GENERAL EMBRYOLOGY

MEIOSIS (S.Ams)

It is a cell division occuring during the formation of gametes.
It consists of two successive divisions called First and Second meiotic divisions.

SPECIAL FEATURES

- cells resulting from this division have HALF the number of chromosomes. (HAPLOID NUMBER)
- DIPLOID NUMBER is restored after fertilization.
- Pairing of homologous chromosomes occurs
- Exchange of genetic materials takes place between homologous chromosomes.

STAGES

- It consists of two successive divisions called First and Second meiotic divisions.
- FIRST MEIOTIC DIVISION (S.Ams)

PROPHASE: is prolonged and divided into stages Leptotene, Zygotene, Pachytene, Diplotene and Diakinesis.

METAPHASE: follows — 46 chromosomes become attached at the spindle in pairs.

ANAPHASE: one entire chromosome of each pair moves to a pole of the spindle. The resulting daughter cells thus have 23 chromosomes.

TELOPHASE: is similar to mitosis.

- SECOND MEIOTIC DIVISION

There is a short interphase — THERE IS NO DUPLICATION OF DNA.
Rest of Second meiotic division is similar to MITOSIS, where the daughter cells receive a chromatid each.

SPERMATOGENESIS (L Sway, S. Sway)

- It is the process of formation of spermatozoa which is the male gamete.
- It takes place during the reproductive period beginning at Puberty and continues into old a

Site:
The male gonad Testis contains seminiferous tubules in the wall of which spermatogenesis takes place.

Time Taken:
2 months or 60-65 days are required for one complete cycle of spermatogenesis.

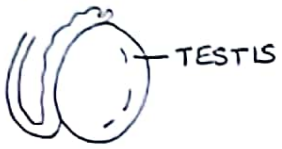
Various cell stages involved:

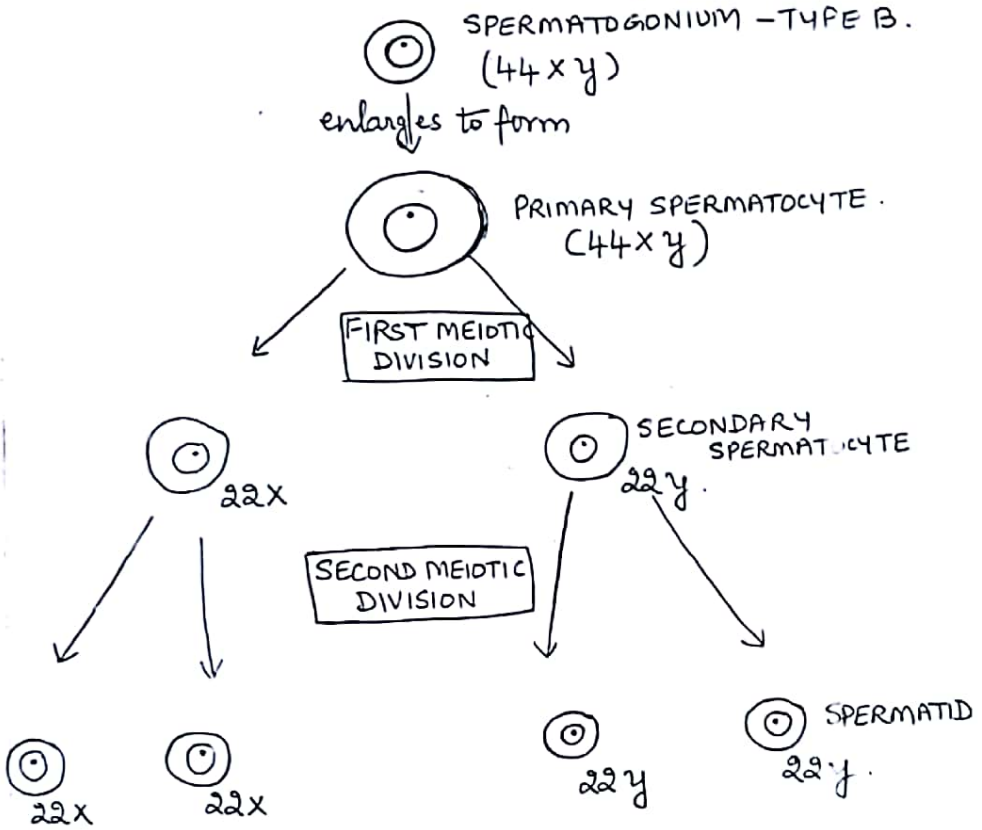
- Spermatogonia (44xy) divide mitotically and give rise to Type A and Type B.
- Spermatogonia Type A continue to divide and maintain the germ cell number.
- Spermatogonia Type B enlarge or divide and form Primary Spermatocyte (44 xy)
- Primary spermatocyte undergoes 1st MEIOTIC DIVISION to form secondary spermatocyte (22 x) and (22 y)
- Secondary spermatocyte undergoes 2nd MEIOTIC DIVISION to form two SPERMATIDS.
- Each Spermatid changes shape to become SPERMATOZOA — a process called SPERMIOGENISIS
- Thus FOUR SPERMATOZOA or SPERMS are formed from ONE Primary Spermatocyte.

CLINICAL CORELATION – (Applied Aspects)

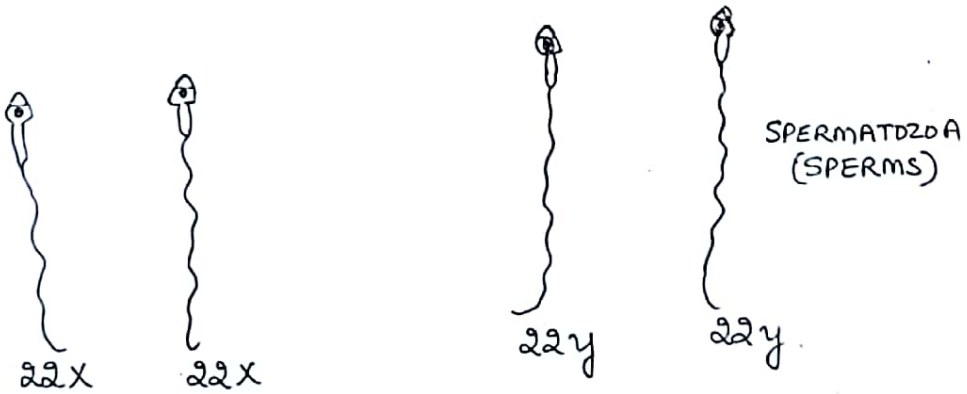
- **Abnormalities of form**
  Spermatozoa may be too large (giant), too small (dwarf)
  Head, body or tail duplicated
- **Chromosomal Abnormalities**
  chromosomal content may be abnormal due to nondisjunction.

SPERMATOGENESIS (S. Ans)



