



Reproduction Block

Embryology Team



Lecture 1: Development of the Male Reproductive Organs

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Objectives:

At the end of the lecture, students should be able to:

- List the causes of differentiation of genitalia into the male type.
- Describe the origin of each part of the male internal & external genitalia.
- List the causes & describe the events of descent of testis.
- List the common anomalies of male genital system & describe the causes of each of them.

Red = important

Green= team notes

P.S. 16 pages may seem too many, but the actual work is 10 pages. So, don't worry about it, and hopefully you'll find the lecture easy to understand. Best of luck!



MALE GENITAL SYSTEM

Gonad:

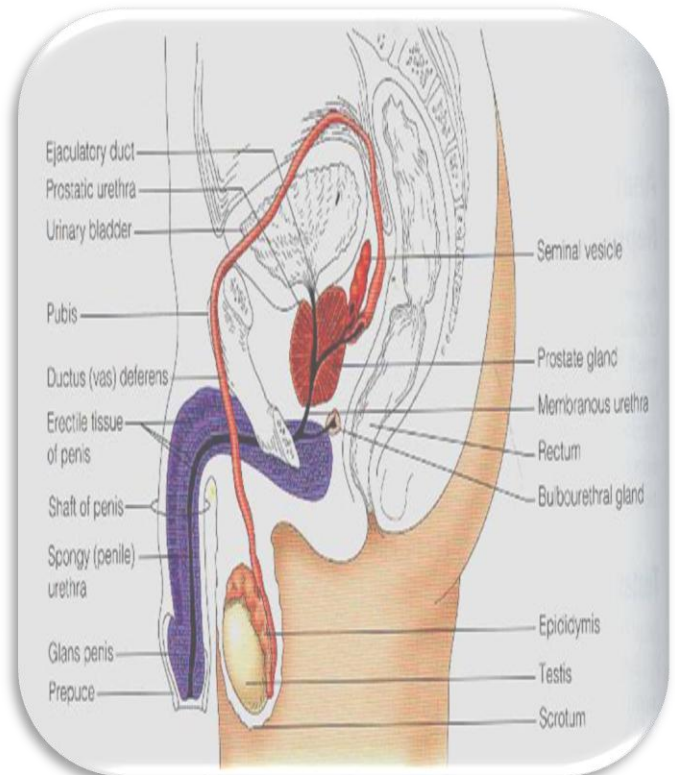
- Testis.

Genital Ducts:

- Epididymis.
- Vas deferens.
- Urethra.

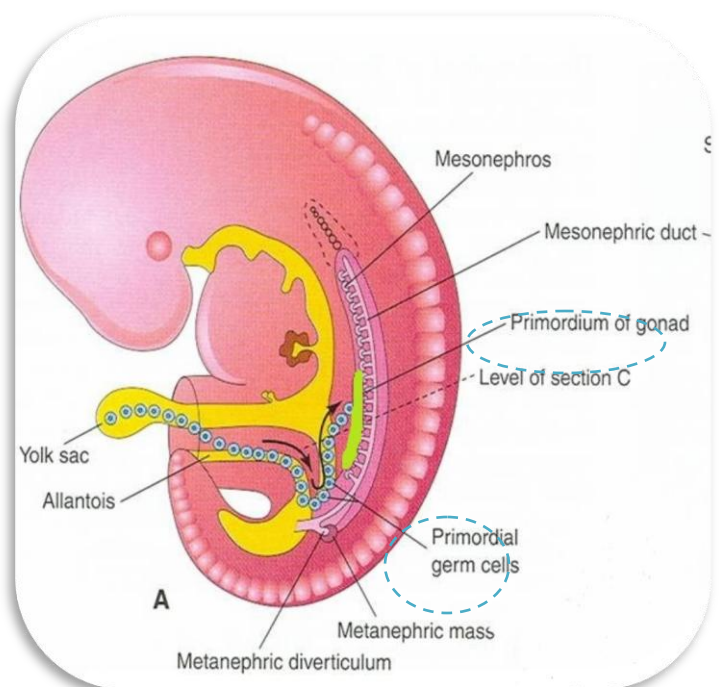
Genital Glands:

- Seminal vesicle (Seminal gland)
- Prostate.
- Bulbourethral Glands.



DEVELOPMENT OF GONADS

- During **5th week**:
Gonadal development occurs.
- **Until 7th week**: gonads are **similar** in both sexes.
- Gonads are **derived from 3 sources**:
 1. **Mesothelium (mesodermal epithelium** lining the coelomic cavity)
 2. **Underlying mesenchyme**
 3. **Primordial germ cells**



INDIFFERENT GONADS

- **Gonadal ridge:**

a bulge on the medial side of mesonephros
produced by:

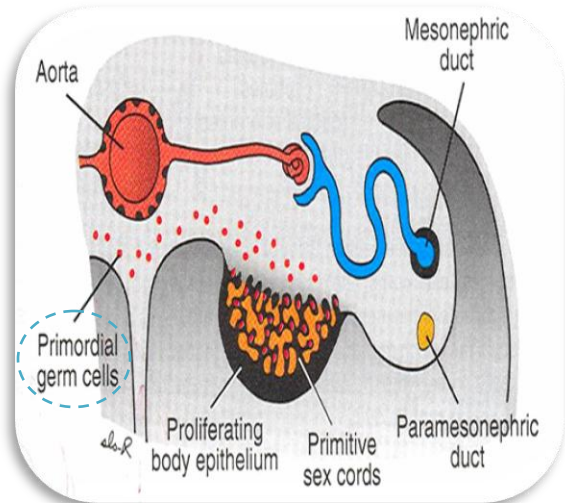
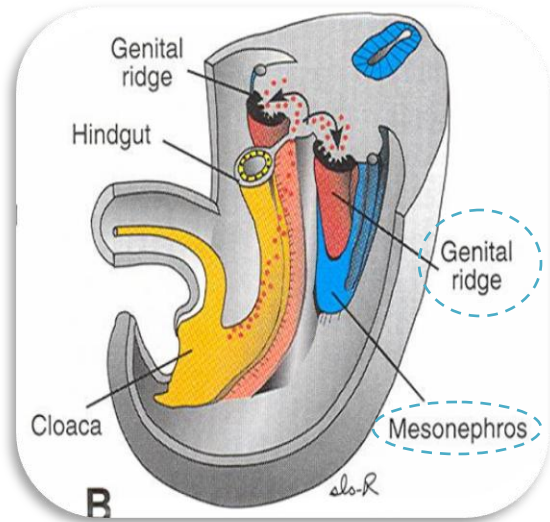
1. Proliferation of **mesothelium** (cortex)
2. Proliferation of **mesenchyme** (medulla)

