

## Ovarian cycle

- These are **periodic changes** which occur in the **ovary** every lunar month ( 28 days ) during the **fertile period** of the **non pregnant** female.
- **The ovarian cycle is divided into three phases:**
  - **Preovulatory** (follicular) phase.
  - **Ovulation.**
  - **Postovulatory** (Luteal phase).

## Hormonal control of Ovarian cycle

Hypothalamus secretes Gonadotropin releasing hormone (GnRH)

**GnRH** stimulate anterior lobe of the pituitary gland which secrete two gonadotrophic hormones (FSH, LH),

**1. Follicle stimulating hormone (F.S.H):** it acts in the first stage of the ovarian cycle and has the following effects.

- It induces maturation of primary follicle into Graffian follicle.
- It induces the follicular cells to secrete **estrogens**.

**2. Lutenising hormone (L.H):** it acts mainly in the second stage of the ovarian cycle and has the following effects:

- 1- It induces final maturation of Graffian follicle and ovulation.
- 2- It induces the conversion of the ruptured follicle into a corpus luteum .
- 3- It induces corpus luteum to secrete **progesterone**

## **Stages of the ovarian cycle**

**I.PREOVULATORY (FOLLICULAR) PHASE:** ( 1<sup>st</sup> half of the cycle )

- At the **beginning** of each ovarian cycle , the anterior lobe of pituitary gland secretes **FSH** which stimulates several **primordial follicles** to develop .
- Only one follicle** reaches maturity and **secretes estrogen** which **inhibit** secretion of **FSH** by pituitary gland
- **Estrogen** stimulate secretion of luteinizing hormone (**LH**) leading to **degeneration** of the remaining follicles which become **atretic follicles** .
- The **estrogen** secreted in this phase is responsible for the **proliferative phase of the uterine cycle** .

## II.OVULATION :

- **Luteinizing hormone (LH ):**

1. Stimulates **collagenase** activity resulting in digestion of collagen fibers surrounding the mature Graafian follicle.
  2. Increases **prostaglandin** activity resulting in **ovarian contraction**.
- **Rupture of the mature Graafian follicle** on the surface of the ovary leads to release of secondary oocyte together with the corona radiata and the zona pellucida

## III.POST OVULATORY (LUTEAL) PHASE:

- **After ovulation** , Under the effect of **luteinizing hormone** , the **corpus luteum *is formed*** .  
**Corpus luteum** secretes **progesterone** hormone responsible for **secretory phase of uterine cycle** and **inhibit** pituitary LH .

- **Fate of corpus luteum:**

**A. If fertilization does not occurs**

the corpus luteum **degenerate** ,becomes **corpus albicans** .

Degeneration of corpus luteum leads to **decrease progesterone** level in the blood .

**B. If fertilization occurs** the corpus luteum changes to **corpus luteum of pregnancy**

(which is maintained till the **4<sup>th</sup> month** of pregnancy by the human **chorionic gonadotropin hormone** secreted from the embryo). After that, the formed **placenta** will secrete progesterone till labor.

**Uterine (Menstrual) Cycle**

- These are **periodic changes** which occur in the **endometrium** ( mucous membrane of the uterus) every lunar month ( 28 days ) during the **fertile period** of the **non pregnant** female.

**It passes through three phases :**

I. Menstrual phase

II. Proliferative (estrogenic or postmenstrual) phase

III. Secretory (premenstrual or progestational) phase

During the **secretory** phase of the menstrual cycle, the **endometrium** itself is formed of :

**1. Stratum functional**

**2. Stratum basalis**

- The **Stratum functional** are supplied by long spiral arteries, which are dilated by progesterone hormone.
- The functional layer of the endometrium shed at menstruation.
- The **basal layer** is supplied by its own short straight arteries, and it does not shed during menstruation.
- It forms the regenerative layer of the endometrium, which is responsible for reformation of the uterine glands after menstruation.