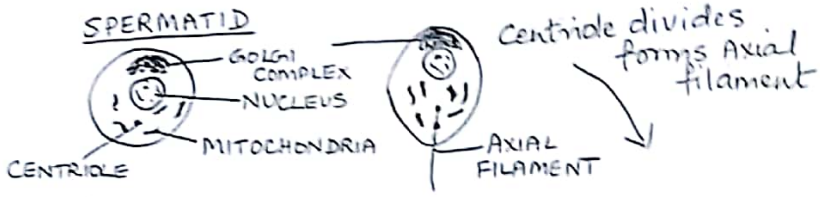


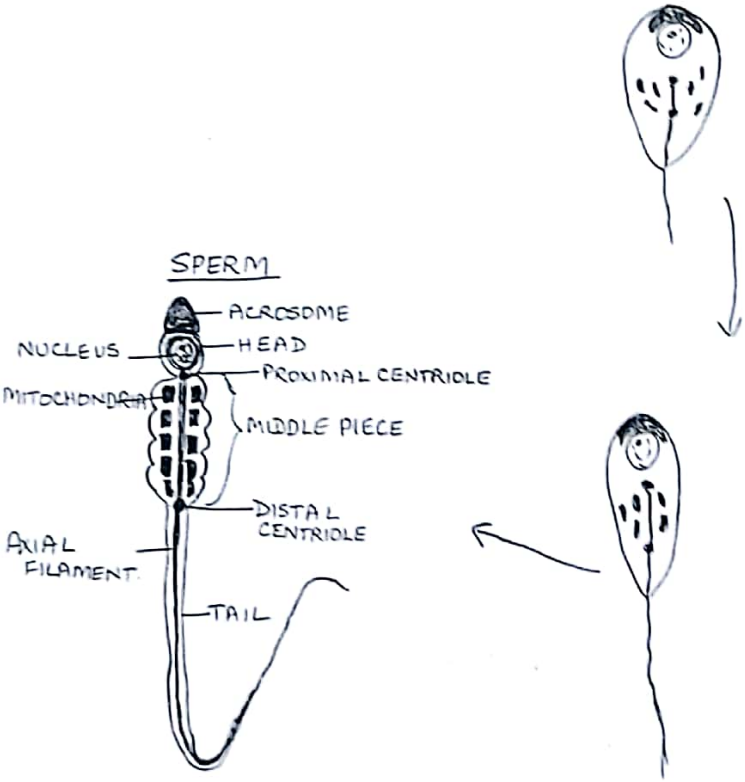
SPERMIDOGENESIS



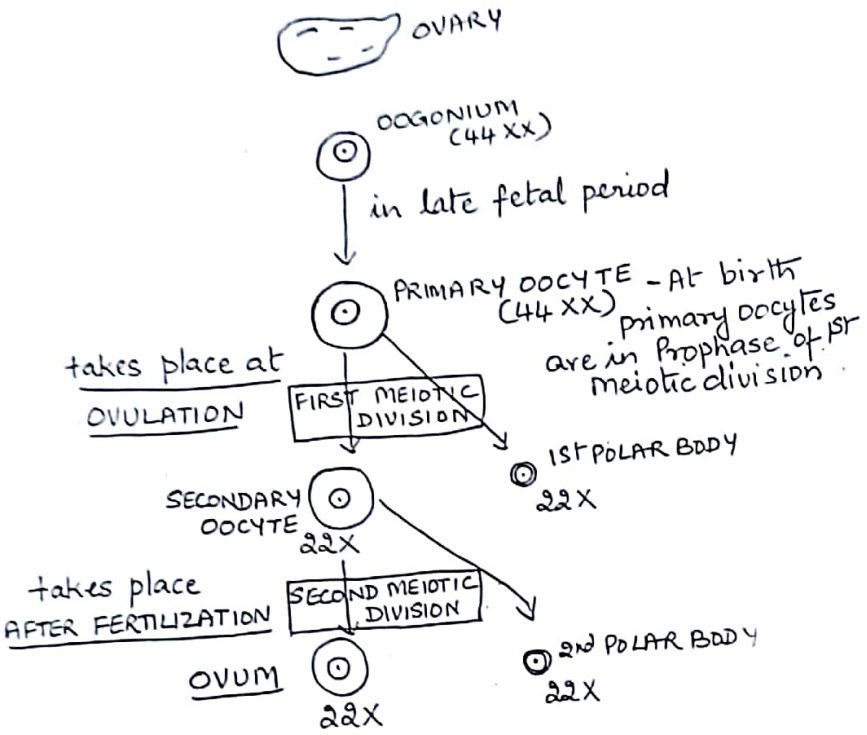
SPERMIOGENESIS (S. Smy)

- Process by which round spermatids becomes spermatozoa.
- The nucleus forms the head.
- Golgi complex becomes Acrosomal cap.
- The centriole divides into two - proximal and distal centriole.
- Axial filament grows out of centriole and forms tail.
- Part of axial filament following the neck gets surrounded by Mitochondria and forms middle piece.
- Excess cytoplasm forms Residual body which is engulfed by Sertoli cells.





OOGENESIS (S. Essay)



SITE: In cortex of female gonad – ovary.

- Begins in late fetal period when oogonia enlarge to form primary oocyte.
- At birth all Primary oocytes are in Prophase of 1st meiotic division.
- Primary oocyte completes 1st meiotic division just at the time of OVULATION to form secondary oocyte and 1st Polar Body.
- Secondary oocyte completes 2nd meiotic division only if FERTILIZATION occurs and releases 2nd Polar Body.
- Thus one Primary oocyte forms only one ovum. extra chromosomes form polar bodies.
- If fertilization fails to occur, secondary oocytes fails to complete second meiotic division and degenerates

APPLIED ASPECTS:

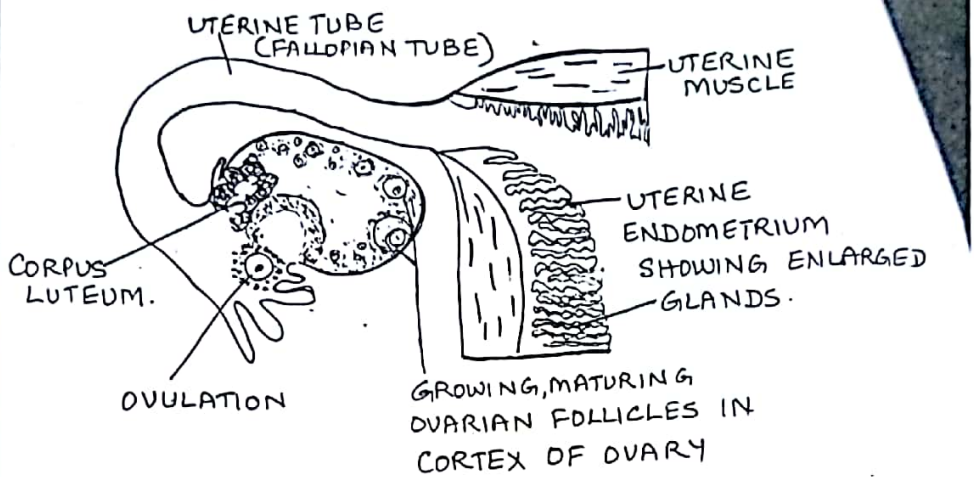
ABNORMALITIES of FORM

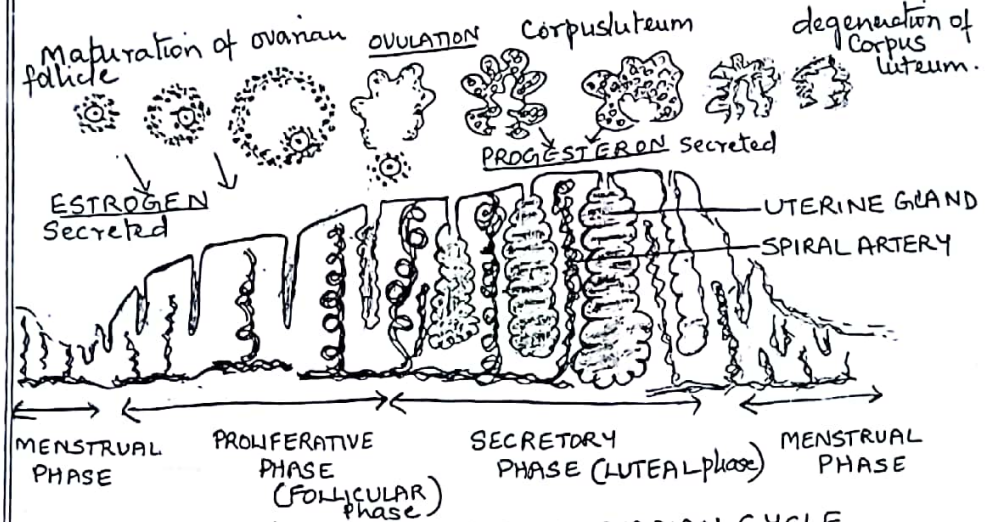
Oocytes may have large nucleus, two or three nuclei

CHROMOSOMAL ABNORMALITIES

Oocytes may have abnormal chromosomal content due to non dysjunction - causing Trisomy, monosomy etc.

OVARIAN AND UTERINE CYCLE (S.Br

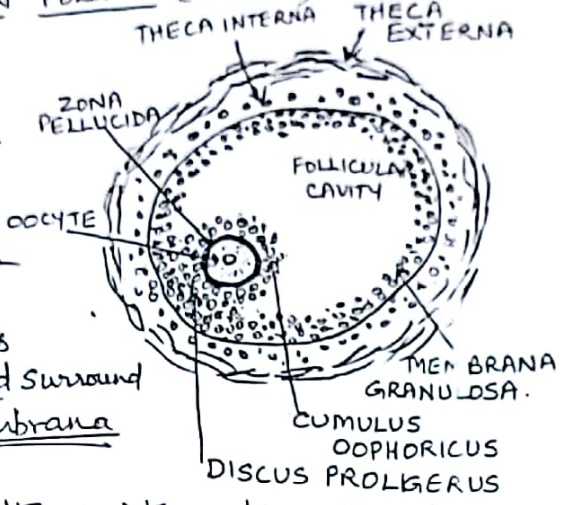




CHANGES IN ENDOMETRIUM DURING OVARIAN CYCLE

- Ovarian and uterine cycles run parallel to each other.
- Follicular phase - under the influence of ESTROGEN secreted by growing ovarian follicles the uterine endometrium proliferates - the glands grow in length, uterine arterial branches also grow.
- Secretory phase - After ovulation under the influence of PROGESTERON secreted by CORPUS LUTEUM the glands increase in diameter, and start secreting glycogen, Arteries lengthen and become spiral, endometrium becomes soft, edematous and thick.
- Menstrual phase - If ovum is not fertilized, Corpus luteum degenerates, the endometrium shrinks, and is shed off. Only the basal part of endometrium, with basal part of glands remain.

GRAAFIAN FOLLICLE (S. Sorsby)

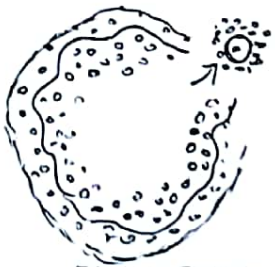


- A fully formed ovarian follicle is called Graafian follicle.
- Primary oocytes are surrounded by stromal cells of ovarian cortex.
- These follicular cells grow, proliferate and surround the ovum to form membrana granulosa.
- Fluid fills inside the cavity (antrum) forming an antral follicle
- The granulosa cells and oocyte secrete a glycoprotein shell around the oocyte - the zona pellucida.
- The antrum increases in size, the oocyte surrounded by zona pellucida is pushed to one side.
- The cells surrounding oocyte are called cumulus oophosicus and cells which attach it to follicular wall are Discus proligerus.
- This enlarged follicle is called Graafian follicle.
- The Graafian follicle is surrounded by cellular stromal THECA INTERNA and fibrous Theca externa.
- The cells of membrana granulosa and Theca Interna secrete ESTROGEN
- The Graafian follicle enlarges, reaches the surface of the ovary, ruptures and releases oocyte surrounded by corona radiata (some granulosa cells)
- This is called OVULATION
- The empty follicle, collapses, its cells enlarge and change - it is now called CORPUS LUTEUM and it starts secreting PROGESTERON.