- **Gonadal (primary sex) cords:**

The proliferating **mesothelial cells** (of the **gonadal ridge**) fuse and penetrate the underlying mesenchyme to form gonadal cords.

- **Primordial germ cells:**

endodermal cells of the **yolk sac** migrate along dorsal mesentery of hindgut to gonadal ridges & become incorporated into gonadal cords.

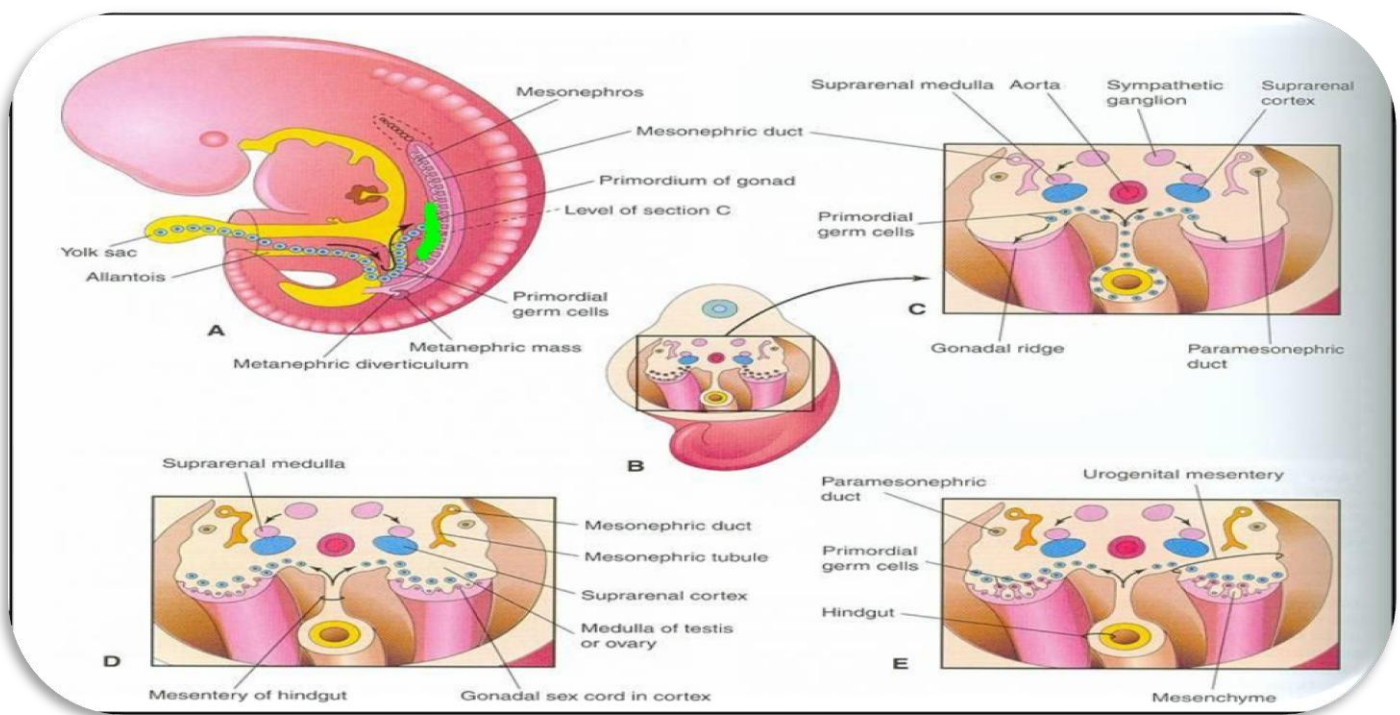


Sources of gonads :

Mesothelium :
 which gives gonadal ridge and gonadal cords .

Underlying mesenchyme which gives gonadal ridge and gonadal cords.

