

## Development of Gonads

During 5<sup>th</sup> week - Gonadal development occurs.

Until 7<sup>th</sup> week gonads are similar in both sexes.

Gonads are derived from 3 sources:-

- Mesothelium (mesodermal epithelium lining the coelomic cavity)

- Underlying mesenchyme

- Primordial germ cells (PGCs)

### Indifferent Gonads

Gonadal ridge - a bulge on the medial side of mesonephros produced by:-

- Proliferation of mesothelium (cortex)

- " mesenchyme (medulla)

Gonadal primary sex cords - The proliferating mesothelial cells fuse to form cords.

Primordial germ cells - Endodermal cells of yolk sac migrate along dorsal mesentery of hindgut to

gonadal ridges & become incorporated.  
the gonadal cords

## Development of testis

The Y chromosome has a testis determining factor (TDF) that differentiates gonad into testis

At 7<sup>th</sup> 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:-  
seminiferous tubules

Seminiferous ~~tubules~~ tubules remain solid until puberty. Its wall

are composed of :-

- 1) Sertoli cells - Derived from primordial germ cells
- 2) Spermatogonia - derived from primordial germ cells.

By 8<sup>th</sup> week - mesenchyme surrounding seminiferous cords gives rise to interstitial cells (of Leydig) secreting testosterone

Regression of cortex & differentiation of medulla

Gonadal cords extend into medulla & form medullary (seminiferous) cords

Appearance of Tunica albuginea

Seminiferous cords give rise to — seminiferous tubules

Mesenchyme surrounding tubules gives rise to interstitial cells of Leydig

Germ cells  
↓

Spermatogonia

Mesothelial cells  
↓

Sertoli cells



# Development of Male Genital ducts

Leydig cells



Testosterone  
(8th week)



Masculine differentiation

mesonephric duct -  
epididymis,  
vas deferens,  
seminal glands,  
ejaculatory duct.

Sertoli cells



Mullerian inhibiting  
substance (Anti-  
mullerian hormone)  
7th week



suppression of  
development of  
paramesonephros  
(Mullerian duct)

Masculine differentiation  
of external genitalia



## Development of male genital ducts and accessory gland

As metanephros develops and mesonephros degenerates.

It is overlapped at the cranial and caudal ends by mesonephros and mesonephric tubules.

These tubules located opposite to rete testis unite with rete tubules and make a link between seminiferous tubules and mesonephric duct. These tubules are known as efferent tubules of the epididymis or vasa efferentia.

The mesonephric tubules retained at cranial end are called ductuli aberrantes superior and the one at caudal end are called ductuli aberrantes inferior.

Ductuli aberrantes inferiores are retained as paradidymis. These structure are vestigial & have no important function.

Cephalic end of mesonephric duct which is joined by efferent ductules, gets convolutions & becomes ductus epididymis.

Caudal portion extending from epididymis to urogenital sinus remains relatively straight & becomes vas deferens.

Vas deferens surrounded by muscular wall from mesenchyme. The ~~terminal end~~

The terminal end of mesonephric duct which joins urogenital sinus become ejaculatory duct.

Accessory organs are derived from evagination of certain segments of urogenital tracts.

These are homologous organs in both sexes and more developed in males.

These glands developed from germ layers.

Ampullary glands } derived from  
Vesicular glands } - lower ductus  
deferens.

Prostate } - from from lower  
Penile urethra } endodermal part  
of urogenital sinus

Prepubertal } - from ectoderm  
Inguinal glands } of pre-pubertal  
& inguinal region

Seminal vesicles } - Develops by evagination  
at caudal region of  
ampullary gland around  
13th week.

Bulbourethral } - arise as evagination  
or Cowper's glands } of proximal end of penile  
urethra. (Endodermal)



Urethral glands of Littre arise as  
multiple & simple outgrowths  
from epithelial lining of the  
urethra.

## Development of External genitalia

\* Stimulated by testosterone  
Starts at 9th week

Differentiation completes at 12th week

Phallus enlarges to form penis

Urogenital folds fuse to form  
spongy urethra

Labioscrotal folds form scrotum

(\*) Primordia of external genitalia, are bipotential.

In male there only one opening for both & called urogenital opening.

At end of 5th week a conical genital tubercle is present in mid-line on ventral side between umbilical cord & tail. It has a groove called urogenital groove whose side walls elevated & called urogenital folds.

During 7th week genital tubercle elongates into a cylindrical phallus

Lateral to phallus a rounded ridge makes its appearance on each side called genital swellings (later scrotal swellings).