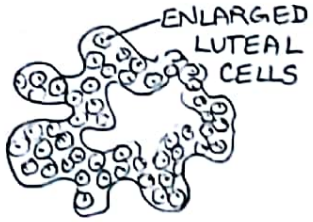
CORPUS LUTEUM (S. Essay)

- After ovulation the wall of ruptured Graafian follicle collapses and becomes folded.
- The follicular cells enlarge, get filled with a yellow pigment lutein and corpus luteum is formed.
- Corpus luteum secretes PROGESTERON.
- Fate of Corpus Luteum – depends on whether ovum is fertilized or not.
- If ovum is not fertilized – it lasts for about 14 days then degenerates to form corpus albicans.
- If ovum is fertilized – corpus luteum persists for 3 to 4 months, enlarges, secretes progesteron and helps to maintain pregnancy till the Placenta is able to secrete progesteron.

MATURE GRAAFIAN FOLLICLE



EMPTY FOLLICLE AFTER OVULATION



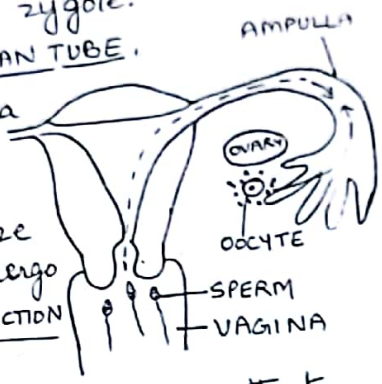
CORPUS LUTEUM

ZONA PELLUCIDA (S. Essay)

- The Primary oocyte and its surrounding granulosa cells secrete a glycoprotein shell that forms a thick homogenous membrane called ZONA PELLUCIDA.
- Zona Pellucida plays important role during FERTILIZATION and IMPLANTATION. by acting as a barrier.
- During Fertilization it facilitates Acrosome Reaction which help sperm to penetrate zona pellucida.
- This contact alters zona Pellucida – The ZONA REACTION, which prevents entry of other sperms – polyspermy.
- Zona Pellucida remains in place till morula reaches uterine cavity and becomes BLASTOCYST
- This ensures that Blastocyst implants in uterine cavity.
- Thus zona Pellucida prevents implantation in abnormal sites – which can cause ECTOPIC PREGNANCY

FERTILIZATION (L.Emay, S.E)

- It is the fusion of male and female gametes (sperm and oocyte) to form zygote.
- Occurs in AMPULLA of FALLOPIAN TUBE.
- SPERMS released in the vagina swim by active movement of the tail to reach the site.
- They are unable to fertilize the oocyte unless they undergo a) CAPACITATION b) ACROSOME REACTION



CAPACITATION (S.Ans)

- It is a process of conditioning of sperms that occurs when they are in the female genital tract.
- Takes about 7 hours time
- Involves removal of glycoprotein coat from Acrosomal cap of sperms
- This is done by mucosal enzymes secreted by cells of female genital tract.
- Only capacitated sperms can cross Corona Radiata

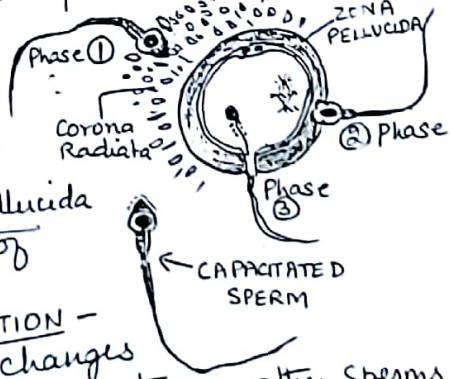
ACROSOME REACTION (S.Ans)

- It occurs when sperm head touches zona pellucida
- Acrosomal enzymes — Acrosin and Hyaluronidase are released which help to penetrate zona Pellucida

STAGES OF FERTILIZATION

Phase① — penetration of corona Radiata — only capacitated sperms can cross.

Phase② — Penetration of zona Pellucida
Acrosome reaction — release of Acrosin facilitates.
This results in ZONA REACTION — in which zona pellucida changes chemically and does not allow entry of other sperms — prevents polyspermy.



Phase③ — fusion of oocyte and sperm cell membrane.
- Head of sperm enters oocyte and becomes MALE PRONUCLEUS.
- oocyte completes 2nd meiotic division, its nuclear membrane disappears and forms female Pronucleus
- This restores DIPLOID number of chromosomes thus ZYGOTE is formed

Contd.

EFFECTS OF FERTILIZATION (S.Ans)

- OOCYTE COMPLETES 2nd meiotic division
- DIPLOID number of chromosomes RESTORED
- CROMOSOMAL SEX IS DETERMINED
- CLEAVAGE is INICIATED.

APPLIED ASPECTS:

IN VITRO FERTILIZATION (S.Ans)

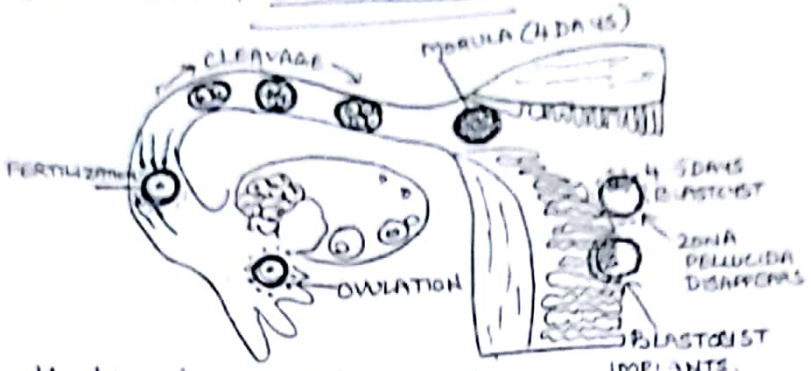
- This Technique is being used in couples who are not able to conceive in the normal way. (in vitro = outside the body)

Steps involved.

- Gonadotrophins are administered to the woman to stimulate maturation of ovarian follicles.
- oocytes are collected by aspiration and placed in suitable medium.
- Capacitated sperms are added.
- Fertilization and cleavage is allowed to take place
- The process is closely monitered.
- When the embryo is at 8 cell stage it is transfer into the uterine cavity which is prepared earlier by hormonal administration.
- successful implantation takes place in 20 percent of such trials.
- These are the so called TEST TUBE BABIES.

MORULA (S. Enay)

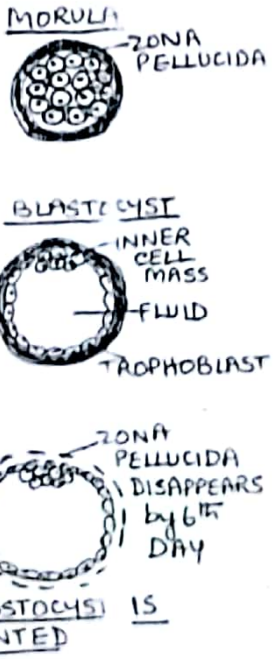
- Single celled zygote formed after fertilization undergoes repeated mitotic divisions called cleavage. These cells are called BLASTOMERES.



- As the cell division continues it passes long uterine tube aided by the sweeping action of cilia lining the tube.
- These cells are surrounded by the thick Zona Pellucida
- When the cells reach 16-cell stage it resembles a Mulberry and is called MORULA. It is about 4 days after fertilization.
- The morula reaches the upper part of uterine cavity.
- Fluids from uterine cavity permeates within and the cells arrange into INNER CELL MASS and outer TROPHOBLAST
- As the fluid increases, the morula takes the shape of a cyst – the BLASTOCYST.
- Zona Pellucida starts disappearing around 5-6day and the Blastocyst starts implantation.

BLASTOCYST (S. Enay)

- The unicellular zygote divides and redivides to form morula.
- When morula enters uterine cavity by 4th day, the cells separate into inner cell mass (embryoblast) and outer Trophoblast.
- Endometrial fluids fill it and it forms a cyst like structure called BLASTOCYST
- It is formed by 4th to 5th day after fertilization.
- It increases in size and zona Pellucida disappears by 6th day.



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Blastocyst contd

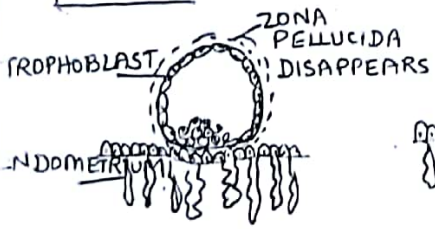
- The outer Trophoblast cells are exposed and erode the endometrium, and penetrate inside which results in implantation of blastocyst.

APPLIED ASPECTS

- Abnormal blastocysts occur frequently. They are usually spontaneously aborted.
- In some blastocysts trophoblast is absent and in some embryoblast is absent.
- Occasionally in some cases Trophoblast develops and forms placental tissue with no embryonic tissue.
- This condition is called HYDATIFORM MOLE
- When such invasive Trophoblastic tissue is malignant it is called INVASIVE MOLE or CHORIOCARCINOMA.

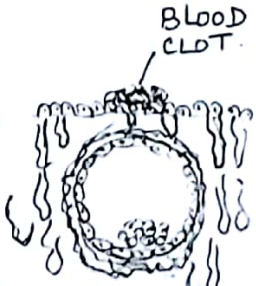
IMPLANTATION (1st May, S.E)

- It is the process by which BLASTOCYST gets embedded in the uterine endometrium.
- Time – about 6th to 7th day after fertilization.
- Normal site – Posterior or Anterior wall of upper uterine segment – fundus of uterus.
- The embryo is in BLASTOCYST stage.
- The Uterine Endometrium is in PROGESTATIONAL or SECRETORY PHASE.
- PROCESS



Zona Pellucida disappears by 6th day

Trophoblast invades uterine endometrium



Intestitial implantation Completed

Contd.

