoderm & the 2 layers degenerate

Notochordal plate:

Is the roof of notochordal process

Neuro –enteric canal:

The temporary communication between amniotic cavity & yolk sac. It rapidly closes by regeneration of

surrounding endoderm

4- Definitive notochord:

Notochordal plate is folded around its long axis →form definitive notochord.

Differentiation in Germ layer

Time: between 3rd- 8th week of development. It is the period of organogenesis.

Differentiation of Ectoderm (neurulation)

Def: formation of neural tube. Through induction from notochord.

1- Formation of neural plate

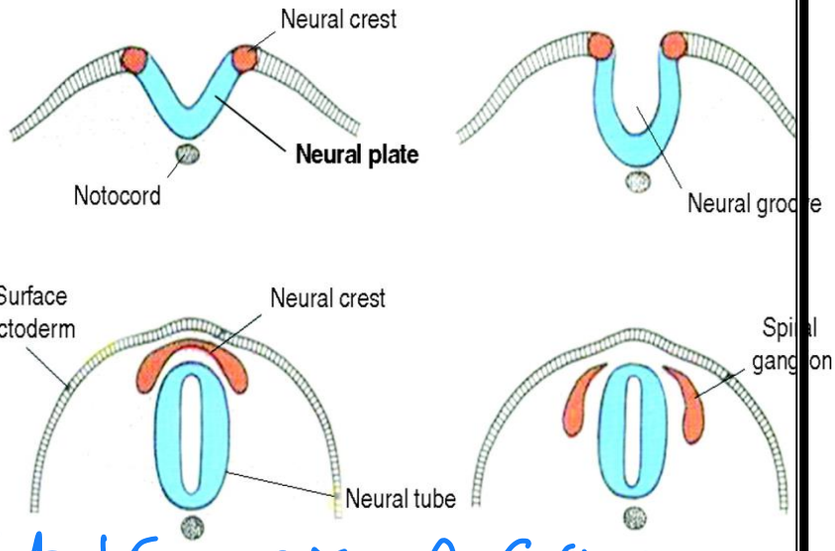
The ectoderm overlying the notochord thickened to form neural plate under induction from notochord.

2- Formation of neural crest:

Ectodermal cells on sides of neural plate.

3- Formation of neural folds & groove:

- Lateral edges of neural plate are elevated → neural folds & depressed mid region → neural groove.
- At end of 3rd week



4- Formation of neural tube:

Neural folds approach each other in midline then fuse with each other to form the neural tube.

5- The neural tube has anterior (cephalic) & posterior (caudal end) neuropores that rapidly Closed at end of 4th wk.

Ectoderm → CNS and Epidermis

Fate of neural tube : **Cephalic broad part** → brain

Caudal narrow part→ spinal cord.

N.b.: The remaining part of ectoderm → Form epidermis of skin.

4th week of pregnancy

- Formation of somites-
- folding- primitive heart tube formation-
- Yolk sac is reduced& amniotic cavity increased.

Differentiation of intra embryonic (secondary) mesoderm

On each side of notochord, the mesoderm divided by longitudinal groove into:

1- Paraxial mesoderm: medial to groove.
2- Intermediate mesoderm: in floor of groove.
3- Lateral plate mesoderm: lateral to groove.