**I. Menstrual phase : (3-5 days)**

- It corresponds to the **beginning** of the **pre-ovulatory phase** of the ovarian cycle.
- **Cause : decreased** progesterone level & estrogen level to less extent ( at the end of the previous luteal phase of ovarian cycle ) , leading to **constriction of spiral arteries** supplying the superficial part of endometrium .
- The superficial part of **endometrium** degenerates and expelled with **mucous & unclotted blood**.
- At the end of this phase the endometrium is reduced in thickness .

- The **basal layer** of the endometrium is not affected.

## ***II. Proliferative (estrogenic or postmenstrual) phase : (10 days)***

- It corresponds to the **last 10 days** of the **pre-ovulatory** phase of the ovarian cycle.
- It is under the effect of **estrogen** hormone secreted by developing follicle.
- The **endometrium** is gradually regenerate and thickened; its blood supply increases, and its mucous glands enlarge.

## ***III. Secretory (premenstrual or progestational) phase : ( last 14 days)***

- It corresponds to the **postovulatory** phase of the ovarian cycle.
- It is under the effect of **progesterone** hormone mainly(from corpus luteum ) & estrogen to less extent .
- The thickness of the **endometrium** is markedly increased. The **arteries** become spiral, and the **mucous glands** become long , tortuous & distended with secretion .

- **If fertilization does not occur:** the corpus luteum degenerates with drop in the progesterone hormone which leads to **vasoconstriction** of the spiral arteries leading to **ischemia** of the **functional** layer of the endometrium followed by its **shedding with bleeding**.

**-If fertilization occurs:** **corpus luteum** is transformed into **corpus luteum** of pregnancy and **continues** to secrete **progesterone**.

Now the uterine endometrium is transformed into what is called **decidua** of pregnancy to receive the zygote

### **C. The decidua has three parts :**

-Decidua is the endometrium of pregnancy which is divided into three parts:

- 1. Decidua basalis:** between the fetus and myometrium. It will form the maternal part of the placenta
- 2. Decidua capsularis:** covers the rest of the foetus.
- 3. Decidua parietalis:** lines the uterine cavity.

The intra-uterine life is **divided into** 3 periods :

	<b>1-Germinal period</b>	<b>2-Embryonic period</b>	<b>3-Fetal period</b>
<b>Duration</b>	1 <sup>st</sup> 2 weeks	3-8 weeks	From beginning of 9 <sup>th</sup> week to birth
<b>Characters</b>	Formation of 2 germ layers (ectoderm & endoderm)	-Formation of mesoderm -Differentiation of 3 germ layers to organs & systems (organogenesis)	- Growth of organs & systems . - Appearance of external features of the fetus .
<b>Congenital anomalies</b>	More liable to occur during the germinal and embryonic periods .		Less liable to occur .



## I-Fertilization

**Definition :** is the fusion between a single sperm and an ovum to form a zygote

**Site :** it occurs in the **ampulla of the uterine tube** .

**Process of fertilization: -**

### 1-Capacitation of the sperms:

- It occurs in the uterus and uterine tube.
- It is the process of removal of glycoprotein coat which covers acrosome of the sperm.
- This **increases** the **activity** of the sperms.

### 2-Penetration of the zona pellucida:

- The capacitated sperms **pass through corona** radiate to reach and **bind to the zona pellucida** at specific **binding sites**.
- They start secreting **acrosomal enzymes** that allow only **one** sperm to **penetrate** the zona pellucida (**acrosomal reaction**).
- The plasma membrane of the head **fuses** with that of the 2<sup>nd</sup> oocyte.

### 3. Cortical and zona reactions:

The secondary oocyte releases enzymes from the cortical granules ,these enzymes cause:

- Changing of the **sperm binding sites** at the **zona pellucida** preventing entry of more sperms.
- Changing the **plasma membrane** to become **impermeable** to other sperms.

**4. Completion of the 2<sup>nd</sup> meiosis:** The 2<sup>nd</sup> oocyte changes to a mature ovum.

### 5. Formation of male and female pronuclei:

- The nucleus of the sperm mature ovum enlarge to form the male and female pronucleus.

**6. Fusion of the male and female pronuclei** to form a new cell called the zygote

## **Results of fertilization**

### **A. In the zygote:**

1. Restoration of the diploid number of chromosomes (46).
2. Sex determination:

Fertilization by X - bearing sperm will form XX zygote giving rise to a female.

