

Review Chapters 22, 23

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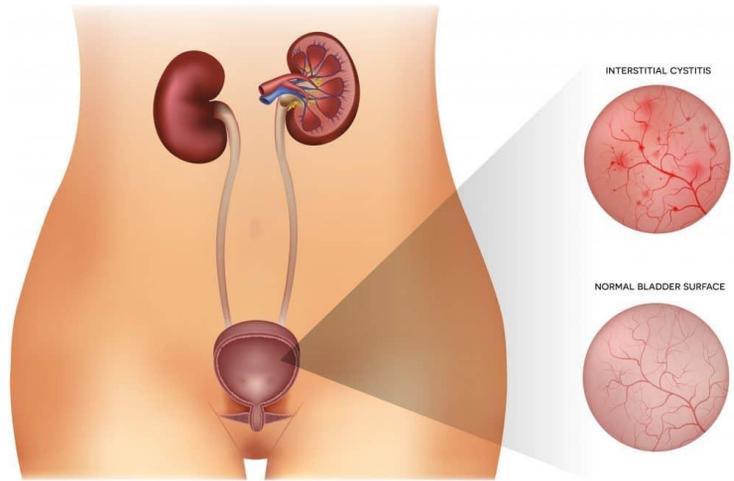
- The kidney is **located in** the costovertebral angle (CVA) region.
- In **physical examination**, the examiner should firmly tap the CVA to **assess its pain** of kidney disorder (percussion of the kidneys).
 - If feels pain, we have to investigate for nephrolithiasis and pyelonephritis.



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The major urological disorders include:

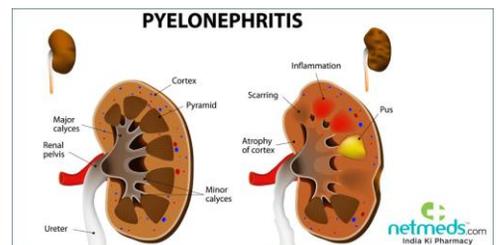
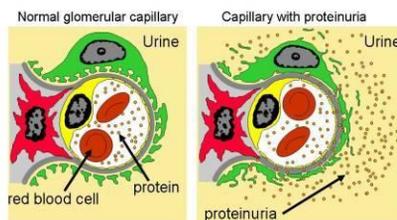
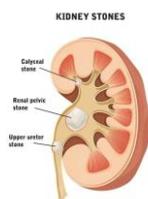
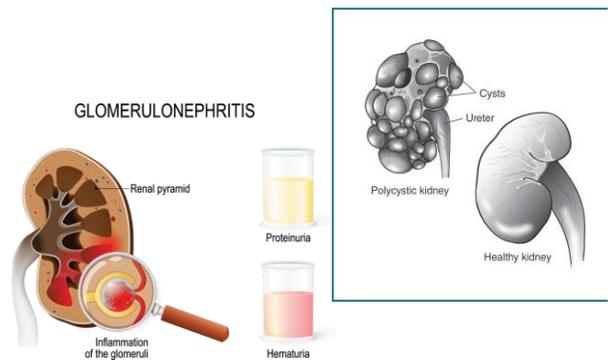
- lower UTI;
- asymptomatic bacteriuria (ASB);
- Interstitial cystitis (IC);
- urolithiasis, also commonly called nephrolithiasis;
- bladder cancer;
- urinary incontinence.



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Major pathophysiological conditions/ urological disorders of the kidney include:

- Acute glomerulonephritis
- Nephrotic syndrome
- Nephrolithiasis (urolithiasis)
- Pyelonephritis; lower UTI; asymptomatic bacteriuria
- Polycystic kidney disease
- Goodpasture syndrome (anti-glomerular basement membrane (anti-GBM) disease)
- Acute kidney injury
- Chronic renal failure; urinary incontinence
- Bladder cancer



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Nephrolithiasis - Urolithiasis

- **Urolithiasis** = calculi that are formed or located anywhere in the urinary system.
 - **Ethiology:**
 - Urolithiasis occurs because of supersaturation of the urine with stone-forming salts as a result of chemical, metabolic, or genetic causes.
- **Cystolithiasis** = Stones in the bladder
 - can also occur as a result of stasis of urine, repeated UTIs, urinary obstruction, or neurogenic bladder.
- **Ureterolithiasis** = Intraureteral stones → cause pressure proximal to the stone in the ureter → spasm.