Implantation contd.

TYPES OF IMPLANTATION (S.Ans)

INTESTITIAL — When Blastocyst is embedded in Endometrium of uterus eg Humans.

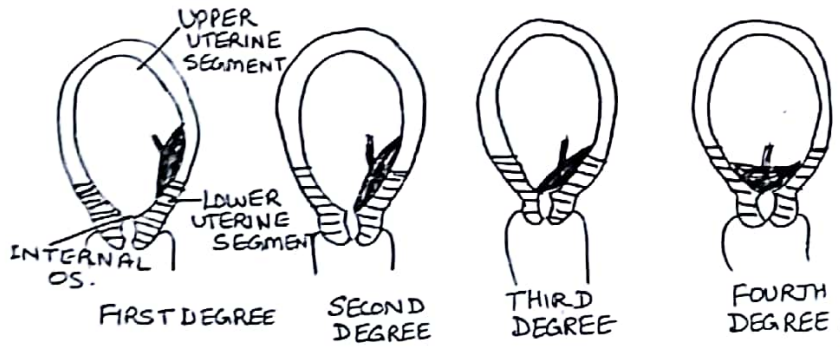
CENTRAL — Blastocyst attached to cavity of uterus eg cow..

ECCENTRIC — Blastocyst embedded in a crypt of uterus eg Rat.

ABNORMAL SITES OF IMPLANTATION

(A) Abnormal implantation within the uterus in lower uterine segment gives rise to PLACENTA PRAEVIA (S.Ans)

- It causes difficulty during childbirth and may cause severe bleeding during pregnancy.
- Various degrees have been recognised.



First degree — Placental attachment reaches lower uterine segment.

Second degree — Placental margin reaches internal os.

Third degree — Edge of placenta covers internal os but when os dilates during childbirth, it does not occlude.

Fourth degree — Placenta completely covers Internal os even after it has dilated during childbirth.

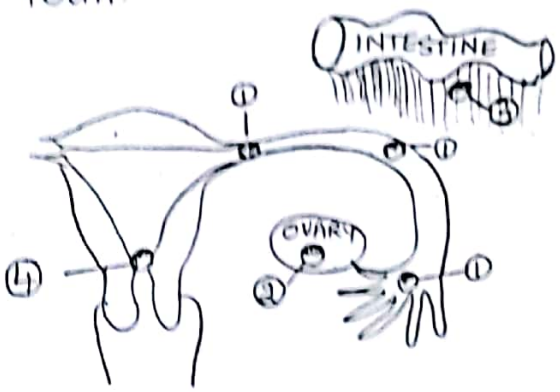
contd.

ABNORMAL SITES OF IMPLANTATION

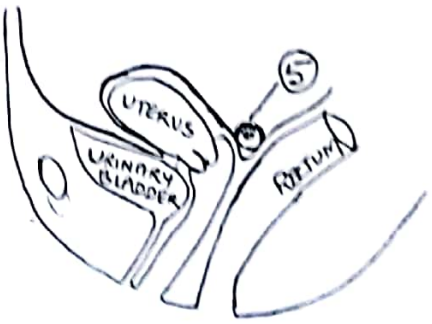
① OUTSIDE THE UTERUS – gives rise to ECTOPIC P

TUBAL PREGNANCY – (S.Aw)

- The most common site of ECTOPIC PREGNANCY is the uterine tube.
- This may result in rupture of the tube, with severe bleeding and shock.
- Other sites of ectopic pregnancy may be ovary.
- Rarely Abdominal cavity – mesentry, Rectouterine pouch, greater omentum.
- Most of these pregnancies cannot go on to full term.



① In uterine tube
② ovary
③ Mesentry of Intestine
④ Lower uterine segment
⑤ Recto uterine pouch.

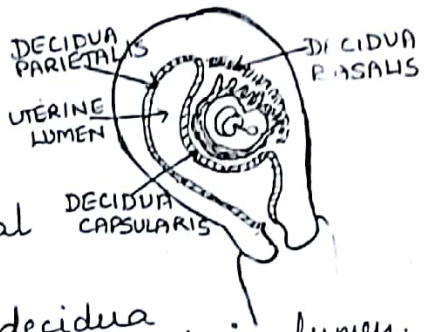


IMPLANTATION in RECTOUTERINE POUCH of Peritoneum

DECIDUA (S. Essay)

- The uterine endometrium after implantation of embryo is called Decidua.
- During implantation the endometrium is in secretory phase under the influence of Progesteron secreted by Corpus luteum.
- These features of endometrium are intensified the stromal cells enlarge and store glycogen and lipids. These changes are called DECIDUAL REACTION

- Parts of Decidua



Decidua Basalis – The part of decidua deep to the developing embryo.
- It takes part in maternal component of Placenta.

- Decidua Capsularis – The decidua that separates the embryo from uterine lumen.

Decidua Parietalis (Vera) – The decidua lining the rest of uterine lumen. Decidua capsularis & Parietalis fuse in later stages of pregnancy.

Functions and Fate

- The decidua provides support and is the site for implantation of embryo.
- It provides nutrition to blastocyst till placenta is formed.
- Decidua Basalis forms maternal component of placenta
- During childbirth decidua is shed off along with placenta. It is this shedding which gives it its name. (Decidous trees)

FORMATION OF GERM LAYERS

BILAMINAR GERM DISC (S. Essay)

- This is formed in 2nd week.
- Cells of inner cell mass or Embryoblast found at one end of implanted Blastocyst differentiate into a cubical layer – the HYPOBLAST or ENDODERM and EPIBLAST or ECTODERM – a layer of columnar cells.
- These together form a flat disc called BILAMINAR GERM DISC having 2 lamina – ectoderm and endoderm.
- A cavity appears above EPIBLAST – The Amniotic cavity, lined by Amniogenic cells.
- A cavity also appears below the hypoblast enclosed by Heuser's membrane – the primitive yolk sac.
- The EPIBLAST – later develops primitive streak, primitive node, primitive groove and cell proliferation from these form all the 3 germ layers – ECTODERM, MESODERM and ENDODERM.

APPLIED ASPECT – Inner cell mass are Embryonic STEM CELLS which can be cultured in labs for treatment of diseases.

TRILAMINAR GERM DISC (GASTRULATION) (L. Essay, S. Essay)

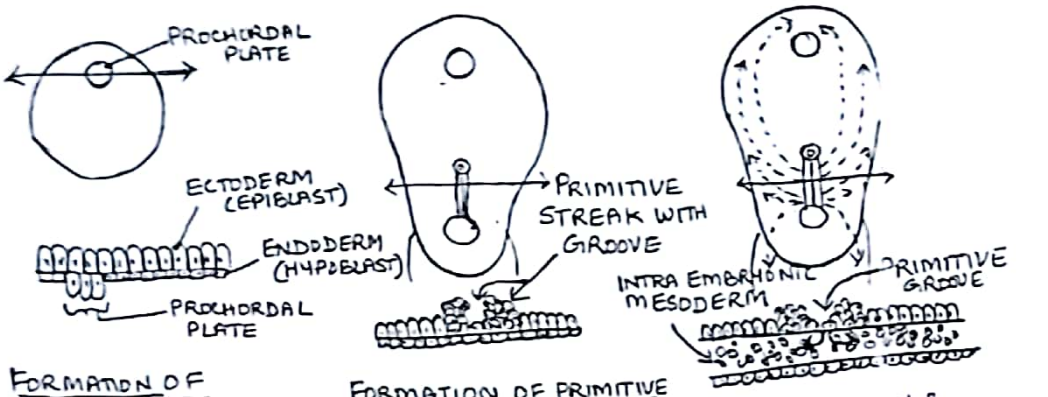
Formation – in 3rd week.

- The process of formation of Trilaminar germ disc is called GASTRULATION.
- ~~After~~ The inner cell mass differentiates into 2 layered germ disc in 2nd week, having a cuboidal celled endoderm and columnar celled ectoderm.
- At this stage the cranial and caudal end of the embryonic disc cannot be made out.
- Soon a circular area is seen where the cubical endoderm becomes columnar.
- This is called PROCHORDAL PLATE, which determines the cranial end of the embryo. Later it forms BUCCOPHARYNGEAL MEMBRANE.

contd

Gastrulation contd.

- At the caudal end of the embryo around 15th day, the epiblast shows a linear thickening (S.Gray) called PRIMITIVE STREAK, whose cranial end shows a bead like swelling – PRIMITIVE NODE or KNOT. The round disc also elongates.



FORMATION OF PROCHORDAL PLATE

FORMATION OF PRIMITIVE STREAK & GROOVE IN ECTODERM (EPIBLAST)

PROLIFERATION & MIGRATION OF CELLS FROM PRIMITIVE STREAK to form INTRA EMBRYONIC MESODERM

- Primitive streak shows a linear groove – Primitive groove.
- Epiblast (ECTODERM) cells in Primitive streak proliferate and migrate pushing themselves between ectoderm and endoderm forming Intra Embryonic Mesoderm the 3rd germ layer.
- Thus Trilaminar germ disc is formed.
- (Latest view is that they (EPIBLAST) also replaces endoderm cells)

FUNCTIONS OF PRIMITIVE STREAK & FATE

- It is called as PRIMARY ORGANIZER.
- Gives rise to Intra embryonic mesoderm, Septum transversum and also replaces endoderm.
- Determines cranio-caudal and Right and left axis of embryo. FATE – Regresses and disappears by 4th week

Applied Aspects

- Embryo is most sensitive to TERATOGENS during this period of Gastrulation.
- Defective development of cranial end of Primitive streak can result in embryos born with. Holoprosencephaly (fusion of Cerebral hemispheres and lateral ventricles), Hypotelorism (fusion of eyes – cyclops). This is seen in alcohol abuse.