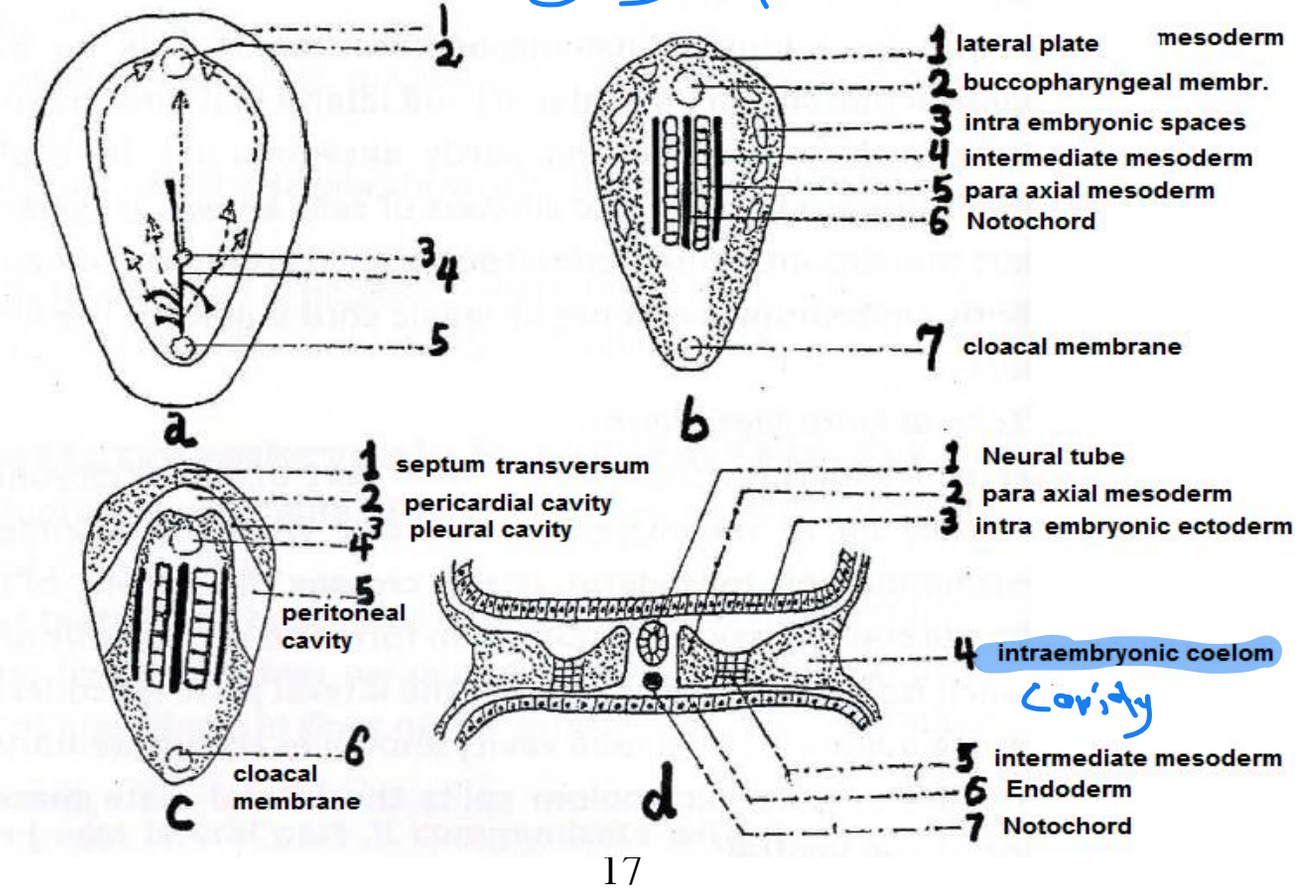
Paraxial mesoderm

- **Two mesodermal masses in each side of notochord.**
- Paraxial mesoderm is divided into Paris of cubical masses called Somites.
- They develop first in cephalic region then proceeds in cephalo-caudal direction.
- Start at 20th day, 3 pairs/ day & end at end of 5th week to become 42-44 pairs of somites.

Fate of somites:

Divided into 2 parts.

Sclerotome is ventromedial part	Dermomyotome is dorsolateral part
It surrounds notochord & spinal cord → form vertebral column	Dermatome → dermis of skin. Myotome → voluntary muscles.



Intermediate mesoderm

- The mesoderm lies lateral to paraxial mesoderm.
- Partly segmented & partly unsegmented:
- **The segmented cephalic part** is divided into nephrotomes.
- **The unsegmented caudal part** →form nephrogenic cord that will form
→ Kidneys, gonads & their ducts.

