Development of Reproductive System

**before study this lec make sure you have study the anatomy lec about genital**

**the slide is included in bold but not the figures so you have to open slide and see fantastic figures there (^-^)**

**I am very sad and happy to say that …the slide contain most information and the thing I have added are to understand and a little amount of new information**

**Development of Urogenital System**

- Both the urinary & reproductive systems are closely related (structurally & developmentally)
- Urogenital system develop from the intermediate mesoderm
- Urogenital ridge is a longitudinal elevation of the mesoderm lateral to the dorsal aorta
- Nephrogenic cord (ridge) develop in the urogenital ridge
  - Gives rise to part of the urinary system
- Genital (gonadal) ridge develop close to the nephrogenic cord
  - Gives rise to part of the genital system

The gonadal ridge (cord) developed medial to the nephrogenic cord

So from medial to lateral we have a raw as following (gonadal ridge, mesonephrone, mullerian duct (which is important in female not in male) ) we will talk about each later on in this lecture

**Development of Gonads**

- Early development of male & female gonads are similar (indifferent stage indifferent gonads) >> same for male and female
- Development of gonads begin in the 5th week
- Source of gonadal development
  - Mesothelium of posterior abdominal wall – lateral somatic mesoderm – cortex >> as the posterior abdominal wall begins to develop then a part of the gonads develop (mainly female organs)
    - Proliferate and form gonadal ridge
    - Primary sex cords >>it is a finger like projection toward mesoderm (indifferent gonads “male and female”)
    - In female form ovary
- Underlying mesenchyme – intermediate mesoderm – medulla (inside)
  - In male form testis >> also form mesenchyme of ovaries
Primordial germ cells – from the yolk sac
- Migrate via mesentery & mesenchyme to the primary sex cords (6th week)

Sex Determination
- Y chromosome has SRY gene in the sex determining region for testis determining factor (TDF)
- Presence of TDF determines the differentiation of testis
  - Primary sex cords (in medulla) → seminiferous tubules
  - Absence of Y chromosome & TDF results in ovary formation
- Testosterone from fetal testis determines male characteristics
  - Female characteristics determined without hormonal effect

Development of Testes
The primary sex cord separate from the mesothelium from which it developed and then develops to form seminiferous tubules
- **Primary sex cords** extend into medulla and form **seminiferous cords** (obliterated tubules)
  - Lumen form on puberty
- **Seminiferous cords** Branch & connect to form **rete testis**
- **Rete testis connect with 15-20 mesonephric tubules** ...... → **efferent ductules**
- **The sequence of sperm from the testis** (seminiferous tubules >> straight tubules >> rete testis >> efferent ductules (mesonephric tubules)>> ductus epididymis (form from proximal part of Mesonephric duct) >> vas deferens (form from distal part of Mesonephric duct)>> ejaculatory duct )
- **Mesonephric duct becomes ductus epididymis**

- The fibrous **tunica albuginea** form:
  - seminiferous cords loose connection with surface epithelium
- Testis enlarge & separate from the abdominal wall leaving a mesentery (mesorchium)
  - tunica albuginias its dense irregular connective tissue developed from the intermediate mesoderm that surround the testis after that a septa come from tunica albuginias will separate the testis into lobules each contain 2-3 seminiferous tubules
- **as the testis form in the abdominal cavity it will be connected to the abdominal wall and this connection contract (called “mesorchium”)**

- **Interstitial (leydig) cells** form from the mesenchyme between seminiferous cords
  - By 8th week secrete testosterone under influence of hCG
    - Induce differentiation of mesonephric ducts & external genitalia
- **Sertoli cells** derived from **surface epithelium** of testis
  - Secrete antimullerian hormone (AMH) at 6-7 week (near the end of indifferent stage)
    - Suppresses development of paramesonephric (mullerian) ducts
- **Spermatogonia** develop from **primordial germ cells**

- the interstitial (leydig) cells from the intermediate mesoderm
- **the sertoli cells develop from the surface epithelium which develops from mesothelium**

Development of Ovaries
- **Primary sex cords** → **rete ovarii** → degenerate
- **Secondary sex cords** (cortical cords)
  - Extend to underlying mesenchyme at early fetal life
  - **Primordial germ cells** incorporated in it
  - Disconnect and form **primordial follicles**
    - **Oogonium** surrounded by 1 layer of follicular cells
**the secondary sex cord which is form only in female (not found in male) will develop to form most of the cortical region of the ovaries which contain developing follicles**  
**primordial follicles which is formed from oogonium surrounded by one layer of secondary sex cord**  

- Surface epithelium form 1 layer of germinal epithelium  
  - Separated from cortex (which located internal to the surface epithelium) by fibrous tunica albuginea  
- Ovary separate from the abdominal wall leaving a mesentery (mesovarium)  
**the mesovarium persist in adult not like mesorchium in the male.**

### Development of Genital Ducts

- In the indifferent stage twoducts develop (5th-6th week)  
  - Mesonephric (woiffian) ducts from mesonephrone  
    - Important in male genital structures  
    - Disappear in female  
  - Paramesonephric (mullarian) ducts – develop lateral to the gonads & mesonephric ducts  
    - Form from longitudinal invagination of the mesothelium  
    - Important in female genital structures  
    - Disappear in male  
**the Paramesonephric (mullarian) ducts form the uterine tube, uterus and first part of the vagina**

- Mesonephric ducts  
  - Proximally – form epididymis  
  - Distally – form ductus deferens & ejaculatory duct  
    - Lateral outgrowth give rise to seminal vesicle  
- Paramesonephric ducts  
  - Rostrally (with funnel shape opening into the abdomen) >> this opening represents the opening of the uterine tube at infandublim which is normally open toward abdominal cavity  
  - Caudally they cross anterior to mesonephric ducts & fuse together (two paramesonephric duct fuse) forming uterovaginal primordium (sinus tubercle)  
    - Ends at the posterior wall of the urogenital sinus  
    - Results in an elevation called sinus tubercle >> which will develop into uterus and upper part of vagina

