

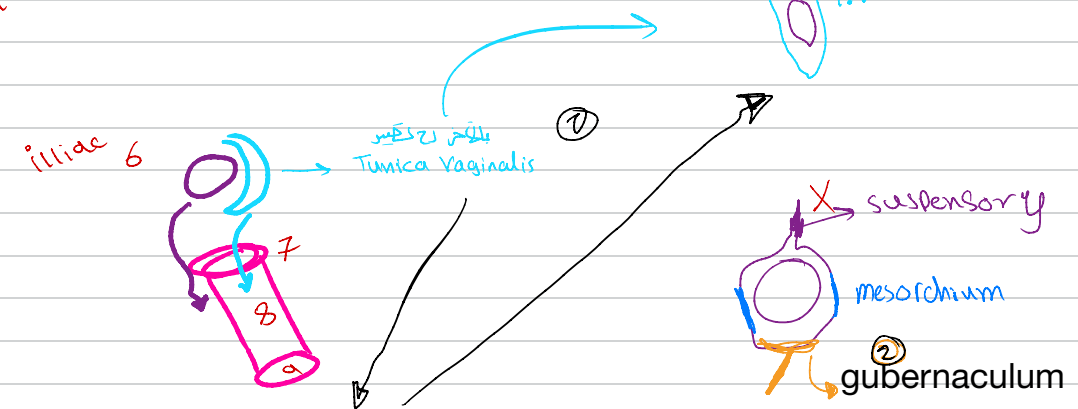
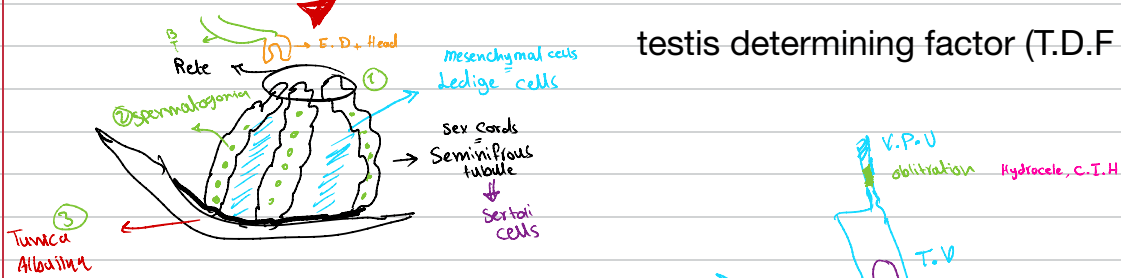
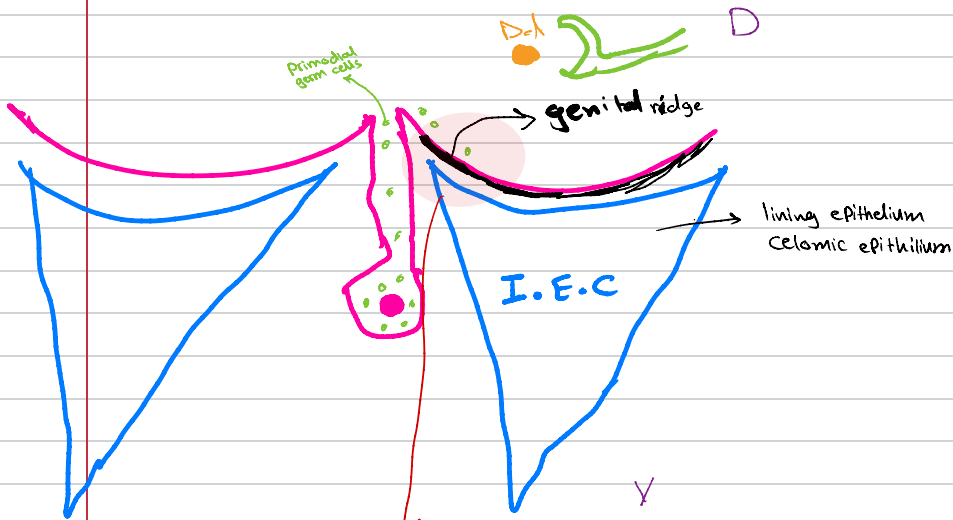
Development of the gonads



Dr. Ahmed Salman

Associate professor of anatomy & embryology

* Cross Section at the level of L2



- ③ Abdominal Pressure
- ④ Hormone

The gonads develop from **three** sources (the first two are mesodermal, the third one is endodermal) .

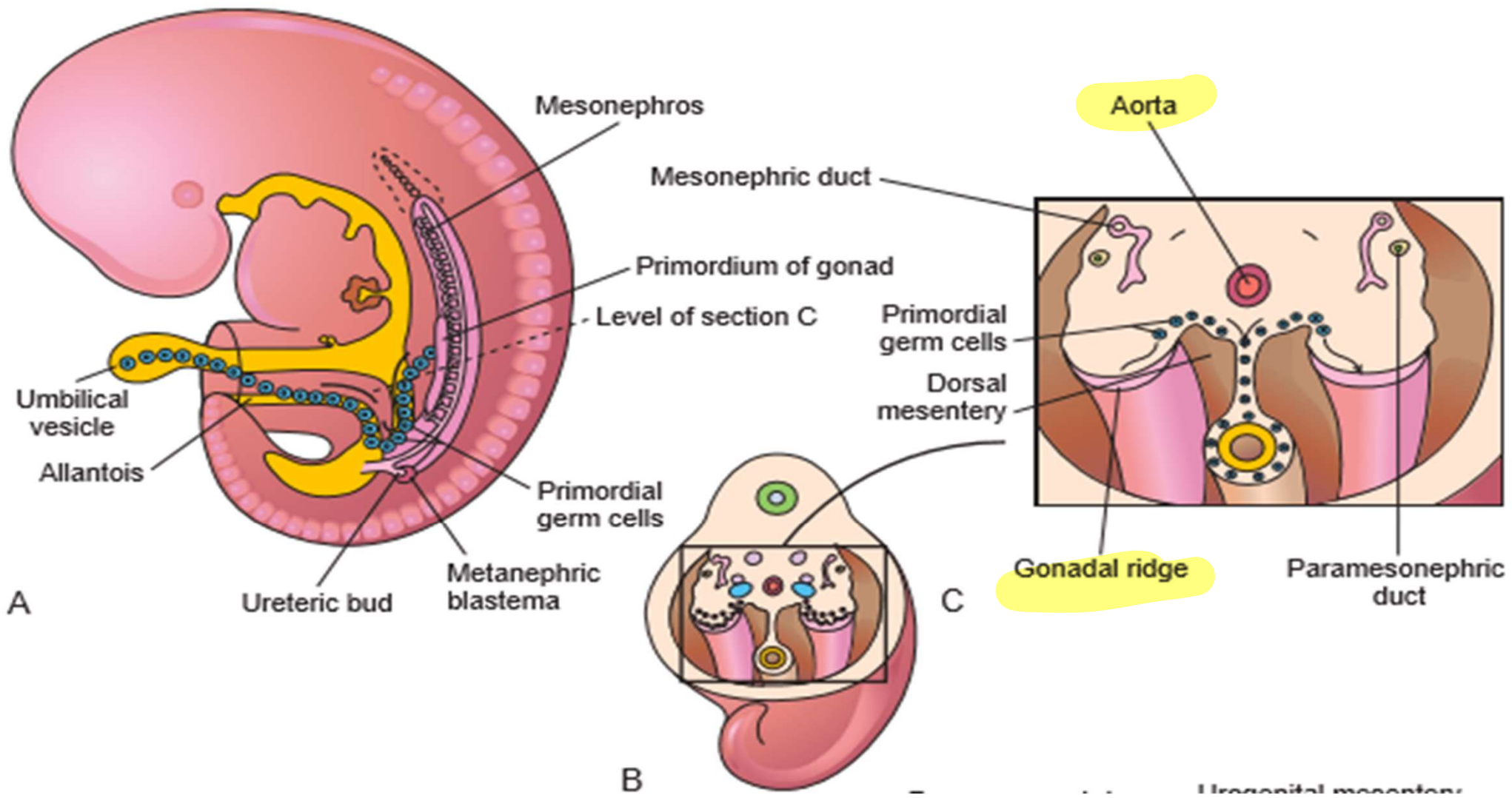
1. Proliferating coelomic epithelium on the medial side of the mesonephros.

2. Adjacent mesenchyme dorsal to the proliferating coelomic epithelium.

3. Primordial germ cells (endodermal), which develop in the wall of the yolk sac and migrate along the dorsal mesentery to reach the developing gonad.

The indifferent stage of the developing gonads

- The coelomic epithelium (on either side of the aorta) proliferates and becomes multi layered and forms a longitudinal projection into the coelomic cavity called the **genital ridge**.
- The genital ridge forms a number of epithelial cords called the **primary sex cords** that invade the underlying mesenchyme, which separate the cords from each other.
- Up to the 6th or 7th week, the developing gonad cannot be differentiated into testis or ovary.

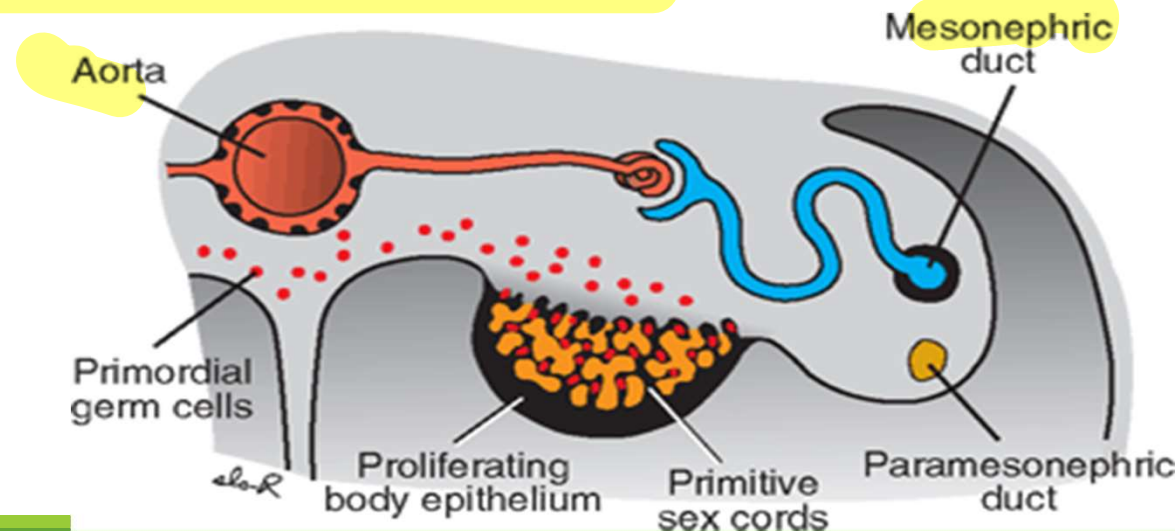


Development of the testis and its descent

Under the effect of the **testis determining factor (T.D.F)** present on the short arm of Y - chromosome, the undifferentiated gonad is switched to form a testis.

1. The coelomic epithelium.

- The primary sex cords elongate to form testis cords (future seminiferous tubules) which undergo **three** important events :
 - **Ventrally**, they lose contact with the surface epithelium by the developing **tunica albuginae**.
 - **Dorsally**, they communicate with each other to form rete testis.
 - **Internally**, they are invaded by the primitive germ cells.



The testis cords become lined by two types of cells:

A. Sertoli supporting cells (mesodermal) from the coelomic epithelium.

They synthesize **mullarian inhibitory factor (M.I.F)**, which affects the development of the genital ducts.

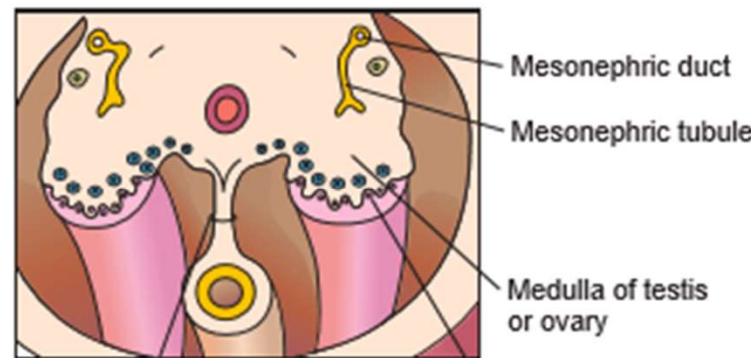
B. Primitive germ cells (endodermal) from the wall of the yolk sac, they give rise to spermatogonia

2-The subjacent mesenchyme.

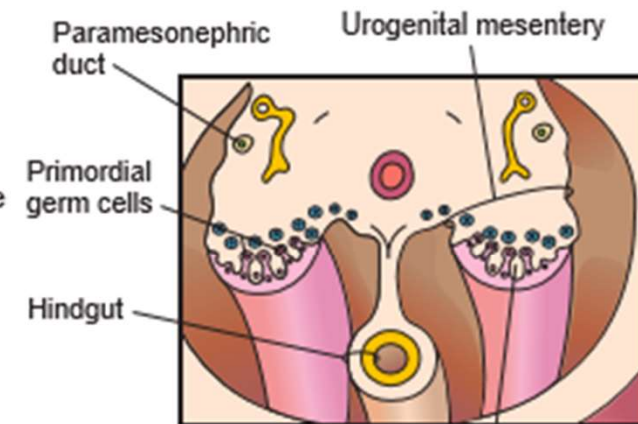
- It forms **tunica albuginea** that surrounds the testis.
- It forms the **interstitial cells of Leydig**, which secrete testosterone.