Primordial germ cells

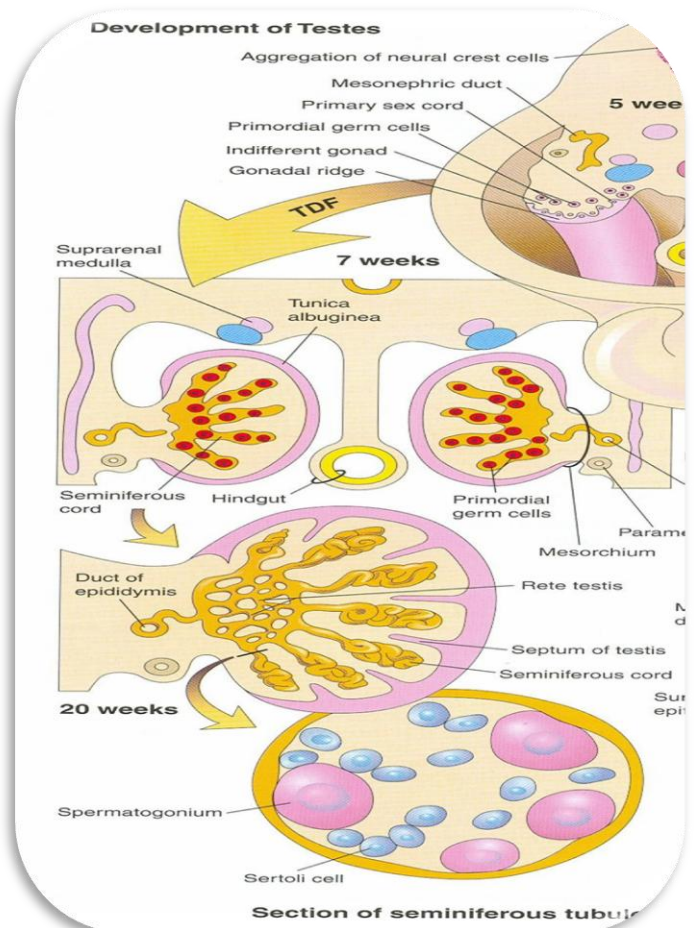


DEVELOPMENT OF TESTIS

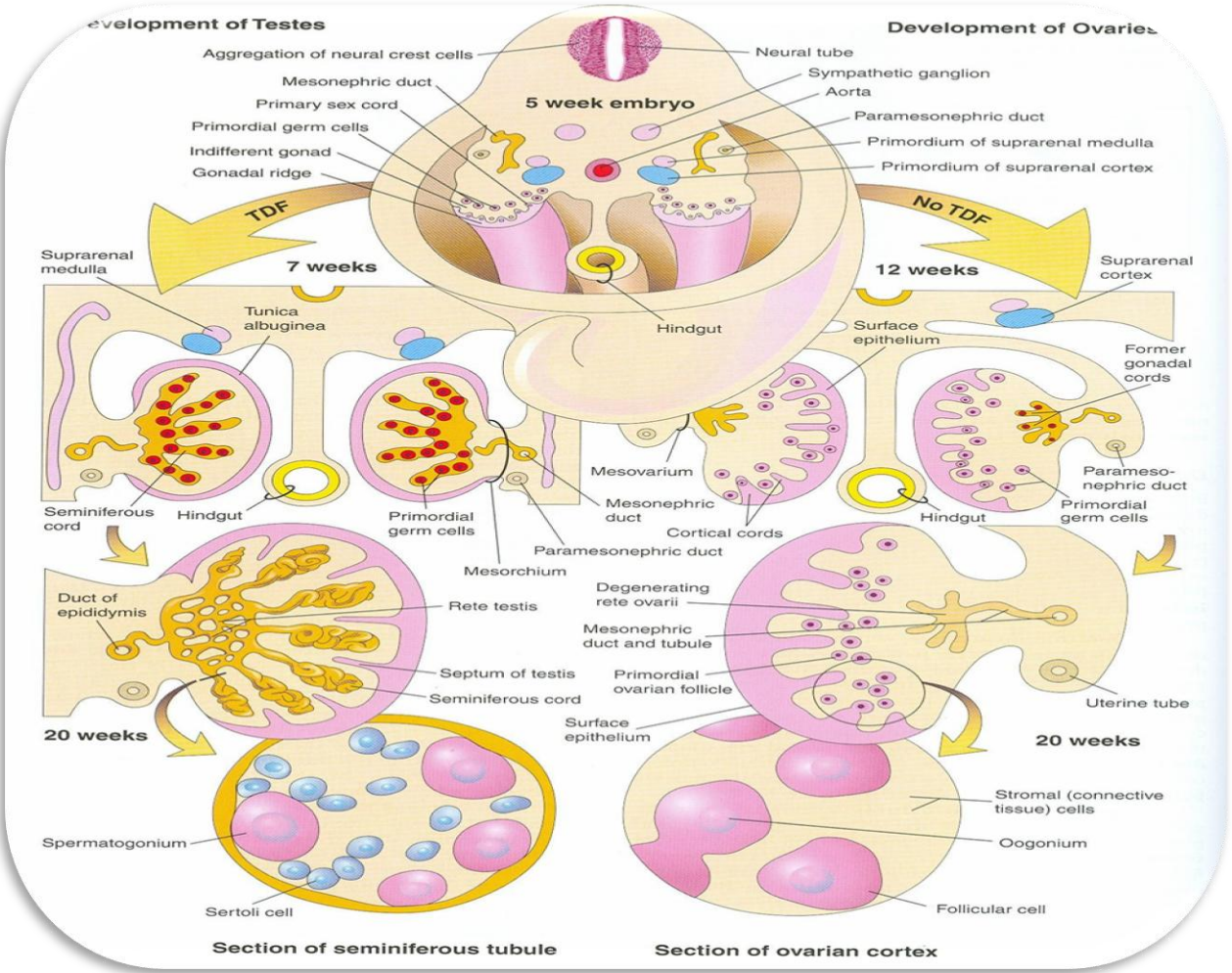
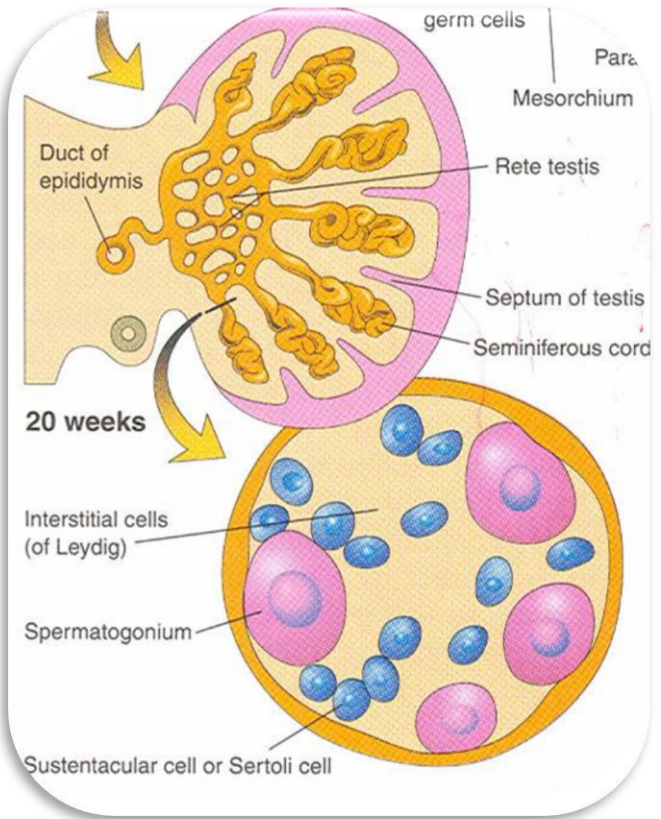
The Y chromosome has a **testis-determining factor (TDS)** that differentiates gonad into testis.