Fertilization by Y - bearing sperm will form XY zygote giving rise to a male.

3. Initiation of cleavage of the zygote, which is a series of rapid successive mitotic divisions.

### **B. In the ovary:**

1. Ovulation stops due to the feed back inhibition of the pituitary gland by the high level of estrogen and progesterone.
2. Corpus luteum enlarges and forms corpus luteum of pregnancy

### **C. In the uterus:**

1. Menstrual cycles stop.
2. The secretory phase of the endometrium (under the effect of hormones of corpus luteum) continues to grow forming the decidua of pregnancy.

## Chromosomal anomalies

### A. Sex chromosome anomalies:

1. Klinefelter syndrome (44 + XXY): male with rudimentary testis.
2. Turner syndrome (44 + XO): female with rudimentary ovaries and no sex maturation.

### B. Autosomal anomalies:

Represented by Down syndrome or trisomy of chromosome 21 (mongolism) in which the zygote contains 47 chromosome either 45 + XY (male) or 45 + XX (female).

## II-MIGRATION

- The **transport** of the zygote from the lateral 1/3 of the uterine tube to the **uterine cavity** takes place by 3 mechanisms:
  1. Muscular **peristalsis** of the uterine tube.
  2. The motion of the **cilia** of tubal mucosa .
  3. **Secretion** of a fluid which act as a vehicle & nourishment for the dividing zygote .

**Cleavage** of the zygote leads to formation of morula and blastocyst

### **A. Formation of the morula :**

- In the **uterine tube** the zygote divides by repeated **mitotic** divisions to form small blastomeres. It forms 2, 4, 8 cells stages .
- The **morula** is a mass formed of 16 small blastomeres surrounded by zona pellucida .
- The blastocyst has the following features:

#### **1. Two cell groups separated by the blastocoel:**

- Outer cell layer, **the trophoblast** (It will form fetal membranes).
- Inner cell mass, **the embryoblast** (will form embryo ).

#### **2. Two poles:**

**Embryonic pole:** it is adjacent to the uterine endometrium.

**Abembryonic pole:** is away from the uterine endometrium.

## Implantation

**Definition:** It is the process of penetration of the superficial layer of the endometrium by the blastocyst.

**Site:** upper part of the posterior wall of the body of the uterus .

### **Abnormal sites of implantation :**

#### **A-Outside the uterus**

**1-Tubal pregnancy :** In the uterine tube **2-Ovarian pregnancy :** In the ovary .

**3-Abdominal pregnancy :** In the abdominal cavity

#### **B-Inside the uterus (placenta previa):**

-Implantation occurs in the lower segment of the uterus, it called the placenta previa may be one of three types:

•**1-Placenta previa Partialis** :The placenta partially covers your cervix.

**2-Placenta previa marginalis** : The placenta reach the margin of the cervix **BUT NOT** covering it .

**3-Placenta previa centralis** : The placenta overlies internal os.

The following changes occur during 2<sup>nd</sup> week of pregnancy :

### Changes in the embryoblast :

▪ Formation of the **bilaminar germ disc** :

▪ 1-**Hypoblast** adjacent to the blastocele.

2-**Epiblast** adjacent to the trophoblast in floor of the amniotic cavity

### Changes in the trophoblast :

During 2<sup>nd</sup>. week , the trophoblast is differentiated into an outer syncytiotrophoblast and an inner cytotrophoblast.

#### – Formation of 2 cavities :

##### A. Amniotic cavity : (8<sup>th</sup> day)

▪ The **amnioblasts** form the **roof** of the amniotic cavity while its **floor** is formed by the epiblast .