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Nephrolithiasis

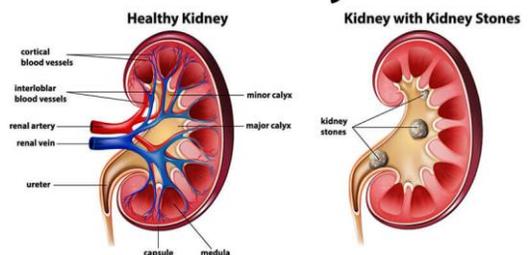
- **Nephrolithiasis** = Formation of **stones** (calculi) in the kidney.
- **Ureterolithiasis** = if the Calculi travel into the ureter.
- **Cystolithiasis** (vesical calculi) = stones in the bladder.

Signs and symptoms: **pain** is common. Characteristics vary based upon the stone's location.

Epidemiology

- Risk factors:
 - Male
 - Caucasians
 - Age: young adults and middle age
 - Dehydration
 - A family history
 - Past history of nephrolithiasis (52% chance of recurrence)

Human Kidney Stones



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Nephrolithiasis (cont.)



Etiology (exact cause is unknown)

→ ~ 90% have a metabolic risk factor:

- Hypercalcemia*, hyperoxaluria, hyperuricemia, hyperparathyroidism, or gout.

→ low fluid intake (dehydration enhances kidney stone formation)**

→ genetic predisposition (> 30 genetic variations associated with renal calculi)

→ Differences in intestinal calcium absorption, renal calcium transport, and renal phosphate transport.

→ Dietary habits

- most common predisposing factors that lead to nephrolithiasis → excessive calcium supplements leading to Hypercalciuria*; and low fluid intake**

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Nephrolithiasis

• Signs and Symptoms:

- Pain (major symptom) - Flank pain with radiation into the groin
- Hematuria
- Infection
- Crystalluria (classic in nephrolithiasis).



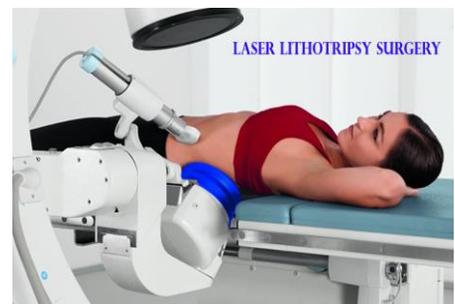
• Diagnosis: requires stone analysis.

- Routine urine analyses are conducted, along with analysis of any stone fragments.
- Imaging studies:
 - noncontrast abdominopelvic CT scan, renal ultrasound, plain abdominal x-ray, IV pyelography, plain renal tomography, retrograde pyelography, and nuclear renal scanning.

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Treatment for renal calculi

- **Symptom management**
 - Pain relief is a priority because of the excruciating nature of the pain that interferes with activities of daily living.
 - **Antibiotics if UTI is present.**
 - large amounts of fluid to increase urine volume. (at least 3 liters/day and strain all urine)
 - **Lithotripsy:** If the patient cannot pass the stone, **lithotripsy** is often used.
 - Lithotripsy utilizes sound waves to break up the stone into smaller particles to facilitate passage.
 - If lithotripsy is unsuccessful, cystoscopic surgery may be necessary.
 - Alteration of the pH of urine with medications such as thiazide diuretics or specific types of antibiotics
 - Meat and cranberry juice can keep the pH of urine acidic.
 - A diet rich in citrus fruits, legumes, and vegetables raises the pH and produces urine that is more alkaline.
- Major treatment goal: to prevent recurrence