3. The primitive germ cells.

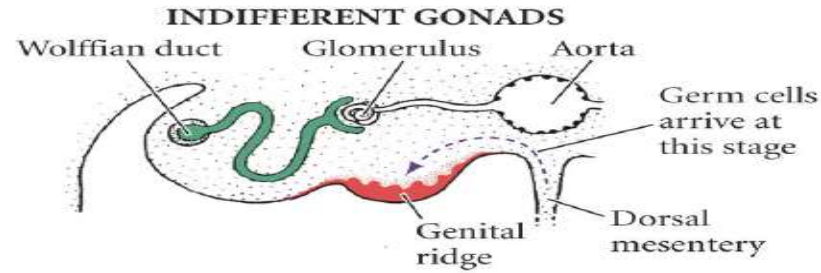
They reach the genital ridge and give rise to spermatogonia, which (at puberty) differentiate to form spermatozoa.



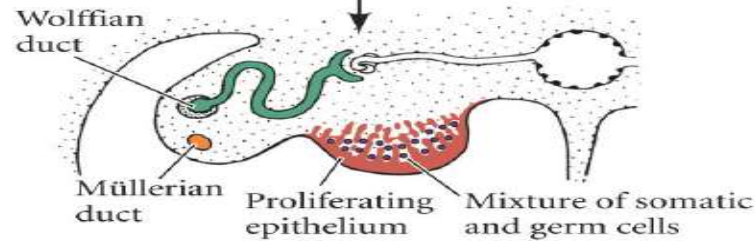
D Mesentery of hindgut Gonadal cord in the cortex



E Mesenchyme

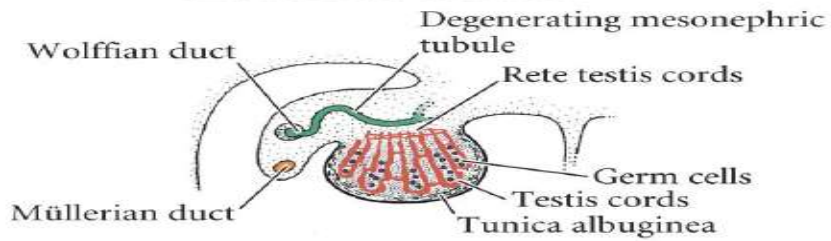


(A) 4 WEEKS

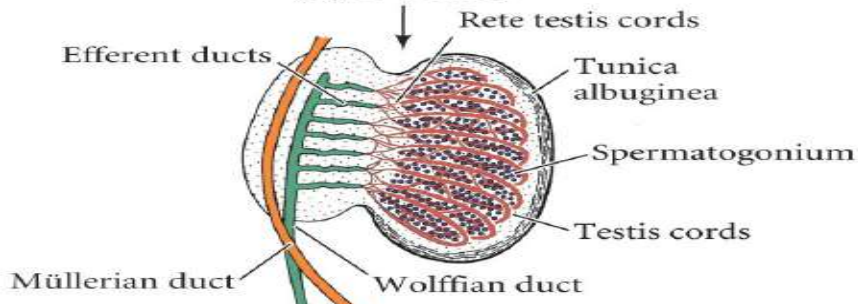


(B) 6 WEEKS

TESTIS DEVELOPMENT

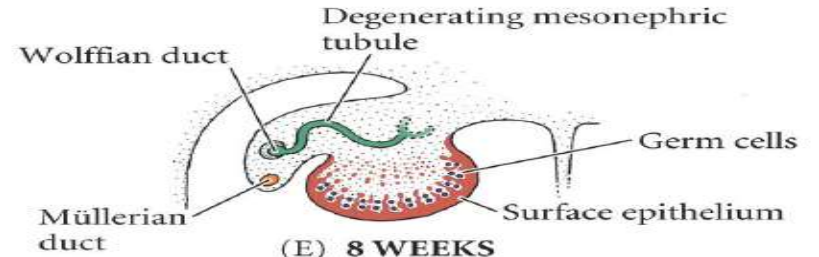


(C) 8 WEEKS

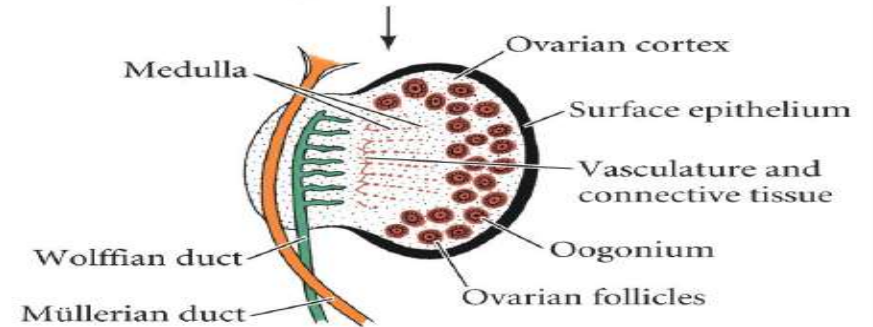


(D) 16 WEEKS

OVARIAN DEVELOPMENT



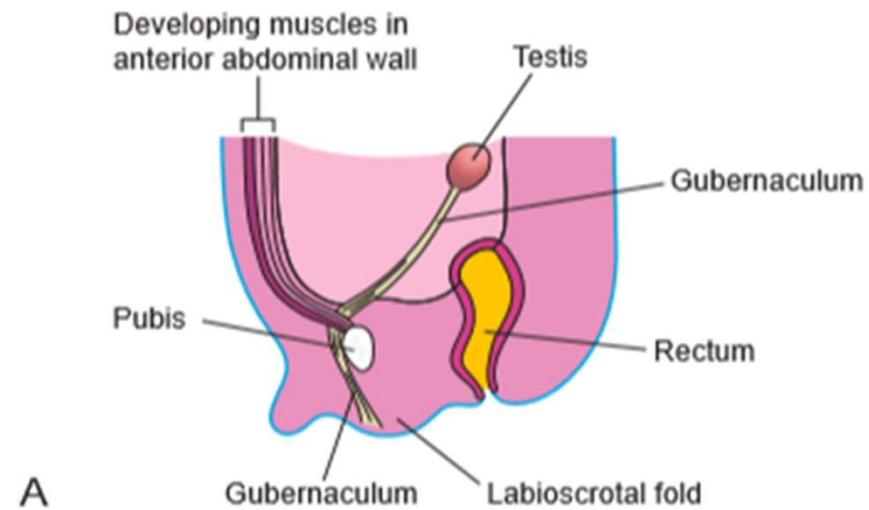
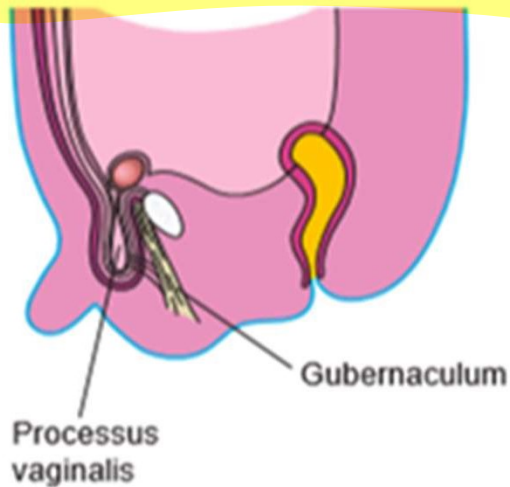
(E) 8 WEEKS



(F) 20 WEEKS

Descent of the testis :

- The testis develops in the posterior abdominal wall opposite the 2nd lumbar vertebra. Here, it receives its testicular artery from the abdominal aorta.
- The genital mesentery of the testis is divided into **three** parts:
 - Its **cranial part** forms the **suspensory ligament of the testis**. It soon degenerates.
 - Its **middle part** forms the **mesorchium**, which forms the site at which blood vessels, and lymphatics enter and leave the testis.
 - Its **caudal part** is transformed into a fibromuscular structure called **gubernaculum** of the testis.
- It extends between the caudal end of the testis to the developing scrotum.
- It is aiding its descent into the scrotum .



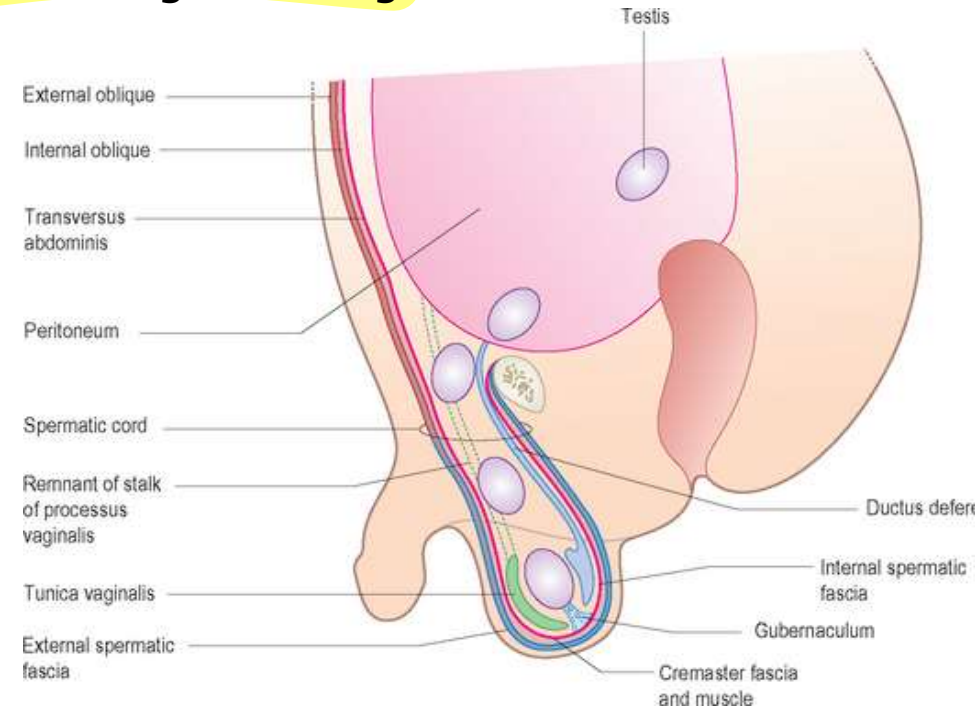
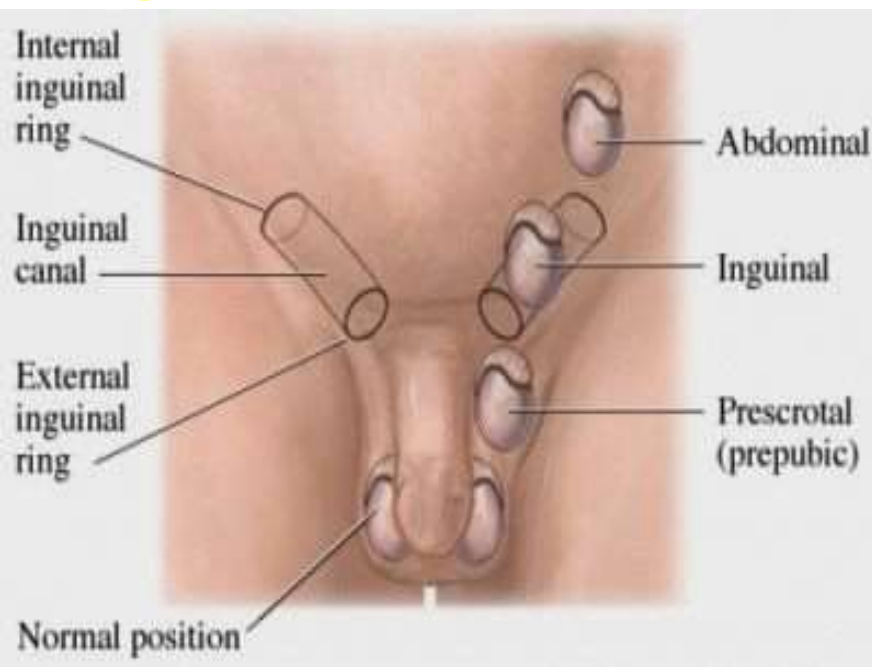
The testis undergoes **two** steps of descent:

1. Internal descent: occurs from the 4th to the 6th month of development.

The testis descends into the iliac fossa close to the deep inguinal ring.

2. External descent: occurs from the 7th to the 9th month of development

- At 7th month, it traverses the deep inguinal ring.
- At 8th month, it traverses the inguinal canal.
- At 9th month, it begins to traverse the superficial inguinal ring.



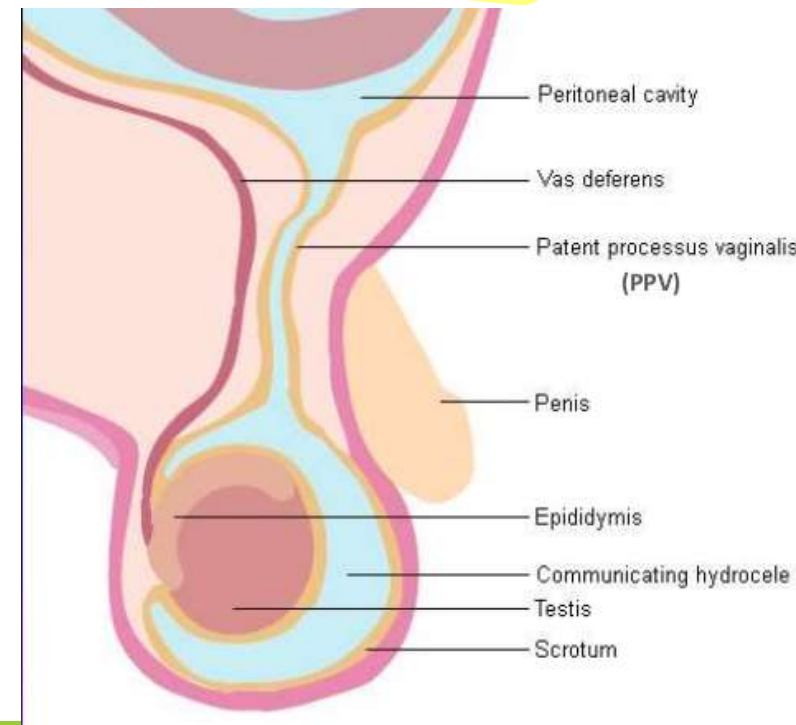
Before descent of the testis, a peritoneal diverticulum called ***processus vaginalis*** creates and traverses the inguinal canal down to the scrotum.

