Libyan International Medical University
Faculty of Basic Medical Science
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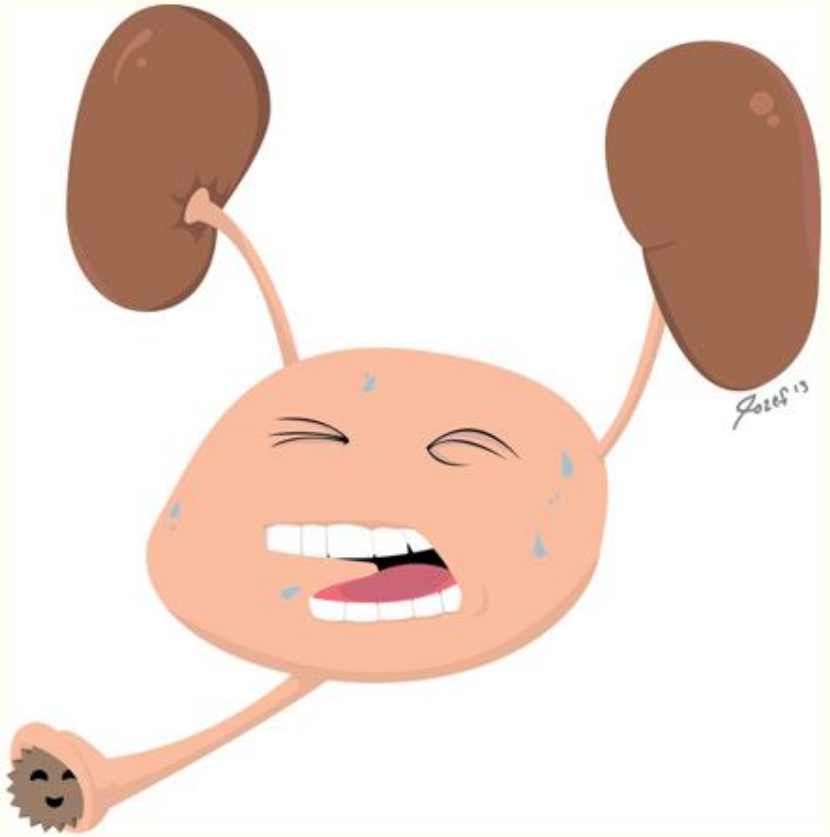


KIDNEY STONES

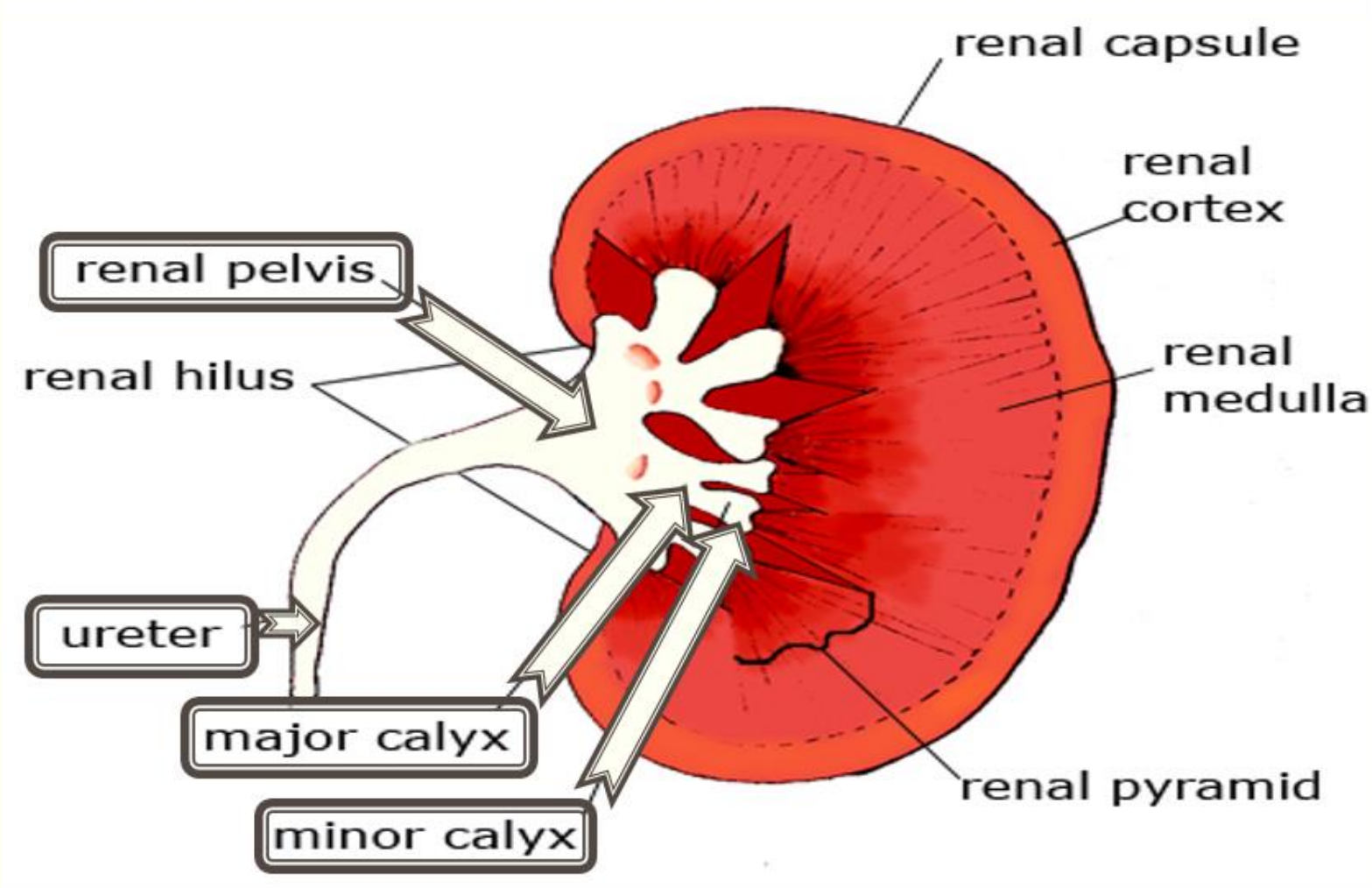
The Objectives

1. Describe the Histological Structure of Urinary Passages?
2. Discuss The Important Properties, Epidemiology And Pathogenesis Of Proteus Bacteria ?
3. Describe The Causes And Morphology of pyelonephritis?
4. Describe The Causes And Pathogenesis Of Kidney Stones?
5. Outline causes and complications of Obstructive Uropathy?
6. Outline the role of potassium citrate in renal stones?

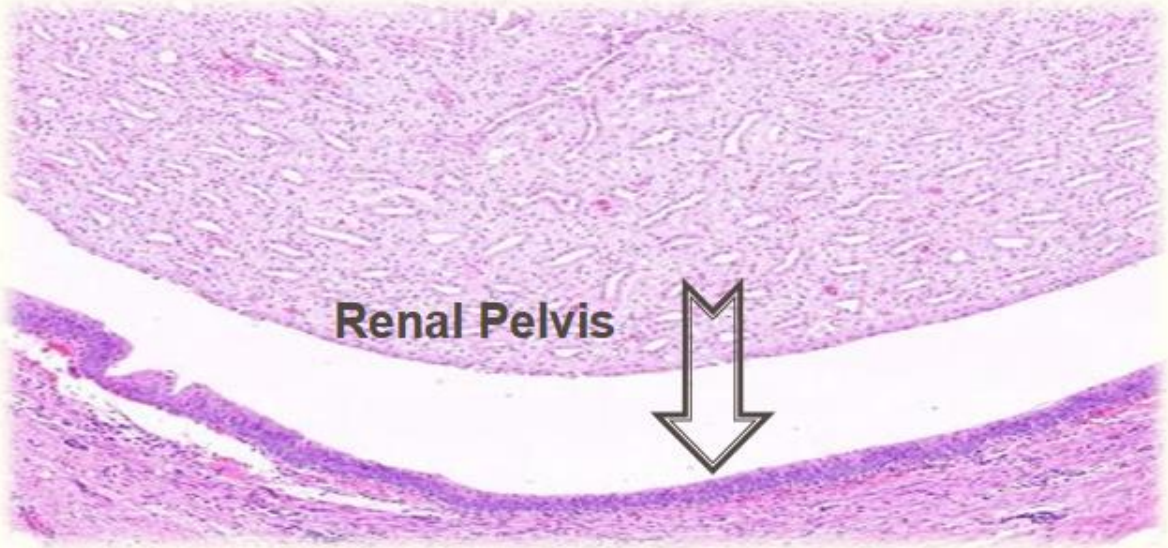
What is Nephrolithiasis ??