At 7th week:

- Regression of cortex & differentiation of medulla into testis.
- Gonadal cords condense & extend into medulla to form **seminiferous cords**.
- The **characteristic feature** is the **development** of a thick fibrous capsule (**tunica albuginea**) that separates the enlarging testis from mesonephros.



- Seminiferous cords develop into: **semineferous tubules**
- Semineferous tubules remain solid **until puberty**. Its walls are composed of:
 - 1) **Sertoli cells**: derived from surface epithelium of testis (**mesothelial cells**)
 - 2) **Spermatogonia**: derived from **primordial germ cells**
- By 8th week, **mesenchyme surrounding semineferous cords gives rise to interstitial cells (of Leydig)** secreting testosterone.



DEVELOPMENT OF MALE GENITAL DUCTS

Leydig's cells → Testosterone (8th week):

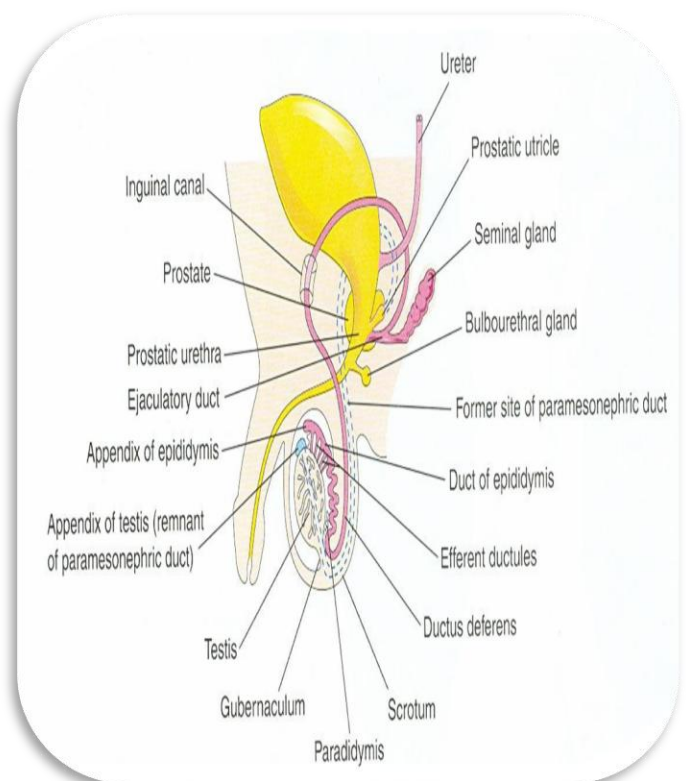
- 1) Masculine differentiation of mesonephric duct: epididymis, vas deferens, seminal glands, ejaculatory duct.
- 2) Masculine differentiation of external genitalia

Sertoli cells → Müllerian inhibiting substance (Anti- Müllerian hormone which is responsible for development of female gonads) (7th week):

Suppression of development of paramesonephric (Müllerian) duct (Which gives female ducts)

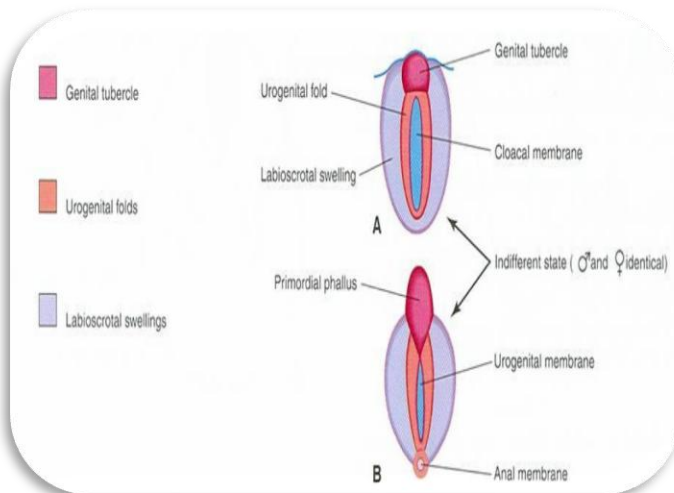
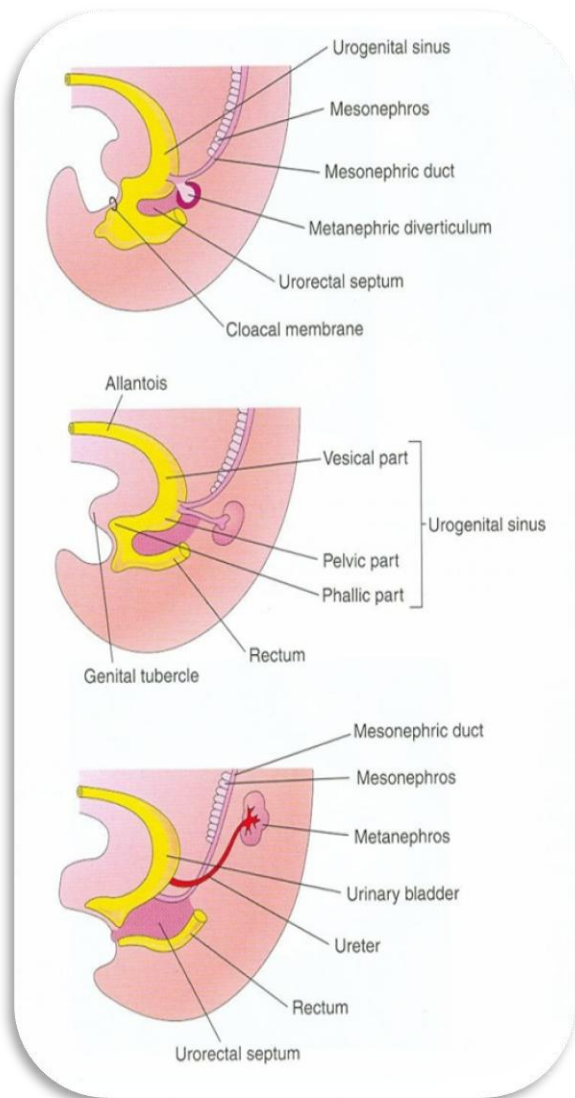
DEVELOPMENT OF MALE GENITAL GLANDS