After descent of the testis the tunica vaginalis is divided into ***three*** parts:

- **Proximal part** forms the **vestige of processus vaginalis** at the deep inguinal ring.
- **Intermediate part is obliterated** .
- **Distal part** (in the scrotum) persists and forms the **tunica vaginalis**

Factors helping descent of the testis:

1. Shortening of the gubernaculum.
2. Hormones as androgens and gonadotrophins.
3. Increased intra - abdominal pressure.



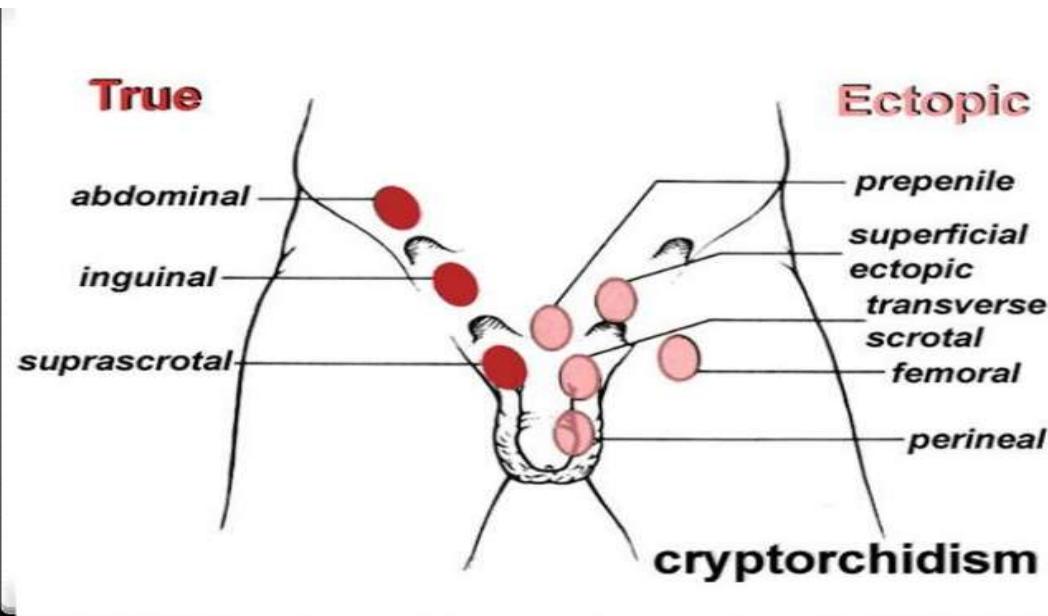
Congenital anomalies:

1. Cryptorchidism (undescended testis): in which the testis may remain in the iliac fossa or in any part of the inguinal canal.

Undescended testis is susceptible to damage of the process of spermatogenesis and occurrence of malignancy .

2. Ectopic testis (maldescended testis) in which, the testis descends in the inguinal canal but is located **outside** the scrotum at root of penis or in the upper part in the front of the thigh .

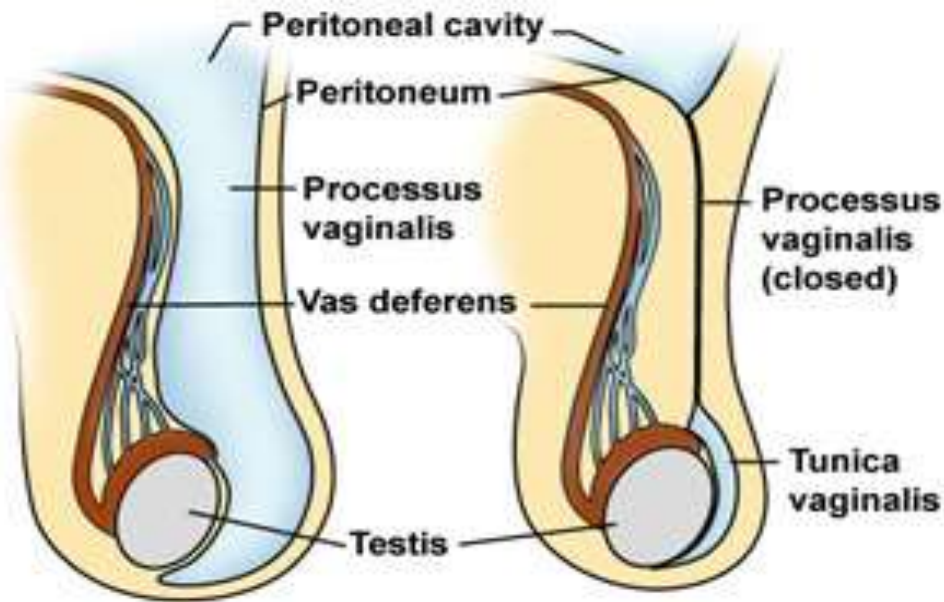
3. Congenital oblique inguinal hernia, in which a loop of intestine descends via unobliterated tunica vaginalis .



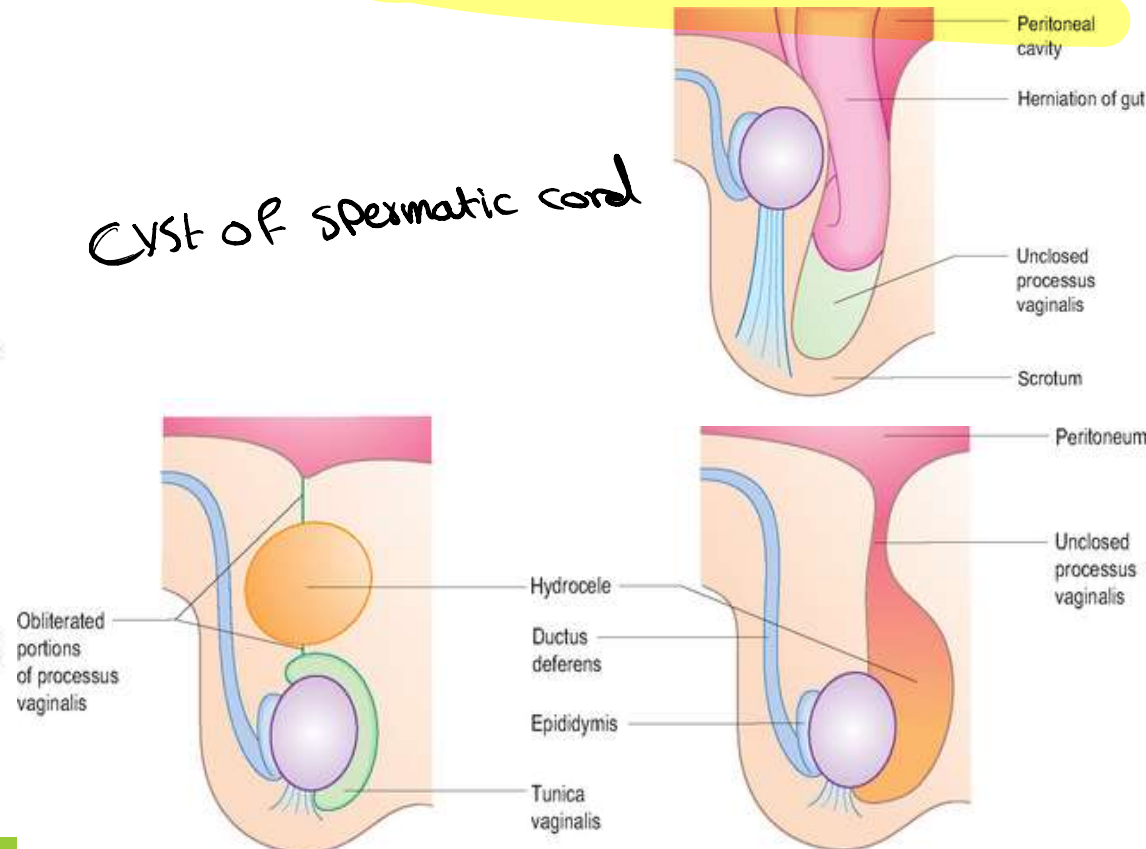
4-Hydrocele : the abdominal end of the processus vaginalis remains open but is too small to permit herniation of intestine .

Peritoneal fluid passes into the patent processus vaginalis and forms a scrotal hydrocele.

If only the middle part of the processus vaginalis remains open, fluid may accumulate and give rise to a hydrocele of the spermatic cord

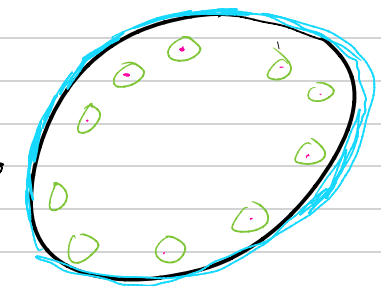
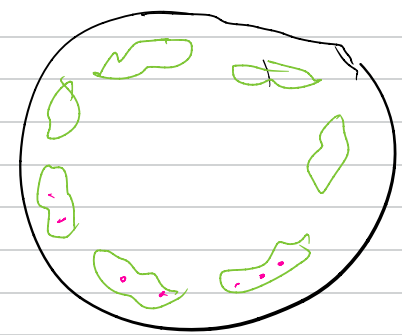
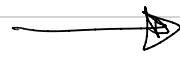
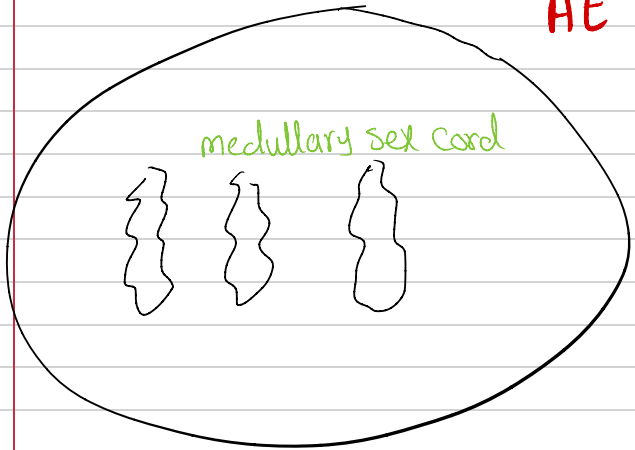


Cyst of spermatic cord

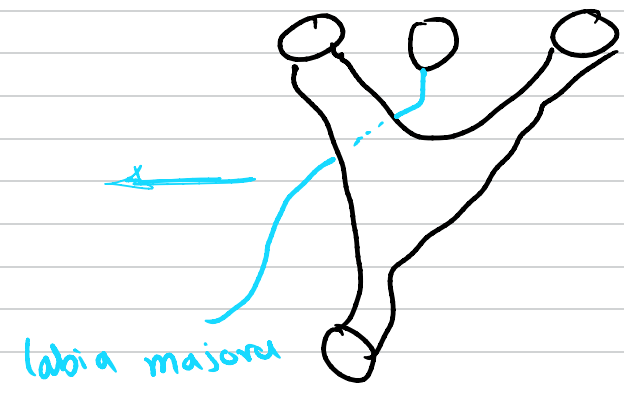
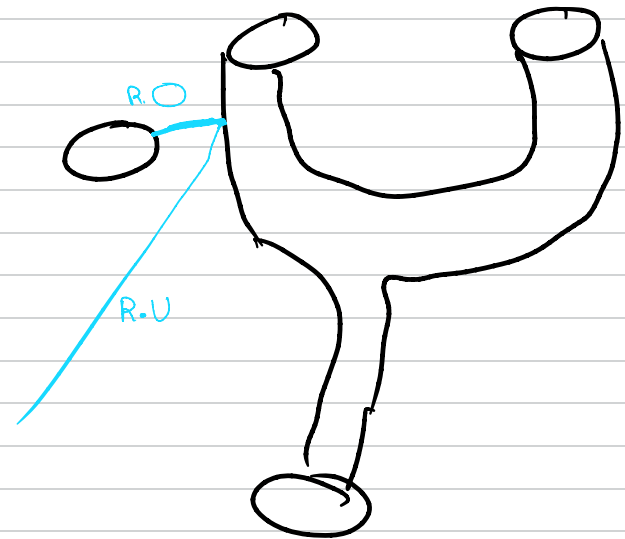