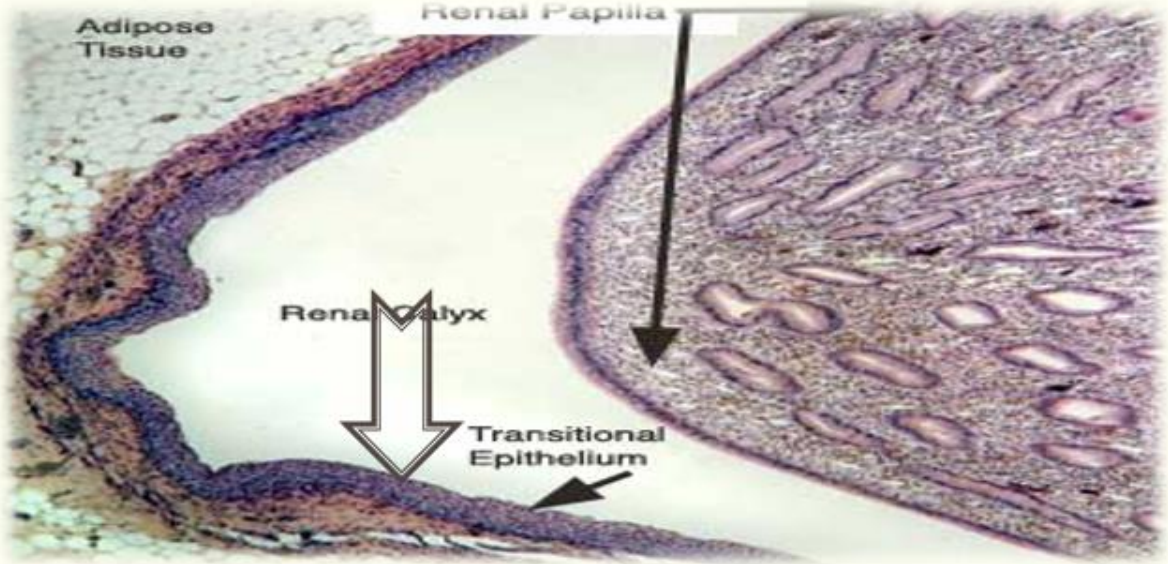
#1
Describe the Histological Structure of Urinary Passages?

