Functions of Urinary System:

1. Excretion – removing nitrogenous wastes, certain salts and excess water from blood.
2. Maintain acid-base balance
3. Secrete waste products in the form of urine
4. Eliminate urine from bladder

KIDNEYS

- Bean-shaped organs
- Located between peritoneum and the back muscles (RETROPERITONEAL)
- Indentation along concave medial border is the HILUM – a passageway for lymph vessels, nerves, blood vessels and ureter.
- RENAL PELVIS – funnel shaped structure at the beginning of the ureter
MEDULLA

- Inner, striated layer
- Striated cones are **RENAL PYRAMIDS**
- Base of each pyramid faces cortex, while apex empties into cuplike cavities called **CALYCES**

CORTEX

- Composed of millions of microscopic functional units called nephrons.

NEPHRON

- Functional unit of the kidney
- Parts include:
  1. Bowman’s capsule
  2. Glomerulus
  3. Proximal convoluted tubule
  4. Loop of Henle
  5. Distal convoluted tubule
  6. Collecting tubule
Urine Formation in the Nephron

1. Filtration
2. Reabsorption
3. Secretion

FILTRATION
- First step in urine formation
- Blood from renal artery enters glomerulus
- High blood pressure in glomerulus forces fluid (FILTRATE) to filter into Bowman’s capsule
- Filtrate does not contain plasma proteins or RBCs – they’re too big
- Bowman’s capsule filters out 125cc of fluid/min. – 7500cc/hour
- As filtrate continues through nephron, 90% of water is reabsorbed

REABSORPTION
- Water and useful substances are reabsorbed
- If blood levels of certain substances are high (glucose, amino acids, vitamins, sodium) then those substances will not be reabsorbed (THRESHOLD)
SECRETION

- Opposite of reabsorption
- Secretion transports substances from blood into collecting tubules
- Substances include creatinine, hydrogen ions, potassium ions, and some drugs
- Electrolytes are selectively secreted to maintain body’s acid-base balance

Urinary Output

- Ave = 1500 ml/day
- **URINALYSIS** – examination of urine to determine presence of blood cells, bacteria, acidity level, specific gravity and physical characteristics (color, clarity and odor)

URETERS

- One from each kidney
- Carry urine from kidney to bladder
- Smooth muscle tube with mucous membrane lining
- Peristalsis pushes urine down ureters

URINARY BLADDER
• Hollow, muscular organ
• Made of elastic fibers and involuntary muscle
• Stores urine – usually about 500cc
• Emptying urine (voiding) is involuntary but controlled through nervous system (voluntary)
• Urine leaves through URETHRA to outside opening = URINARY MEATUS
Control of Urinary Secretion

Chemical Control

- Reabsorption of H₂O in distal convoluted tubule controlled by ADH (antidiuretic hormone)
- Secretion and regulation of ADH controlled by hypothalamus
- ALDOSTERONE – secreted by adrenal cortex, promotes excretion of potassium and hydrogen ions, reabsorption of sodium, chlorine ions and H₂O
- RENIN – hormone released by kidneys, stimulates release of aldosterone from adrenal cortex
- DIURETICS inhibit reabsorption of H₂O

Nervous Control

- Direct control through nerve impulses on kidney blood vessels
- Indirect control though stimulation of endocrine glands
ACUTE KIDNEY FAILURE
- Caused by nephritis, shock, injury, bleeding, sudden heart failure or poisoning
- Symps – OLIGURIA (scant urine) or ANURIA (no urine produced)
- Suppression of urine formation can lead to UREMIA – toxic condition when blood retains urinary waste products

CHRONIC RENAL FAILURE - gradual loss of function of nephrons

GLOMERULONEPHRITIS
- Inflammation of glomerulus
- Filtration process affected
- Plasma proteins are filtered through and found in urine, RBCs too (HEMATURIA)
- Can be acute (caused by bacteria) or chronic (when there is permanent damage)
HYDRONEPHROSIS
• Urine backs up because of blockage in ureter, renal pelvis and calyces become distended
• Can be due to kidney stone
• Can also be caused by pregnancy or enlarged prostate
• Rx – remove the cause

PYELONEPHRITIS
• Inflammation of kidney tissue and renal pelvis
• Usually caused by infection from ureters
• One symptom is PYURIA (pus in urine)
• Rx – antibiotics

RENAL CALCULI (Kidney Stones)
• Made of crystals of calcium phosphate and uric acid
• Gradually they get larger until they block ureters
• First symptom – severe pain
• Other symptoms – nausea and vomiting, frequency, chills, fever, hematuria
• Diagnosis – by symptoms, ultrasound, or x-ray (IVP or KUB)
• Rx – increase fluids to flush out stone, medications, and if needed – LITHOTRIPSY
LITHOTRIPSY
- Surgical procedure to remove kidney stones
- Shock waves hit dense stones and break them up
- Done on outpatient basis

CYSTITIS
- Inflammation of the mucous membrane lining of the urinary bladder
- Most common cause – E. Coli
- Symps – DYSURIA (painful urination) and frequency
- Usually in females (shorter urethra)
- Rx – antibiotics

INCONTINENCE – involuntary urination

DIALYSIS
- Used for kidney failure
- Involves the passage of blood through device with semipermeable membrane
- Dialysis serves as substitute kidney
HEMODIALYSIS

- Blood from patient flows through machine and is filtered
- Usually a **FISTULA** is created (opening between vein and artery) for inserting needles
- Can be done at home or in clinic
- Takes 2-4 hours, 2-3 times a week

PERITONEAL DIALYSIS

- Uses the peritoneal lining to filter blood
- Dialysate (cleaning solution) flows in and out via tube

KIDNEY TRANSPLANT

- As a last resort
- Involves donor organ from someone with a similar immune system
- Main complication – rejection

ENURESIS – bedwetting
GLYCOSURIA – sugar in urine
NOCTURIA – frequent urination at night
POLYURIA – large amounts of urine