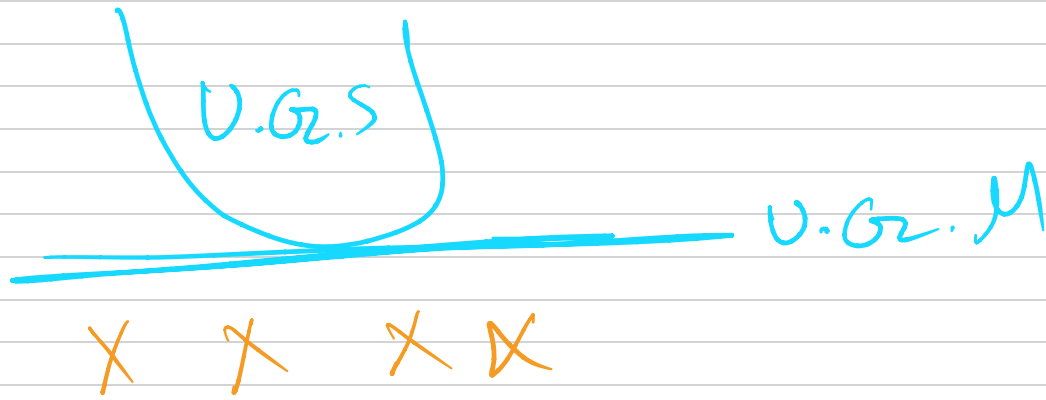
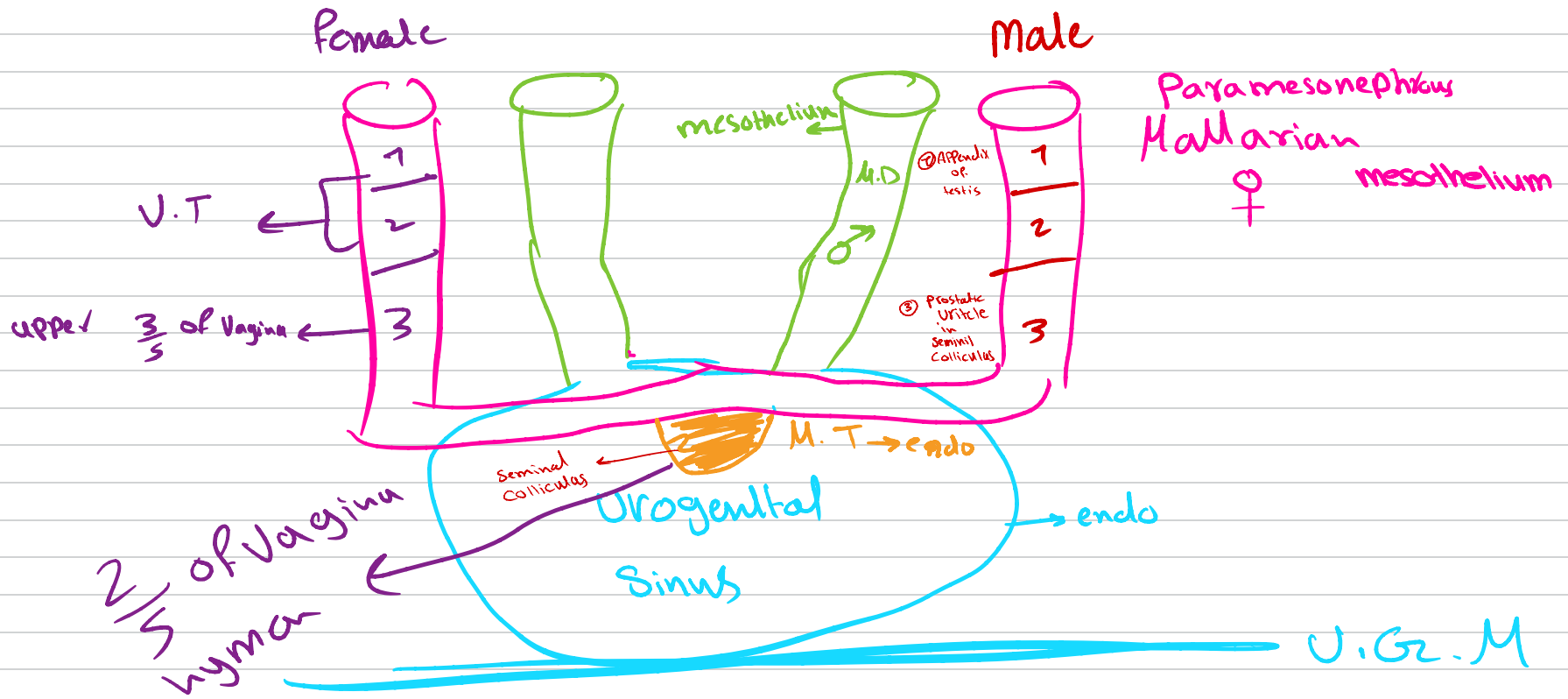
Follicle → cortex

At level of h2

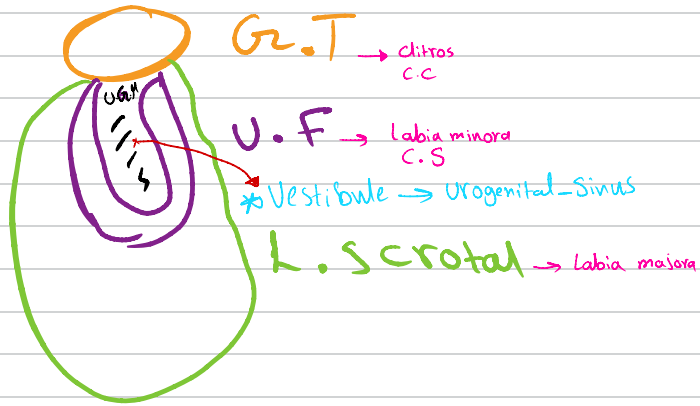


بہا تنہا ای
lesser pelvis



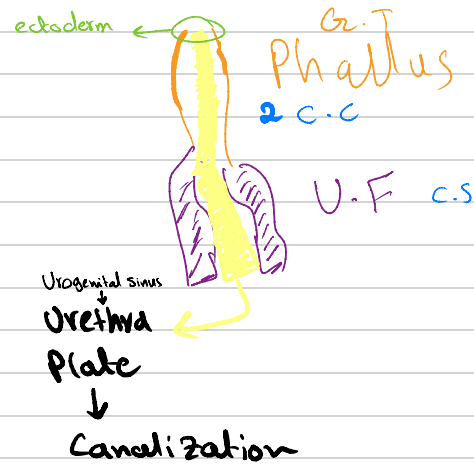


Female



↳
Mesoderm

Male

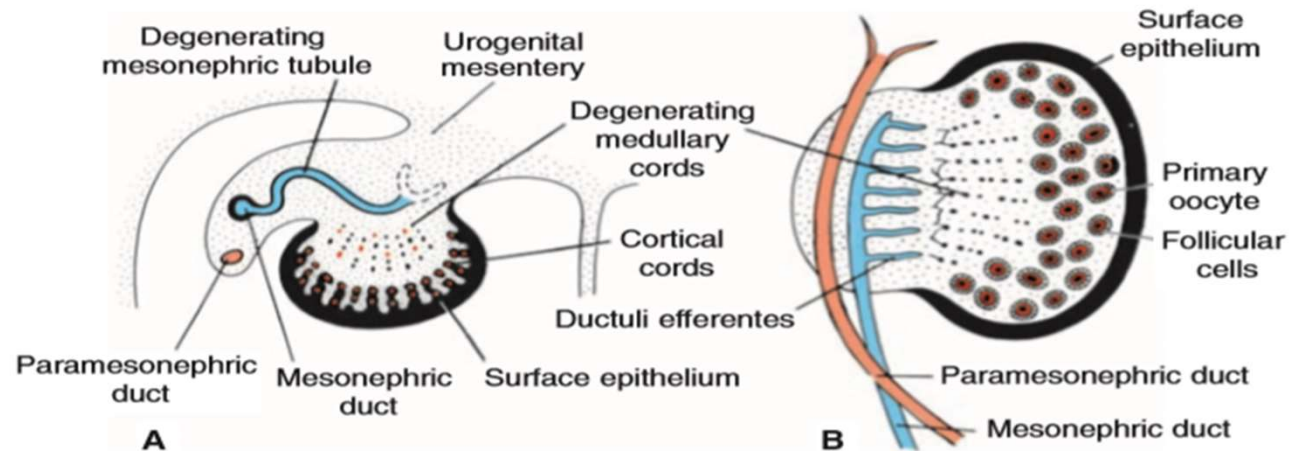


Development of the ovary

- In the absence of **T.D.F.** , the undifferentiated gonad is switched on to form an ovary.

1. Coelomic epithelium:

- The primary sex cords invade into the subjacent mesenchyme to form **medullary sex cords**.
- It replaced by fibromuscular stroma, forming the medulla of the ovary.
- The coelomic epithelium proliferates to form a second generation of sex cords called the secondary (**cortical sex cords**), which remain near the coelomic epithelium, forming the **cortex of the ovary**.
- The **cortical sex cords** break down to form cell clusters which form **perimordial ovarian follicles**



2. Subjacent mesenchyme: it forms:

- The stroma of the ovary.
- Very thin tunica albuginea, which intervenes between the ovary and the surface epithelium.

3. Primitive germ cells:

- They invade the primordial follicles and proliferate by **mitosis** to form Primary oocytes.
- At 12th week of the intrauterine life, the primary oocytes enter the first meiotic division and are arrested (at 20th week) in its prophase till puberty.

Descent of the ovary :

- The ovary developed (like the testis) in the posterior abdominal wall opposite at 2nd lumbar vertebra, where it is suspended by a genital mesentery.
- It reaches the greater pelvis at 3rd month of gestation
- Then reach the lesser pelvis shortly after birth

The genital mesentery of the ovary is divided into **three** parts:

- **Cranial part** forms the **suspensory ligament of the ovary** → ليجن
- **Middle part** forms the **mesovarium**.
- **Caudal part** is transformed into the **gubernaculum of the ovary**, which extends between the lower end of the ovary and the developing labium majora.

- The middle of: **the gubernaculum** is attached to the lateral angle of the developing uterus and thus gives rise to **two** ligaments.

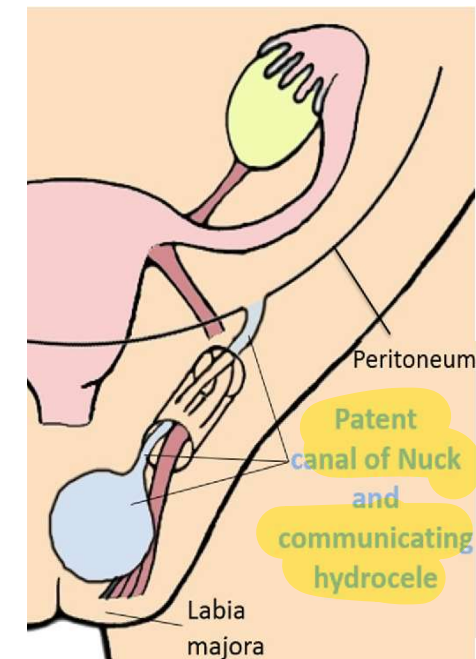
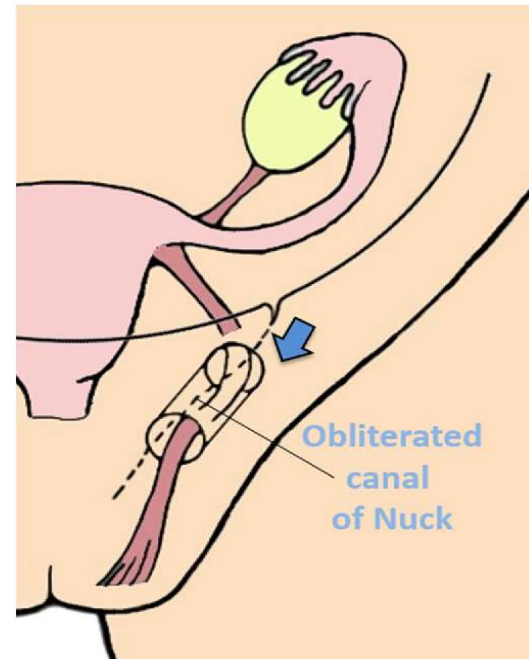
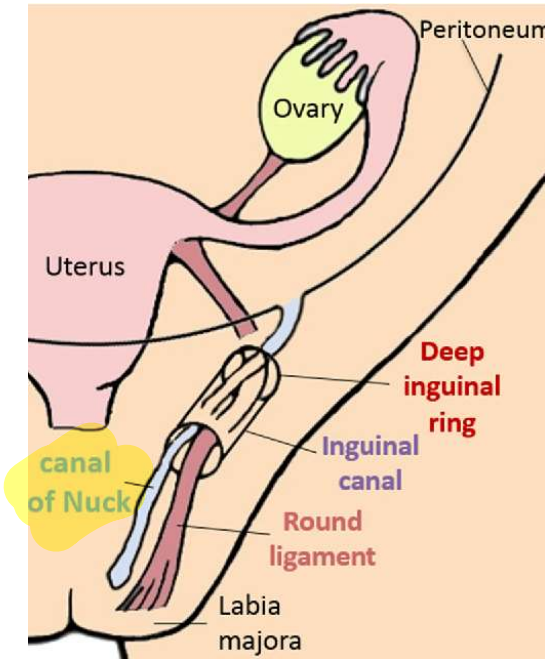
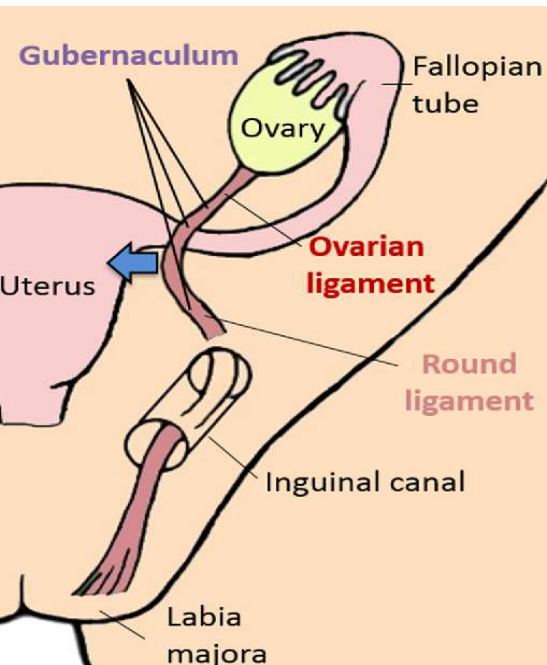
- **Ligament of the ovary**, between the ovary and uterus.
- **Round ligament of the uterus**, between the uterus and labium majora.

Persistence of small processus vaginalis, gives rise to canal of Nuck.

