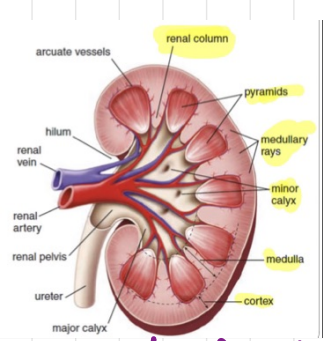
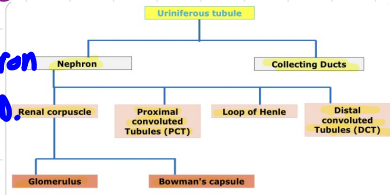


# ★ Histology of Urinary system.



- **Kidney**
  - stroma: capsule, tabeculae, Reticular stroma.
  - parenchyma: uriniferous tubules.
- **General structure**
  - cortex: forms columns between pyramids.
  - medulla: pyramids → papilla.
  - Lobe: medullary pyramid + cortical columns.
  - Lobule: central medullary ray + surrounding cortical tissue. (collecting duct & nephrons)



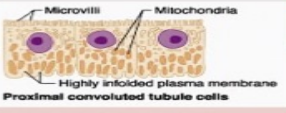





- **Uriniferous tubule**: functional unit, convoluted, densely packed, nephron + collecting duct, 1.3 million nephron in each kidney, alot nephrons → 1 cc.
- **Nephron**: consist of: Renal corpuscle, PCT, Loop of Henle, DCT.
  - Types
    - Cortical: innumerable, superficial cortex, short Henle.
    - Juxtamedullary: near the junction of cortex & medulla, long Henle.
  - Number of nephrons slightly in older adults, accelerated by TBP.
  - Transplant: hypertrophy in proximal parts → ↑ filtration → Normal Renal function.

- **Renal corpuscle**: oval to round, in cortex, filtration barrier function.
  - Bowman's capsule: was a hollow epithelial sphere (blind end of nephron).
    - 2 poles
      - Urinary pole: continuous with PCT.
      - Vascular pole: afferent & efferent arterioles.
    - 2 Layers
      - outer (parietal) (capsular epi): simple squamous epi.
      - inner (visceral) (glomerular epi): modified epithelium (podocyte).
      - urinary space: between 2 layers, receives the filtered fluid.
    - podocyte → modified flat cells (stellate), primary cytoplasmic (major) & secondary (pedicled) which envelop glomerular capillaries & terminate around BM of glomerular capillaries.
      - Between minor process → filtration slit closed by slit diaphragm.
      - filtration & Renewal of glomerular capillaries BM.
  - Glomerulus: so tortuous capillary loop, thick BM, fenestrated endothelial afferent & efferent A.

- **Mesangial cells**
  - Location
    - intraglomerular: within stalk of capillary tuft.
    - extraglomerular: vascular pole.
  - function: structural support to BM & capillaries, immune defense & repair in glomerulus, maintain an optimal filtration rate by adjusting contraction in response to BP changes.

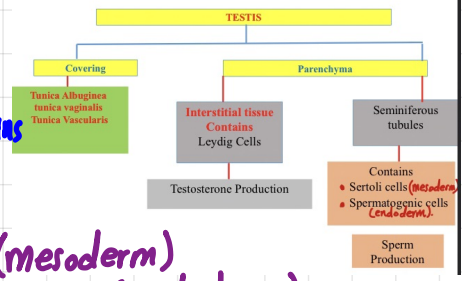
- **Blood Renal Barrier (filtration barrier)**: blood in glomerular/capsular space of Bowman's capsule.
  - pores of capillary epi: prevent RBC pass.
  - Continuous BM: basal lamina of capillaries + basal lamina of podocyte.
    - Lamina rara externa: adjacent to epi.
    - Lamina rara interna: adjacent to endothelium
    - Intermediate zone: ↑ electron dense.
  - filtration slit & thin diaphragms: composed of Nephritins & glycoprotein & proteoglycans, restrict passage of larger than 70 kDa (kilodalton), small protein degenestered → AA → Reabsorbed.

- function
  - filtered blood plasma
  - Allow water & ions to enter capsular space
  - prevent large proteins from entering the capsular space.