Lateral plate mesoderm

The mesoderm in the lateral part of embryonic disc. Laterally it is continuous with extra embryonic mesoderm & cranially crosses in front of buccopharyngeal membrane forming cardiogenic area.

Intraembryonic coelom:

- Spaces appear in lateral plate mesoderm then unite → form inverted U shaped cavity called intraembryonic coelom.

  Fate of intraembryonic coelom → Form 3 serous cavities.

1- **Pericardial cavity**: from transverse part of coelom that crosses midline of disc in cardiogenic area.

2- **Pleural cavities**: from junction between transverse part & 2 caudal limbs of coelom which is called pericardio-peritoneal canal.

3- **Peritoneal cavity:** from 2 caudal limbs of the coelom.

- Intra embryonic coelom splits **lateral plate mesoderm** into 2 layers.

Samatopleuric mesoderm	Splanchno – pleuric mesoderm

Differentiation of endoderm (Formation of Gastro – intestinal tract).

Folding of the embryonic disc

Def.:- flexion of the trilaminar embryonic disc ventrally towards the yolk sac.
Time: 4th week of development.
The folding occurs around **2 axes:**

- An A- P axis **(cephalo-caudal folding):** →formation of head & tail folds.
- A transverse axis **(lateral folding):** →formation of 2 lateral folds

Causes of folding:

- Expansion of amniotic cavity (the most important)
- Cephalo – caudal folding by: rapid growth of neural tube

- Lateral folding by: rapid growth of somites.

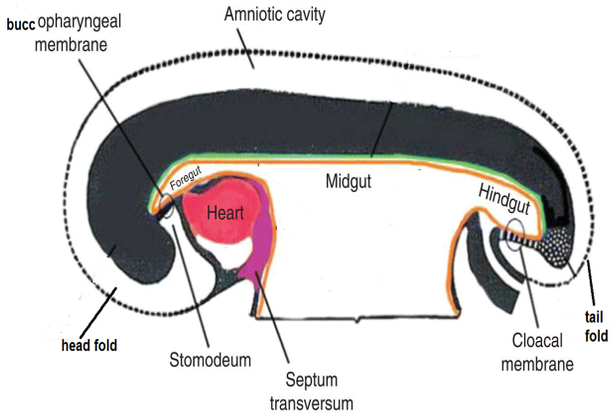
Head & tail fold is **restricted** due to the firm notochord & primitive streak.

Results of folding:

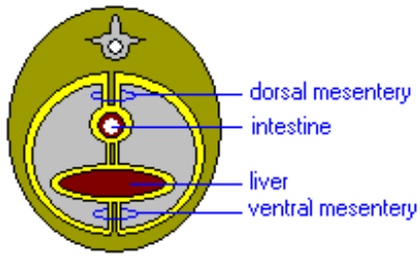
1- Formation of the Primitive gut: (lined by endoderm)

As a result of folding of the embryonic disc ventrally →Large dorsal part of yolk sac is enclosed in body of embryo forming primitive gut which is divided into 3 parts:

- **Foregut**: in head fold.
- **Hindgut**: in tail fold.
- **Midgut:** between foregut and hind gut, this midgut ventral part of yolk sac by vitello-intestinal duct.
- **Anterior intestinal portal** is junction between foregut & midgut
- **Posterior intestinal portal** is junction between midgut & hind gut.



2- Formation of gut mesentery: As a result of lateral folding of embryonic disc →Forming dorsal & ventral mesenteries.



3- Formation of umbilical orifice (future umbilicus):

- Lies between the 4 folds that surround umbilical orifice which contains vitello intestinal duct & connecting stalk.

4- Reversal of position:

Foetal membranes

Def: - any tissue or structure developed from zygote & does not form part of embryo proper. Such as Chorion, umbilical cord, yolk sac, amnion, allantois, & placenta.

Chorion

N.B: At the stage of blastocyst transformed into chorionic vesicle. The membrane formed by extra embryonic mesoderm & overlying Syncytiotrophoblast & Cytotrophoblast is called **chorion**.