1. **SEMINAL GLAND:** mesodermal outgrowth from **mesonephric duct.**
 2. **PROSTATE GLAND:** endodermal outgrowth from **prostatic urethra.**
 3. **BULBOURETHRAL GLAND:** endodermal outgrowth from **spongy urethra.**
- **Stroma & smooth muscles in 2 & 3 are derived from surrounding mesenchyme**



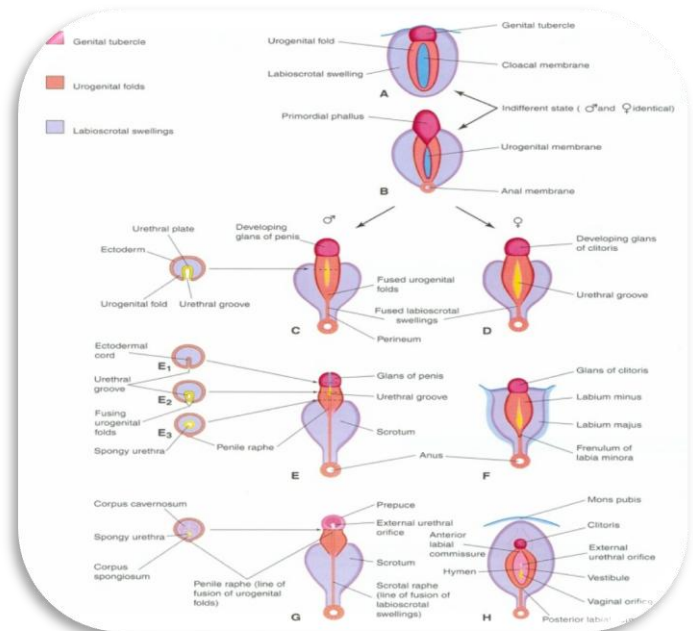
INDIFFERENT STAGE OF EXTERNAL GENITALIA (from 4th to 7th week)

- **Genital tubercle:** produced from **mesenchyme** at the cranial end of cloacal membrane. It elongates to form a **primordial phallus**
- **Urogenital folds:** develop on each side of cloacal membrane
- **Labioscrotal swellings:** develop on each side of urogenital folds



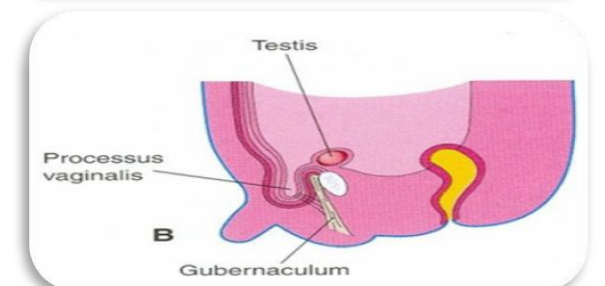
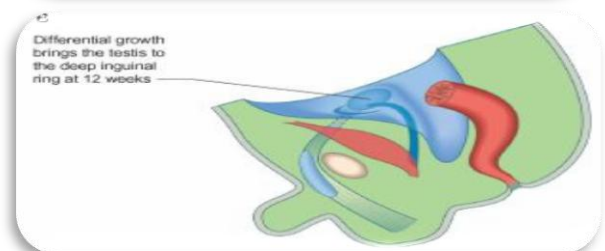
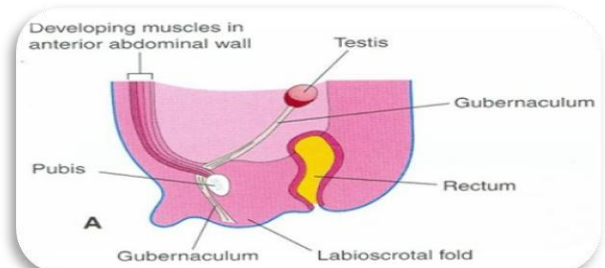
DEVELOPMENT OF MALE EXTERNAL GENITALIA *(stimulated by testosterone)*

- Begins at **9th week**
 - Complete differentiation at **12th week**:
1. The phallus (which come from **Genital tubercle**) enlarges to form the penis
 2. The urogenital folds fuse to form **the spongy (penile) urethra**
 3. The **labioscrotal folds** (swellings) fuse to form the **scrotum**