From this indifferent stage, external organ of male & female are formed in later weeks.

During 8th week sex of embryo begins to be indicated by erectness of phallus, length of urethral groove & relations of urogenital folds with genital swellings.

At 3 months, external genitalia show recognizable characters.



# Development of female Genital System

## Differentiation of ovaries

Female gonads not exhibit any distinctive ovarian features until several weeks after gonad of male has differentiated as testis.

This indifferent gonad can only be identified as a potential ovary by absence of developing seminiferous cords & absence of sertoli cell differentiation.

In 8th week - gonadal blastema begins to show small indifferent cells and one or more primordial germ cells

Now a dense primary cortex below germinal epithelium may be identified from loose primary medulla.

With this a compact cellular mass bulges from medulla into mesovarium to form rete ovaries (homologous to rete testis)

At this stage neither epithelial cord nor tunica albuginea are developed in testis.

In 3<sup>rd</sup> month ovary gains a mesentery called mesovarium and takes caudal position.

At 4 months two crucial changes take place:-

- a) ovary grows in size due to cortex deposition upon original blastema. This is called secondary cortex. It is formed by division of PGCs and cells of superficial blastema and by renewable proliferation of germinal epithelium.
- b) Ingrowth of connective tissue & blood vessels from rete ovaris. It produces septula.

At 7<sup>th</sup> month this septula forms a connective tissue layer called tunica albuginea.



First generation cords called medullary or primary cords developed from cellular blastema of mesonephric origin & degenerate shortly.

Second generation of cords developed from coelomic epithelium & form follicles. These cords are called cortical cords as they are present in cortical part of gonads.

Ovary cortex populated with germ cells & medulla consisting mesonephric cells.

Embryonic ovary after differentiation will not receive any PGCs.

Only PGCs present in differentiated ovary will divide mitotically to form cells called oogonia.

The cells surround immediately oogonia called pre-granulosa cells.

After formation of follicles they are known as granulosa cells.



Neighboring cells of germinal epithelium surround the PCICs entrapped in cortical cortex.

This initiates formation of primordial follicles — a characteristic of ovary in later fetal months and even after birth.

In these follicles cord cell secretes an outer basement membrane called membrana propria.

Interstitial cells of the ovary & thecal layer of follicles arise from inter-tubular components.

Earlier germ cells present in primary medulla regress and are replaced by permanent medulla of ovary.

## Development of female genital ducts and accessory glands

In embryo at 37<sup>th</sup> day paramesonephric duct appears.

This forms the entire female reproductive tract.

It runs parallel to mesonephric duct and at caudal position it fuses with duct of opp side. in the mid-line.

Mesonephric duct degenerates & leaves only duct & tubules which is suspended from dorsal body. This contains enlarging paramesonephric duct or uterine duct and degenerated mesonephric duct or tubules.

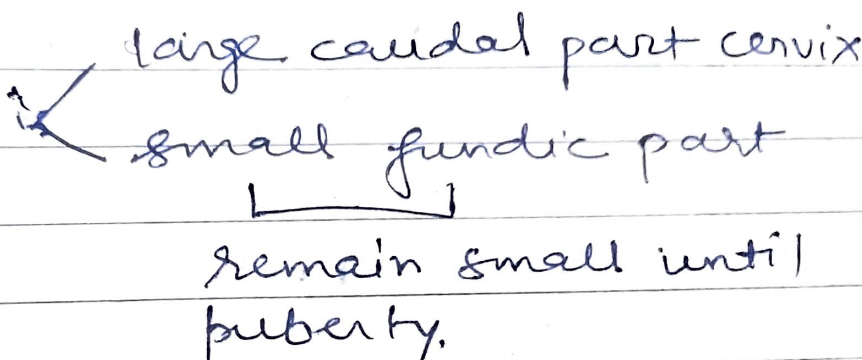
— 10<sup>th</sup> week

At caudal end of paramesonephric duct get fused & form a single cavity called utero-vaginal canal and the blind end of posterior wall of urogenital sinus form mullerian tubercle.

Mass of all cells laid down between urogenital sinus and utero-vaginal canal in cranio-caudal direction & completed by 5th month.

The unfused portion of paramesonephric ducts form uterine tubes called fallopian duct.

Fused portion form uterus and vagina.

Uterus   
large caudal part cervix  
small fundic part  
remain small until puberty.

Uterine tube or fallopian tube becomes coiled & differentiate into epithelia & fimbriae.