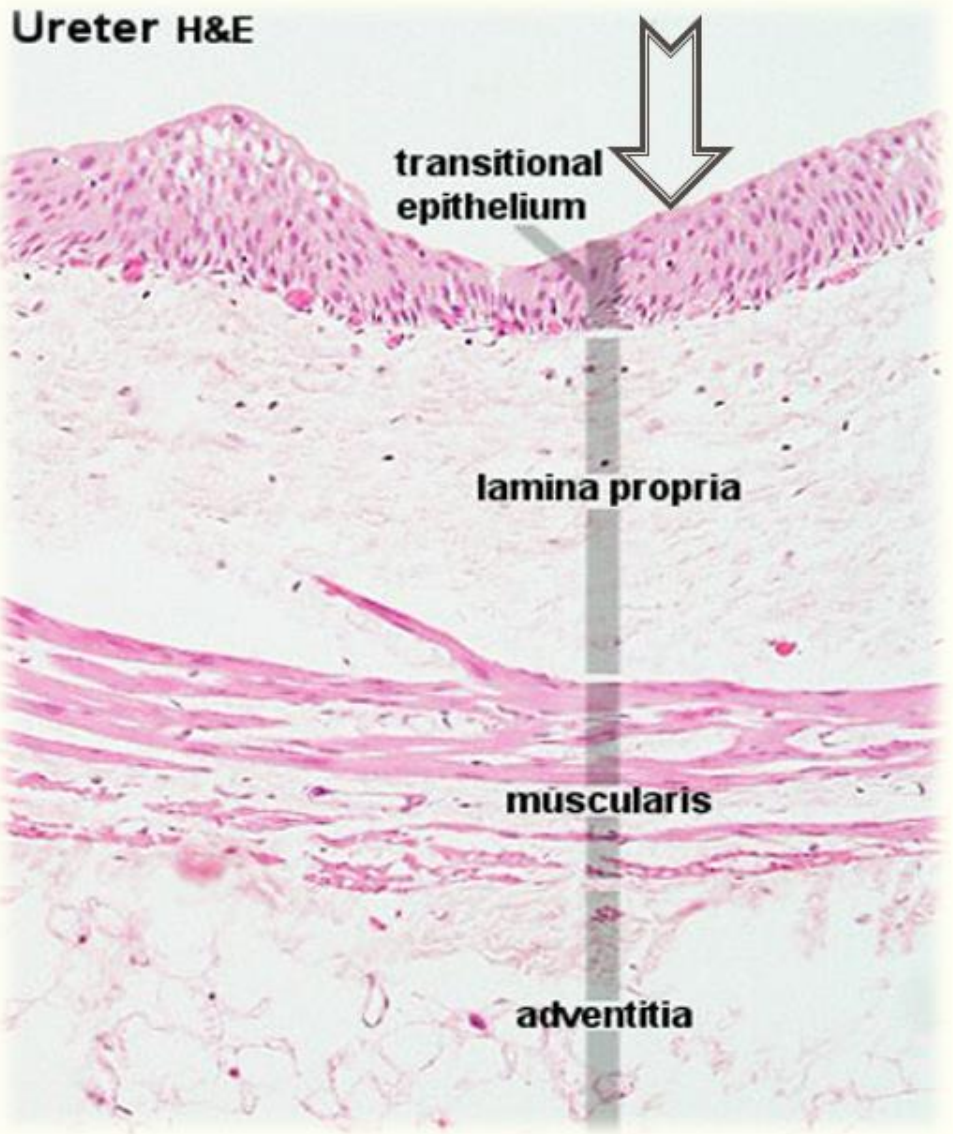
Histology of Renal Passages



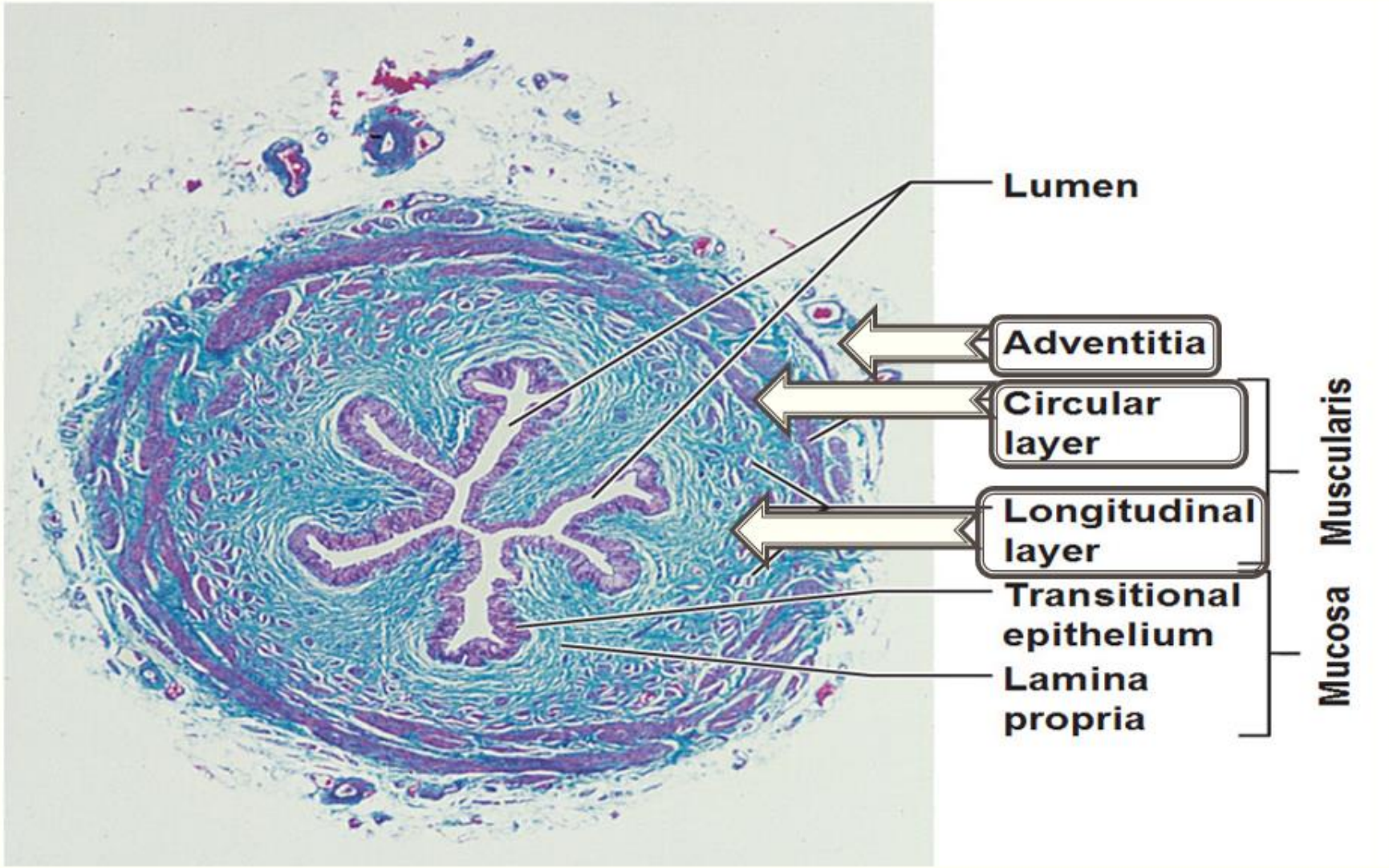
Renal Passages



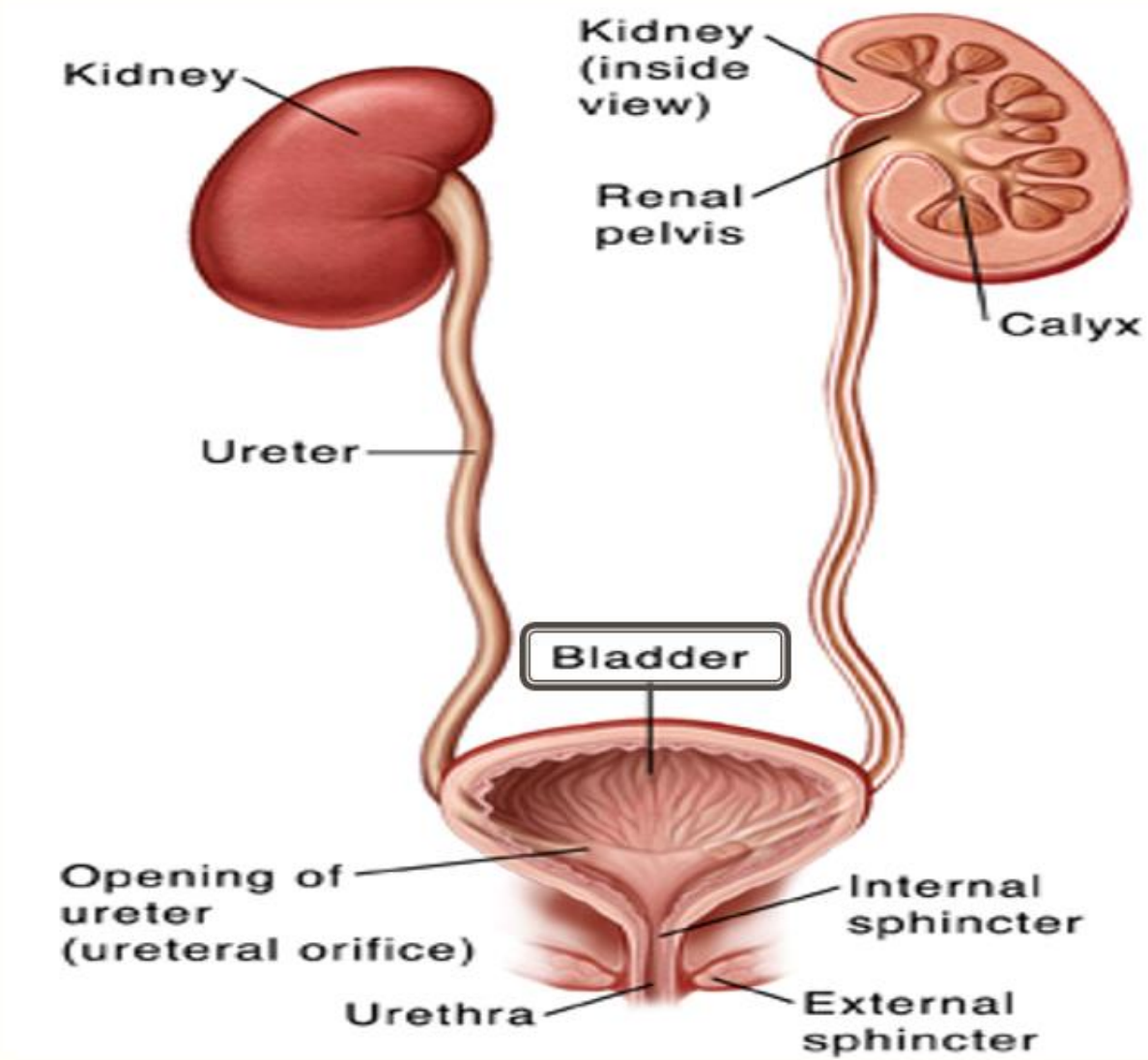




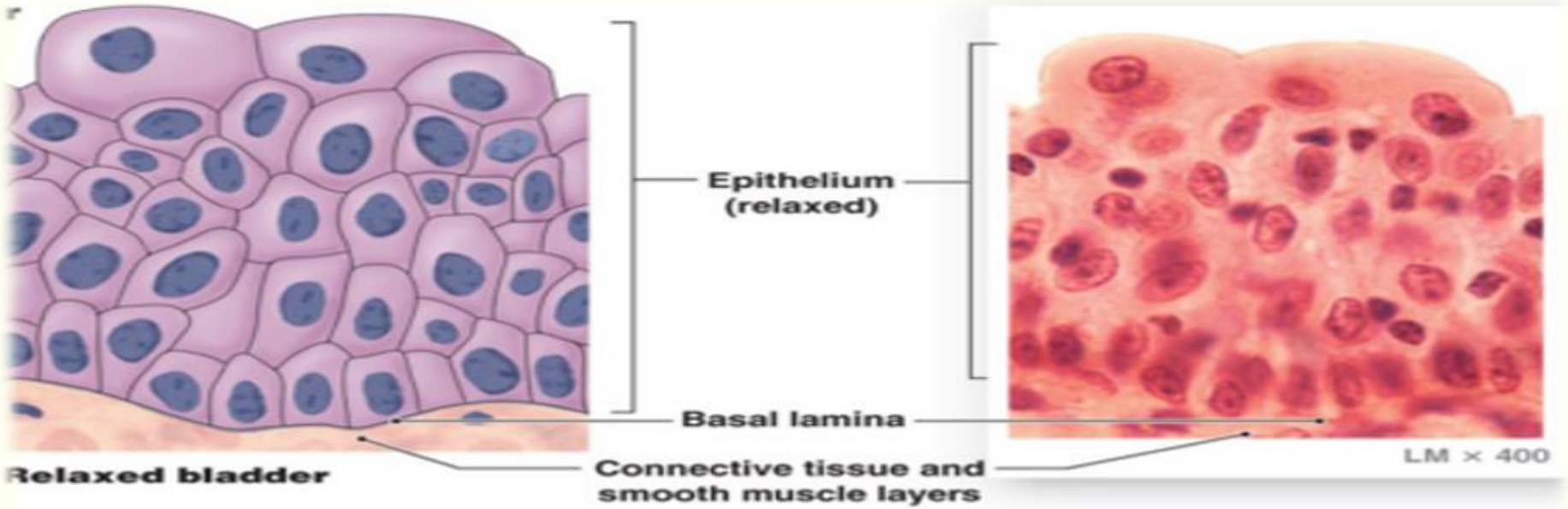
Ureter


Lumen
Adventitia
Circular layer
Longitudinal layer
Transitional epithelium
Lamina propria
Muscularis
Mucosa

