CHAPTER 25 URINARY

Urinary system

• Kidneys 2
• Ureters 2
• Urinary Bladder 1
• Urethra 1

functions

• fluid waste elimination
• secretion of wastes
• control blood volume and BP
• control blood pH
• electrolyte levels
• RBC levels
• hormone production

Homeostasis of Body Fluids

Anatomy - external

• location
  • “retroperitoneal”
• hilus
  • renal artery and vein
  • ureters
• surrounding tissue
  — renal capsule on surface of kidney
  — adipose capsule
  — renal fascia
  — pararenal fat

gross internal anatomy

• renal cortex
• renal medulla
  • renal pyramids
  • papilla apex of each pyramid
  • renal columns between pyramids
• renal sinus
  — minor calyx collects from pyramid
  — major calyx
  — renal pelvis connects to ureter
renal circulation

- renal artery
- segmental a.
- interlobar a. = cortical radiating a.
- arcuate a.
- interlobular a. into cortex
  - afferent arterioles
  - glomerular capillaries
  - efferent arterioles
  - peritubular capillaries

renal circulation - venous

- peritubular capillaries ; vasa recta
- interlobular veins
- arcuate v.
- interlobar v.
- renal v.

micro anatomy

- nephron = functional unit
  - include collecting duct ?
- uriniferous tubule = structural units
  - nephron
  - collecting duct

definitions

- filtrate = fluid being processed in nephron
  glomerular capsule to collecting duct
- urine = final product
  after reabsorption, secretions, concentration
  end of collecting duct

Nephron anatomy

- urine formation

- renal corpuscle
  - glomerulus = capillary network
  - glomerular capsule = Bowman’s capsule

- renal tubules
  - proximal convoluted tubule = PCT
  - loop of Henle
  - distal convoluted tubule = DCT
- collecting duct
renal corpuscle

- glomerulus capillary bed
  - fenestrated tissue
  - afferent arteriole
  - efferent arteriole

- Bowman’s capsule 1st part of nephron
  - parietal layer
  - visceral layer podocytes on capillary
  - capsular space collects filtrate

filtration membrane =
  - capillary endothelium + podocyte

renal tubules

- PCT proximal convoluted tubule
  - simple cuboidal + microvilli
  - mitochondria

- loop of Henle
  - descending limb
    - thick segment s. cuboidal
    - thin segment s. squamous
  - ascending limb
    - thick and thin segments

- DCT distal convoluted tubule
  - simple cuboidal

collecting ducts

- collects filtrate from 2’ nephrons
- simple cuboidal epithelium
- cortical collecting duct
- medullary collecting duct

- papillary ducts joined collecting ducts
  empty into minor calyx

what is where?

renal cortex
- renal corpuscle
- PCT
- DCT
- cortical collecting duct

renal medulla
- loop of Henle
- collecting ducts
- papillary ducts
• glomerular filtration
  • forms filtrate
• tubular reabsorption
  • reabsorbs nutrients and water
  • from tubules to blood
• tubular secretion
  • adds wastes to filtrate
  • from blood to tubules
• blood volume regulation (urine concentration)
  • reabsorbs more water
  • from tubules to blood

what happens where?
• filtration
  renal corpuscle
• reabsorption of most stuff PCT
• secretion of wastes PCT
•
• blood volume control:
  • varied reabsorption of Na DCT
  • varied reabsorption of H₂O collecting duct

classes of nephrons
• cortical nephrons 85% of nephrons
  — mostly in cortex
  — short loop of Henle
• juxtamedullary nephrons
  — renal corpuscle near medulla
  — long loop of Henle

blood vessels associated with nephron
• glomerulus
  — capillary bed
  — afferent arteriole branch of interlobular a.
  — efferent arteriole
  — high blood pressure
• peritubular capillaries
  — extend from efferent arteriole
  — at convoluted tubules
• vasa recta
  — at loop of Henle
**juxtaglomerular apparatus**

- area next to glomerulus and afferent arteriole
- regulates blood pressure

- juxtaglomerular cells = granular cells
  - wall of afferent arteriole
  - produces renin

- macula densa cells
  - wall of DCT (ascending loop of Henle)
  - monitors filtrate
  - stim j-g cells to make renin

**path of urine**

- nephron
- collecting duct
- papillary duct
- minor calyx
- major calyx
- pelvis
- ureter
- urinary bladder
- urethra

**urine**

- contains:
  - water
  - wastes - urea, uric acid, creatinine
  - electrolytes
  - minerals

- pH
  - ~ 6 (4.5 – 8.0)

- abnormal
  - glucose
  - protein
  - bacteria
  - WBC
  - RBC

**ureters**

- continuation of renal pelvis
- connect to urinary bladder
- 3 layered wall
  - mucosa
    - transitional epith + lamina propria
  - muscularis
    - smooth muscle
  - adventitia
    - connective tissue

**urinary bladder**

- function:
  - urine storage
- transitional epithelium
- detrusor muscle
  - smooth muscle
- trigone
  - between 3 openings
    - 2 ureters
    - 1 urethra
urethra

- bladder to environment
- stratified squamous epithelium
- internal urethral sphincter near bladder involuntary smooth musc
- external urethral sphincter voluntary skeletal musc
- external urethral orifice
- males:
  - prostatic urethra thru prostate
  - membranous urethra prostate to penis
  - spongy (penile) urethra thru penis

micturition

- = urination = voiding
- initial filling contract int and ext sphincters
- addl filling contract detrusor relax int sphincter parasympathetic
- ext sphincters voluntary control learned