Congenital anomalies

1. Ovarian agenesis.
2. Congenital inguinal hernia Very Rare

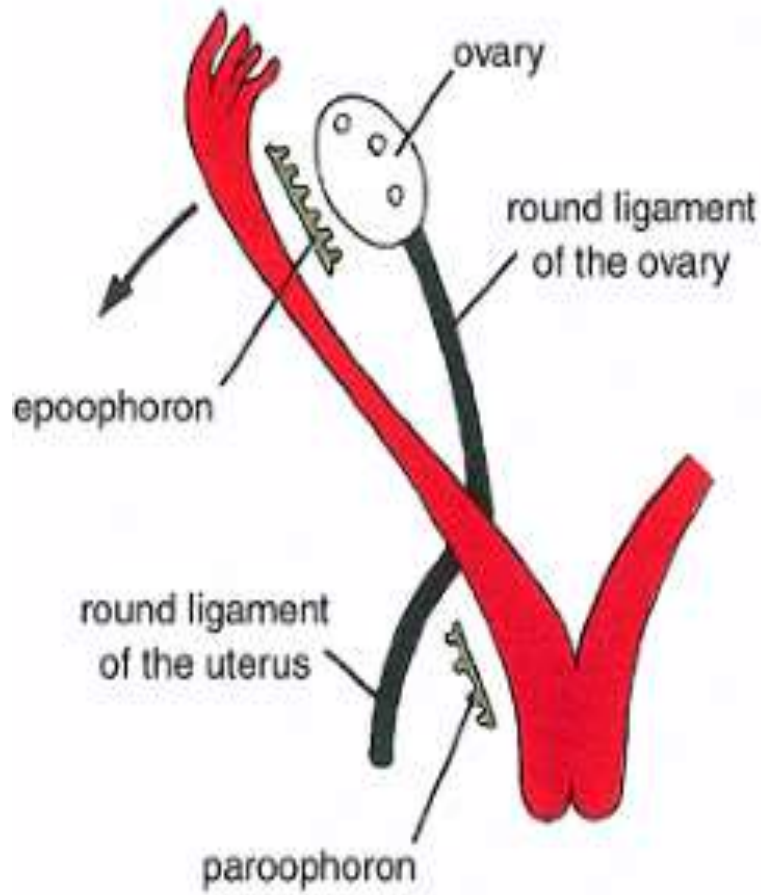
The ovary may undergo external descent via the inguinal canal when the gubernaculum is not attached to the angle of the developing uterus may occur in a **persistent canal of Nuck**



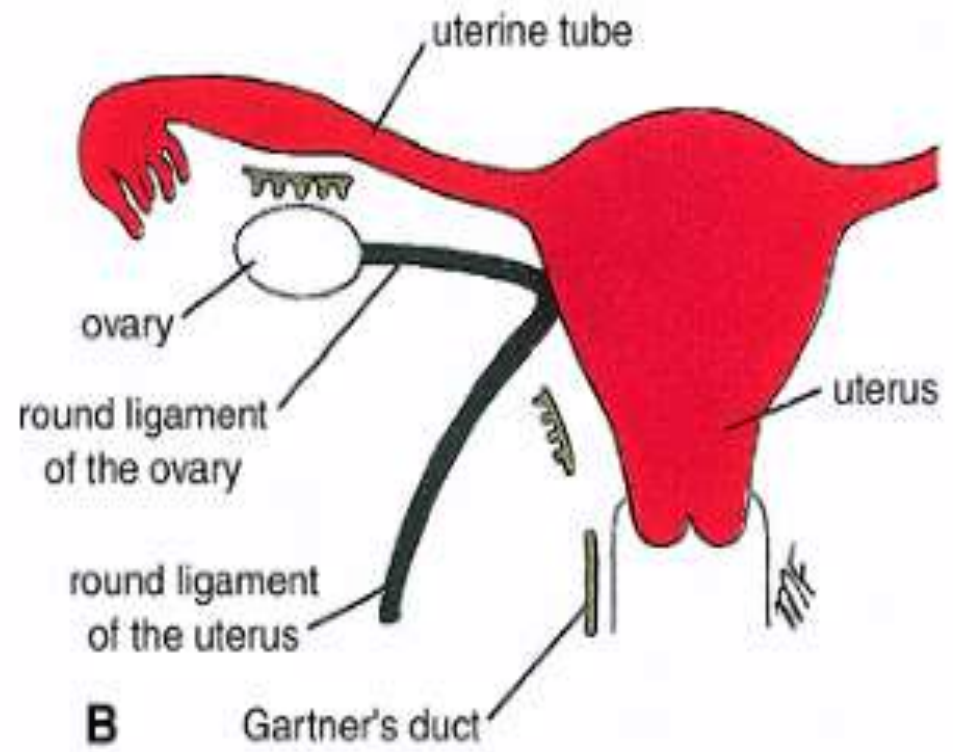
bilateral labial fullness in a 4-monthold girl

Swelling ←

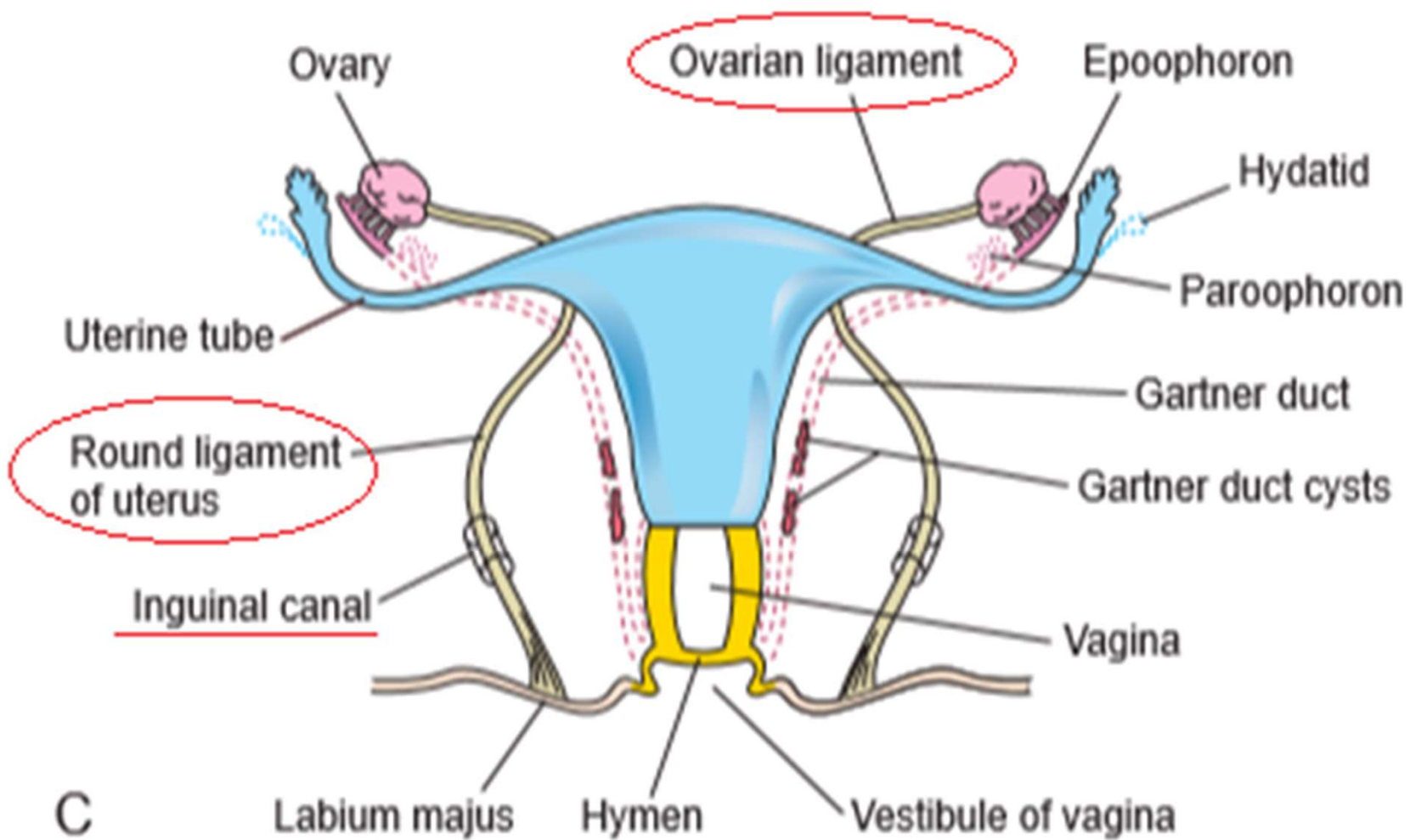




A



B



C



Development of the genital ducts

Dr Ahmed Salman

- In either the male or female, there are two genital ducts on each side:

Mesonephric (Wolffian) duct and a laterally located **paramesonephric (Mullerian)** duct

All are **mesodermal** in origin.

- **In the male**, under the effect of **antimullerian factor (A.M.F)** synthesized by Sertoli cells of the testis, mesonephric ducts will develop .

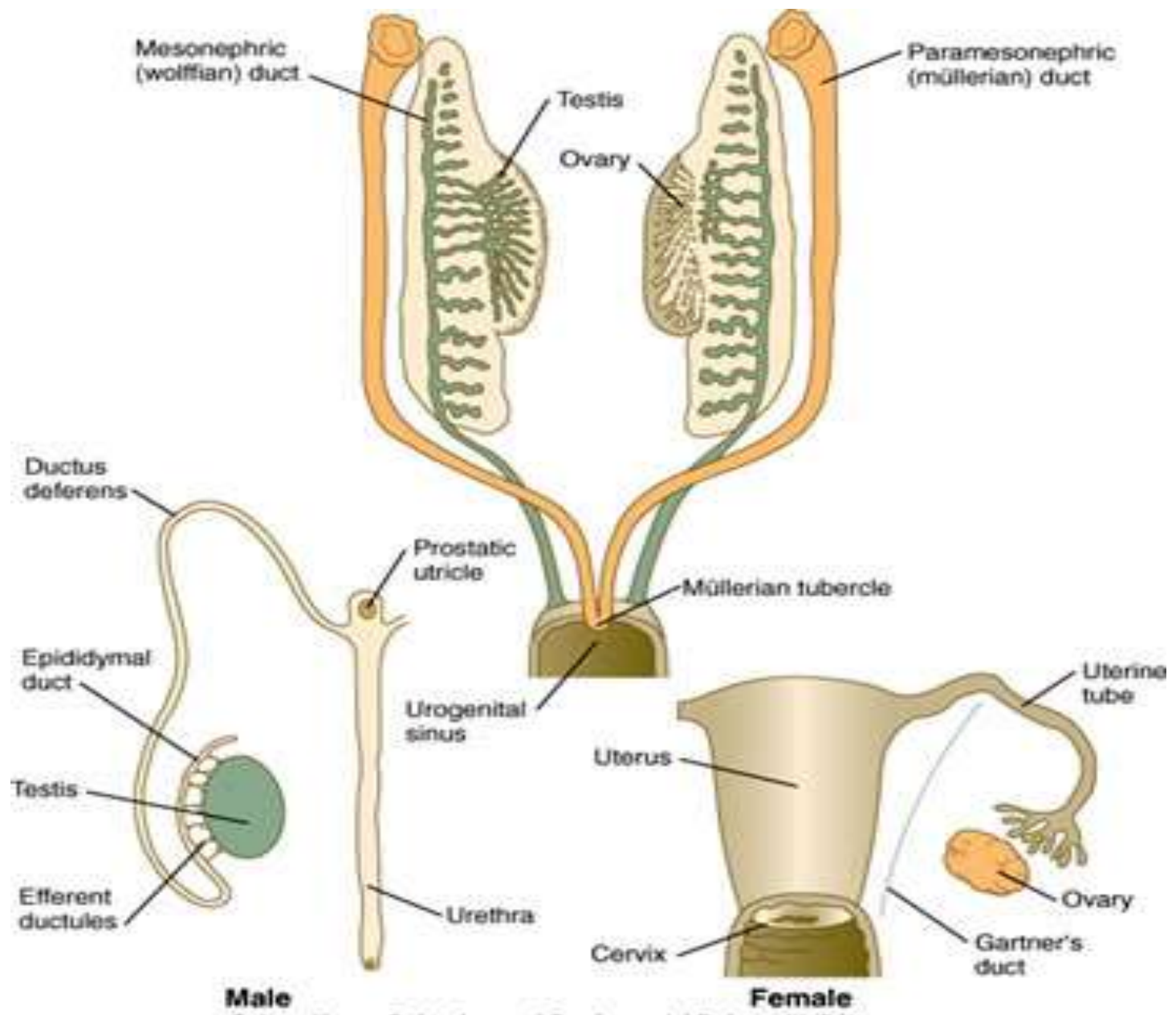
- Paramesonephric ducts will regress, leaving **vestigial** structures.

- **In the female**, in the **absence** of A.M.F, paramesonephric ducts will develop.

- The mesonephric ducts will regress leaving **vestigial** structures.