Urinary Bladder



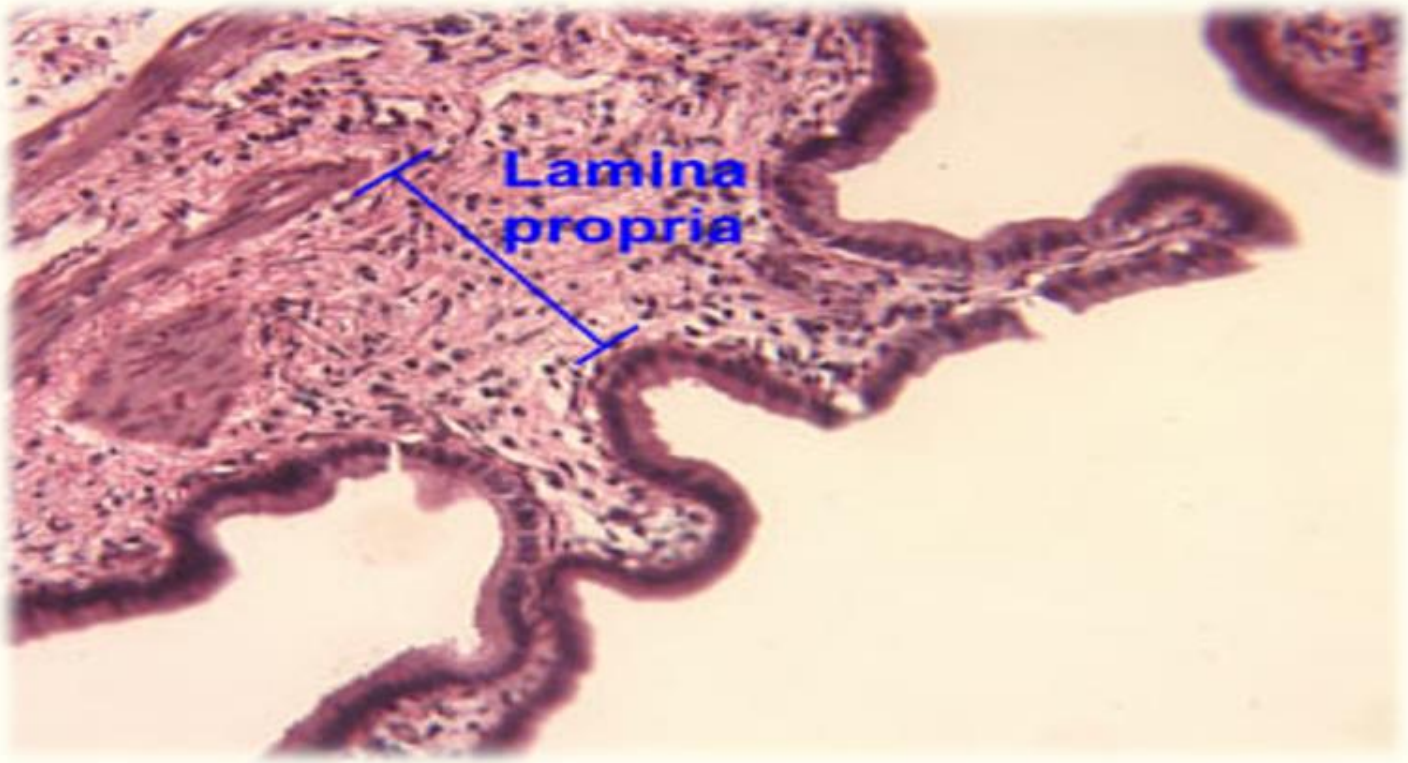
Urinary Bladder



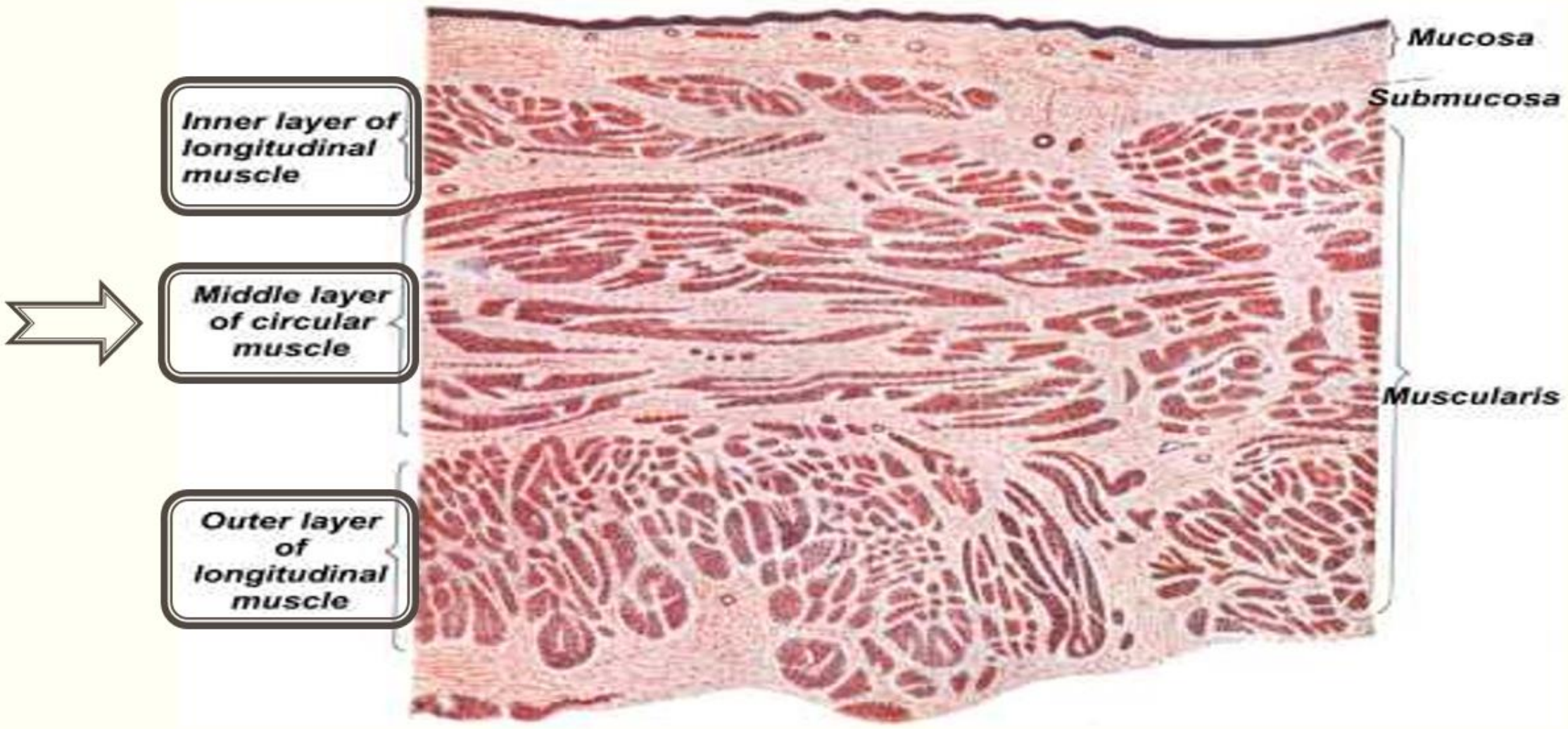
Lamina Propria of the Bladder

The lamina propria of the bladder subdivided into two layers:

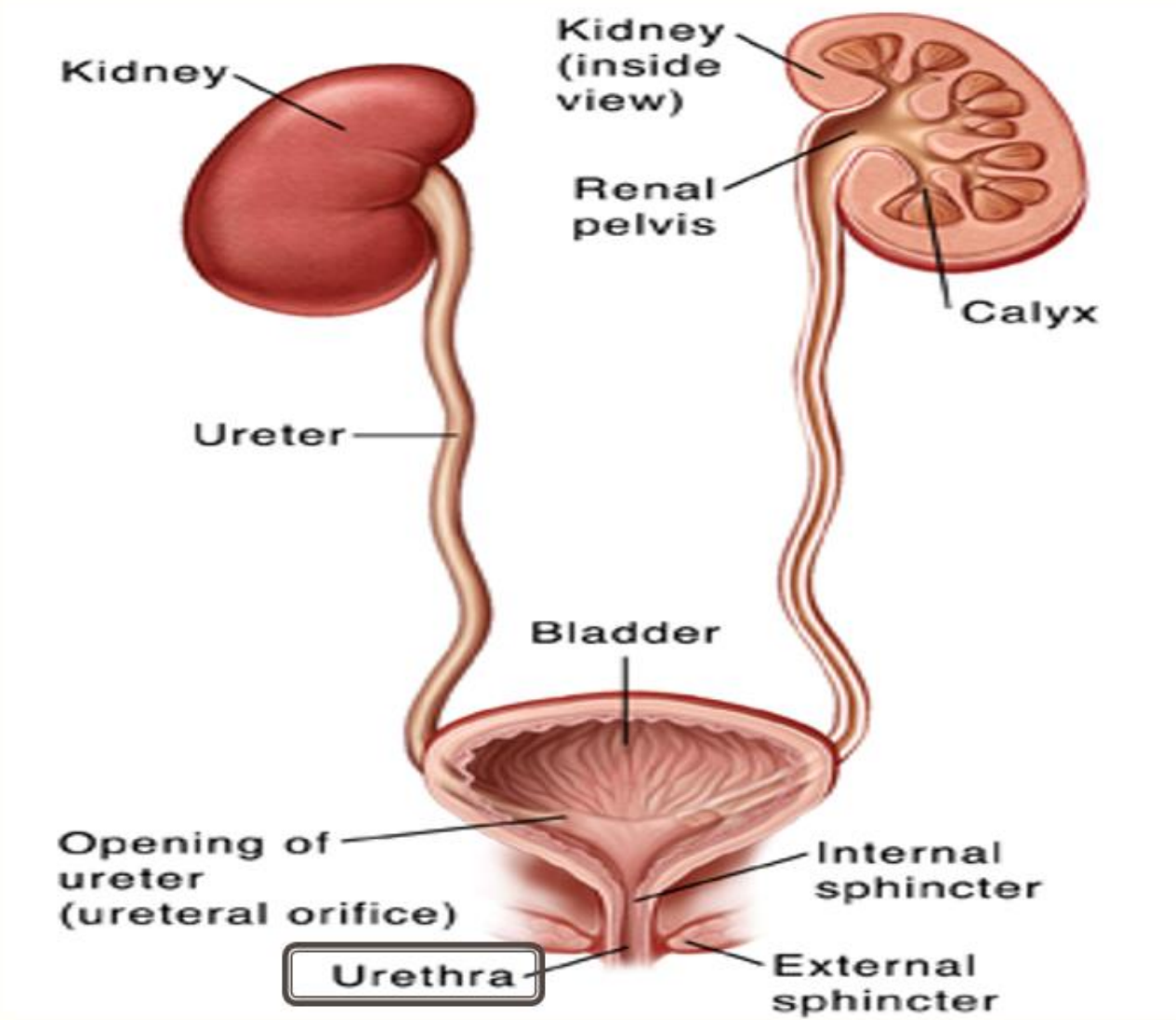
- *Superficial*, dense, irregular collagenous connective tissue.
- *Deep*, loose layer of connective tissue composed of a mixture of collagen and elastic fibers.



Muscularis of the Bladder



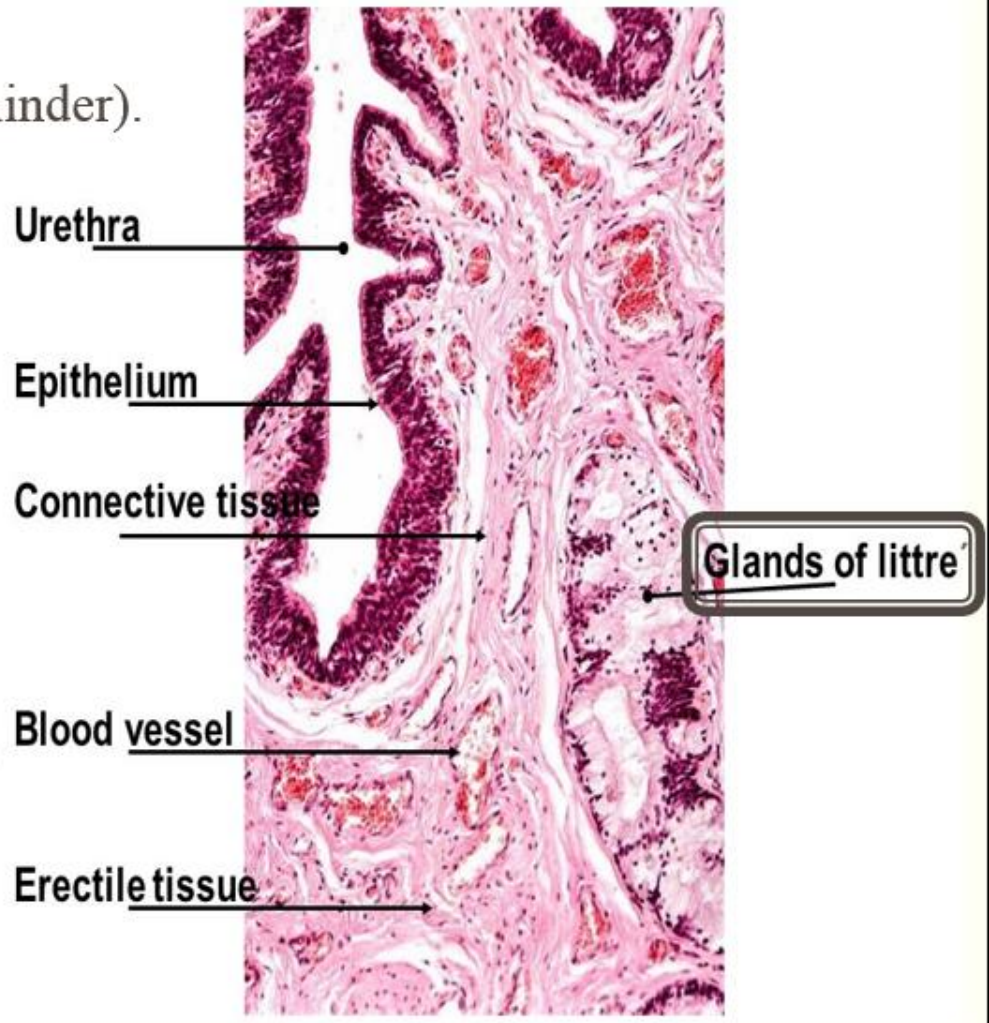
Urethra


Kidney
Kidney (inside view)
Renal pelvis
Calyx
Ureter
Bladder
Opening of ureter (ureteral orifice)
Internal sphincter
Urethra
External sphincter

Urethra

- Female Urethra is lined by:
  - ∞ Transitional epithelium (Near the bladder).
  - ∞ Stratified squamous nonkeratinized epithelium (Along the reminder).

- Male Urethra
- ∞ Subdivided into three regions :
  1. The Prostatic Urethra:
     - 3 to 4 cm long.
     - Lies entirely in the prostate gland.
     - It is lined by a transitional epithelium.
  2. The Membranous Urethra:
     - 1 to 2 cm long.
     - This segment passes through the perineal membrane.
  3. The Spongy urethra:
     - 15 cm long.
     - This segment located in the corpus spongiosum.
     - It is lined by stratified columnar epithelium.



