Gross Anatomy of the Urinary System
Lecture Objectives

• Overview of the urinary system.
• Describe the external and internal anatomical structure of the **kidney**.
• Describe the anatomical structure of the **ureter** and its location in the body.
• Describe the structure of the **urinary bladder** and its relations to the peritoneum.
• Discuss the anatomical structure of **urethra** and the difference between males and females.
• Understand the **blood supply, venous drainage and lymphatics** of the urinary system.
• Discuss the **innervation** of different parts of the urinary system, with special attention to the nervous control of urinary bladder.
Urinary Tract

- Kidneys, ureters, urinary bladder & urethra
- Urine flows from each kidney, down its ureter to the bladder and to the outside via the urethra
- Filter the blood and return most of water and solutes to the bloodstream
Overview of Kidney Functions

- Regulation of blood ionic composition
  - Na+, K+, Ca+2, Cl- and phosphate ions
- Regulation of blood pH, osmolarity & glucose
- Regulation of blood volume
  - conserving or eliminating water
- Regulation of blood pressure
  - secreting the enzyme renin
  - adjusting renal resistance
- Release of erythropoietin & calcitriol
- Excretion of wastes & foreign substances
Kidneys: Shape & Location

• Paired kidney-bean-shaped organ
• 4-5 in long, 2-3 in wide, 1 in thick
• Found on the upper part of the posterior abdominal wall
  – retroperitoneal along with adrenal glands & ureters
• Protected by 11th & 12th ribs with right kidney at a lower level
  – Right kidney could be palpable
External Anatomy of Kidney

• Superior & inferior poles
  – Lower pole of R. kidney could be palpable
• Lateral border
• Medial border – 3 fingers from midline
  – Hilum
    • Anterior and posterior libs
    • Content
      – Renal v. – renal aa. – ureter – renal a. (VAUA, from front to back))
      – Sympathetic fibers and lymph vessels
  – Renal sinus – cavity internal to the hilum
    • Content
      – Same as hilum + drainage system
Kidney Coverings

- **Renal capsule** (fibrous capsule) = transparent membrane maintains organ shape
- **Perirenal fat** = helps protect from trauma
- **Renal fascia** = dense, irregular connective tissue that holds against back body wall
  - Encloses the kidney & the suprarenal gland
  - Continuous with fascia transversalis
- **Pararenal fat** (paranephric fat) = protection
  - Part of retroperitoneal fat
Internal Anatomy of the Kidneys

• Parenchyma of kidney
  – renal cortex = superficial layer of kidney
  – renal medulla
    • inner portion consisting of 8-18 cone-shaped renal pyramids separated by renal columns
    • renal papilla point toward center of kidney
      – Apex of renal pyramid

• Drainage system fills renal sinus cavity
  – minor calyces - cuplike structure
    • collect urine from the papillary ducts of the papilla
      – One minor calyx for each renal papilla
    – minor calyces empty into major calyces
      • Each major calyx empties 2-3 minor calyces
    – Major calyces empty into the renal pelvis, which empties into the ureter
• What is the difference between renal hilus & renal sinus?
• Outline a major calyx & the border between cortex & medulla.
Kidney- blood supply

- **Blood supply**
  - Renal aa. – aorta – L2
  - Renal vv. – IVC

- **Lymph drainage**
  - Lateral aortic lymph nodes

- **Nerve supply**
  - Sympathetic – renal plexus
  - Afferents – T10-T12 spinal segments
Kidney- relations

• Anteriorly
  – Viscera ...

• Posteriorly
  – Ribs, muscles, nerves ...

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Kidney Surface Anatomy

- **Kidneys**
  - From T12 – L3 spines
  - Right kidney at a lower level
    - Inferior pole of R. kidney could be palpable at lumbar region
  - Moves about 1 in up and down during respiration

- **Hilum**
  - Anteriorly – at transpyloric line (L1)
  - Posteriorly – three fingers from midline
Ureters

- 10 to 12 in long
- Varies in diameter from 1-10 mm
- Extends from renal pelvis to bladder
- Retroperitoneal
- Enters posterior wall of bladder
- Three Constrictions (arrows)
  - At junction with renal pelvis
  - At crossing the pelvic brim
  - At entering the urinary bladder (oblique entrance)
- Physiological valve only
  - Bladder wall compresses ureteral opening as it expands during filling
  - Flow results from peristalsis, gravity & hydrostatic pressure
Ureters: Relations