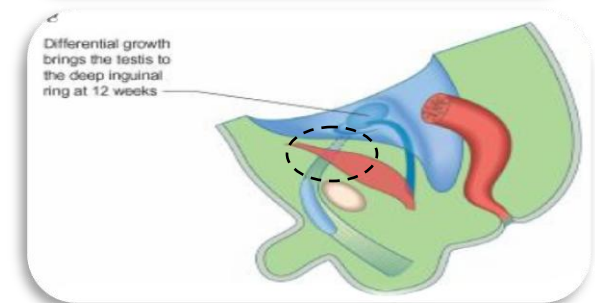
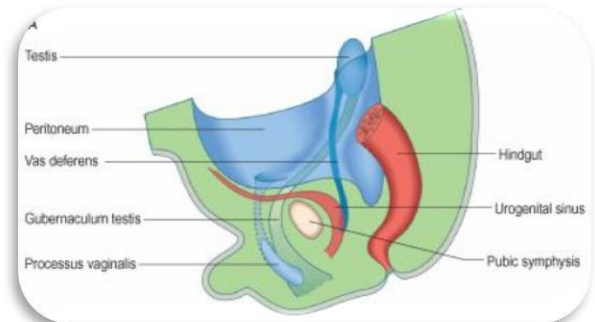
DESCENT OF TESTIS

- **Gubernaculum:**
A **mesenchymal band** extending from inferior pole of **gonad** to **labioscrotal fold**.
- **Inguinal canal:**
A pathway form by **gubernaculum** through layers of **anterior abdominal wall**.
- **Processus vaginalis:**
A **peritoneal fold** passing through inguinal canal before testis to **facilitate** its descent.



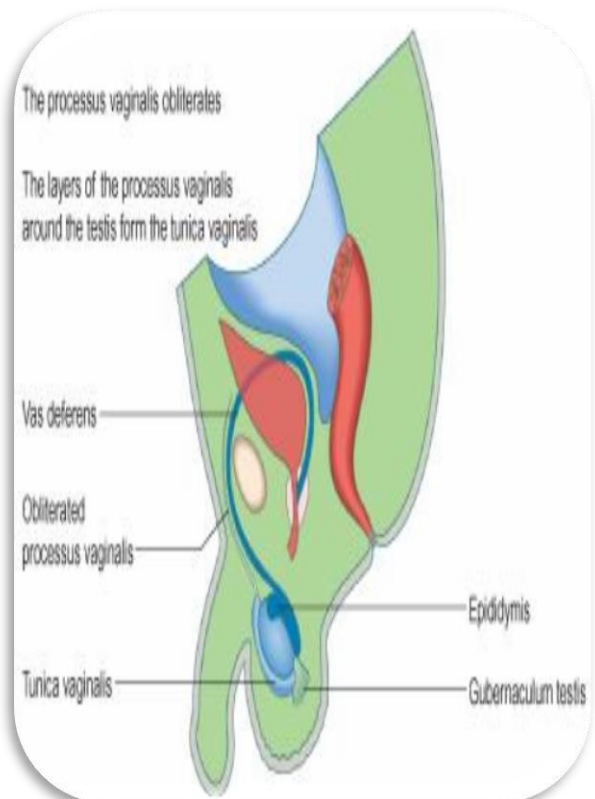
INTERNAL DESCENT OF TESTIS

- **Definition:** Descent of testis from posterior abdominal wall **to deep inguinal ring.**
- **Time:** During **12th week**
- **Cause:** a relative movement resulting from **elongation of cranial part of abdomen away from its caudal part** (future pelvic cavity).



EXTERNAL DESCENT OF TESTIS

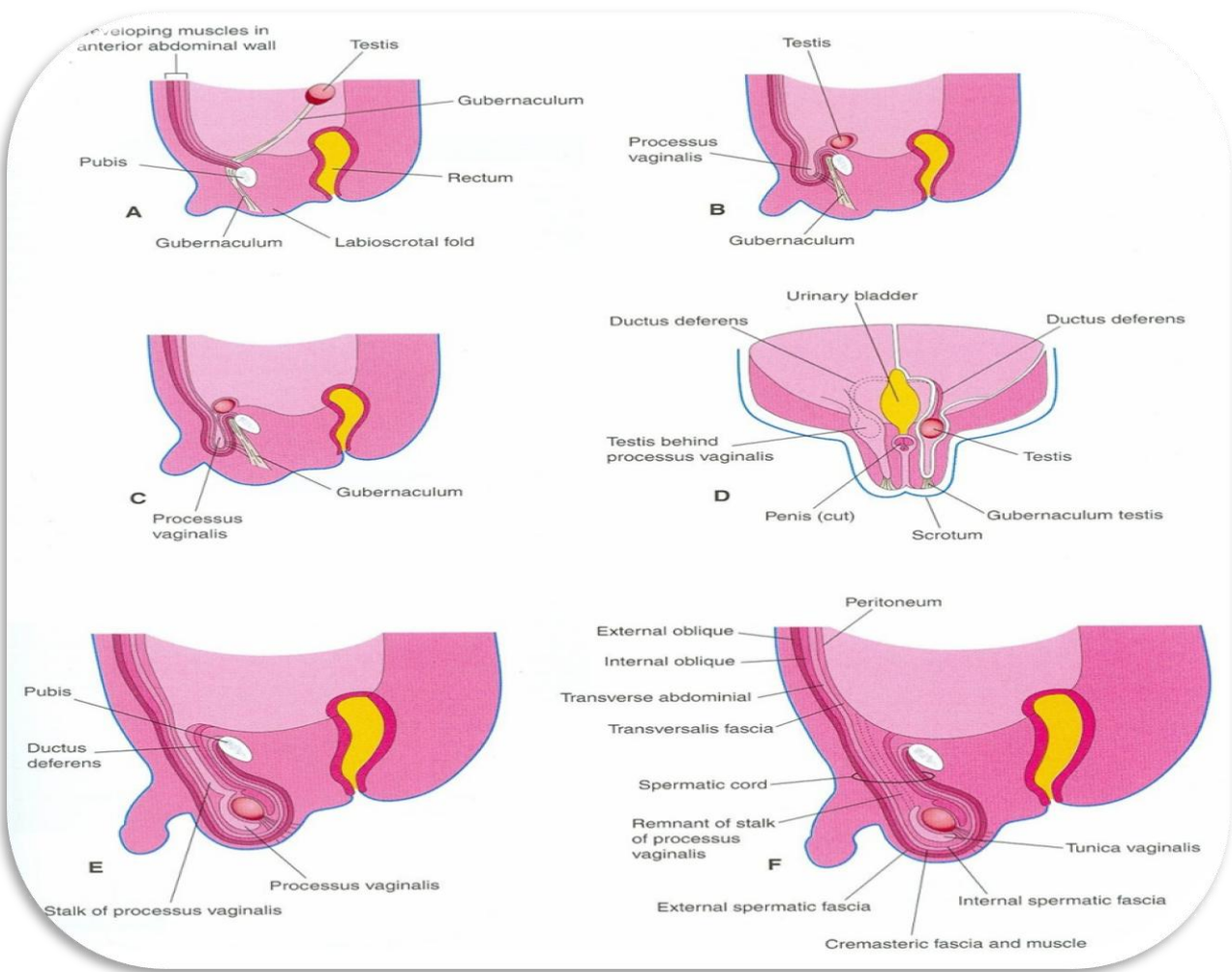
- **Definition:** Descent of testis from deep inguinal ring, through inguinal canal, **to scrotum**
- **Time:** Begins in **7th month** and takes **2 to 3 days**
- **Causes:**
 1. **Controlled by androgens.**
 2. **Guided by gubernaculum.**
 3. **Facilitated by processus vaginalis.**
 4. **Helped by increased intra-abdominal pressure resulting from growth of abdominal viscera.**