#2

Discuss The Important Properties, Epidemiology And Pathogenesis Of Proteus Bacteria ?

Introduction

- **There were four medically important species :-**

1- Proteus morganii - Morganella morganii.

2- Proteus rettgeri - Providencia rettgeri.

3- Proteus vulgaris.

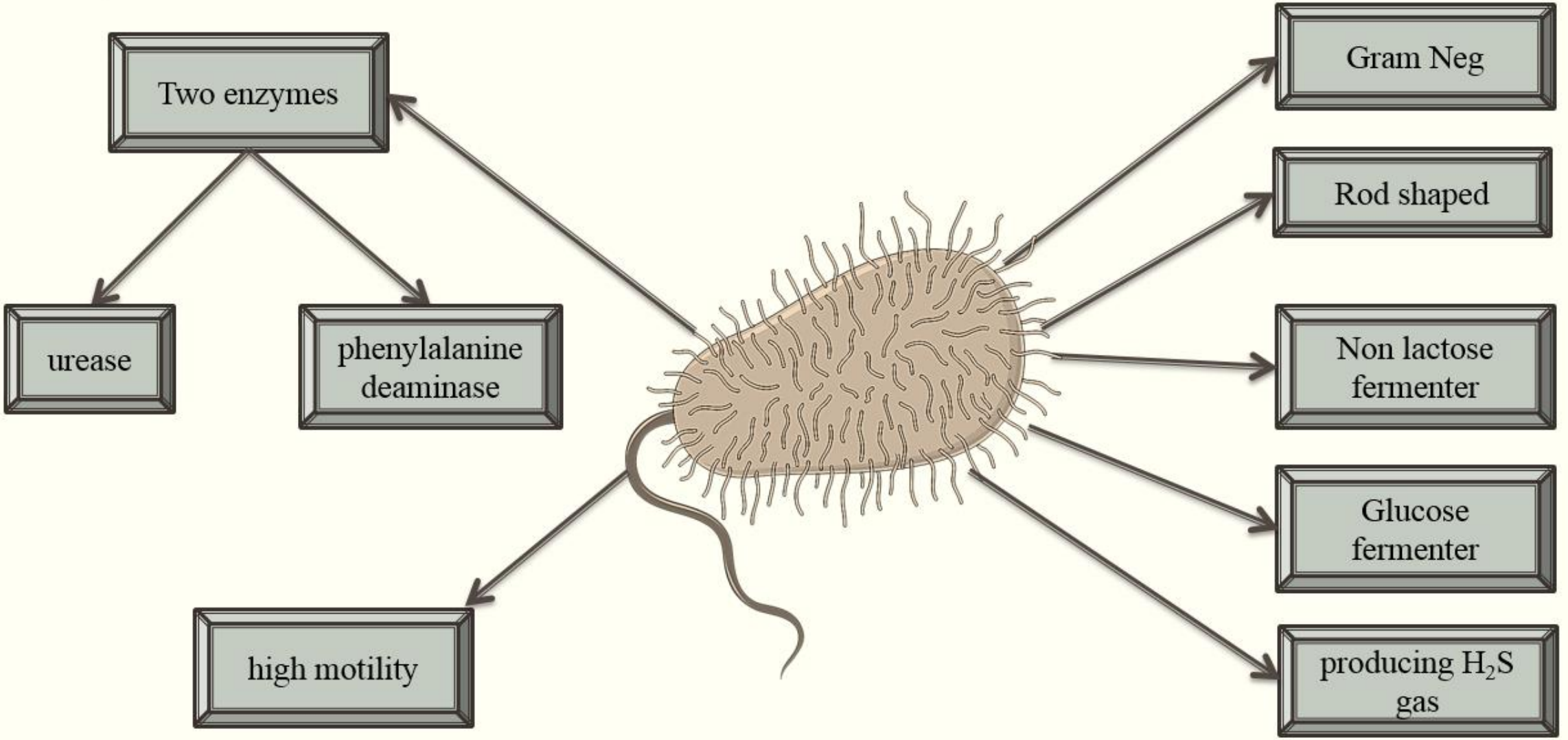
4- Proteus mirabilis.