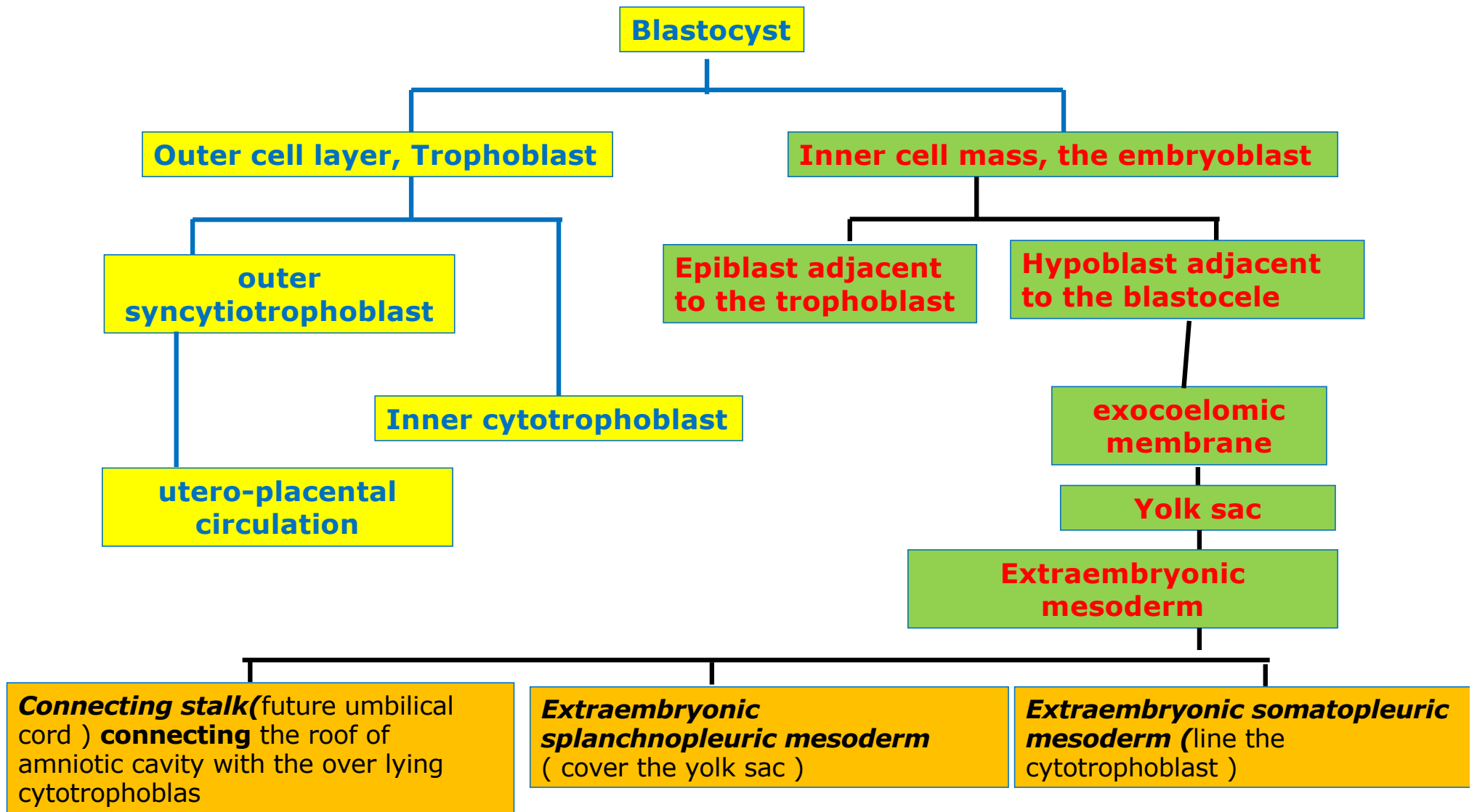
##### A.Primary yolk sac : (9<sup>th</sup> day)

▪ Its **roof** is the hypoblast and the remaining part of its wall is formed of Hauser's membrane .

## **-Extraembryonic mesoderm:**

- It is a very loose tissues between the cytotrophoblast externally and the yolk sac internally.
- Cavities appear & coalesce , in the extra-embryonic mesoderm , forming a single large C shape cavity called the extra-embryonic coelom (or chorionic cavity).
- The extra-embryonic mesoderm is **divided** by the extra-embryonic coelom into:
  - a. Extraembryonic somatopleuric mesoderm** which line the cytotrophoblast
  - b. Extraembryonic splanchnopleuric mesoderm** which cover the yolk sac.
  - c. Connecting stalk** : ( future umbilical cord ).