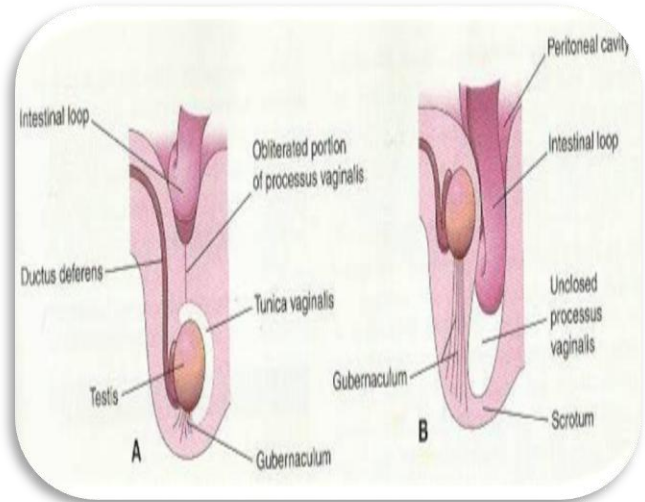
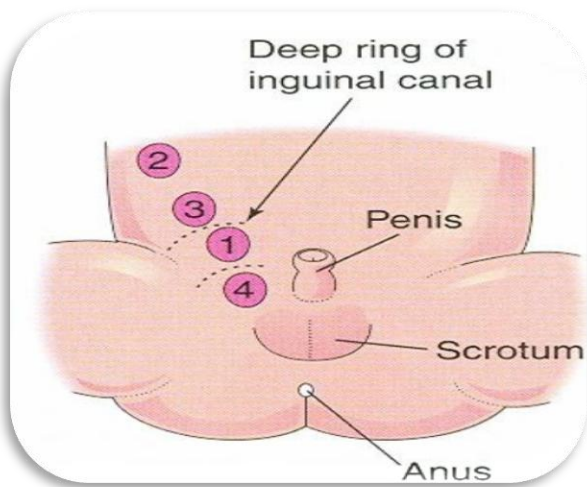
1. More than 97% of full-term newborn males have both testes in scrotum.
2. During first 3 months after birth, most undescended testes descend into scrotum.
3. No spontaneous descent occurs **after the age of 1 year**.

Complete descent of testis is associated by:

- Degeneration of **gubernaculum**
- Obliteration of stalk of processus vaginalis
- Persistence of part of processus vaginalis surrounding the testis in the scrotum to form "**tunica vaginalis**"



Congenital Anomalies



CRYPTORCHIDISM (UNDESCENDED TESTIS) :

- **Incidence:** in up to 30% of premature & 3-4% of full term males
- **Cause:** deficiency of androgens.
- **Common sites:** look to figure
- **Complications:**
 1. **Sterility**, if bilateral.
 2. **Testicular cancer (20-44%)**.

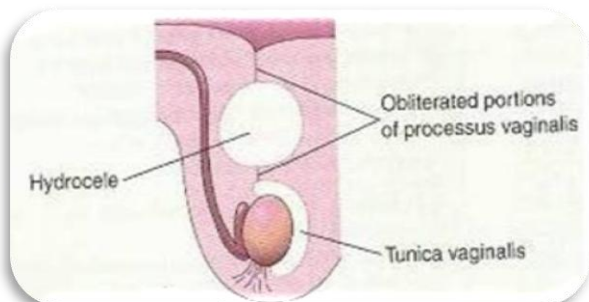
CONGENITAL INGUINAL HERNIA:

Definition: Herniation of a loop of intestine through a non-obliterated processus vaginalis.

A: incomplete

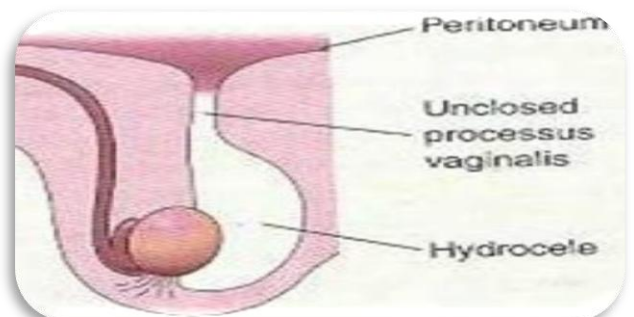
B: complete (in scrotum)

Cause: The processus vaginalis does not obliterate & remains in open communication with the peritoneal cavity



HYDROCELE OF SPERMATIC CORD:

Accumulation of fluid in spermatic cord due to a non-obliterated portion of stalk of processus vaginalis



HYDROCELE OF TESTIS:

Accumulation of fluid in tunica vaginalis (in scrotum) due to non-obliteration Of the whole stalk of Processus vaginalis

Summary

-During 5th week: gonadal development occurs. Until 7th week: gonads are similar in both sexes.