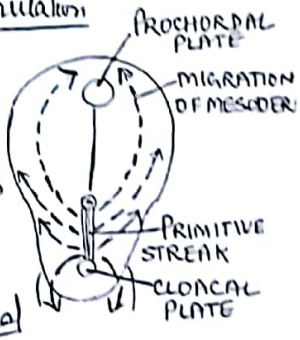
contd

Applied Aspects contd

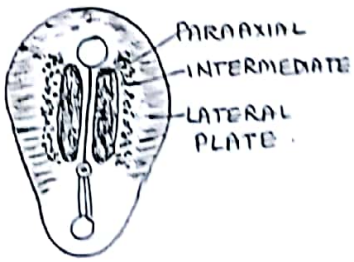
- Defective development of Caudal part gives rise to CAUDAL DYSGENESIS or SERINOMELIA where lower part of the body and lower limbs are fused. giving a MERMAID appearance.
- If primitive streak fails to regress and remains it can give rise to SACROCOCCYGEAL TERATOMA – A tumour in the sacral region have all types of tissue - skin, bone, muscle hair etc.
- STEM CELLS – from Primitive streak can be harvested for treatment of diseases.

INTRAEMBRYONIC MESODERM (S.Essay)

- It forms 3rd germ layer.
- It is formed in 3rd week of gestation.
- Formation – By a process called gastrulation from Primitive streak, which is a thickening in the ectoderm (epiblast)
- The cells from Primitive streak form mesoderm which pushes and migrates between ectoderm and endoderm and spreads throughout the embryonic plate except at Prochordal plate and cloacal plate



- Intraembryonic mesoderm can be sub divided into 3 parts
  PARAAXIAL MESODERM
  INTERMEDIATE MESODERM
  LATERAL PLATE MESODERM



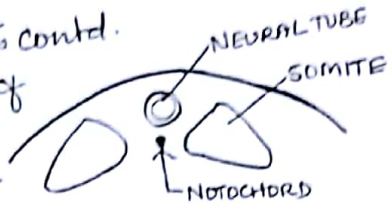
(S.Ans)

- PARAXIAL MESODERM – undergoes segmentation to form SOMITES
- These form in cranio-caudal sequence.
- At this stage Age is determined by counting Somites.
- 42 to 44 somites are formed.
  There are 4 occipital
  8 cervical
  12 Thoracic
  5 Lumbar, 5 Sacral
  8-10 coccygeal

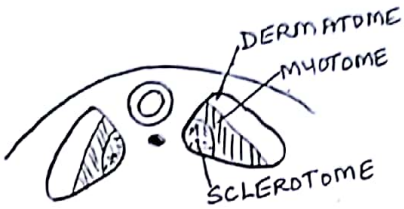
contd.

Paraxial Mesoderm — Somites Contd.

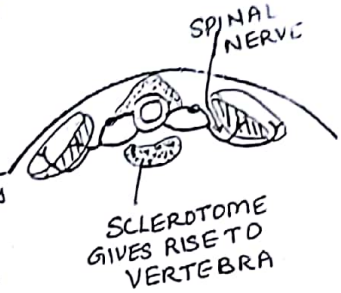
- Somites lie on either side of developing Neural tube.
- Each is divided into 3 parts
  SCLEROTOME
  MYOTOME
  DERMATOME.



- The cells of Sclerotome surround Neural tube and give rise to Vertebral Column and ribs



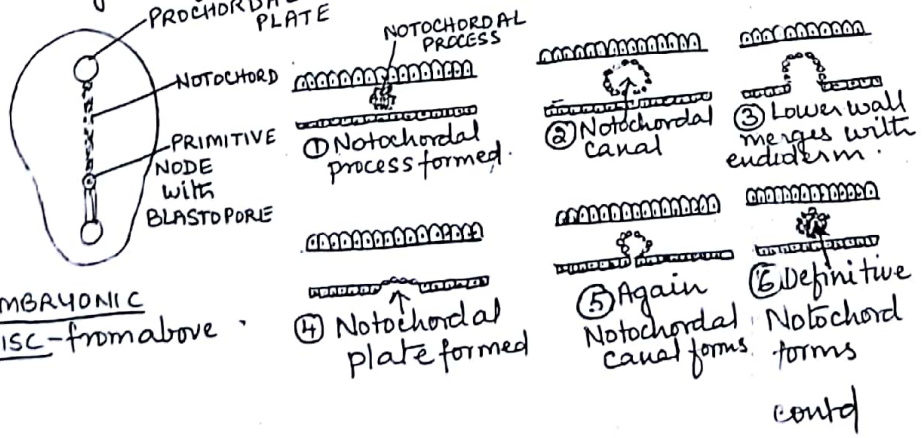
- The myotome gives rise to muscles of that segment
- Dermatome gives rise to Dermis of that segment.
- One spinal nerve innervates muscles of each myotome and skin of that segment.



NOTOCHORD (S. Essay)

- The notochord is a midline structure that develops from the Primitive node found at the cranial end of the Primitive streak. to the Prochordal Plate
- The Formation — is in several stages.
- The cranial end of Primitive streak is thickened to form Primitive node or Henson's node.
- A depression the blastopore forms, from which cells proliferate and migrate till the caudal margin of Prochordal Plate.

STAGES IN NOTOCHORD FORMATION



contd

Notochord contd

- The notochord goes through several stages during formation — Notochordal process, Notochordal canal, Notochordal plate and finally DEFINITIVE NOTOCHORD is formed.

FUNCTIONS OF NOTOCHORD

- It forms central Axis of Embryo.
- It provides central column around which vertebrae develop.
- MOST IMPORTANTLY — IT INDUCES the formation of NEURAL TUBE from the overlying ECTODERM.

FATE:

- Mostly disappears but Remnants are Nucleus Pulposis of Intervertebral disc and Apical Ligament of Dens.

APPLIED ASPECTS:

- Abnormal remnants of notochord give rise to tumours called CHORDOMA
- They may be found in cranial region or Sacral region

(S. Emay)

FORMATION OF NEURAL TUBE - NEURULATION

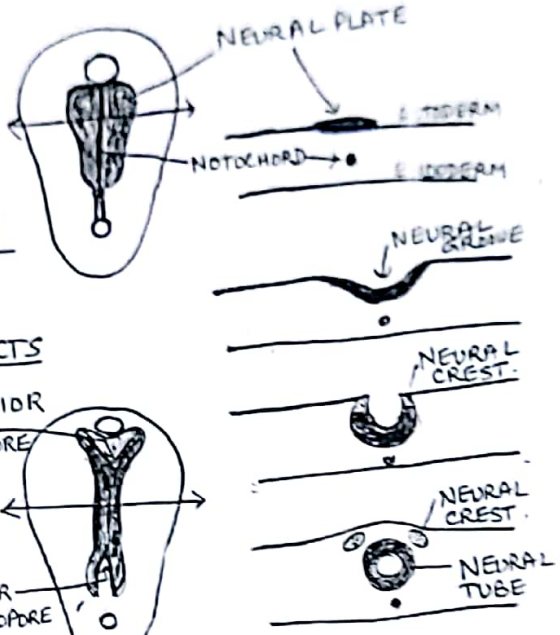
- NEURAL TUBE - gives rise to brain and spinal cord
- ECTODERM overlying the NOTOCHORD thickens and forms Neural plate
- It gets depressed along midline - the neural groove.
- The neural groove deepens, edges come together and forms Neural tube.
- The neural tube formation first occurs in the middle part of neural plate, hence for sometime the neural tube is open cranially and caudally.
- These openings are called Anterior and Posterior Neuropores
- Anterior Neuropore closes by 25th day and Posterior Neuropore closes by 27th day.

At the time of closure of neural tube a few Specialized cells at the edge between neural plate and edge ectoderm form specialised tissue called NEURAL CREST

contd.

Neural Tube contd

- The enlarged cranial part of Neural tube forms the **Brain** and caudal tubular part forms the **Spinal Cord**



ANOMALIES & APPLIED ASPECTS

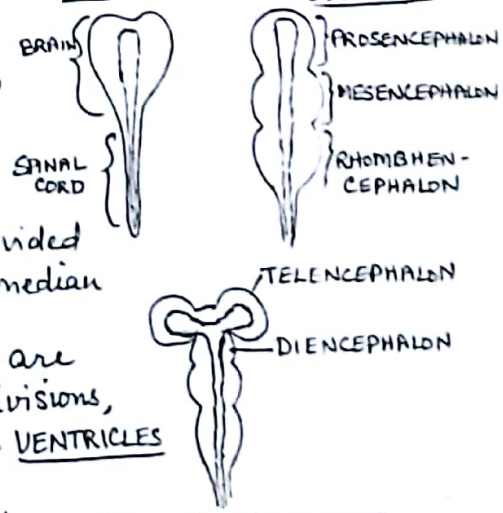
- non closure of Anterior neuropore gives rise to condition **ANENCEPHALY**.

- non closure of posterior neuropore gives rise to **SPINA BIFIDA**
- This may accompanied by faulty development of overlying bone giving rise to varied forms like – myelocoele, meningocoele, meningomyelocoele.
- It has been seen that deficiency of **FOLIC ACID** in the diet of pregnant woman predisposes the fetus to various types of neural tube defects especially Spina bifida.