Hymen - incomplete membrane present at union of utero-vaginal canal & urogenital sinus.



Homologue of seminal vesicle is not present in females.

Para urethral glands - represent prostate gland - Arise as epithelial diverticula from urogenital sinus which form urethra.

Poorly developed as male prostate glands. Enlargement occurs in pseudohermaphroditism.

Bartholin glands - homologous to male bulbourethral glands.

Well developed & arises from urogenital sinus, degenerates & form vestibule.

External Genitalia in females.

Changes to form external genitalia are slower in females than males

Phallus become clitoris

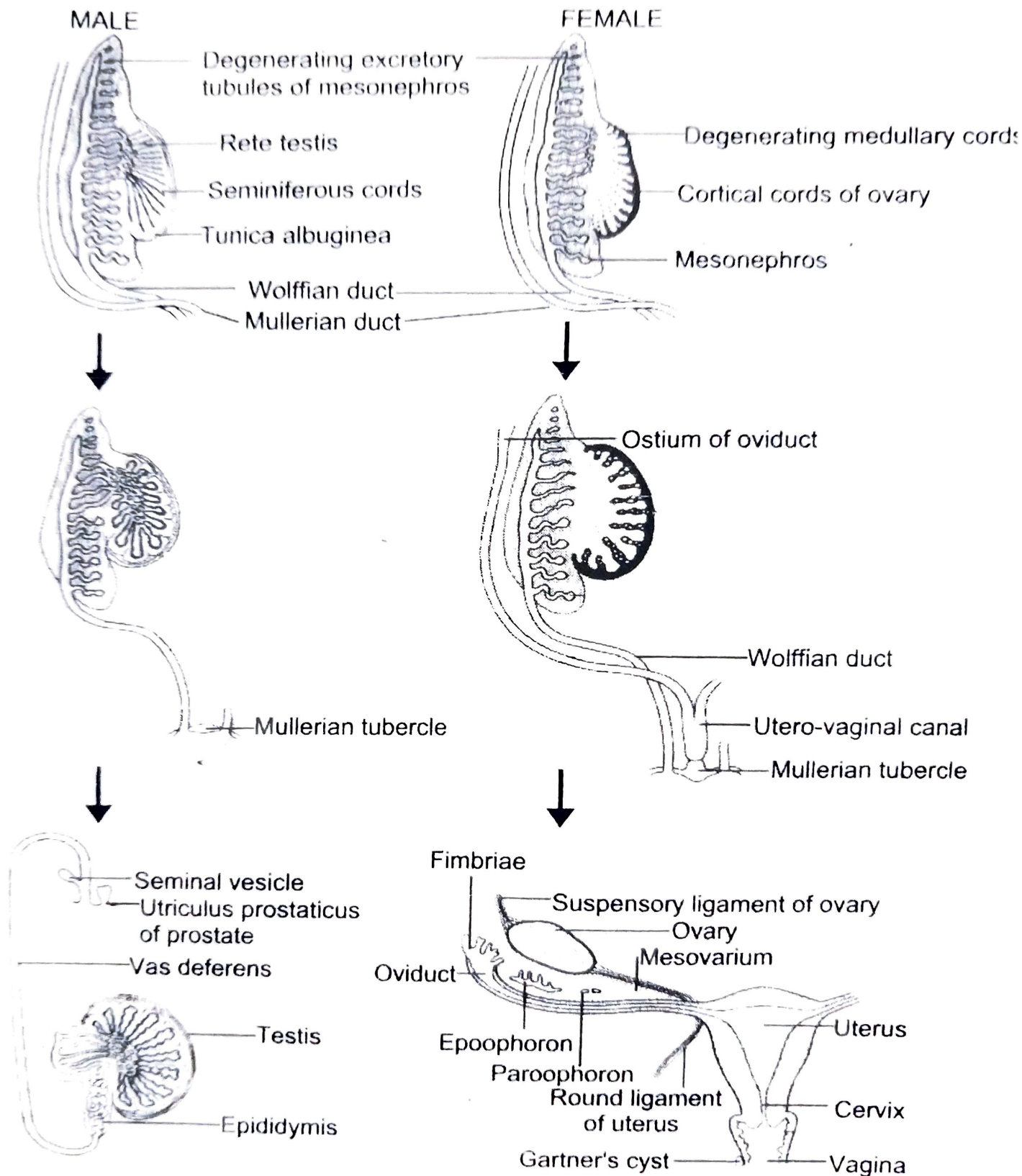
Urogenital groove is short, never invade ~~the~~ clitoris. It opens <sup>to</sup> exterior.