## . The chorionic villi

- The chorion gives rise to finger like processes called chorionic villi
- The spaces (lacunae ) between the chorionic villi are filled with maternal blood derived from the uterine vessels.

## Types of Chorionic Villi

### A. Primary chorionic villi

Consists of a (syncytiotrophoblast + cytotrophoblast)

### ▪ B. Secondary chorionic villi:

2ry villus is formed of (cytotrophoblast + syncytiotrophoblast + core of mesoderm)

### C. Tertiary chorionic villi:

Tertiary villus is formed (syncytiotrophoblast + cytotrophoblast + core of mesoderm + blood capillaries).

## Parts of chorion

### ➤ Chorion frondosum

The villi adjacent to decidua basalis (of endometrium) enlarge and form chorion frondosum, which will form the fetal part of the placenta.

### ➤ Chorion leave

The villi adjacent to decidua capsularis (of endometrium) will form the chorion leave ,which will atrophy .

## **Gastrulation :**

It is the process of transformation of the **bilaminar embryonic disc** to form a **trilaminar germ disc**

### **2. Invagination :**

The cells of epiblast, slip beneath primitive streak to :

- a) Invade and replaces the hypoblast to form the **endoderm**.
- b) The remaining part of the epiblast forms the **ectoderm**
- c) Some of the invaginated epiblast cells migrate between the ectoderm and the endoderm to form **intra-embryonic mesoderm** .

**The embryonic disc remain bilaminar (ectoderm and endoderm with no intervening mesoderm ) in 2 sites :**

**1) Prochordal plate**

**2) Cloacal membrane**

### **➤ Significance of notochord :**

It acts as **temporary axial skeleton** for the embryo being **replaced later** on by the vertebral column.

## Three Germ Layers

### Ectoderm

#### 1-The epidermis of the skin

#### 2. Nervous system :

- **The neural tube** gives brain , spinal cord  
Peripheral nerves.