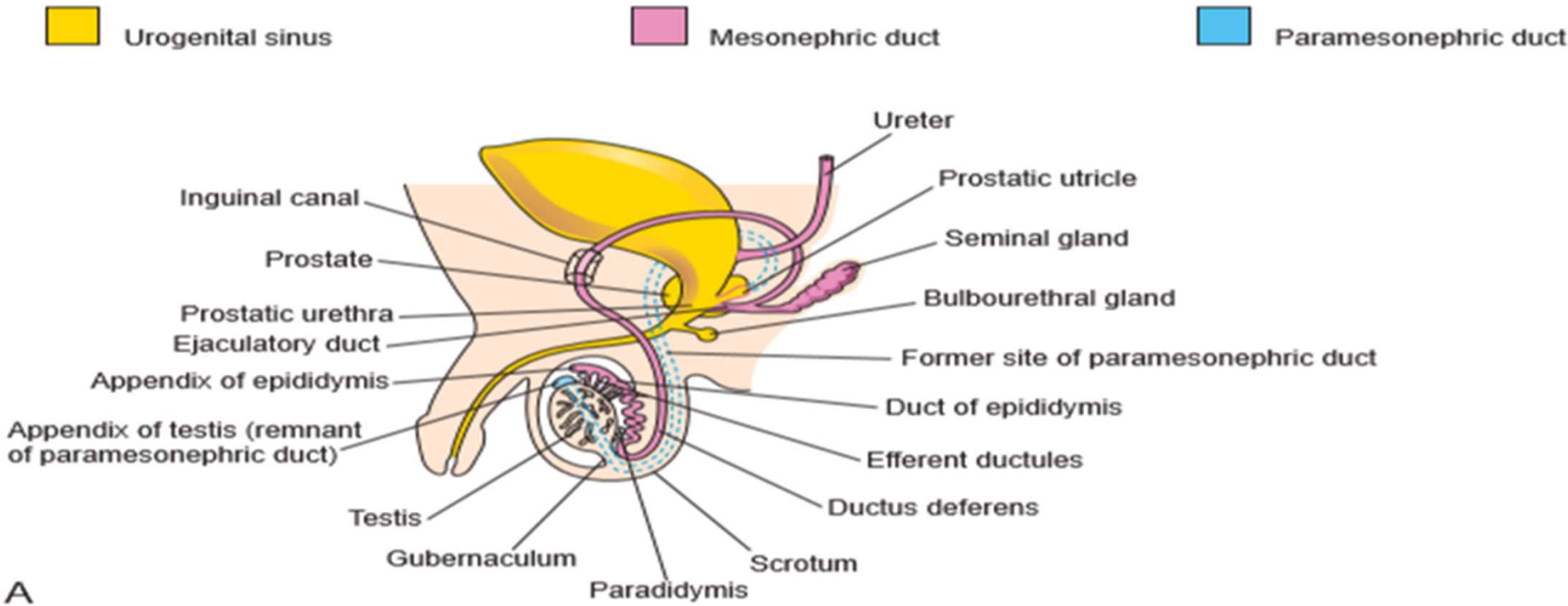
1-Indifferent stage of genital ducts

- Up to the 6th week of development, male or female embryos have two pairs of genital ducts.
 - Two (right and left) mesonephric ducts.
 - Two (right and left) paramesonephric ducts.
- **The paramesonephric duct** develops in the coelomic epithelium **lateral** to the cranial end of the mesonephric duct and continues to grow caudally lateral to that duct
- Then crosses ventral to it and then descends **medial** to it.
- The upper end of each paramesonephric duct opens by an abdominal ostium into the coelomic cavity (future peritoneal cavity).
- Their lower parts fuse to form a Y - shaped **uterovaginal canal** project into dorsal wall of the urogenital sinus to induce formation of **Mullerian tubercle**.



A. Paramesonephric ducts in the male

- They regress under the effect of M.I.F synthesized by Sertoli cells of the testis.
- Its **cranial** end forms **appendix of the testis**.
- Their **caudal** fused parts form **utricle** inside the prostate.
- **Mullarien tubercle** gives rise to **seminal colliculus** in the posterior wall of the prostatic urethra



A. Paramesonephric ducts in the female

- The **cranial and middle** parts of each duct form the **uterine tube**, which opens in the coelomic cavity close to the ovary
 - Their **caudal** vertical parts (utrovaginal canal) form the **uterus and upper 3/5 of the vagina (mesodermal)**.
 - ❖ The **Mullerian tubercle** form two **solid** invaginations called sino-vaginal bulbs which unite to form a single **vaginal plate**.
 - ❖ The vaginal plate is **canalized** to form the lower 2/5 of the vagina.
 - ✓ At the lower end of the vagina, the vaginal plate form a thin membrane which form the hymen .
 - ✓ The vaginal vestibule is formed from definitive urogenital sinus
- So, the vagina is formed as follows:**
- Upper 3/5 (**mesodermal**) develops from the lower part of the utrovaginal canal.
 - Lower 2/5 (**endodermal**) develops from the vaginal plate derived from the Mullerian tubercle
 - The vaginal vestibule (**endodermal**) develops from definitive urogenital sinus.

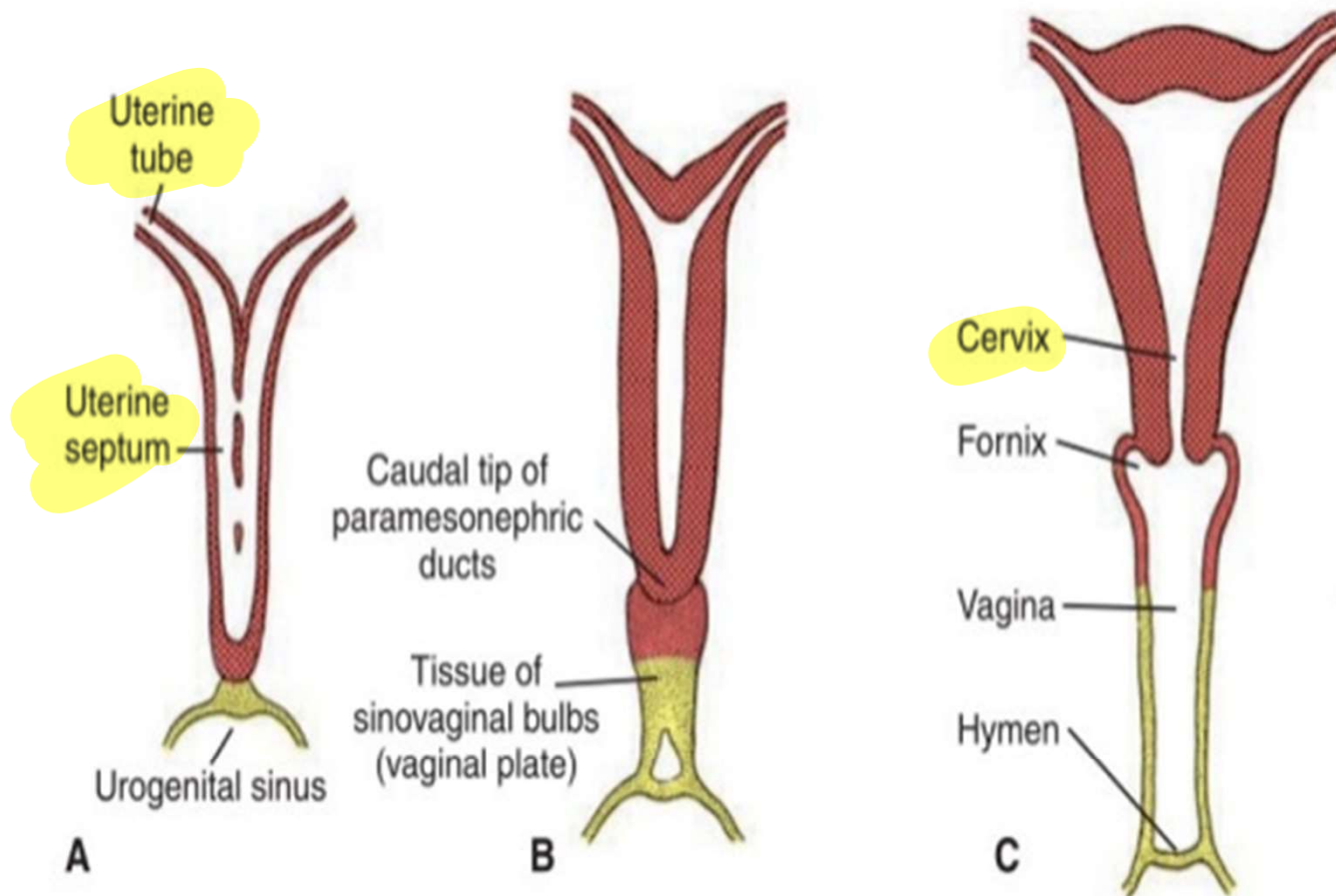
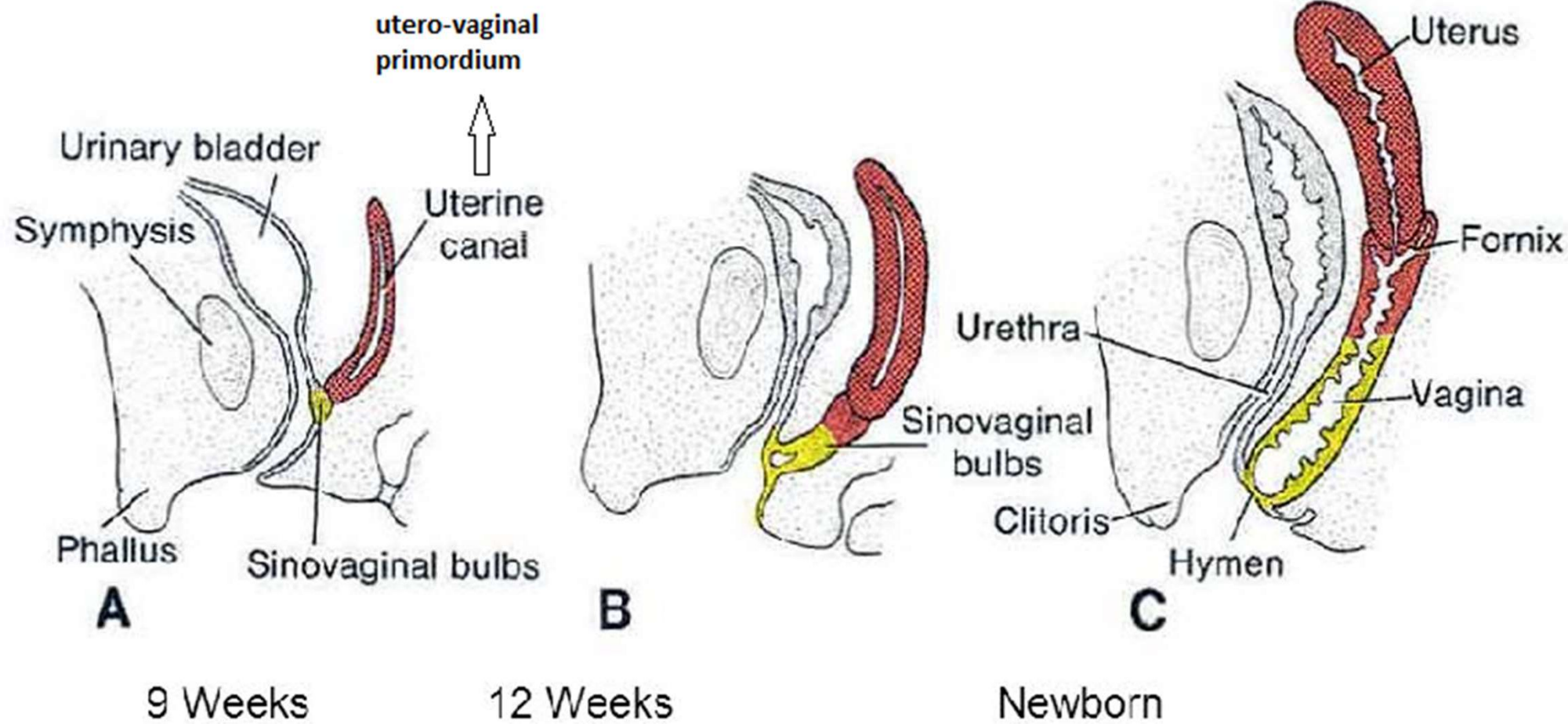
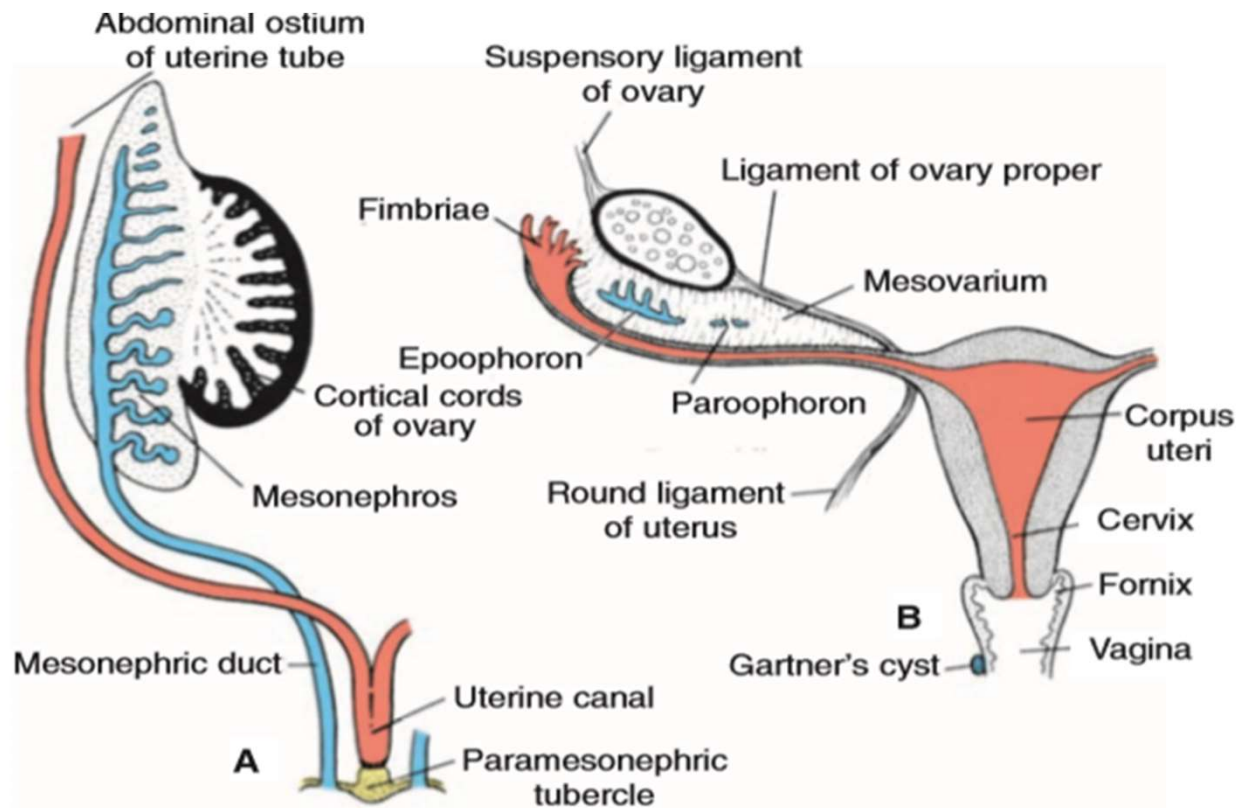


Figure 16.29 Formation of the uterus and vagina. **A.** 9 weeks. Note the disappearance of the uterine septum. **B.** At the end of the third month. Note the tissue of the sinovaginal bulbs. **C.** Newborn. The fornices and the upper portion of the vagina are formed by vacuolization of the paramesonephric tissue, and the lower portion of the vagina is formed by vacuolization of the sinovaginal bulbs.