Region of Tubule	Histological Features	Locations Major	
PCT	Simple cuboidal epithelium; cells well-stained, with numerous mitochondria, prominent basal folds and long microvilli, lumens often occluded	Cortex	 Microvilli, Mitochondria Highly infolded plasma membrane Proximal convoluted tubule cells
Loop of Henle Thick limbs	Simple cuboidal epithelium; no microvilli, but many mitochondria	Medullary rays and Medulla	 (c) Loop of Henle cells: thick ascending limb
Loop of Henle Thin limbs	Simple squamous epithelium; few mitochondria	Medulla	 Loop of Henle (thin-segment) cells
DCT	Simple cuboidal epithelium; cells smaller than in PCT, short microvilli and basolateral folds, more empty lumens (wide)	Cortex	 Distal convoluted tubule cells
Collecting system Principal cells	Cuboidal to columnar pale-staining, distinct cell membranes	Medullary rays and medulla	 Collecting duct cells
Intercalated cells	Few and scattered; slightly darker staining		 Intercalated Cell, Principal Cell (e) Collecting duct cells

- **Loop of Henle**: Between PCT & DCT, U-shaped  
↳ The nuclei of the cells lining the thin limbs bulge into the lumen of the tubule → capillaries in CS.
- **Collecting ducts**: Between DCT & minor calyx.
  - ↳ connecting tubules: extends from each nephron & several join together → collecting duct.
  - ↳ cortical collecting ducts: simple cuboidal, passes through cortical medullary rays.
  - ↳ Medullary collecting ducts: columnar cells, larger & straighter, parallel with limbs & vasa recta.
  - ↳ papillary duct (Bellini): medullary merge → at the apex of pyramid.
- 2 cells
  - ↳ principle (LH) : cuboidal → columnar distally, central round nuclei, basal infolding, short microvilli, Reabsorb  $\text{Na}^+$  & secrete  $\text{K}^+$ , respond to Aldosterone & ADH.
  - ↳ intercalated (DCK) : ↑ organelles, well developed microvilli, No basal infoldings, Acid-Base by  $\text{H}^+$  (A or  $\alpha$ ),  $\text{HCO}_3^-$  (B or  $\beta$ ).
- **Juxta-glomerular Complex**: regulation of systemic BP, Between Affrent/DCT
  - ↳ Macula densa: Lining DCT close to vascular pole, columnar, prominent deeply stained nuclei,  $\text{Na}^+$ .
  - ↳ Juxta-glomerular: Renin, modified SM of Affrent, myoepithelium with rounded nuclei & granular cytoplasm, mature & immature membrane-bound granules of Renin.
  - ↳ Extrajlomerular mesangial (Lacis): pale nuclei, in triangular region Affrent/Effrent/macula densa apex is formed by glomerular mesangial cells of vascular pole.
- function: Erythropoietin, Renin, regulates GFR.
- **Urine formation**: filtration, reabsorption, secretion
  - ↳ 3 layers: Thin BM, intermediate cuboidal, superficial umbrella cells (uroplakins protein → plaques that work as osmotic barrier → protect against hypertonic urine & dilution of stored urine).
- **Ureter**: small muscular tube, pelvis → bladder
  - ↳ Mucosa: Transitional epi, loose CT (lamina propria).
  - ↳ Muscularis: inner longitudinal & outer circular.
  - ↳ Adventitia: CT, nerve, & BV.
- **Male urethra**:
  - ↳ prostatic: transitional
  - ↳ membranous: stratified/pseudo-columnar
  - ↳ spongy: membranous + stratified squamous.
- **Urinary bladder**
  - ↳ Mucosa: Transitional epi & Lamina propria
  - ↳ Muscularis: inner & outer longitudinal + middle circular (detrusor)
  - ↳ Adventitia: CT, covered superiorly by serosa.
  - ↳ empty: ↑ folded mucosa, U has umbrellas.
  - ↳ full: mucosa is pulled smooth, U is thin, flat umbrella.
- **Female urethra**: Transitional → stratified squamous before end LP → ↑ vascularized CT.

# ★ Topic 2:- Male Reproductive system



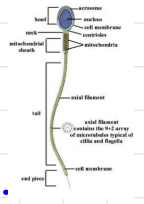
• **Testis interstitial tissue**:- Loose CT between seminiferous tubules, contains the interstitial cells of **Leydig** → **Testosterone**.

• **Seminiferous tubules**:- seminiferous epi rests on BM

- Sertoli cells (mesoderm)
- spermatogenic cells (endoderm)
- myoid cells → peristalsis waves → movement of spermatozoa & testicular fluid.

• **Spermatogenic cells**:- Male germ cells that replicate & migrate from BL → Lumen (endodermal).