FURTHER DEVELOPMENT

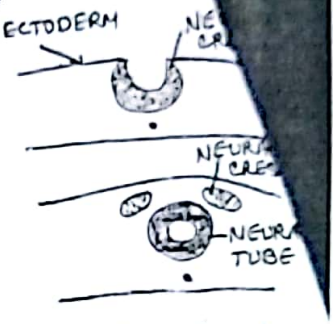
- The developing Brain shows 3 dilatations – PROSENCEPHALON
  MESENCEPHALON
  RHOMBENCEPHALON
- The Prosencephalon gets divided into 2 TELENCEPHALON and a median DIENCEPHALON.
- All the parts of the brain are developed from these subdivisions, and their cavities form the **VENTRICLES** of the brain.

PRIMARY BRAIN VESICLES & their SUBDIVISIONS



- The cavity of Telencephalon forms LATERAL VENTRICLE
  Cavity of Diencephalon – THIRD VENTRICLE
  Cavity of Mesencephalon – AQUEDUCT
  Cavity of Rhombencephalon – FOURTH VENTRICLE
  Its continuation in Spinal cord – CENTRAL CANAL.

NEURAL CREST (S. Gray)



- When NEURAL TUBE is folding some cells at the junction of neural tube and ecto derm specialise to form NEURAL CREST
- Thus Neural tube when formed has groups of Neural crest cells lying along its dorsal sides.
- Neural crest cells migrate and several important structures are derived from them.

- DERIVATIVES

1. Schwann Cells
2. Dorsal root ganglia cells
3. Neurons of Sympathetic ganglia
4. Neurons of Sensory ganglia of cranial nerves.
5. Cells of adrenal medulla
6. Chromaffin tissue
7. Melanoblasts of skin.
8. Pia and Arachnoid mater

LATEST VIEWS –

Other structures believed to be derived from Neural crest.

1) Mesenchyme of dental papilla, odontoblasts, dentine.
2) Bones of face & vault of skull.
3) Dermis & Smooth muscle of face & neck.
4) connective tissue of pharyngeal arch derivatives thyroid, parathyroid, thymus.
5) C cells of thyroid gland.
6) Spiral septum & bulbar septum forming valves of heart
7) Smooth muscles of blood vessels of face and forebrain
8) Satellite cells of sensory ganglia.

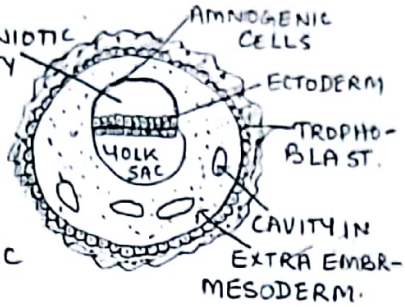
APPLIED ASPECTS

- Several diseases and syndromes are associated with diseases of Neural crest. eg.

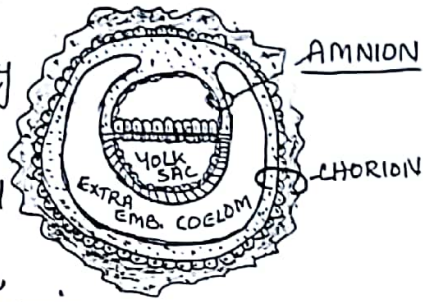
Fortico-pulmonary septal defects of heart
cleft lip, cleft palate, frontonasal dysplasia
tumours of adrenal medulla.
Albinism.
Hirschsprung's disease (aganglionic megacolon)

FETAL MEMBRANES

AMNION (S.Essay)



- It is a thin extraembryonic membrane that loosely envelops the embryo forming Amniotic sac filled with Amniotic fluid.
- The sac is lined by Amniogenic cells derived from trophoblast
- As amniotic sac enlarges during pregnancy, it gradually surrounds the embryo and enshealths the developing connecting stalk – the umbilical cord.



- The amnion consists of 2 layers, outer somatopleuric extraembryonic mesoderm and inner amniogenic cells
- As pregnancy advances, Amnion, chorion, fuse obliterating extraembryonic coelom. later this Amniochorionic membrane fuses with decidua capsularis and parietalis and obliterates original uterine cavity.

AMNIOTIC FLUID: (S.Ans)

- Amniotic fluid is derived from amniotic cells by filteration and fetal urine when fetal kidneys start functioning.
- Amniotic fluid provides support for the growing embryo, permits ~~per~~ symmetrical development, allows free movements, protects from external jolts.
- It forms a hydrostatic bag and helps in dilatation of cervix during childbirth.
- Normally amniotic fluid is about 1500ml.
- There is constant exchange of water between maternal blood and amniotic fluid.
- Sometime from 5th month fetus starts swallowing little amount of amniotic fluid, and when its kidneys develop, fetus passes urine into amniotic fluid, which is mostly water.

contd.

Amnion contd.

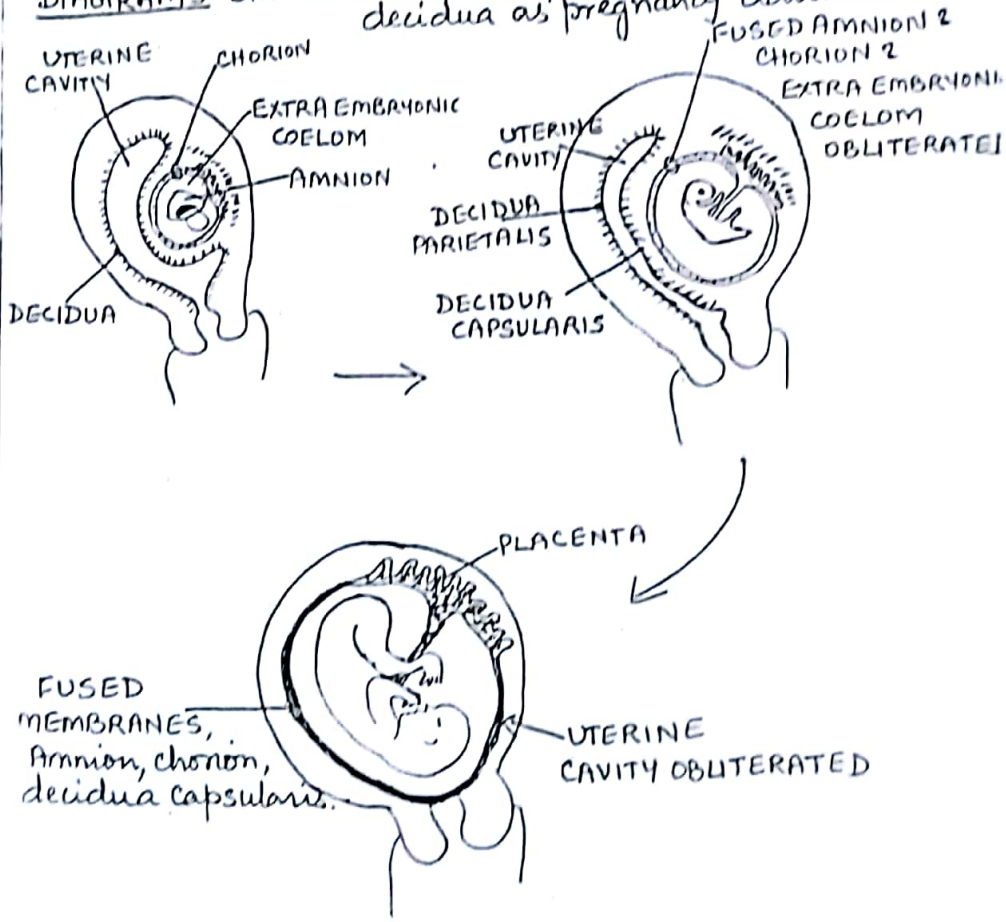
APPLIED ASPECTS (S. Ans)

1) Amniocentesis – A procedure by which amniotic is asperated by a needle, for diagnostic purp to detect chromosomal anomalies, neural tube defects, sex of fetus (which is illegal). This is an invasive procedure and can harm the fetus

2) Hydramnios – Excessive amniotic fluid – more than 2000ml may indicate fetal abnormalities like esophageal atresia, central nervous syster defects etc.

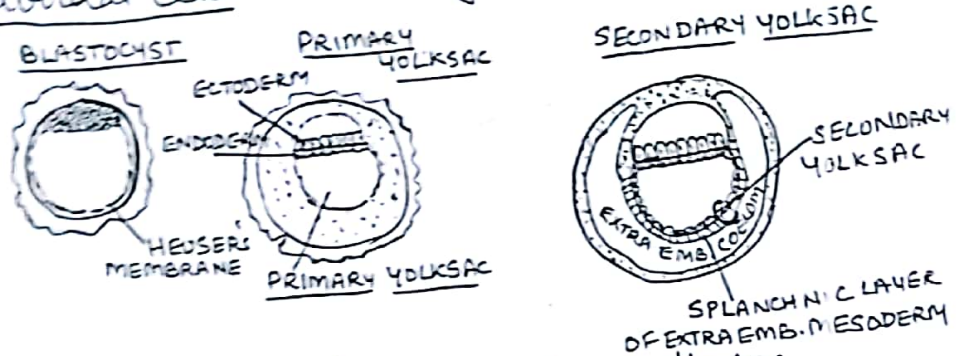
3) oligamnios – less amniotic fluid – 700 to 1000ml at full term may indicate anomalies like non development of kidneys (agenesis), placental insufficiency.

DIAGRAMS SHOWING Relationship between Amnion, chorion, decidua as pregnancy advances.