### Formation of the Peritoneal Structures

- The fusion of the distal parts of the paramesonephric ducts extend parts of the peritoneum towards the midline  
- The extended peritoneum forms the **broad ligament**  
  - Anterior to it forms the vesicouterine pouch  
  - Posterior to it forms the rectouterine pouch  
**as the paramesonephric duct formed in the abdomen then descend into pelvis this will pull part of the posterior abdominal wall and form the broad ligament**

### Development of Male Glands

- Seminal vesicle develop from a Lateral outgrowth of the distal part of the mesonephric duct  
- Prostate gland develop from endodermal outgrowth of the prostatic urethra into the surrounding mesenchyme >> from the pelvic part of Urogenital sinus  
- Bulbourethral glands develop from outgrowths of the penile urethra >> from the phallic part of the Urogenital sinus

### Development of Female Genital Organs

- Uterine tubes develop from proximal part of paramesonephric Ducts  
- Uterus develops from the uterovaginal primordium
• Vagina develops from the urogenital sinus
  - Sinus tubercle induces the outgrowth of sinovaginal bulbs → vaginal plate → vagina
• Separation between urogenital sinus & vagina → hymen
** the vagina mainly form from the urogenital sinus but the upper part of it formed from paramesonephric duct
**vestibule formed from the urogenital sinus and which contain the vaginal opening inside ......the vestibule separated from vagina by membrane which will develop and form the hymen

Development of Female Glands
• Urethral & paraurethral glands develop as buds from urethra
• Greater vestibular glands develop from outgrowth of urogenital sinus

Development of External Genitalia
Indifferent Stage (4th-7th weeks)
• Genital tubercle formed from mesenchymal proliferation at the cranial end of the cloacal membrane (anterior part of the cloacal membrane //urogenital membrane)
  - Phallus is an elongated genital tubercle
• Urogenital (urethral) & labioscrotal folds (these two folds formed from the ectoderm) develop on sides of the cloacal membrane (urogenital membrane)
• Cloacal membrane separated into urogenital membrane (anteriorly) and anal membrane (posteriorly) by the urorectal septum
• The end of the urorectal septum form the perineal body (perineal body separate between the anus and uterus)
• After a week the membranes rupture and form anus & urogenital orifice

Development of Male External Genitalia
• Phallus enlarge to form penis
• Penile corpora (Genital tubercle) formed by phallus mesenchyme (corpora cavernosa)
• Urogenital folds fuse & close the urethral groove forming spongy urethra (fusion form the corpora spongiosum)
  - Site of fusion – penile raphe
• Prepuce formed by circular ectodermal ingrowth around the glans
• Scrotum formed by the fusion of the labioscrotal folds
  - Site of fusion is the scrotal raphe
** the navicular fossa formed from ectoderm

Development of Female External Genitalia
• Phallus become the clitoris
• Urogenital folds form the labia minora
  - Fuse posteriorly to form frenulum of the labia minora
• Labioscrotal folds form the labia majora
  - Fuse posteriorly & anteriorly to form posterior & anterior labial commissures

Development of Inguinal Canal
• While mesonephric duct degenerates, a ligament (gubernaculum) appears
** in the side of mesonephric duct the ligament (gubernaculum)
• Gubernaculum connects the gonads with the labioscrotal swellings through the abdominal wall
• Peritoneal evagination (processus vaginalis) follows the gubernaculum taking the layers of the abdominal wall in front of it forming the inguinal canal
** processus vaginalis : it part of the peritoneum which follow the gubernaculum and form the inguinal canal
• Processus vaginalis guide the descent of testis through inguinal canal (gubernaculum is the route for testis to descend toward the scrotum)
• Gubernaculum in females >> the gubernaculum will differentiate into ligament as following:
  - Cranially – ovarian ligament
  - Caudally – round ligament
Female Genital Malformation
- Double uterus
  - Failure of fusion of inferior part of paramesonephric ducts
- Bicornuate uterus
  - Failure of fusion in the superior part
- Unicornuate uterus
  - Failure of development of one paramesonephric duct

Male Genital Malformation
**normal urethra end in navicular fossa then into tip of glans penis**
- Hypospadias
  - 1/300
  - External urethral orifice in the ventral side of the penis ...its type:
    - Glans (glandular hypospadias)
      - Failure of canalization of glandular plate
    - Body of penis (penile hypospadias)
      - Failure of fusion of urogenital folds
**in this case there is failure of fusion between the urethra and navicular fossa in the glans penis >> and the opening found in the ventral side of the neck of the glans penis
- Epispadias (have less frequency than hypospadias)
  - Orifice opens dorsally at the root of the penis
  - Dorsal development of genital tubercle
**if there is failure in fusion of the two scrotal hypospadias >> this will lead to scrotal hypospadias
- Testicular anomalies
  - Cryptorchidism (undescended testes)
    - 3-4% of full term men
    - Found in its path
**look at figure A in slide 25 and complete the number indicate the order by which the undescended testis found
**from the figure the most frequent part involved is the inguinal canal (deep ring) .......other place can be involved is abdominal cavity, superficial ring of the inguinal canal and inguinal canal itself (spermatic cord)
  - Ectopic testes
    - Deviate from its path
    - Abnormal location of gubernaculum

**the table in slide 26 shows the different embryonic structures that develop into different male and female structure ...The doctor say take a lock and note the note in the end which show that the italic text is functional part (important part you have to know)

Good luck