-Gonads are derived from 3 sources: 1-Mesothelium (mesodermal epithelium lining the coelomic cavity).
2- Underlying mesenchyme. 3- Primordial germ cells.

-INDIFFERENT GONADS: 1-Gonadal ridge. 2-Gonadal (primary sex) cords. 3-Primordial germ cells.

#DEVELOPMENT OF TESTIS:

-The Y chromosome has a testis-determining factor (TDS) that differentiates gonad into testis.

- At 7th week: Regression of cortex & differentiation of medulla into testis. Gonadal cords condense & extend into medulla to form seminiferous cords.

-Seminiferous cords develop into: seminiferous tubules which will remain solid until puberty, its walls are composed of 1-Sertoli cells 2-Spermatogonia

- At 8 weeks: mesenchyme surrounding seminiferous cords gives rise to interstitial cells of Leydig

- 1-Leydig's cells → Testosterone (8th week)

2-Sertoli cells → Müllerian inhibiting substance (7th week)

#DEVELOPMENT OF MALE GENITAL GLANDS:

1-SEMINAL GLAND: mesodermal outgrowth from mesonephric duct.

2-PROSTATE GLAND: endodermal outgrowth from prostatic urethra.

3-BULBOURETHRAL GLAND: endodermal outgrowth from spongy urethra.

-Genital tubercle: produced from mesenchyme at the cranial end of cloacal membrane. It elongates to form a primordial phallus.

-Urogenital folds: develop on each side of cloacal membrane.

-Labioscrotal swellings: develop on each side of urogenital folds.

#DEVELOPMENT OF MALE EXTERNAL GENITALIA:

-stimulated by testosterone.

-Begins at 9th week and complete differentiation at 12th week

1-The phallus → the penis.

2-The urogenital folds → the spongy (penile) urethra

3-The labioscrotal folds → the scrotum

#INTERNAL DESCENT OF TESTIS:

- 1-Descent of testis from posterior abdominal wall to deep inguinal ring.2- time: **During 12th week**
- 3-Cause: a relative movement resulting from elongation of cranial part of abdomen away from its caudal part (future pelvic cavity).

#EXTERNAL DESCENT OF TESTIS:

- 1-Descent of testis from deep inguinal ring through inguinal canal to scrotum.2-Time: Begins in 7th month and **takes 2 to 3 days**.3-Causes: Controlled by androgens, Guided by gubernaculum, Facilitated by processus vaginalis Helped by increased intra-abdominal pressure resulting from growth of abdominal viscera.
- More than 97% of full-term new born males have both testes in scrotum.
 - During first **3 months after birth, most undescended testes descend into scrotum**.No spontaneous descent occurs after the age of **1 year**.
 - Complete descent of testis is associated by:
 - 1-Degeneration of gubernaculum
 - 2-Obliteration of stalk of processus vaginalis
 - 3-Persistence of part of processus vaginalis surrounding the testis in the scrotum to form "tunica vaginalis"

#CHRYPTORCHIDISM (UNDESCENDED TESTIS)

- Cause: deficiency of androgens -Common sites: **deep ring of inguinal canal** -Complications: Sterility, if bilateral Testicular cancer (20-44%).

#CONGENITAL INGUINAL HERNIA

- Herniation of a loop of intestine through a non-obiterated processus vaginalis** - Cause: The processus vaginalis does not obliterate & remains in open communication with the peritoneal cavity.

HYDROCELE OF SPERMATIC CORD

- Accumulation of fluid in spermatic cord due to a non-obiterated portion of stalk of processus vaginalis.**

HYDROCELE OF TESTIS

- Accumulation of fluid in tunica vaginalis(in scrotum) due to non-obiteration of the whole stalk of Processus vaginalis.**

Time Table

5 th week	Gonadal development occurs
7 th week	<ul style="list-style-type: none"> • Gonads are similar in both sexes • Regression of cortex & differentiation of medulla into testis • Gonadal cords condense & extend into medulla to form seminiferous cords. • Development of a thick fibrous capsule (tunica albuginea) • müllerian inhibiting substance (anti- müllerian hormone)
4 th – 7 th week	Indifferent stage of external genitalia
8 th week	Mesenchyme surrounding seminiferous cords gives rise to interstitial cells (of leydig) secreting testosterone.
9 th week	Development of male <u>external</u> genitalia (begins at it)
12 th week	<ul style="list-style-type: none"> • Complete differentiation of male <u>external</u> genitalia • <u>Internal</u> descent of testis
7 th month	<u>External</u> descent of testis (begins at it, takes 2 to 3 days)
1 year	No spontaneous descent of testis occurs after the age of 1 year

Questions

1. Which of the following is the characteristic feature of the testicular development?

- A. Rete testis.
- B. Seminiferous cords.
- C. Tunica albuginea.
- D. Testis- determining factor (TDF).

2. Which structure gives rise the seminal gland?

- A. Genital tubercle.
- B. Mesonephric duct.
- C. Paramesonephric duct.
- D. Urogenital sinus.

3. Which one of the following contributes in accumulation of fluid in scrotum?

- A. Cryptorchidism.
- B. Congenital inguinal hernia.
- C. Hydrocele of spermatic cord.
- D. Hydrocele of testis.

4. Which one of the following structure is a derivative of male urethra?

- A. Seminal gland
- B. Prostate gland
- C. Vas deferens
- D. Ejaculatory duct

5. Which one of the following cells is responsible for masculine differentiation of external genitalia?

- A. Sertoli cells
- B. Leydig's cells
- C. Mesothelial cells
- D. Primordial germ cells

Answers: 1- C 2- B 3- D 4- B 5- B