- These organisms primarily cause urinary tract infections, both in

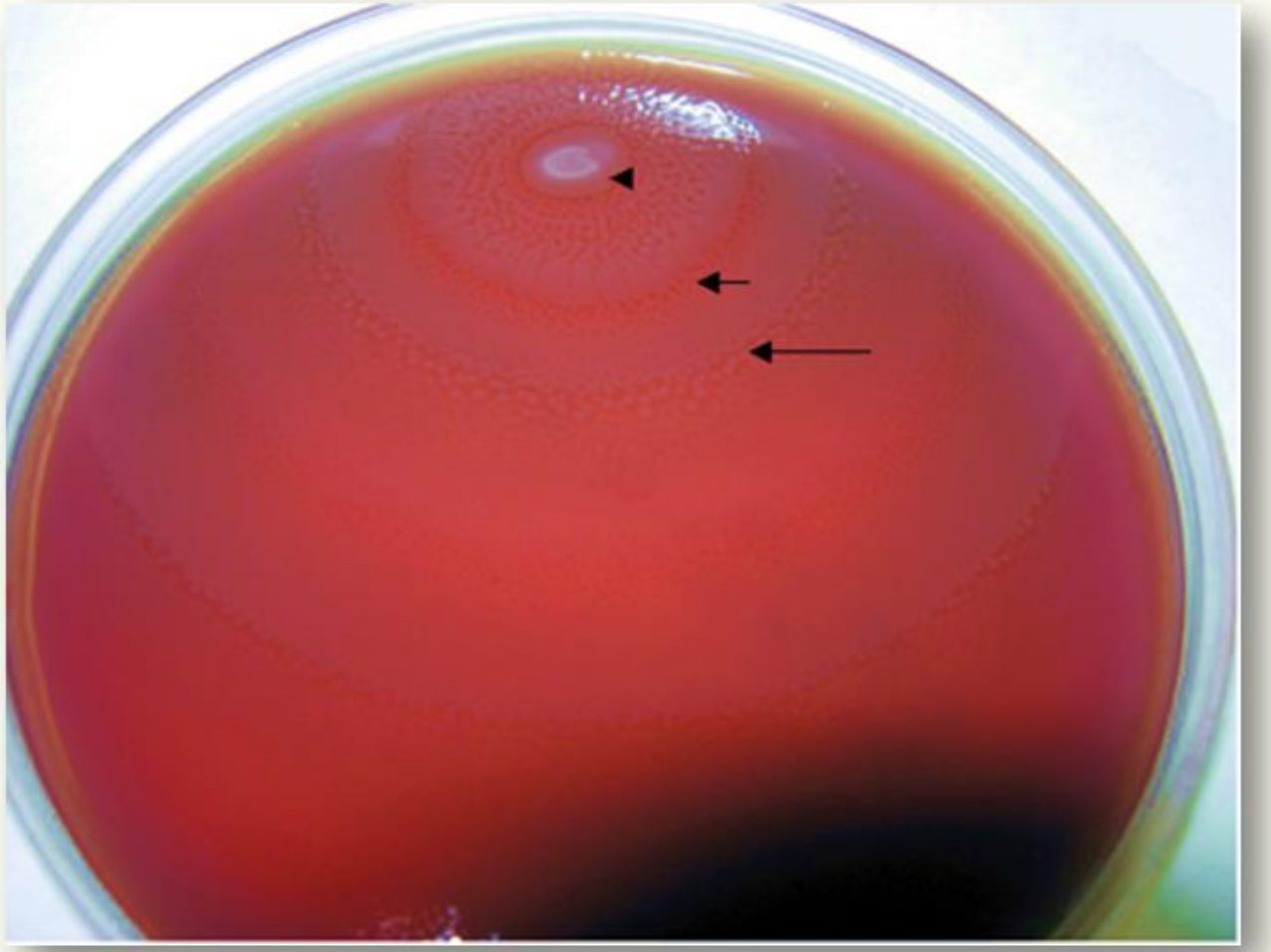
Community

Hospital-acquired

Important Properties



Striking swarming effect on blood agar

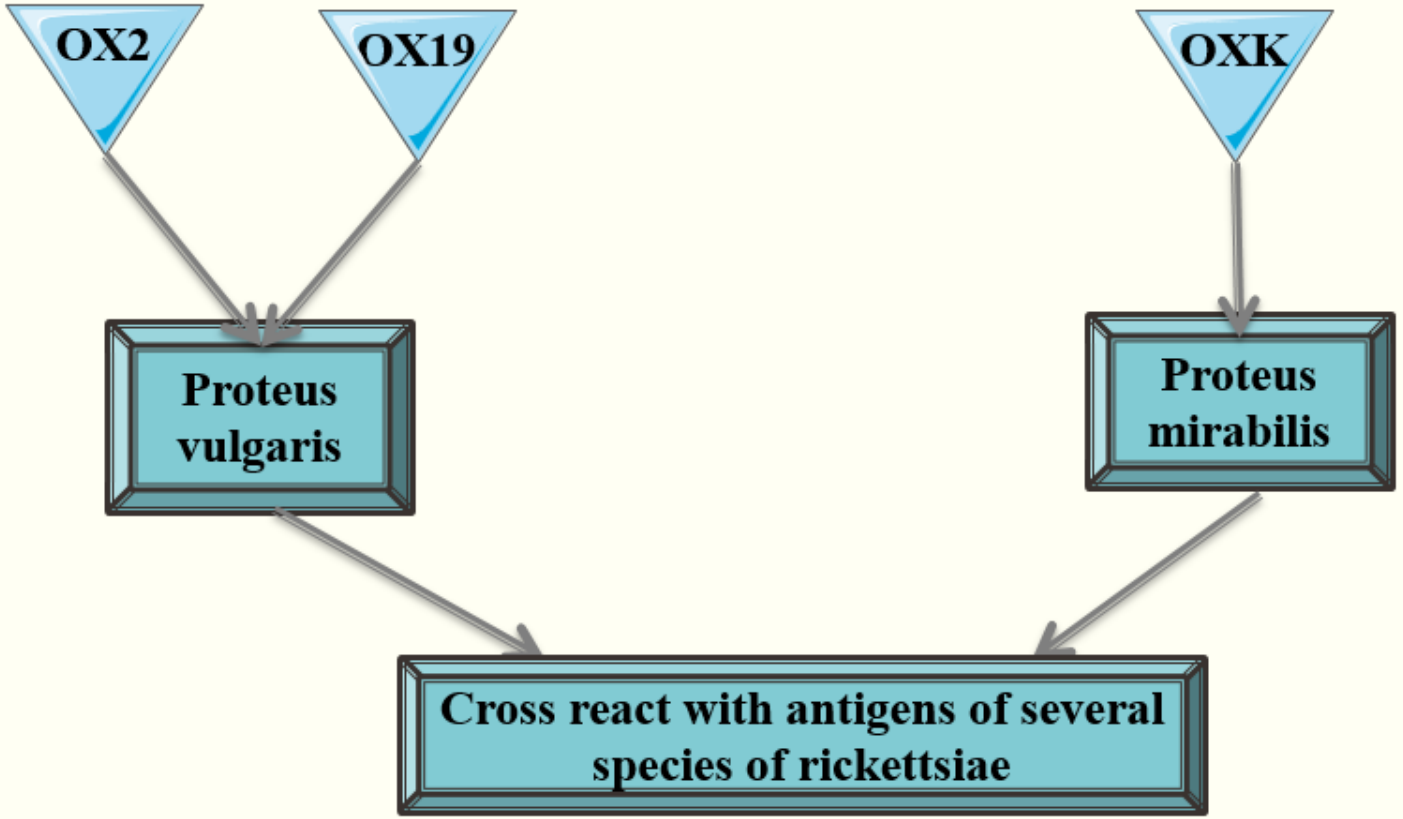


characterized by expanding rings (waves) of organisms over the surface of the agar

What Is The Weil Felix Reaction ?

Answer

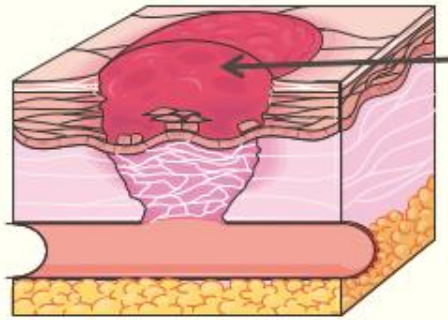
- It is a type of agglutination test in which patient serum is tested for agglutinins to O antigen in cell wall of certain protesus and rickettsial strains

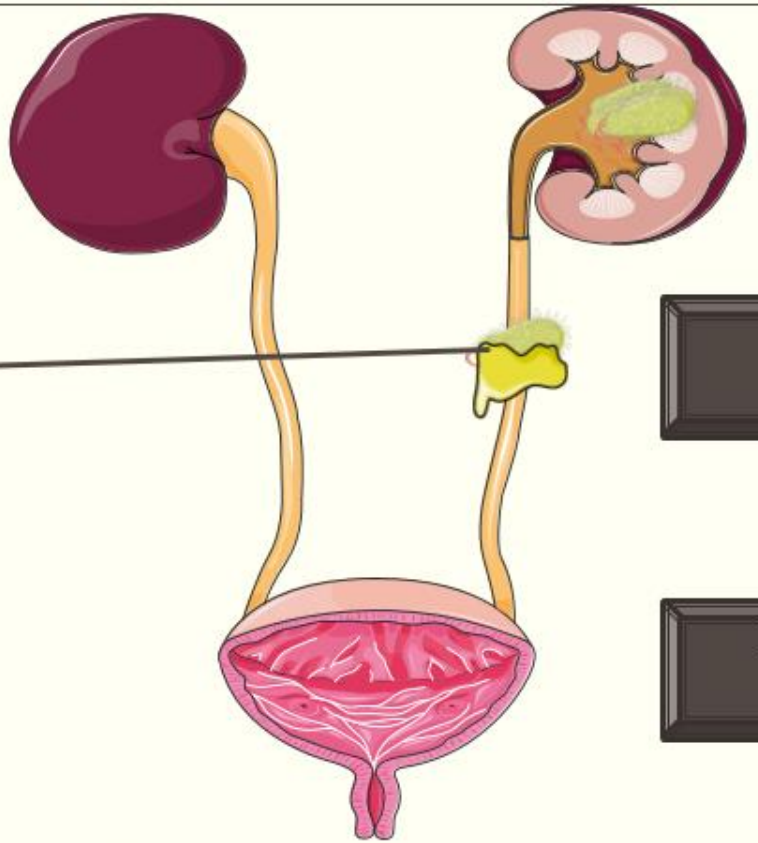


Pathogenesis & Epidemiology

Site of organism

Epithelium damage





Recurrent infection

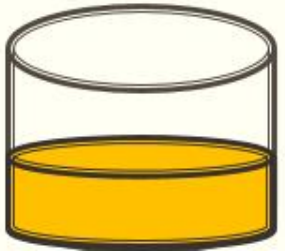
More renal damage

urease

Co2

NH3

Alkaline urine



Struvite stone

#3
Describe The Causes And Morphology of pyelonephritis?

Pyelonephritis

- **Pyelonephritis: renal disorder affecting tubules, interstitium, and renal pelvis**
- **Two types:**
- **Acute pyelonephritis**
- **Chronic pyelonephritis**

Acute pyelonephritis

It is an acute suppurative inflammation of the kidney caused by pyogenic bacteria and sometimes viruses

***Etiology and Pathogenesis**

- the commonest pathogenic organisms are E.coli (90% of cases),Proteus, Enterobacter,Klebsiella, Pseudomonas.

- Viruses: cytomegalovirus, and adenovirus, Polyomavirus.