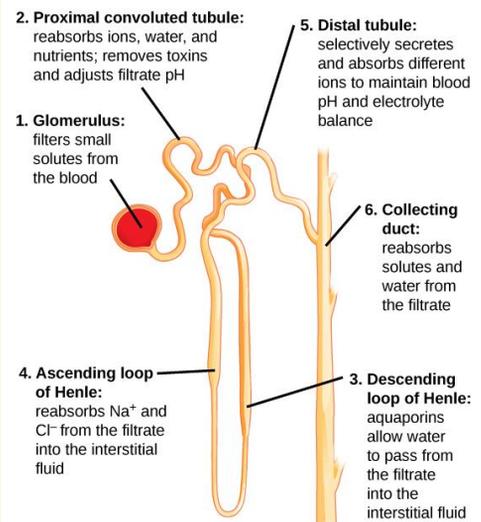
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Keeping homeostasis

- → blood flows through the glomerulus and a membranous cap called Bowman's capsule
- → water and electrolytes leave the blood and pass into the proximal tubule.
 - At this point, the glomerular filtrate is very dilute and contains a high amount of electrolytes, glucose, and metabolic waste products.

Glucose Homeostasis

- The renal tubules reabsorb glucose from the glomerular filtrate up to the renal threshold of a blood glucose level of 180 mg/dL.
- **If the blood glucose level is greater than the renal threshold, the excess glucose is excreted in the urine.**
- Additionally, in states of prolonged fasting or starvation, the kidneys can create glucose from amino acids in a process known as gluconeogenesis.
- The kidneys are also responsible for the degradation of insulin.
- Patients with renal failure have decreased insulin clearance which affects glucose metabolism.



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Urinary Tract Infection

- Lower urinary tract infection (UTI) is the most common urological disorder.
- Also referred to as **cystitis**
- Common condition in women.

Signs/Symptoms:

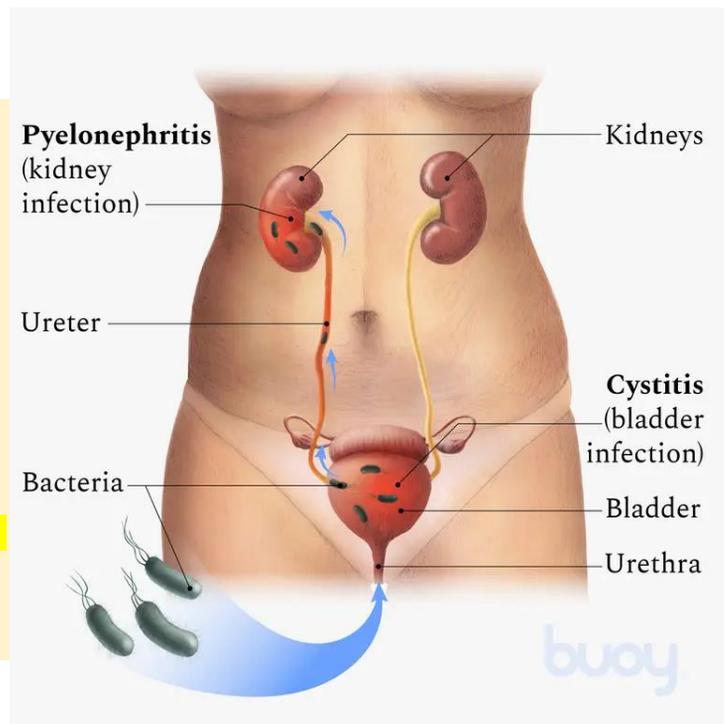
- Dysuria - Pain and burning on urination
- Frequency - An abnormally high number of times that the patient needs to urinate
- Urgency - A feeling that urination will occur imminently
- Hematuria - Blood in the urine
- cloudy, strong-smelling urine
- Bacteriuria - Bacteria in the urine that can be visualized on microscopy
- Nitrites - Bacteria in the urine
- Leukocyte esterase - WBCs in the urine
- Pyuria - WBCs (neutrophils) in the urine
 - A lower UTI is a confined, localized infection and should not raise the WBC count.