- ↳ **Spermatogonia**:- initial germ cells, Rest on BL & + with sertoli, small rounded,  $2n = 46$ 
  - ↳ Type A dark & pale:- Dark type remains as a reserve & pale → B type.
  - ↳ Type B:- Larger & lightly stained, +FSH <sup>mitotic</sup> → primary spermatocytes
    - ↳ primary spermatocyte:- Largest, 46 <sup>1st meiotic</sup> → secondary spermatocyte.
      - ↳ secondary spermatocyte:- 23, small, <sup>2nd meiotic</sup> → 2 spermatids.
        - ↳ spermatids:- small, 23, → mature sperm.



• **Spermatozoae**:- Lumina of seminiferous tubules

- ↳ **Head**:- nucleolus covered with acrosomal cap (lysosomes → penterastry of ovum).
- ↳ **Neck**:- centrioles & connective piece, 9 fibrous rings surrounding the Axoneme.
- ↳ **Middle piece**:- plasma membrane → mitochondrial sheath → fibrous sheath → Axoneme (9+2)
- ↳ **Tail**
  - ↳ principal:- plasma membrane → fibrous sheath → Axoneme (9+2)
  - ↳ End:- plasma membrane → Axoneme (9+2).

• **Sertoli cells**:- mesodermal, Resistant to heat, Radiation, infection & malnutrition, ↑ numerous before puberty → ↓ After puberty because of ↑ germ cells, Have receptors to FSH.

- ↳ **LM**:- Columnar epi, euchromatic nucleus, indistinguishable borders (mergins).
- ↳ **EM**:- SER & RER (nutrition), Lysosomes (phagocytosis), Abundant cytoskeleton (support), Euchromatic nucleus
- ↳ **Borders**
  - ↳ Hemidesmosomes - Sertoli - Basal Lamina.
  - ↳ Desmosome :- Sertoli - Germ cell.
  - ↳ Gap Junction / Tight Junction :- Sertoli - sertoli.
- ↳ **Functions**
  - ↳ Supporting cells:- physically support developing germ cells.
  - ↳ phagocytic cells:- the residual bodies released in the last stage of spermiogenesis
  - ↳ Secretory cells
    - ↳ Testicular fluid:- carry non-motile sperm to epididymis.
    - ↳ Androgen-binding protein (ABP):- concentrate testosterone → spermatogenesis.
    - ↳ Inhibin:- ↓FSH → ↓spermatogenesis.
    - ↳ Anti-mullerian hormone:- regression of embryonic müllerian ducts.
  - ↳ Nutrition:- to sperms (isolated from Blood by Blood-testis barrier).
  - ↳ Formation of Blood-testis Barrier.

• **Blood-testis barrier**:- Barrier that controls the passage of tissue fluids, from outside to inside the seminiferous tubule.

- ↳ **Basal compartment**:- BL → tight Junction (containing spermatogonia).
- ↳ **Adluminal compartment**:- tight Junction → Lumen (primary, 2<sup>ry</sup>, spermatids).
- ↳ **Functions**
  - ↳ passage of useful material for spermatogenesis (Test .., vits, electrolytes).
  - ↳ prevent entrance of damaging substances (A<sub>2</sub>, Ab, toxins).
  - ↳ prevent passage sperm → Blood → Autoimmune disease.



- **interstitial cells of Leydig**:- found in groups between seminiferous tubules in interstitial CT, 3%, ↓ with age, Mesodermal, acidophilic cytoplasm, ↑ lipid droplets & lipochrome pigment.
  - ↳ EM:- SRE (Hormone), developed golgi apparatus (storage), mitochondria (power).
  - ↳ function:- secrete testosterone under the effect of L.H of pituitary gland.

## • The Epididymis

- ↳ Mucosa:- pseudostratified columnar (rounde basal & columnar), stereocilia (Long Branched microvilli).
- ↳ Muscularis:- circular smooth muscle.
- ↳ Adventitia:- connective tissue layer.
- ↳ Functions
  - ↳ site for storage & maturation of sperms.
  - ↳ Reabsorption of testicular fluid.
  - ↳ phagocytosis & digestion of degenerative spermatozoa.

## • Vas deferens

- ↳ Mucosa:- pseudostratified columnar + stereocilia (↑ elastic fibers).
- ↳ Muscularis:- well developed, thick circular between inner & outer longitudinal layers.
- ↳ Adventitia:- connective tissue layer.

## • Ejaculatory ducts:- Ampulla of vas deferens + seminal vesicle → prostatic urethra.

- ↳ Mucosa:- simple or pseudostratified columnar epi (secretory).
- ↳ No muscular coat:- short distance, between vas deferens & seminal vesicle & prostate.