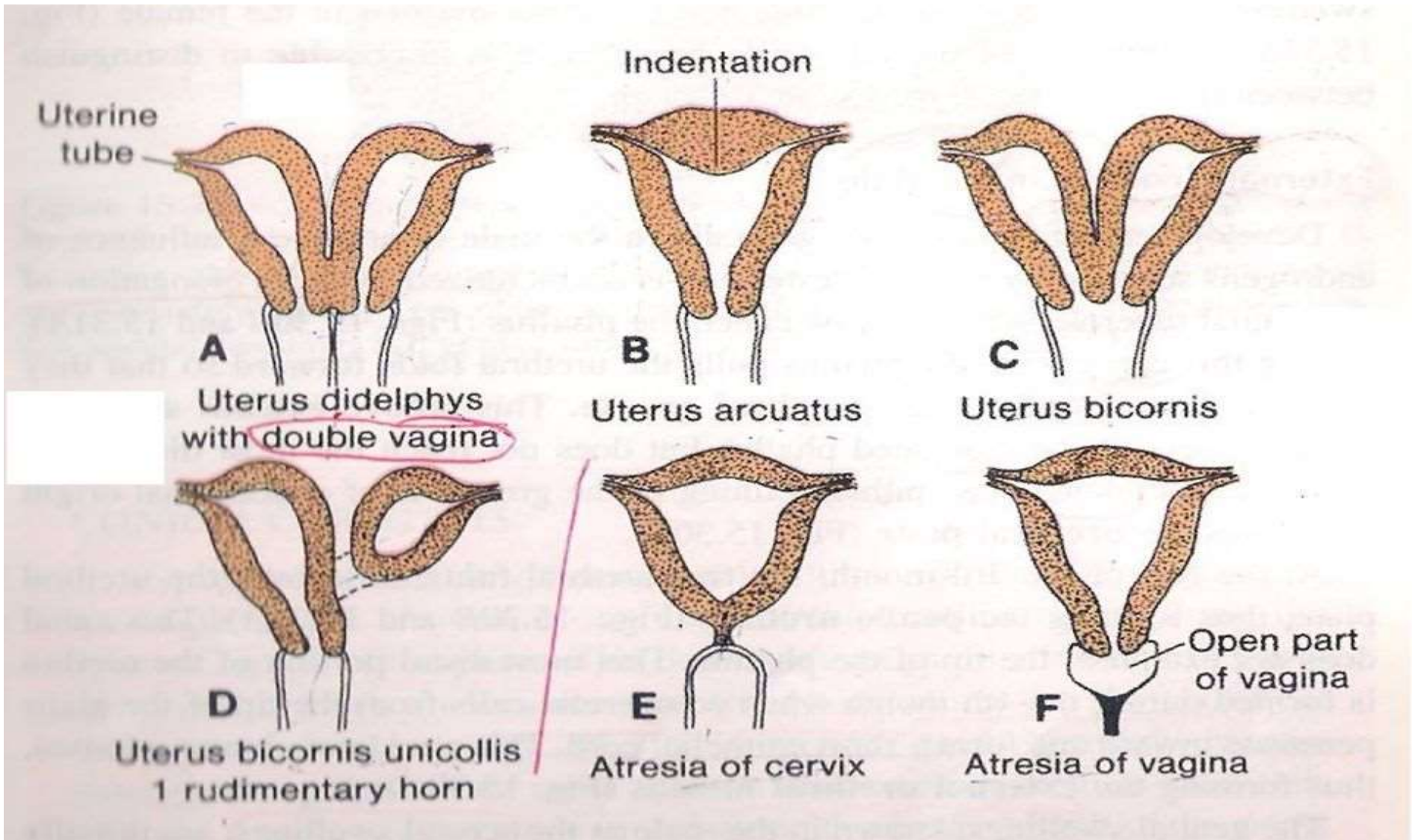


As the middle parts of the paramesonephric ducts cross medially to reach the midline, they drag with them transverse folds of peritoneum, which will form the broad ligaments of the uterus



Congenital anomalies

1. Uterus **bicornis unicollis** (collis = cervix), the uterus has two horns, which open into a **single** vagina.
2. Uterus **bicornis bicollis**, the uterus is divided completely into two horns and each has a **separate** cervix.
3. Uterus **unicornis unicollis** , the uterus is formed only of a single horn and the other horn is rudimentary.
4. **Septate vagina**, in which **only** the vagina is divided into two parts by a median septum.
5. **Atresia of the vagina** due to failure of canalization of the vaginal plate.
6. **Imperforate hymen.**
9. **Congenital rectovaginal fistula** due to incomplete development of urorectal septum.





Development of external genitalia

Dr Ahmed Salman

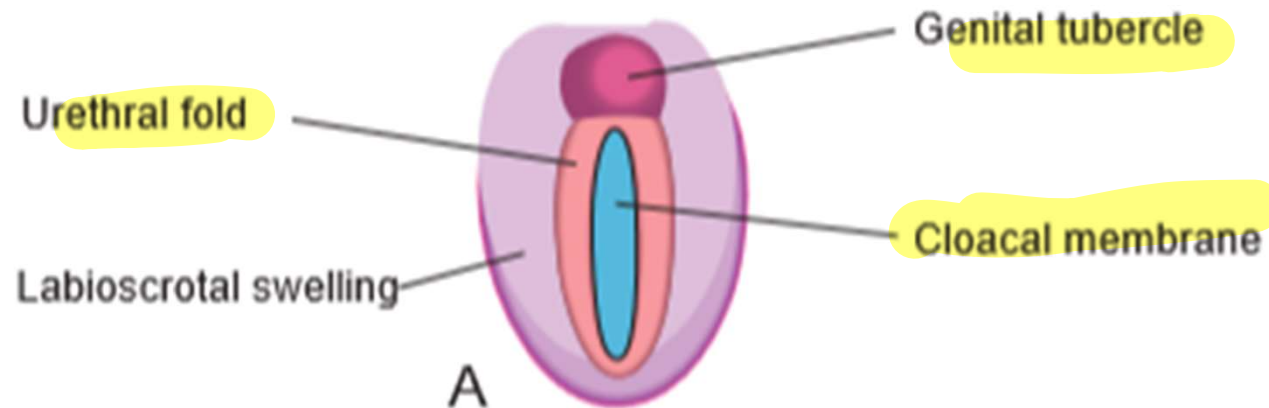
Indifferent stage of the external genitalia

- From the 4th to the 7th week of development, the external genitalia can not be differentiated into male or female.
- In the 4th week, the mesenchyme around the urogenital membrane proliferates to produce five elevations, all are covered by ectoderm.

1- A single **genital tubercle** at the cranial end of the urogenital membrane elongates to form the phallus.

2- Right and left **genital (urethral) folds** on the sides of the urogenital membrane.

3- Right and left genital **(labio - scrotal) swellings** on the sides of the genital folds.



Development of the male external genitalia

➤ Due to the secretion of **testosterone** by the developing testis, the undifferentiated external genitalia are switched to form male type external genitalia.

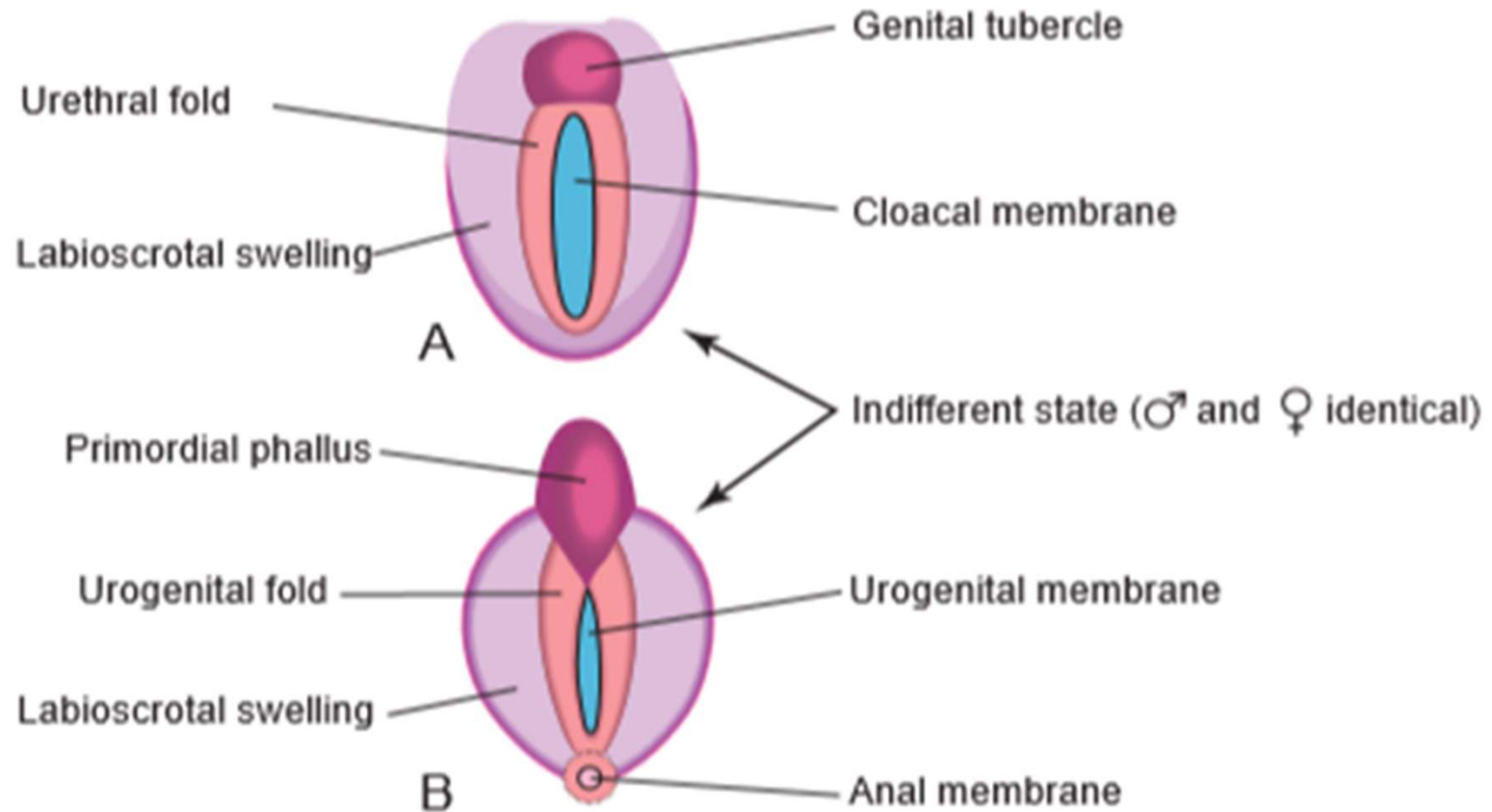
1. Genital tubercle: it elongates to form the phallus, whose mesenchyme forms two corpora cavernosa.

2. The genital (urethral folds):

- Rupture of the urogenital membrane
- A longitudinal **urethral groove** appears on the ventral aspect of the developing penis. The sides of that groove are bordered by the urethral folds.
- The floor and sides of the **urethral groove** become lined with an **endodermal urethral plate**.
- The edges of that plate are continuous with those of the urethral folds.
- The edges of the **endodermal** urethral plate are fused with each other to form the penile urethra **except** its terminal part within the glands penis.

- The edges of the mesenchyme within the urethral folds fuse around the penile urethra and form the single corpus spongiosum.