Chorionic villi:

Def: finger like processes arise from trophoblast into deciduas basalis & capsularis.

Time: 9^{th} – 25^{th} day of development.

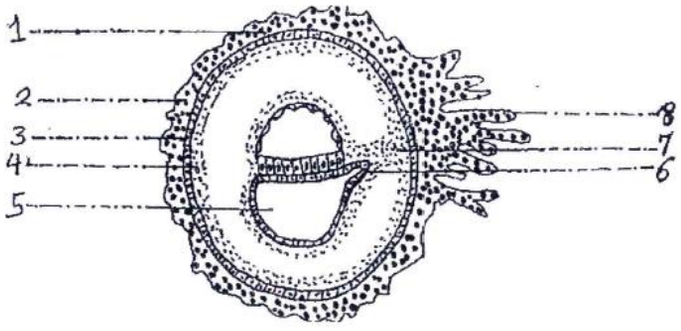


Fig.36: CHORIONIC VESICLE
1-Chorion leave (smooth chroion).
2.Syncytiotrophoblast
3.Cytotropholast.
4.Extraembryonic mesoderm.
5. Secondary yolk sac. 6. Allantois. 7. Connecting stalk.
8. Chorion frondosum.

Types of Chorionic villi:

According to structure:

1- **Primary villus**: formed of two layers .outer syncytiotrophoblast & inner cytotrophoblast.
2- **Secondary villus**: as primary but acquire a core of 1ry mesoderm(outer syncytiotrophoblast , inner cytotrophoblast & core of 1ry mesoderm)
3- **Tertiary villus:** as secondary but a blood vessel develops in its 1ry mesoderm. Formed of 4 layers(outer syncytiotrophoblast , inner cytotrophoblast , core of 1ry mesoderm & a blood vessel)

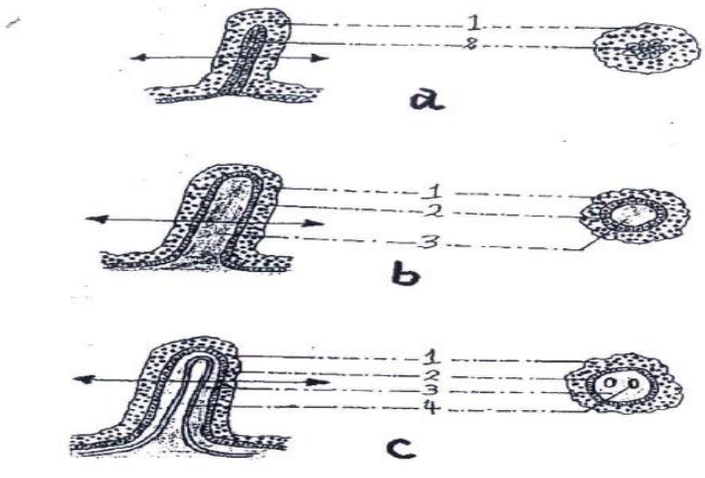
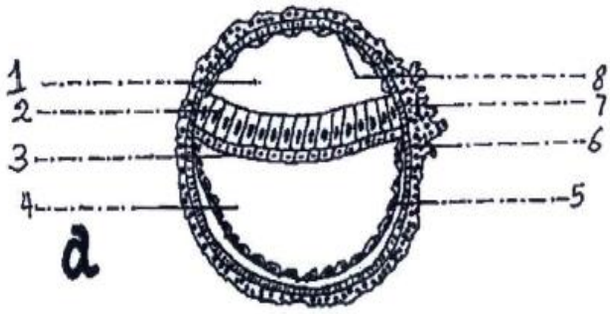


Fig.37: CHORIONIC VILLI
a) A primary villus showing:
1. Syncytiotrophoblast.
2. Cyotrophoblast.
b) A secondary villus showing:
1. Syncytiotrophoblast.
2. Cytotrophoblast.
3. Primary mesoderm.
c) A tertiary villus showing:
1. Syncytiotrophoblast.
2. Cytotrophoblast.
3. Primary mesoderm
4. Foetal blood vessels.