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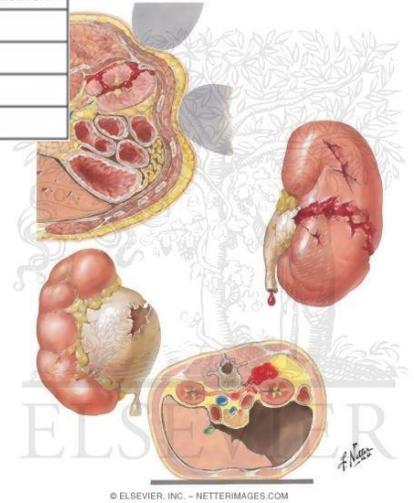
Urinary Tract Infection

- An **untreated lower UTI** can put the patient at risk for an **ascending UTI** that can result in **pyelonephritis**, which is kidney infection.
 - *E. coli*, which usually inhabits the bowel is commonly transmitted from the rectum to the urethra in women due to the anatomical proximity of the anus to the urethra.



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American Association for Surgery of Trauma Renal Injury Scale		
Grade	Type	Description
I	Contusion	Microscopic or gross haematuria. Urological studies normal.
	Haematoma	Subcapsular, non-expanding without parenchymal laceration.
II	Haematoma	Non-expanding peri-renal haematoma confined to renal retroperitoneum.
	Laceration	< 1.0cm parenchymal depth of renal cortex with no urinary extravasation.
III	Laceration	> 1.0cm parenchymal depth of renal cortex w/out collecting system rupture or urinary extravasation.
IV	Laceration	Parenchymal laceration extending through renal cortex, medulla & collecting system.
	Vascular	Main renal artery or vein injury with contained haemorrhage.
V	Laceration	Completely shattered kidney.
	Vascular	Avulsion of renal hilum that devascularises kidney.



Types of intrarenal dysfunction:

- Obstructive uropathy
- Trauma
- Toxic Injury
- Infections

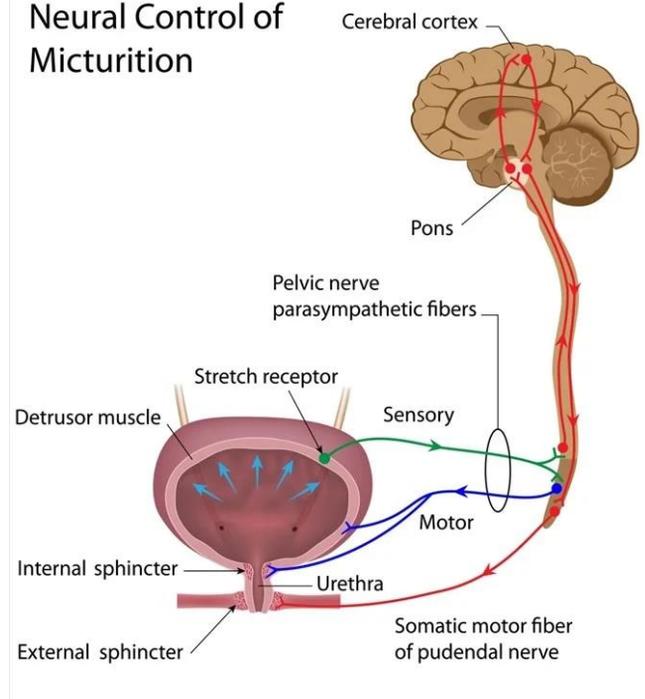
Early recognition and treatment of urological disorders are keys to preventing renal dysfunction.

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Micturition reflex (urination)

- 1) bladder wall stretches to accommodate the increasing volume of urine
- 2) parasympathetic nerves in the reflex arc respond by stimulating the detrusor muscle in the bladder wall to contract.
- 3) At the same time, the spinal cord sends nerve impulses up to the cerebral cortex, thereby allowing a conscious decision about whether it is appropriate to void.
- 4) If voiding is not appropriate, the cerebral cortex initiates impulses that travel back down the spinal cord to inhibit the reflex arc, thereby preventing micturition (keeping the external urinary sphincter contracted)
- 5) When micturition is appropriate, impulses from the cerebral cortex stimulate the micturition reflex.
- 6) The spinal cord nerves allow the external urinary sphincter to relax, thereby allowing urine to be expelled through the urethra.