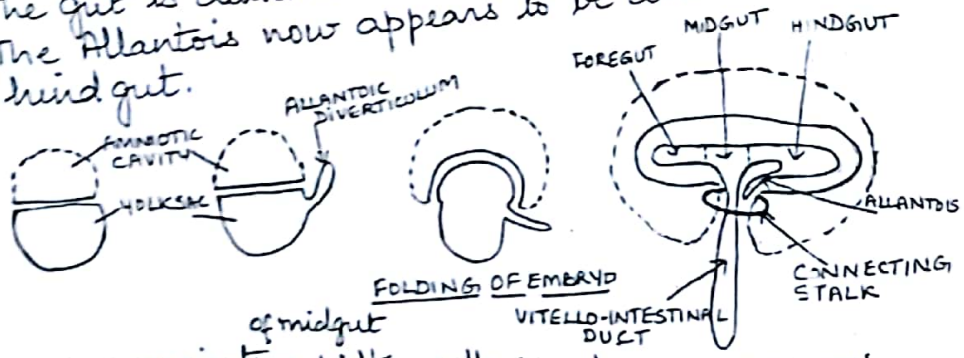


YOLK SAC (5 Emay)

FORMATION - in 2nd week of Intra uterine life
- Flattened cells derived from trophoblast line inside of blastocyst, this is called Heuser's membrane.
- The cavity thus enclosed, whose roof is lined by endoderm is called PRIMARY YOLK SAC
- After formation of extraembryonic mesoderm and coelom, the yolk sac gets lined by a layer of visceral or Splanchnopleuric extraembryonic mesoderm
- The lining cells also get replaced by endodermal cuboidal cells & the cavity is called SECONDARY YOLKSAC.



- A small diverticulum grows from yolk sac called Allantoic diverticulum.
- EFFECT OF FOLDING OF EMBRYONIC DISC.
- With the formation of Head and tail folds and lateral folds of embryonic disc, a large part of yolk sac becomes enclosed within the embryo.
- Thus the GUT or Gastrointestinal tract is formed lined by endoderm.
- The gut is divided into FOREGUT, MIDGUT & HINDGUT.
- The Allantois now appears to be connected to hind gut.

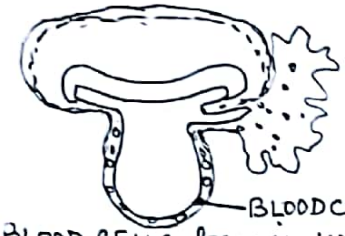


- The communication with yolk sac becomes narrow and is called VITELLO-INTESTINAL duct or VITTELINE DUCT
- This duct disappears later but may persist as MECKEL'S DIVERTICULUM.

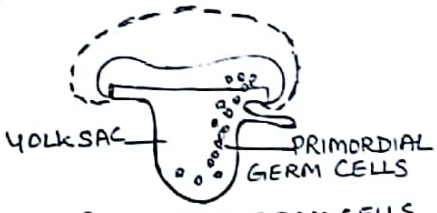
Contd.

Yolk Sac contd.

- Part of yolk sac not taken up inside the embryo is called definitive yolk sac.
- FUNCTIONS OF YOLK SAC.
- Formation of Primitive Gut.
- Haemopoiesis – The mesoderm lining yolk sac is the site of formation of blood cells (haemopoiesis) and blood vessels.
- Formation of Primordial germ cells
Primordial germ cells migrate from wall of yolk sac to the developing gonads where they form primordial germ cells – Spermatogonia & Oogonia.



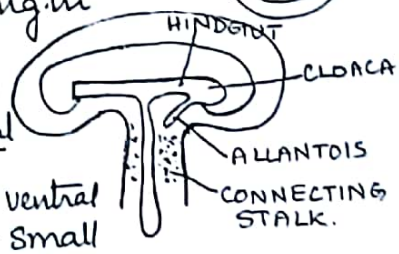
BLOOD CELLS form in wall of YOLK SAC.



PRIMORDIAL GERM CELLS migrate from YOLK SAC WALL to site of developing TESTIS & OVARY

ALLANTOIS (Allantoenteric Diverticulum) (S. Essay)

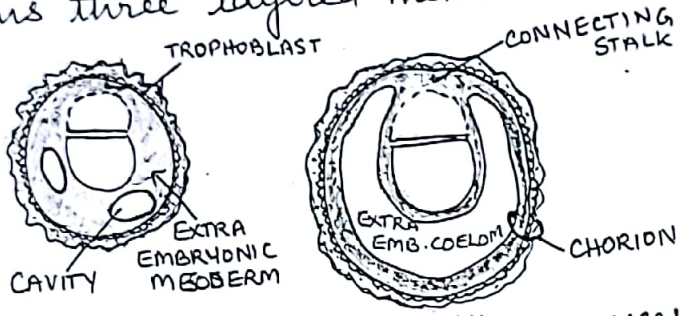
- It is a small diverticulum which arises from yolk sac before formation of tail fold, in the 3rd week.
- After formation of tail fold it is seen to be connected to the dilated terminal part of hindgut – the CLOACA & lying in connecting stalk.
- The Blood vessels which develop around it become fetal umbilical vessels.
- The Allantois is absorbed into ventral part of hindgut & contributes to small part of URINARY BLADDER – near the apex.
- URACHUS is derived from Allantois & its degenerated part forms Median umbilical ligament.



Applied Aspects: Urachal cyst, urachal sinus, urachal fistula are congenital anomalies of urachus which is derived from Allantois.

CHORION (S. Essay)

- CHORION is the fetal component of Placenta.
- The unicellular zygote after repeated divisions forms morula then Blastocyst.
- The outer layer of blastocyst — the TROPHOBLAST which differentiates into syncytiotrophoblast (outer) and inner cytotrophoblast, gets a lining of extraembryonic mesoderm
- This three layered membrane is the CHORION



- Chorion gives out finger-like processes all around
- Then only those villi at Decidua Basalis elaborate and contribute to Placenta and others disappear.
- The smooth chorion is called Chorion Levae and bushy chorion is Chorion Frondosum.
- There are 3 stages in formation of chorionic villi — PRIMARY VILLUS
  SECONDARY VILLUS
  TERTIARY VILLUS.

Applied Aspects

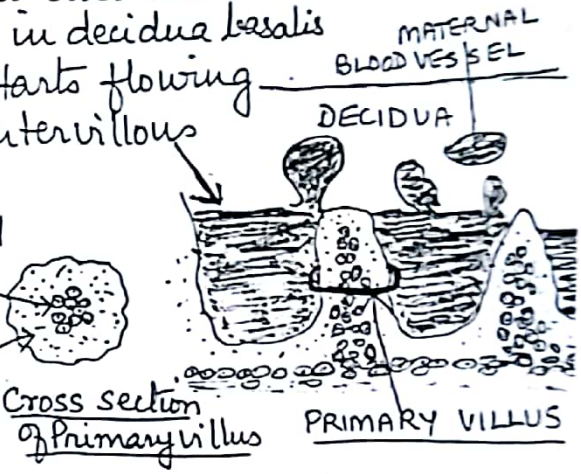
- Chorionic villi Biopsy is an invasive method where cells of chorionic villi are removed for Prenatal diagnosis of Genetic disorders
- In some cases the trophoblast and chorionic tissues develop without development of embryo. This is called HYDATIFORM MOLE.
- The malignant form of this condition is Called CHORIOCARCINOMA or INVASIVE MOLE

PLACENTA (L. Emay, S. Emay)

- Placenta is a highly vascular disc like struc connecting the fetus with the maternal uterine
- Full term placenta weighs about 500gms and is 18-20cms in diameter.
- Placenta is made up of two components.
  Fetal component — is CHORION FRONDOSUM
  Maternal component — is DECIDUA BASALIS
- The fetal component is Chorionic Villi.

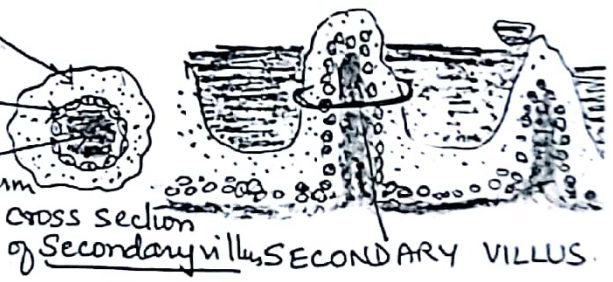
STAGES IN FORMATION OF CHORIONIC VILLI.

- Syncytiotrophoblast develops spaces called LACUNAE, and it also erodes maternal blood vessels in decidua basalis and maternal blood starts flowing in the lacunae — the intervillous spaces.



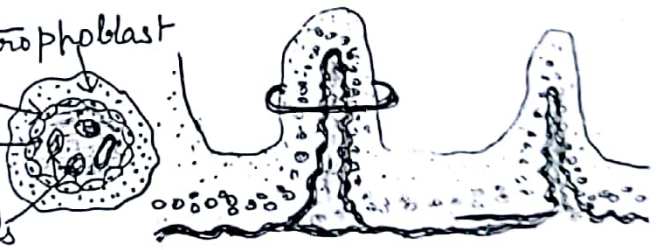
- PRIMARY VILLI — A central core of cytotrophoblast covered by a layer of Syncytiotrophoblast.

