LECTURE ON THE URINARY SYSTEM
(Uropoetic System)

AN OVERVIEW

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URINARY SYSTEM
(Urpoetic System)

1. COMPONENTS

* **Upper Tract** ---- Urine production (homeostasis of the body)
* **Lower Tract** ---- Urine retention Micturition (voiding of urine)

2. **UPPER TRACT**

* **Kidneys**  
  Macroscopic ---- Fixation Relation Location Segmentation (blood supply)  
  Microscopic ---- Cortex / Medulla Nephron etc.
* **Ureter**  
  Structure Constrictions Blood supply

3. **LOWER TRACT**

* **Bladder**  
  Structure / Blood supply
* **Urethra**  
  Structure in Male / Female

4. **MICTURITION**

* **Innervation of the Urinary System**
* **Voiding Reflex**
THE URINARY SYSTEM

The kidneys are responsible for removing wastes from the body, regulating electrolyte balance and blood pressure, and the stimulation of red blood cell production.
The kidneys are situated in the posterior part of the abdomen, one on either side of the vertebral column, behind the peritoneum, and surrounded by a mass of fat and loose areolar tissue.
TOPOGRAPHY OF THE KIDNEYS

STUDY THE RELATIONS TO THE SURROUNDING ORGANS / STRUCTURES
TOPOGRAPHY OF THE KIDNEYS

TRANSPYLOCERIC PLANE
(SURFACE LANDMARK OF ABDOMINAL WALL)-MIDWAY BET.
SUPRASTERNAL NOTCH & UPPER MARGIN OF SYMPHYSIS PUBIS.

CORR. TO HILUM OF KIDNEY - UPPER POLE BEND MORE MEDIALLY.
The kidneys lie partly under cover of the lower thoracic ribs. Renal trauma should be suspected in all injuries associated with trauma to the posterior lower thorax or upper abdomen.

RENAL ANGLE-Between LOWER BORDER OF 12 RIB & LATERAL BORDER OF ERECTOR SPINAES MUSCLE-RENAL COLIC PAIN STARTS FROM THIS ANGLE DOWN & FORWARDS TO GROIN
The kidneys are encased in 3 layers of fat and fascia and lie in the retroperitoneum on either side of the upper lumbar vertebral column.
The adipose capsule, which is thickest at the margins of the kidney and is prolonged through the hilum into the renal sinus. The kidney and the adipose capsule are enclosed in a sheath of fibrous tissue continuous with the subperitoneal fascia, and named the renal fascia.

Above the suprarenal gland the two layers of the renal fascia fuse, and unite with the fascia of the diaphragm; below they remain separate, and are gradually lost in the subperitoneal fascia of the iliac fossa.
TOPOGRAPHY OF THE KIDNEYS

The retro-peritoneal space

The structures lying anterior to each kidney vary quite considerably.

Posteriorly the kidneys are related to muscles, ribs and pleura.

It is important in a surgical approach through the IJ to the kidney to recognize the low pleural reflection.
The kidney is composed of an internal medullary and an external cortical substance. The medullary substance (substantia medullaris) consists of a series of red-colored striated conical masses, termed the renal pyramids.
BLOODVESSELS OF THE KIDNEY

The **renal artery** near the hilum divides into 3 to 5 branches. In the hilum they divide into several **interlobar** branches between the pyramids (lobes). At the base of the pyramids they end abruptly by dividing into wide branches as the **arcuate arteries**.

From the arcuate arteries arise straight arteries directed toward the cortex, the interlobular arteries, between the lobules of the kidney.
BLOOD VESSELS TO THE KIDNEY

Study the venous drainage in the kidney also.
This fissure is named the hilum, and transmits the vessels, nerves, and ureter. Above the hilum the medial border is in relation with the suprarenal gland; below the hilum, with the ureter.
The renal calyces, from seven to thirteen in number, are cup-shaped tubes, each of which embraces one or more of the renal papilæ; they unite to form two or three short tubes, the major calyces.
The nephron is a functional unit of the kidney. The nephron consists of two parts: (1) renal corpuscle and (2) renal tubule.
THE NEPHRON

The collecting tubule is the continuation of the DCT and is developed from branching of the ureteric bud.