Shallow cavity called vestibule into which urethra & vagina open.

Urogenital folds lie on either side of groove become plate like & form labia minora.

Genital swellings grow caudally & enlarge into labia majora.

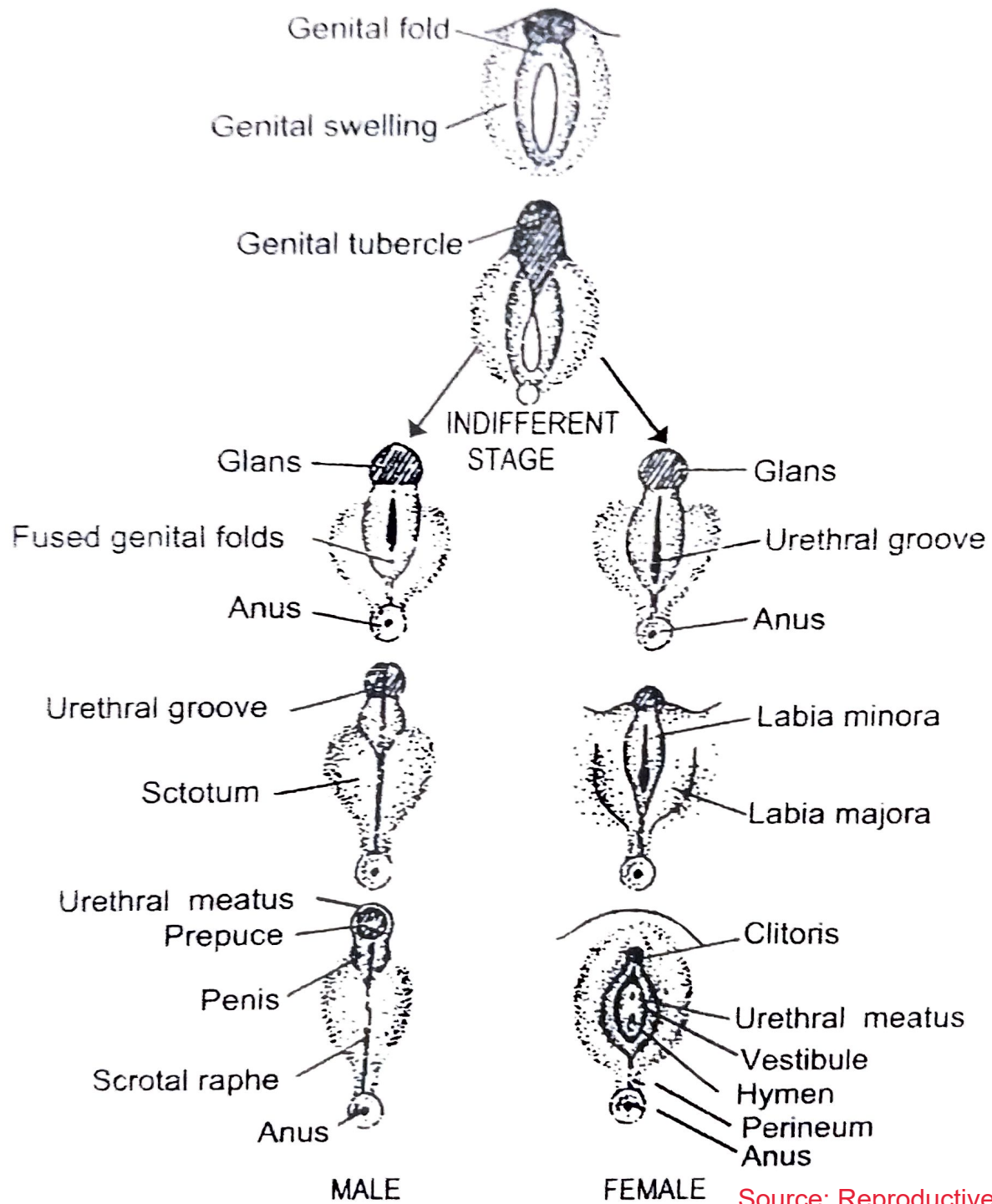
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Source: Reproductive biology by Gayatri Prakash

Figure 8.12: Differentiation of the genital ducts in Human male and female.





Source: Reproductive biology by Gayatri Prakash

Figure 8.14: Development of external genitalia in Human male and female from an indifferent stage.