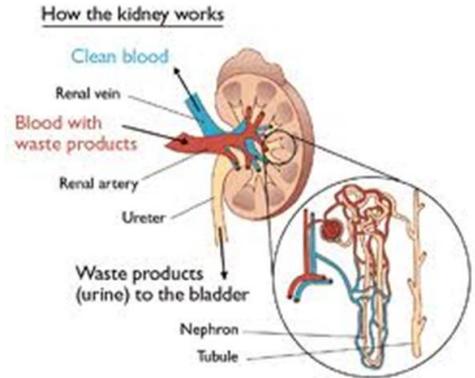
Neural Control of Micturition



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Blood Urea Nitrogen (BUN)

- **Azotemia** = increase of BUN within the bloodstream.
- Normal level for BUN = 5 to 20 mg/dL.
- Decrease in the GFR → Elevated BUN (accumulation of nitrogenous waste products in the blood)
- High BUN level can indicate:
 - kidney dysfunction
 - dehydration
 - any condition that elevates the amount of nitrogen waste in the bloodstream.
 - Examples:
 - High-protein diets
 - Extremely muscular individuals will have a high nitrogen level in the bloodstream because of high muscle breakdown.
 - Muscle cell proteins break down into amino acids (nitrogen compounds)



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Normal excretion of urine per day = AT LEAST 400ml of urine per day

- Anuria
- Oliguria

What affects urine outflow:

- **Immobility** affects urine outflow
 - Prolonged Immobility can cause incontinence, and can also negatively affect urine outflow
 - The rare studies that exist on the subject have shown that prolonged bedrest (≥60 days) was associated with a reduction in glomerular filtration rate (the rate at which fluid is filtered through the kidney and an indicator of renal health) (Arinell et al, 2011)
- Urine outflow depends also on **peristalsis of the ureters**, adequate **pressure from the glomerulus into the nephron tubules**, and the effects of **gravity**.
- **Hydration** affects urine outflow

Reduced urine outflow causes elevation in Blood Pressure :

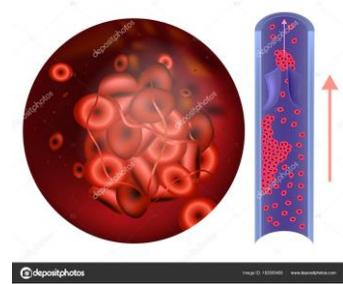
- As GFR decreases, oliguria (lack of sufficient urine production), develops. The patient becomes hypervolemic → edematous, increased blood pressure.

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Reviewing DISORDERS OF VENOUS SYSTEM

Common risks for hypercoagulability:

- smoke
- contraceptive pills



Venous ulcers common causes:

- Poor tissue oxygenation, nutrition, and waste product removal
- Orthopedic surgeries



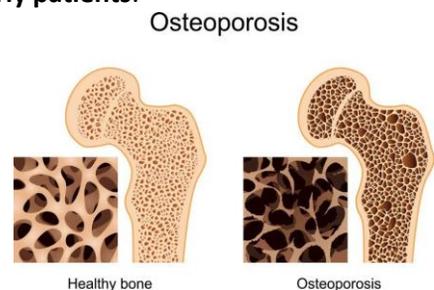
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Reviewing OSTEOPOROSIS

Osteopenia is the term used for thinning of the trabecular matrix of the bone before osteoporosis

Osteoporosis is the term used when actual breaks in the trabecular matrix have occurred.

- **OSTEOPOROSIS**, the most common degenerative disease of bone, is a disorder of bone demineralization.
 - **Osteoporosis is a major cause of hip fracture.** Osteoporotic fracture usually occurs in the femoral head or neck, where there is mainly trabecular (nonsolid) bone.
- **HIP FRACTURE** caused by osteoporosis often causes a **fall in elderly patients.**
 - **Immobility** and its many detrimental effects are the cause for a decline in health after hip fracture



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