- **Sensory** epithelium of sensory organs

3. External auditory meatus & outer layer of ear drum .

4. Nasal epithelium

5. Anterior part of oral cavity and lower ½ of anal canal .

#### Neural crest

#### 1.Ganglia

2.Cells : Glial and melanocyte cells

#### 3.Adrenal medulla

4.Septum between ascending aorta & pulmonary trunk

### Endoderm

#### 1- Epithelium lining of

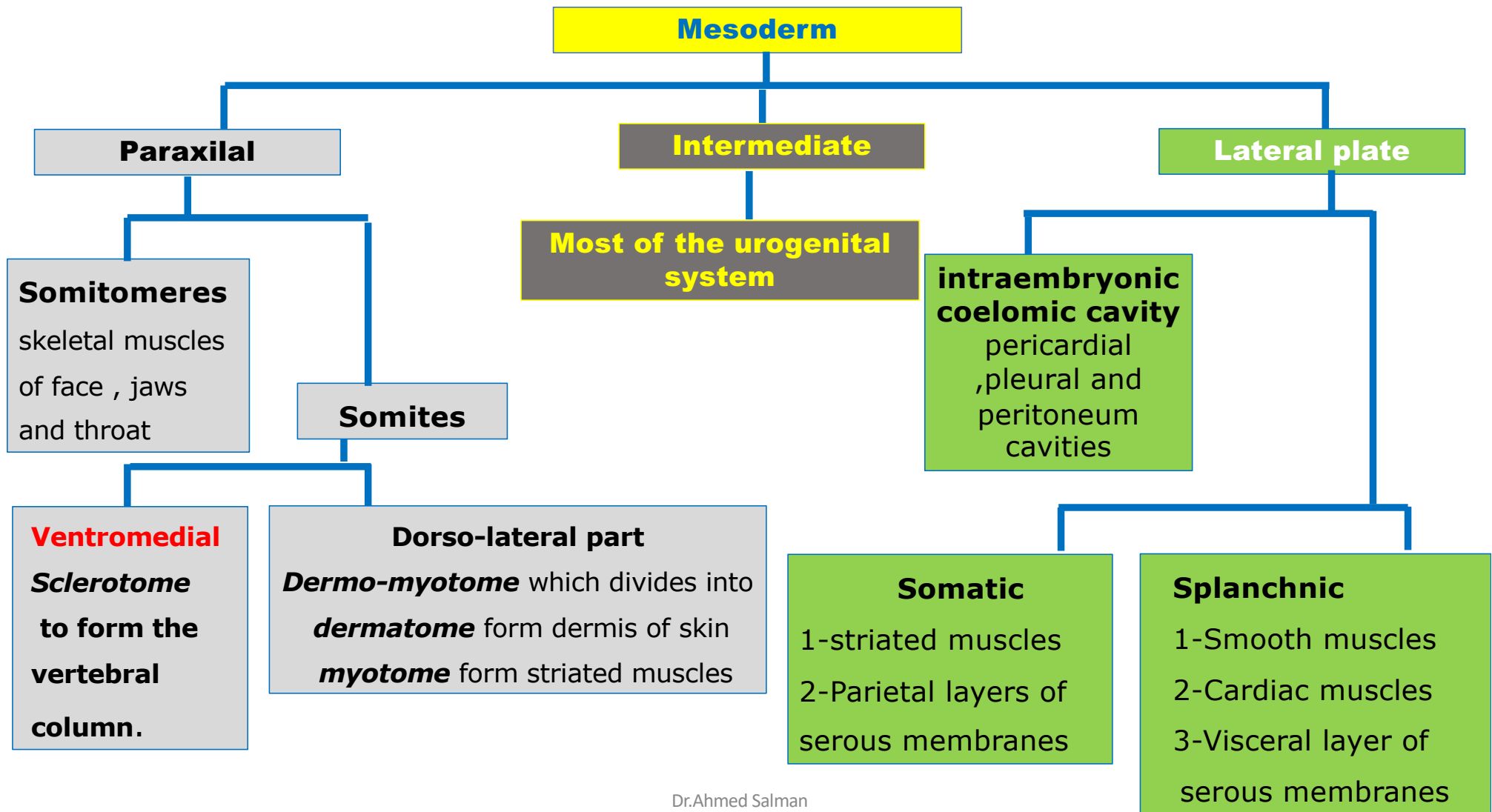
#### A. Most of GIT

B. Most of urinary bladder and urethra

C. Middle ear and Eustachian tube

#### 2-Parenchyma of

Palatine tonsils, thyroid, Liver & pancreas



## Allantois

- **It is formed of 2 parts :**

### Intra-embryonic part :

- **The proximal part :** form the apex of urinary bladder .
- **The distal part , called urachus** connect the urinary bladder to the yolk sac

**Extra-embryonic part :** inside the umbilical cord , become **obliterated** .

**Allantoic vessels** form the **umbilical vessels** .

## Folding of the embryonic disc

- ★ At the **end of 3<sup>rd</sup>. week** , the flat embryonic disc starts to **fold** and **bulges** into the amniotic cavity .

### Two types of folding:

- The embryonic disc becomes folded in 2 directions simultaneously

#### 1-Cephalo-caudal folding :

- It leads to formation of **head and tail folds** .

#### 2- Lateral folding :

- It leads to formation of **lateral folds** .

## Results of folding:

1-The flat shaped **embryonic disc** changes to the ***cylindrical*** appearance with formation of **body cavity**.

2- The **amniotic cavity** surrounds the embryo almost completely .

3- A large part of the cavity of the **yolk sac** is incorporated into the body of the embryo forming the **primitive gut** which is lined by endoderm.

4-The part of the gut found in the **head fold** is called the **foregut**, the part found in the **tail fold** is called the **hind gut**, whereas the part in between within the **lateral folds** is called the **midgut** .

5- The **buccopharyngeal membrane** becomes the **cephalic**, and the **septum transversum** becomes the **caudal** to pericardial cavity , while the pericardial cavity and heart remain in between.

6-The **cranial end** of the folded embryonic disc shows the followings :

- a) **Forebrain swelling** produced by the developing forebrain .
- b) **pericardial swelling** produced by the developing heart .
- c) Depression between the previous 2 swellings called **stomatodeum**