The two **genital swellings**: fuse in the midline to form the scrotum

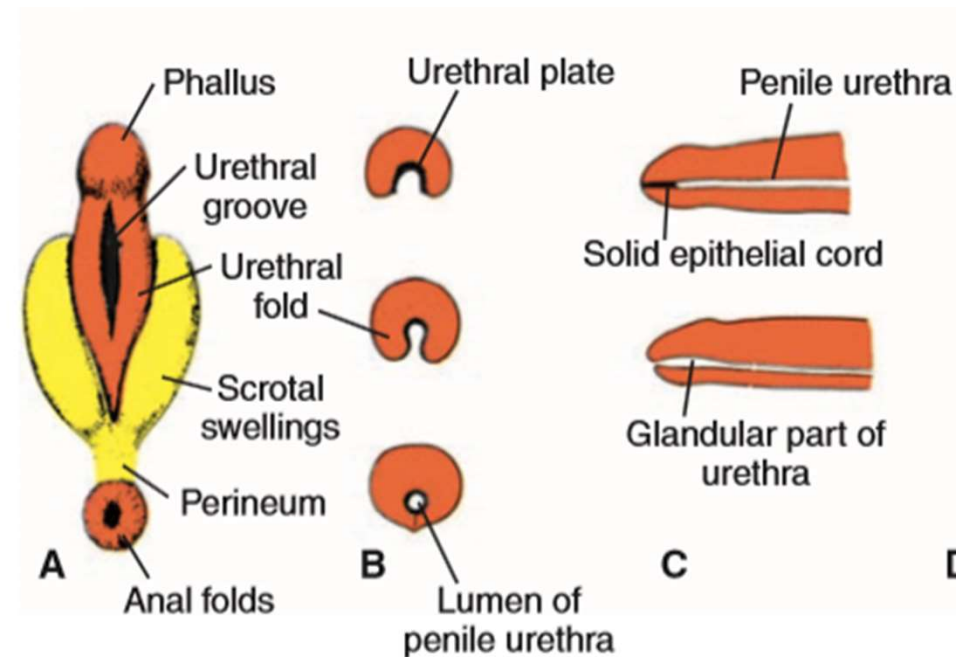
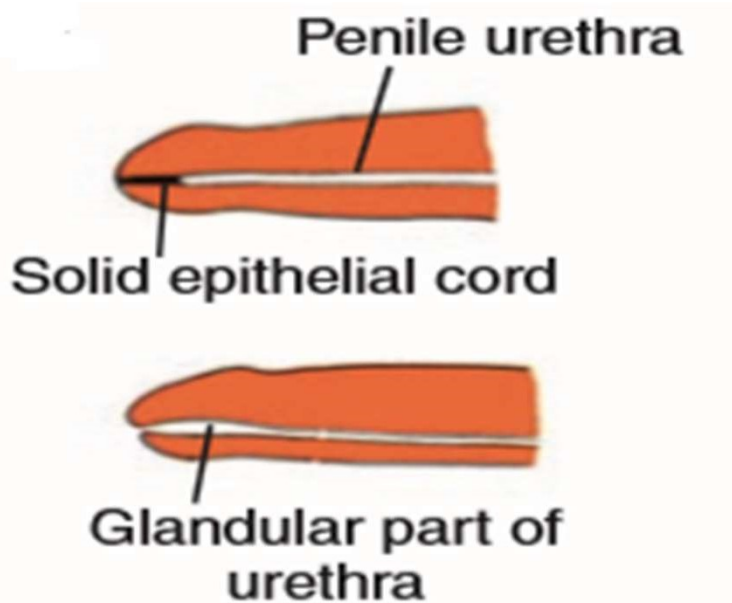


Development of the penis:

- Its **dorsal and lateral aspects** are formed by the **mesenchyme of the phallus**, whose mesenchyme forms the two corpora cavernosa.
- Its **ventral aspect** is formed by the **mesenchyme of the urethral folds**, whose mesenchyme forms the single corpus spongiosum.

Congenital anomalies:

1. **Hypospadias**: the urethral orifice is present in the **ventral** aspect of the penis due to incomplete fusion of the two urethral folds .
2. **Epispadias**: an abnormal orifice is present on the **dorsal** aspect of the penis, usually associated with ectopia vesicae .





Subcoronal



Midshaft



Penoscrotal

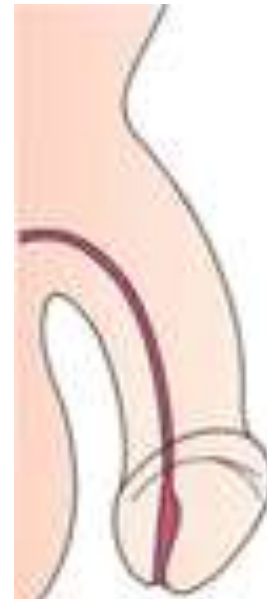
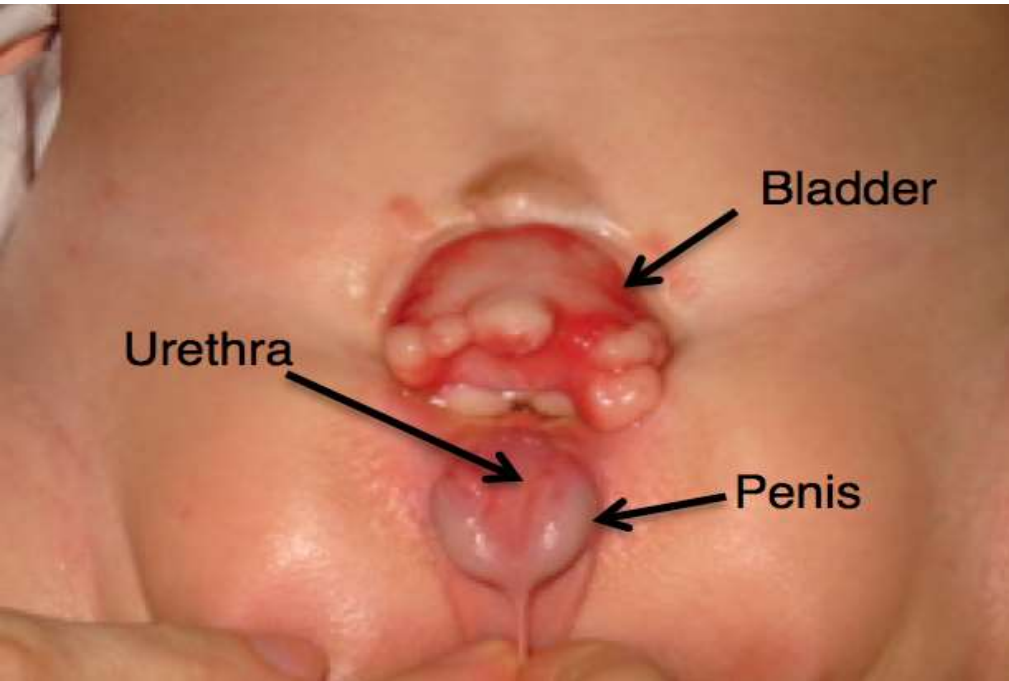


Before surgery



At end of Hypospadias surgery

Hypospadias



A. Normal



B. Hypospadias



C. Epispadias

Epispadias

Development of the female external genitalia

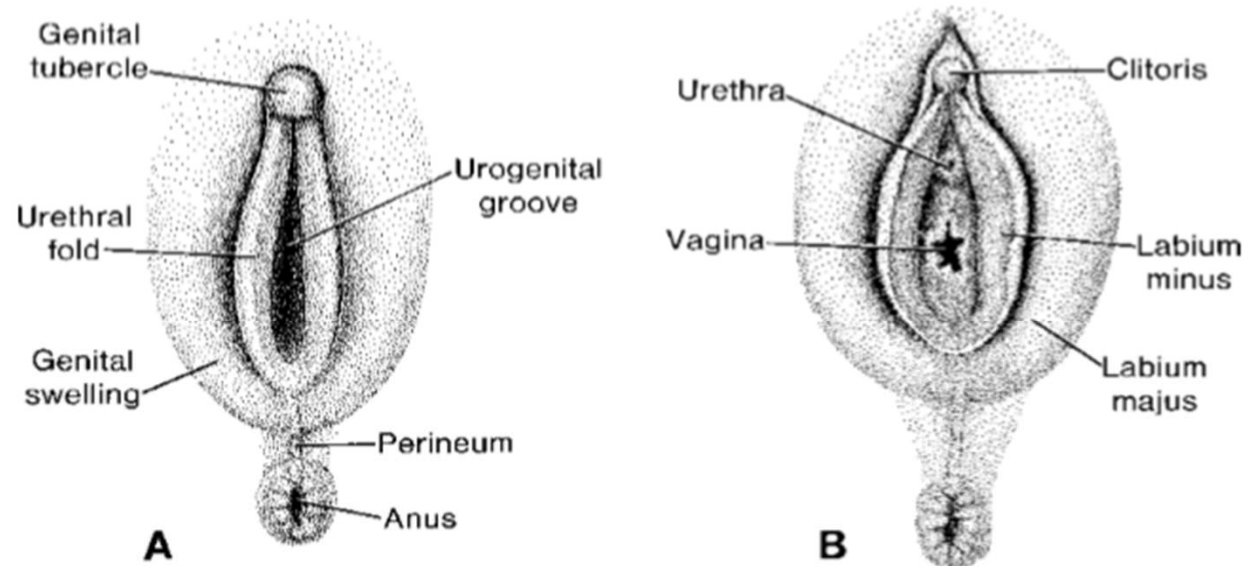
- Under the effects of the maternal and placental oestrogen, the external genitalia are switched to Form Female type of genitalia.

1. Genital tubercle: it elongates to form the clitoris, whose mesenchyme forms its two corpora cavernosa (note that, the clitoris has **no** corpus spongiosum).

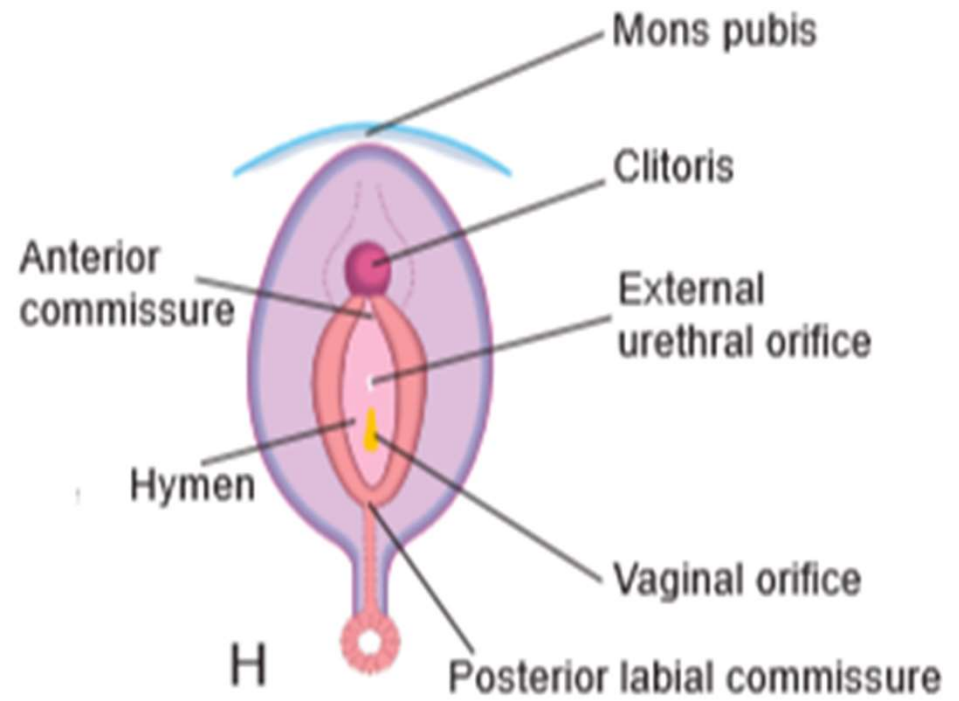
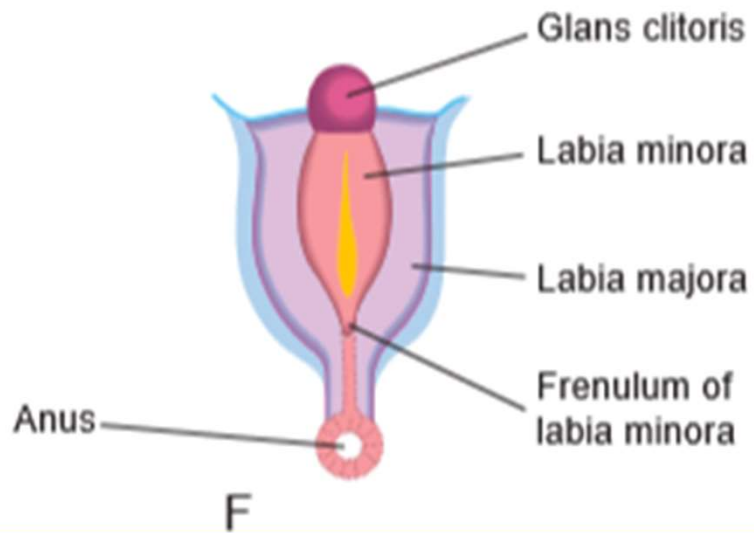
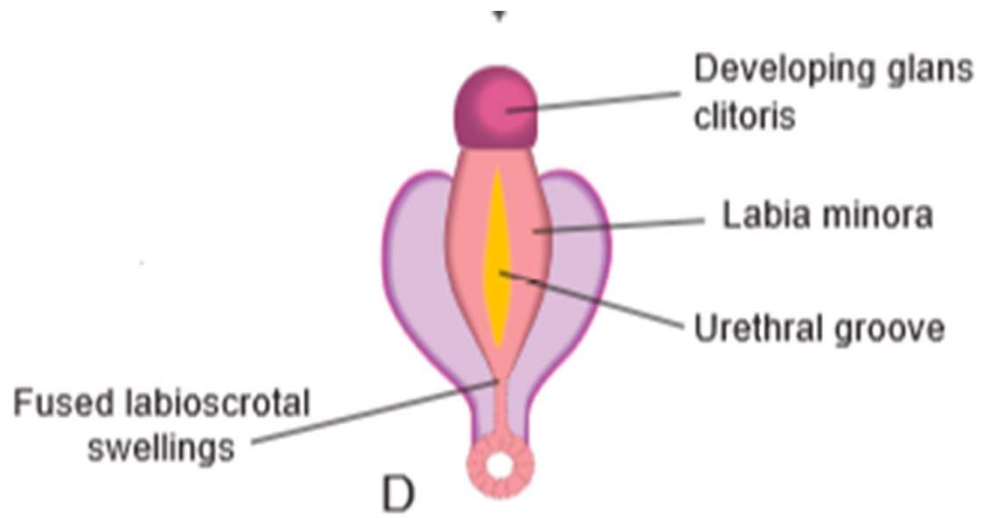
2. Genital (urethral folds): they remain **separate** to form the two labia minora.

3. Genital swellings: they remain **separate** to form the two labia majora.

4. The vaginal vestibule: is formed when primitive urogenital sinus are **shortened** to form the vestibule between the two labia minora.



6.36 Development of the external genitalia in the female at 5 months **A** and in the newborn **B**.





THANK YOU