YOLK SAC

Stages of development

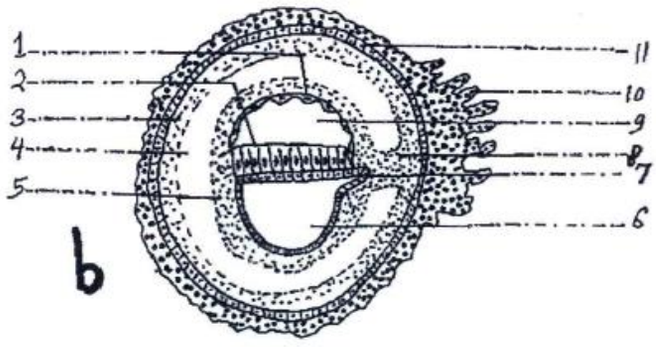
Primary yolk sac:



- It is formed in the stage of blastocyst due to formation of exocoelmic membrane.
- **Boundaries:** - roof formed by hypoblast.

Side& floor:- exocoelmic membrane (Heuser's membrane)

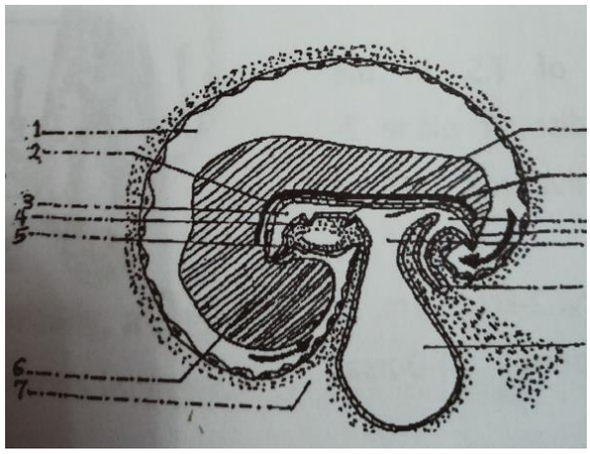
Secondary yolk sac:



- It is formed in the stage of chorionic vesicle from primary yolk sac.
- **Boundaries:-** roofed by endoderm.

Side & floor:- endoderm & extra embryonic mesoderm.

Definitive yolk sac:



- Remaining part of yolk sac outside embryo after disc folding & formation of gut.
- Definitive yolk sac temporary connected with midgut by vitello-intestinal duct which disappear later.

Functions of yolk sac:

1. Early nutrition.
2. form lining epithelium of gastro intestinal &respiratory tracts
3. Allantois form part of urinary bladder.
4. Site of formation of primitive sex cells.
5. Blood vessels & cells are formed in surrounding embryonic mesoderm.

AMNION & AMNIOTIC CAVITY

Amniotic fluid = liquor:

It is the fluid that fills amniotic cavity.

Source: at 1st formed by secretion from amnioblast when the fetal kidneys act, fetal urine is added to the fluid. Also from secretion of mucus cells of lung & secretion from foetal surface of placenta.

Amount: ↑ gradually until 7th month of pregnancy, then ↓ & at time of Birth , it is about 1,5 liters.

Functions of amniotic fluid:

1- Protect embryo from external shocks.
2- Allow Symmetrical growth of embryo.
3- Antiseptic medium (remove bacteria) around embryo.
4- Allow free movement of embryo.
5- Good dilator of cervix of uterus during delivery.