## • Seminal vesicle

- ↳ Mucosa:- columnar or pseudostratified columnar epi, thin, branched, anastomosing folds.
- ↳ Muscularis:- inner circular & outer longitudinal layers of smooth muscle.
- ↳ Adventitia:- thin fibroelastic connective tissue layer.
- ↳ function:- fluid (thick, yellow, alkaline, protein, vit c) → nutrition & production of energy for sperm.

## • Prostate:- 30-50 tubulo-alveolar gland surrounding prostatic urethra.

- ↳ stroma:- capsule & trabeculae (fibromuscular CT & SM & Elastic).
- ↳ parenchyma:- glands
  - ↳ periurethral:- smallest, around urethra.
  - ↳ submucosal:- around periurethral tissue.
  - ↳ Main prostatic:- largest, outer, provide most prostatic secretions.
- ↳ structure
  - ↳ glandular epi:- differs.
  - ↳ acini & duct:- simple columnar epi.
- ↳ function:- milky, alkaline secretion → smell (acid phosphate).
- ↳ clinical
  - ↳ Senile prostate:- enlarged.
  - ↳ Carcinoma:- outer glands, acid phosphate Dx.
  - ↳ Corpora amylacea:- prostatic concretion (condensation of secretory) → calcified

# ★ Topic 3:- female reproductive system

- **Uterus**:- pear-shaped structure attach to uterine tube (upper end) & Vagina (Lower end).
  - ↳ 3 regions:- fundus, Body, cervix (supra vaginal superiorly & vaginal inferiorly).
  - ↳ 3 Layers:- Mucosa (Endometrium), Muscular Layer (myometrium), external layer (perimetrium).

1 **Perimetrium** → Anterior portion of Body:- covered by adventitia (areolar CT).  
→ remaining portion:- serosa, simple squamous cell (mesothelium) resting on areolar CT.

2 **myometrium**:- thickest layer, SM+CT.

- ↳ stratum submucosa (inner):- Longitudinal & circular muscles.
- ↳ stratum vasculare (middle):- Longitudinal, circular, oblique & transverse, ↑vascularized (Arcuate Arteries)
- ↳ stratum subserosum (outer):- Longitudinal.
- ↳ During pregnancy
  - ↳ estrogen → Hyperplasia & hypertrophy & ↑collagen fibers.
  - ↳ corpus luteum → Relaxin → ↓Activity of myometrium until parturition.
  - ↳ neurohypophysis (posterior pituitary) → oxytocin → strong contraction at labour.

3 **Endometrium**

- ↳ Before puberty & menopause:- simple cuboidal, rudimentary tubular glands.
- ↳ During reproductive years:- ciliated columnar, simple coiled tubular glands.
- ↳ Layers
  - ↳ functional:- slough off during menstruation, coiled helical Arteries
  - ↳ Basal:- regenerate functional layer, short straight Arteries

↳ From Arcuate A in stratum vasculare

- **Menstrual cycle**:- By estrogen & progesterone, 3 phases:- menstrual, proliferation, ovulation (IU), secretion.
  - ↳ proliferation (follicular):- 5-14, theca cells of ovarian follicle → Estrogen, simple columnar, tubular glands (straight with narrow lumen + accumulate glycogen).
  - ↳ secretory (Luteal):- 15-28, corpus luteum → progesterone, highly coiled glands.
  - ↳ Menstrual:- no hormones → constrict coiled A → No blood flow to functional layer → sloughed off → coiled A dilates again → rupture → blood removes patches of functional layer as menses.

- **Uterine cervix**
  - ↳ Mucosa
    - ↳ Endocervix (uterine part):- columnar epi.
    - ↳ vaginal part:- stratified squamous non-keratinized epi.
    - ↳ Transition (transformation zone):- abrupt as a result of vaginal acidity, nabothian follicles or cysts (occlusion of mucosal glands ducts), ↑Risk of cervical cancer.
    - ↳ The glands changes secretory activity from thin alkaline fluid at mid cycle → ↓thick viscous after ovulation & formation of corpus luteum
  - ↳ Muscular:- inner circular & outer long muscle layer.

- **Uterine tube**
  - ↳ Mucosa:- many longitudinal folds prominent in ampulla, simple columnar (ciliated & non-ciliated)
    - peg cells:- non-ciliated, produce watery fluid which nourish spermatozoa, zygote.
  - ↳ Muscularis:- inner circular & outer long → peristaltic movement with the beating of cilia help to propel oocyte to the uterus.

- **Vagina**
  - ↳ Mucosa:- stratified squamous non-keratinized, ↑glycogen → Lactic acid, dense CT ↑vascularized (secretion) + ↑elastic fibers (distention in parturition)
  - ↳ Muscular layer:- circular & longitudinal SM.
  - ↳ Adventitia:- elastic fibers.