Whereas the nephron is derived from the metanephric blastema.
The juxtaglomerular apparatus is a collective term referring to the cells near a structure called the glomerulus in the kidney.
Other parts of the juxtaglomerular apparatus are extraglomerular mesangial cells and the juxtaglomerular cells surrounding the afferent arteriole (modified smooth muscle cells), which produce and secrete renin.

The juxtaglomerular cells are specialized cells that stimulate the secretion of the adrenal hormone aldosterone and play a major role in renal autoregulation.
THE NEPHRON

NEPHRON: Overview

1: Interlobular artery
2: Interlobular Vein
3: Glomerulus/Bowman’s Capsule
4: Distal Tubule
5: Proximal Tubule
6: Loop of Henle
7: Collecting Duct
**THE NEPHRON**

**Cortical and Medullary Nephrons**

Cortical nephrons: 85%
- peritubular capillaries encircling all nephron sections

Juxtamedullary nephrons: 15%
- some peritubular capillaries and vascular loops (vasa recta) which surround loop of Henle which descend into medulla

**Nephron:** A key unit, both anatomically and functionally, of the kidney.
THE RENAL CORPUSCLE

Glomerulus and Glomerular Capillary

- Efferent arteriole
- Parietal layer of Bowman's capsule
- Podocytes (visceral layer)
- Mesangial cells
- Basement membrane
- Macula densa
- Afferent arteriole
- Capillary
- Red blood cells
The capsule of Bowman consists of two layers: outer parietal and inner visceral layer.

The epithelium of the inner layer, the podocytes, surround and closely invest the capillary loops. Podocytes have many cytoplasmic extensions and small processes called pedicles.

The narrow slits between the packed pedicles are called the slit diaphragm. The capillaries of the glomerulus are fenestrated capillaries having pores between the endothelial cells.
Nephron: The Glomerulus (pages 382-384)
MICROSCOPIC ANATOMY OF KIDNEY
DEVELOPMENT OF KIDNEY
The ureteric bud grows laterally and invades the center of the metanephrogenic blastema, the primordial renal tissue.
DEVELOPMENT OF KIDNEY

The ureteric bud divides and branches forming the renal pelvis, infundibulae, calyces, and collecting tubules which will provide a conduit for urine drainage in the mature kidney.

The metanephrogenic blastema forms glomeruli, proximal tubules and distal tubules.
The ureteric bud grows laterally and invades the center of the metanephrogenic blastema, the primordial renal tissue.
THE URETER

The ureters are about 25 cm long. Muscles in the ureter walls constantly tighten and relax to force urine downward to the bladder.
The minor calyces merge to form major calyces within the kidney, which in turn merge to form the renal pelvis (still within the kidney). The urine flows through these structures to the ureter and is channelled to the bladder.
Urine leaves the bladder through another tube, the **urethra**.

Note the difference of the male and female urethra.
TRANSITIONAL EPITHELIUM
INNERVATION OF BLADDER

- The muscular wall of the bladder is called the *detrusor muscle*.

- Innervation is by *autonomic nerves*.
  - **Parasympathetic** -- contraction, but relaxation of internal sphincter.
  - **Sympathetic** – opposite action.

- The *pudendal nerve (somatic)* supplies the external sphincter of the urethra.

- Higher centres influence the micturition reflex.
**MICTURITION**

Is a reflex mechanism.

Is under voluntary control.

Appr. 300 cc urine in the bladder – urge to pass urine.

Reflex initiated by relaxation of external sphincter.

Afferent pathway – sympathetic nerves.

Efferent pathway – parasympathetic nerves.

Voluntary control is by somatic nerve – pudendal nerve.
THANK YOU

- The fear of the Lord teaches a man wisdom, and humility comes before honor. (Prov 15:33)

- Pleasant words are a honeycomb, sweet to the soul and healing to the bones. (Prov 16:24)

- A cheerful look brings joy to the heart, and good news gives health to the bones. (Prov 15:30)
Summary of Tubular Resorptive Processes
THE RETROPERITONEUM KIDNEYS
THE URETER