- SECONDARY VILLI
- Shows three layers outer syncytiotrophoblast inner cytotrophoblast and a core of extra embryonic mesoderm



TERTIARY VILLI

Shows outer Syncytiotrophoblast next cytotrophoblast core mesenchyme and development of fetal blood vessels

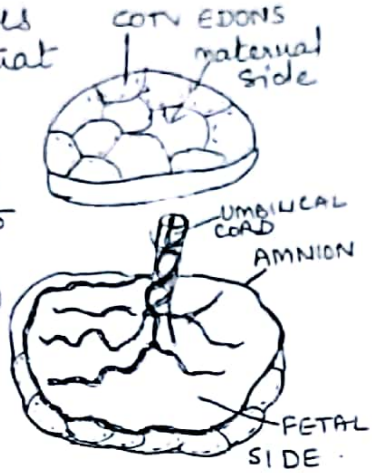


- The first villi formed are the Anchoring villi. Each villus divides and redivide forming Rami chorii and Ramuli chorii which sprout from all sides and float in maternal blood in intervillous spaces.

Placenta contd

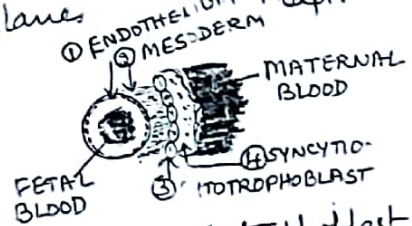
FULL TERM PLACENTA

- Placenta viewed from maternal side is seen to be divided into lobes called cotyledons with septa that grow into intervillous spaces.
- Fetal side is lined by Amnion and umbilical cord is seen to be attached.



PLACENTAL MEMBRANE or BARRIER (S.Ans)

- The membrane made up of layers of chorionic villus and the fetal blood vessels which separates maternal blood from fetal blood is called Placental Barrier.
- The fetal and maternal blood do not mix.
- The human placenta is HAEMO-CHOREAL.
- The Placental barrier or membrane is made up of:
  1) Endothelium of fetal capillaries
  2) Surrounding mesoderm
  3) Cytotrophoblast
  4) Syncytiotrophoblast.



- In later stages of pregnancy the placental membrane becomes thin — cytotrophoblast disappears, mesenchyme becomes less, syncytiotrophoblast thins out. This is for effective absorption of oxygen and nutrients.

FUNCTIONS OF PLACENTA (S.Ans)

- Placenta transports from the mother oxygen, water, electrolytes, nutrition - carbohydrates, lipids, aminoacids, vitamins. Even a short interruption of oxygen is fatal to fetus.
- It provides for excretion of carbondioxide urea & other waste products.
- Maternal antibodies reach fetus through placenta, hence immunising the mother gives fetus immunity.
- It synthesises several hormones — progesteron, estrogen. Human chorionic gonadotrophins, somato-mammotrophins
- It acts as a barrier for some bacteria. However many viruses & toxins cross placental barrier and cause fetal defects.

contd.

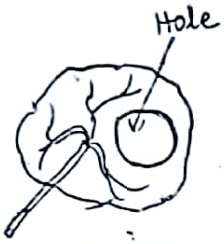
Placenta contd

PLACENTAL ANOMALIES (S.Anus)

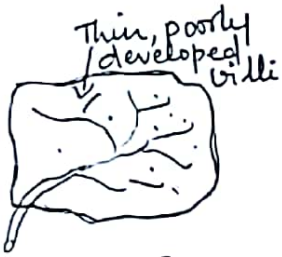
BILOBED (BIDISCOIDAL)

LOBED

PLACENTA SUCCENTURATA



FENESTRATED PLACENTA



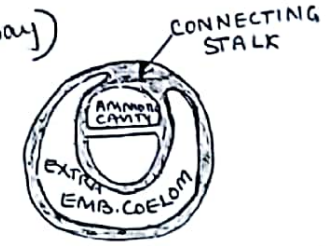
DIFFUSE

CIRCUMVALLATE PLACENTA

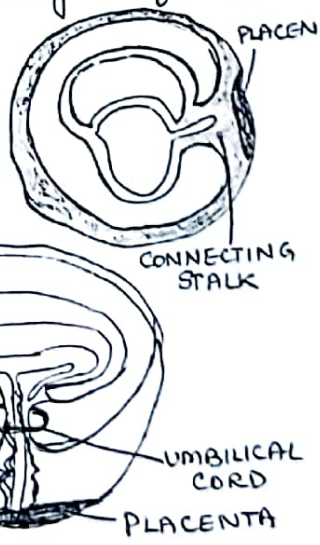
Variations in Umbilical cord attachment

NORMAL MARGINAL FURCATE VELAMENTOUS

CONNECTING STALK. (S.Essay)



- The extra embryonic coelom does not extend into a part of extra-embryonic mesoderm that connects Amniotic cavity to trophoblast.
- With the formation of tail fold the attachment of connecting stalk moves to the ventral aspect of embryo. It is now attached to the region of umbilical opening.
- Blood vessels within the embryo and placenta communicate through vessels in connecting stalk.
- Connecting stalk gets converted to UMBILICAL CORD after development of blood vessels
- At first there are 2 umbilical arteries and 2 umbilical veins but the Right umbilical vein disappears.



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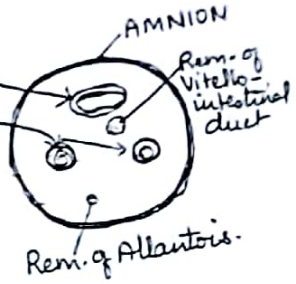
Connecting stalk – Umbilical cord contd.

- Primitive umbilical ring contains vitello-intestinal duct, allantois (both are obliterated later) along with blood vessels.
- Thus contents of umbilical cord are
  1) one umbilical vein
  2) two umbilical arteries
  3) Remnants of vitello-intestinal duct & allantois
  4) WHARTON's jelly (extra embryonic mesenchyme)



All are enveloped by AMNION

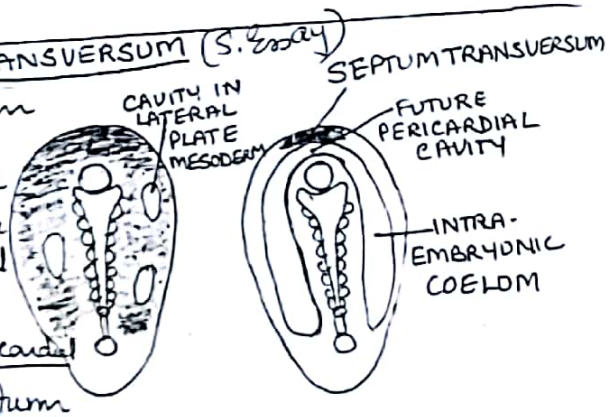
- Umbilical cord increases in length to allow free movement of fetus within amniotic cavity.
- At birth it is 1/2 meter long and shows torsion due to fetal movements.

Applied Aspects:

- Very long chord may prolapse during childbirth.
- It may encircle the neck of fetus & endager the life of fetus.
- Knots may form.
- Abnormal number of vessels in umbilical cord sometimes indicate cardiac and other vascular anomalies.

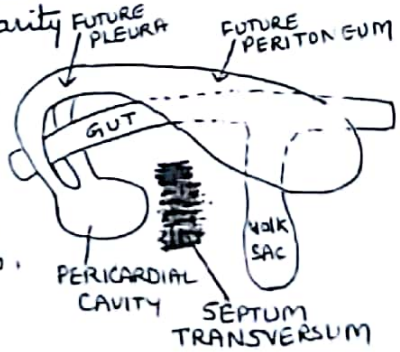
SEPTUM TRANSVERSUM (S. Essay)

- Lateral plate mesoderm develops cavities which fuse to form Intra embryonic coelom. This forms future Pericardial, Pleural and Peritoneal cavities.
- Cranial to the future Pericardial cavity the mesoderm is Septum transversum
- When head fold takes place it lies caudal to Pericardial cavity



DERIVATIVES:

1) Central Tendon of Diaphragm
2) Part of fibrous Pericardium
3) In the Liver – connective tissue Stroma, Kupffer cells, Haemopoietic cells, Sinusoids.



NAME INVESTIGATIONS FOR INFERTILITY (S.Ans)

IN MALE

- Seminal Analysis.

This is done mainly for Sperm count
The average count is 100million perml.

IN FEMALE

A. Tests for checking OVULATION —

a) Temperature method — Body temperature is recorded. A sudden fall with rise indicates ovulation. This is related to hormone Progesterone secreted by Corpus luteum

b) Mid cycle pain - slight lower abdominal pain felt by women due to ovulation.

B. Test for patency of Fallopian tube

This is done by injecting Radio opaque dye into the uterus and taking Radiographs to check if fallopian tubes are patent or blocked by disease. This is called HYSTERO-SALPHINGOGRAPHY

NAME DERIVATIVES OF ECTODERM (S.Ans)

1. Epithelium of skin, hair follicles, sweat glands, Sebaceous glands, mammary glands
2. Epithelium over cornea, conjunctiva, lens, external acoustic meatus, outer surface of Tympanic membrane
3. Epithelium of lower part of anal canal, terminal part of male urethra.
4. Neural tissue - Brain and spinal cord.

DERIVATIVES OF ENDODERM (S.Ans)

1. Epithelium of entire gut except part of oral cavity & lower part of anal canal.
2. Epithelium of auditory tube, middle ear.
3. Epithelium of Respiratory tract.
4. Epithelium of most of urinary bladder, urethra and part of vagina
5. Glands associated with gut — liver pancreas —

Contd

DERIVATIVES OF MESODERM (5 Ans)

1. Tubules of kidney, ureter, trigone of urinary bladder
2. Uterine tubes, uterus, upper part of vagina
3. Testis and its duct system, ovary
4. Endothelium of Heart, Blood vessels, lymphatics
5. Mesothelium lining pericardium, peritoneum, pleural cavities
6. The bulk of mesoderm gets converted to mesenchyme which gives rise to muscles, connective tissue - bones, cartilage etc.