Anomalies:

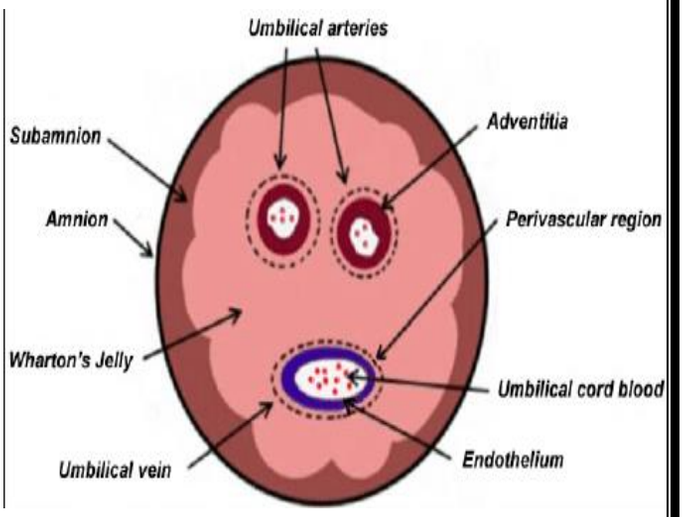
1- Oligohydramnios: volume <500 cc.
2- Polyhydramnios: volume > 2500 cc.

UMBILICAL CORD

Formation: in 5th week of development by.

Structure of umbilical cord at 5th week:

- Sheath of amnion.
- Wharton's jelly: mesoderm of connecting stalk.
- Remains of extra – embryonic coelom.
- Allantois.
- Vitello intestinal duct.
- Umbilical vessels, 2 arteries & 1 vein.
- Vitelline vessels.

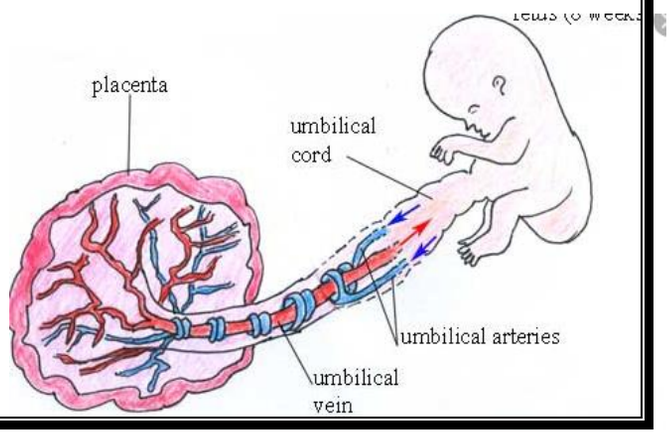


At birth (full term): features at full term:

1- 50 cm in length.
2- Attached to foetal surface of placenta near center.
3- Twisted as umbilical arteries are longer than vein.

Functions:

1- Flow of blood ( ) fetus & placenta.
2- Fetus floats freely in amniotic cavity.



Anomalies:

- Double cord.
- Triple cord.
- Very long cord that may turn around neck of fetus → suffocation.
- Very short → premature separation of placenta.

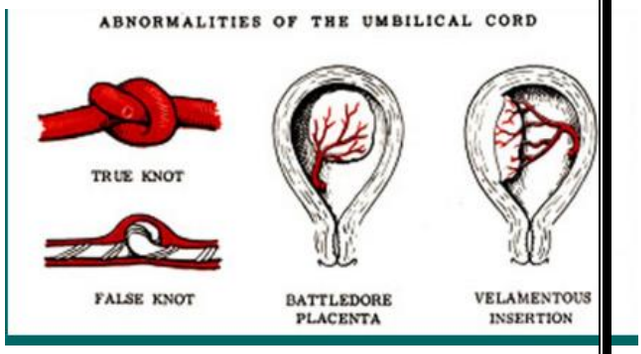
- true knots:

✓ Due to excessive fetal movements associated with too long cord.

✓ Obstruction of umbilical vessels → fetal death.

- false knots:

No obstruction of vessels.



- Abnormal attachment to placenta:
  i. Central attachment.
  ii. Marginal attachment (battledore placenta).
  iii. Velamentous attachment: cord attached to foetal membranes with blood vessels passing towards placenta.