- **Anteriorly**
  - Viscera, BVs, mesentery
- **Posteriorly**
  - Lumbar transverse processes, psoas m., bifurcation of common iliac a.
Ureters

- Blood supply
  - Upper end – renal vs.
  - Middle part – gonadal vs.
  - Lower end – superior vesical vs.
- Lymph drainage
  - Lateral aortic nodes & iliac nodes
- Nerve supply
  - Renal & gonadal plexuses in abdomen
  - Hypogastric plexus in pelvis
  - Afferents – L1-L2 segments
Urinary Bladder

- Hollow, distensible muscular organ with capacity of about 500 ml
- In adults it is located in the pelvis behind the pubic symphysis
  - Upon distention, the superior surface extend to the abdomen
  - In infancy bladder have higher position
    - Empty bladder lies within the abdomen
Urinary Bladder

- **Shape and surfaces**
  - **It is pyramidal in shape**
    - Apex – anteriorly
      - Median umbilical ligament
    - Base (posterior surface) – triangular in shape
      - Superolateral angles – Ureteral openings
        - Inferior angle – Urethral opening
    - Superior surface
      - Covered by peritoneum
    - Inferolateral surfaces
      - Faces the pubic symphysis & lateral pelvic wall
    - Neck – inferiorly
      - Puboprostatic ligaments (male)
      - Pubovesical ligament (female)
Urinary Bladder: Internal Structure

- **Mucus membrane folds**
  - Disappear on distention
- **Trigone** is the mucus membrane of the bladder base
  - Always smooth flat area
  - Bordered by 2 ureteral openings (above) & urethral opening (below)
  - Interureteric crest (superiorly)
- **Uvula vesicae** (in male)
  - Elevation behind the urethral opening
  - Caused by the median lobe of the prostate
- **Detrusor muscle** (bladder smooth m.)
  - Three layers
    - Inner & outer longitudinal
    - Middle circular
      - At neck – *sphincter vesicae* (internal urethral sphincter)
Urinary Bladder- Relations in Male

- Anteriorly – abdominal wall, retropubic pad of fat & pubic symphysis
- Laterally – obturator internus & levator ani mm.
- Inferiorly – prostate
- Superiorly – peritoneal cavity & parts of intestine
- Posteriorly – rectovesical pouch, vas deferens, seminal vesicles, rectovesical fascia & rectum
Urinary Bladder- Relations in Female

- Anteriorly – abdominal wall, retropubic pad of fat & pubic symphysis
- Laterally – obturator internus & levator ani mm.
- Inferiorly – urogenital diaphragm
- Superiorly – uterovesical pouch & uterus
- Posteriorly – vagina
Urinary Bladder

- **Blood supply**
  - Superior and Inferior vesical aa. – internal iliac a.
  - Vesical venous plexus – prostatic venous plexus – internal iliac v.

- **Lymphatics**
  - Internal & external iliac nodes
Urinary Bladder

• Nerve supply
  – Inferior hypogastric plexus
    • Sympathetic: L1-L2 ganglia (sympathetic trunk) – hypogastric plexus
      – Contraction of sphincter vesicae
    • Parasympathetic: S2-S4 – pelvic splanchnic nn.
      – Contraction of detrusor m.
  – Afferent fibers
    • Parasympathetic (most) – S2-S4 segments
    • Sympathetic (some) – L1-L2 segments
Female Urethra

- Length of 1.5 in.
- Traverse the sphincter urethrae in the urogenital diaphragm
- Internal urethral orifice – at bladder neck
- External urethral orifice (meatus) – at the vestibule
  - 1 in. posterior to clitoris & anterior to vaginal opening
  - On sides has openings of the paraurethral glands
Male Urethra

- Length 8 in. from bladder neck to glans penis
- Parts
  - Prostatic urethra (1.25 in.) – widest part
    - Urethral crest
      - Prostatic utricle
        » On both sides has the openings of ejaculatory ducts
    - Prostatic sinus
  - Membranous urethra (0.5 in. – in urogenital diaphragm)
  - Penile urethra (6 in.) – narrowest part
    - Traverse the pulp & corpus spongiosum of the penis
    - Receives the bulbourethral ducts – proximally
    - Fossa terminalis – dilated distal part