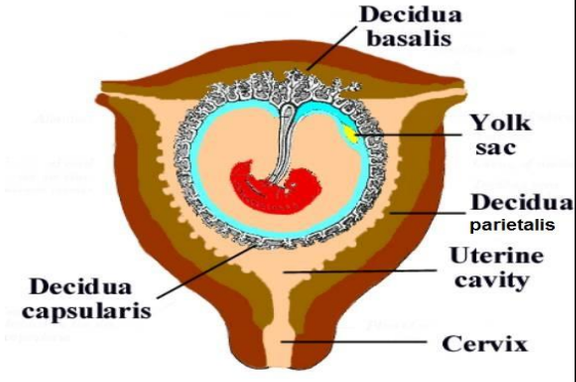
- Cord with only 1 umbilical artery.
- Omphalocele (umbilical hernia).

PLACENTA

It is the organ of exchange between maternal blood & foetal blood.

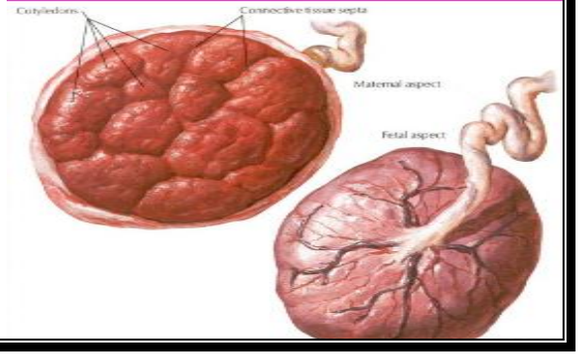
Origin of placenta: 2 parts.

- **Foetal part**: chorion frondosum.
- **Maternal part**: decidua basalis.



Full term placenta:

- Is disc shape of flattened cake.
- 15-20 cm diameter
- 3-4 cm thickness "more thick in center"
- 500 grams.
- It has two surfaces.

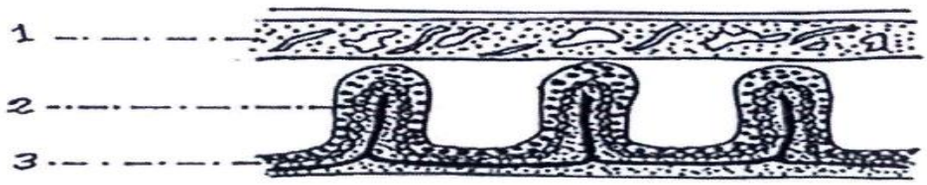


1- maternal surface:	2- foetal surface:
Formed by decidua basalis	Formed by chorionic plate
Rough with 15-20 cotyledons & fissures	Smooth covered by amnion & umbilical cord is attached to it near center.

Placental (foetomaternal) barrier:

- Between maternal blood & fetal blood. In early pregnancy formed of:
  - Syncytiotrophoblast.
  - Cytotrophoblast.
  - Extra embryonic mesoderm.
  - Endothelium of fetal blood vessels.

In 2nd half of pregnancy, the barrier loses Cytotrophoblast & extra embryonic mesoderm & becomes thin formed of two layers only 1- Syncytiotrophoblast 2- endothelium of fetal blood vessels , to increase the rate of exchange in late pregnancy to satisfy growing fetus.



Placental functions:

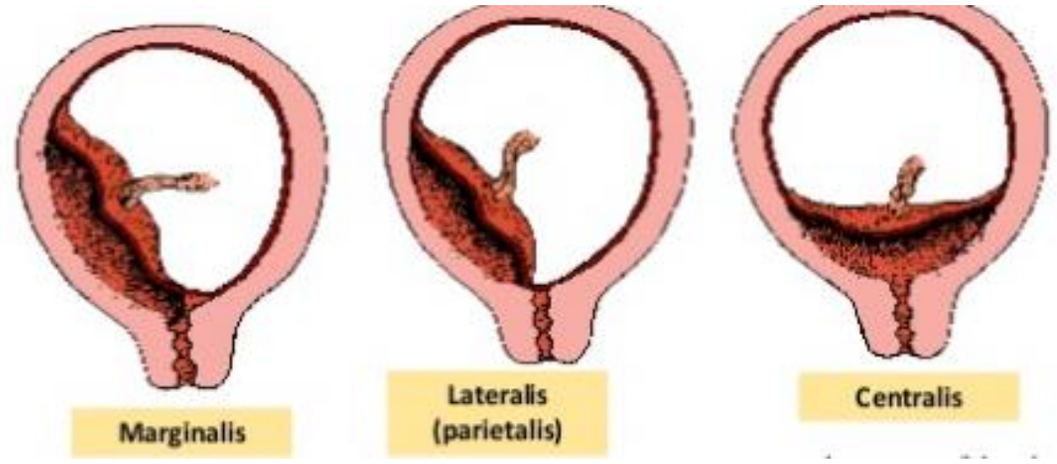
1- Nutritive functions: absorption of nutrients from maternal blood.
2- Excretory functions: fetus gets rid of waste products.
3- Respiratory functions: foetus receive O_2& get rid of CO_2
4- Protective functions: Placenta protects foetus from some diseases as measles & diphtheria.
5- Endocrine: syncytiotrophoblast secretes the following hormones:
   - Progesterone: start at 5th month, maintain pregnancy.
   - Estrogen.
   - Human chorionic gonadotropins: pass in mother's urine .Their presence in urine is an indicator for pregnancy.

Anomalies of placenta:

Anomalies In position: abnormal sites of implantation

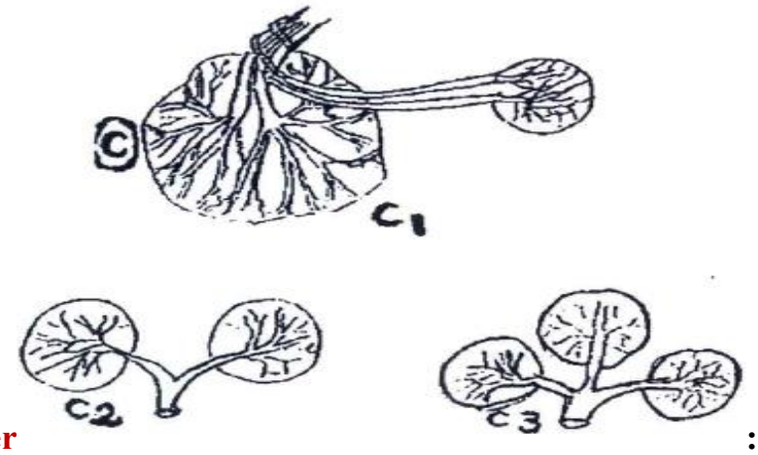
Placenta praevia: in lateral wall of uterus close to internal OS:

1- **Placenta praevia lateralis**: at lateral wall of uterus
2- **Placenta praevia marginalis**: partially covers internal OS.
3- **Placenta praevia** centralis: completely covers internal OS.



Anomalies In attachment of umbilical cord:

1- Central attachment: Umbilical cord attached to the center of placenta.
2- Marginal attachment (battledore placenta).
3- Velamentous attachment: cord attached to foetal membranes with blood vessels passing towards placenta.



Anomalies In number :

1- Accessory placenta (succenturiata): small placenta near original one.
2- Placenta bipartita: bilobed placenta in twin pregnancy.
3- Placenta tripartita: trilobed placenta in triplet pregnancy.

Anomalies In shape:

Membranous placenta: Placenta occupies more than 1/2 the endometrium.

Types of Twins:

- Dizygotic twins	Monozygotic twins
• Commonest. • Results from fertilization of 2 oocytes by 2sperms → 2 zygotes. • the twins are non- identical • may be different sex or the same sex • Each twin has its "amnion – chorionic vesicle – placenta".	• Less common • Results from fertilization of one oocyte by one sperm → one zygote then the zygote splits at various stages of development. • the twins are identical • The twins are the same sex