Ways of infection

Organisms reach the kidney by 2 routes:

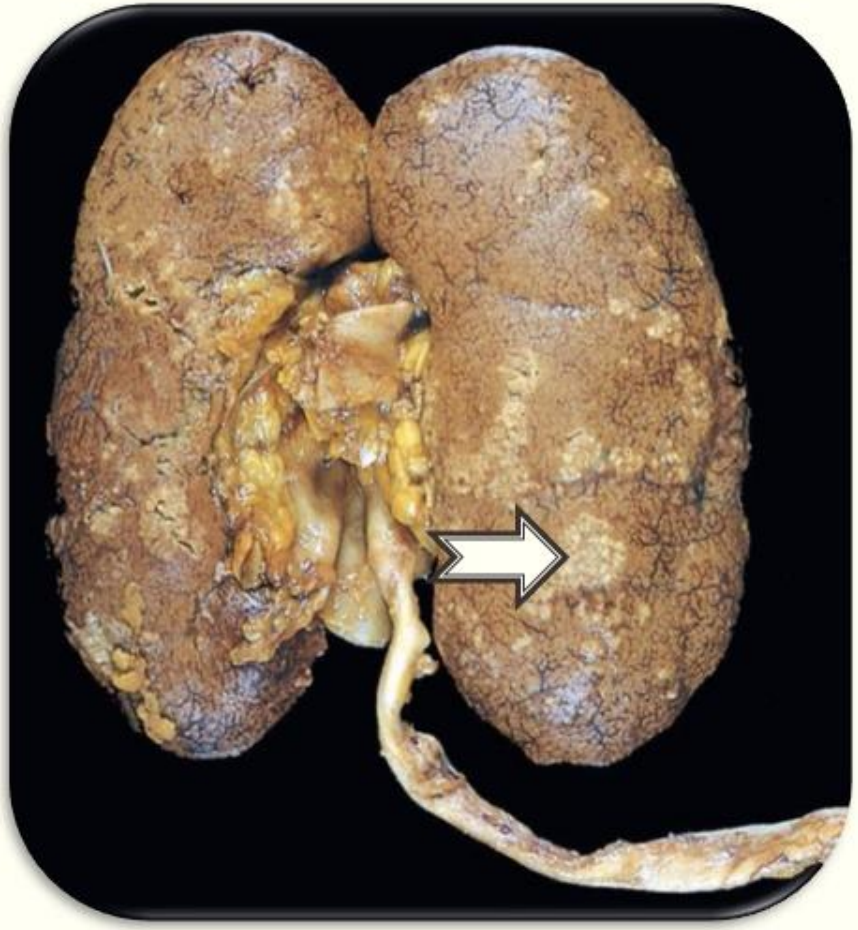
1- Ascending infection:most common route,

- its common in DM or pregnancy,
- the pathogens are inhabitants of the colon >> fecal contamination of urethral orifice

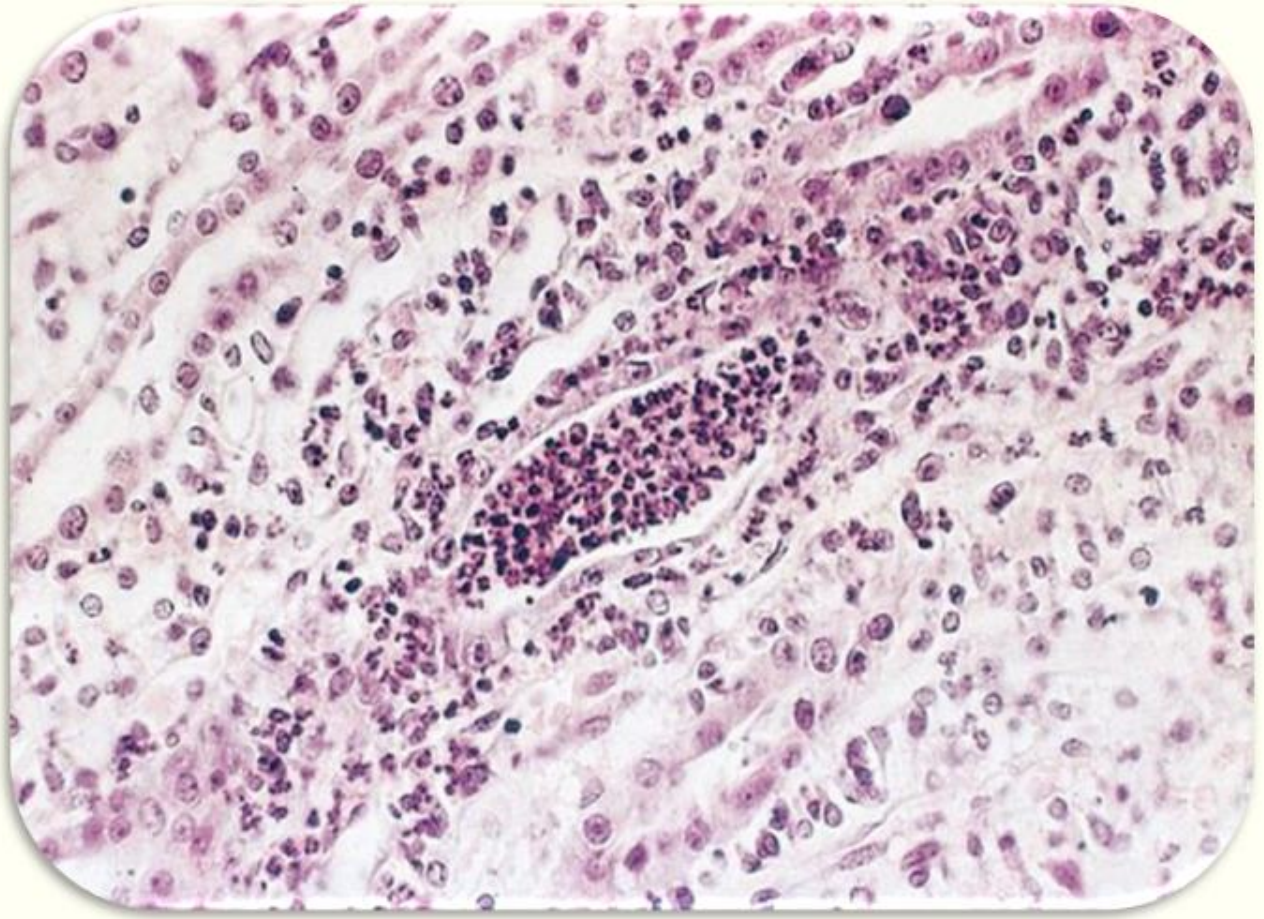
2- Hematogenous infection: less common

Morphology

N/E

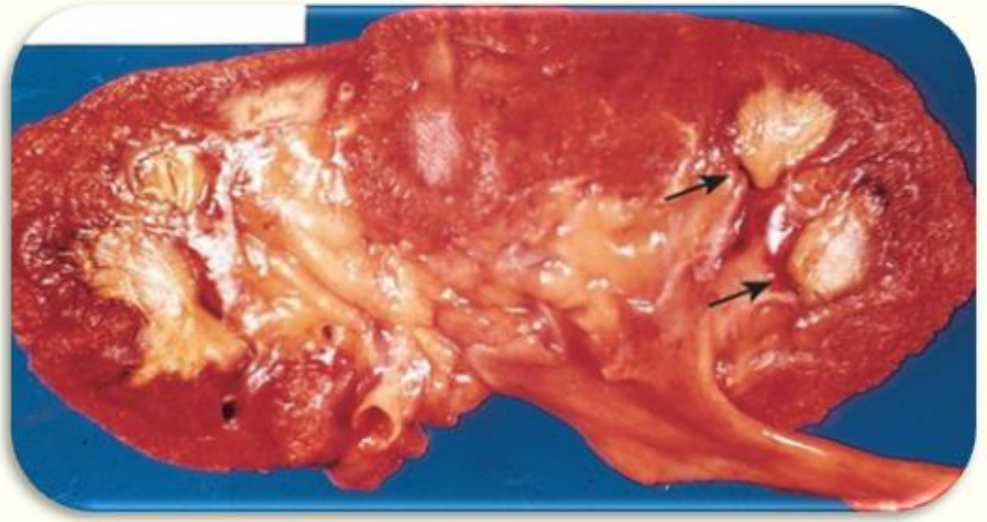


M/P



Complications

1-Papillary necrosis



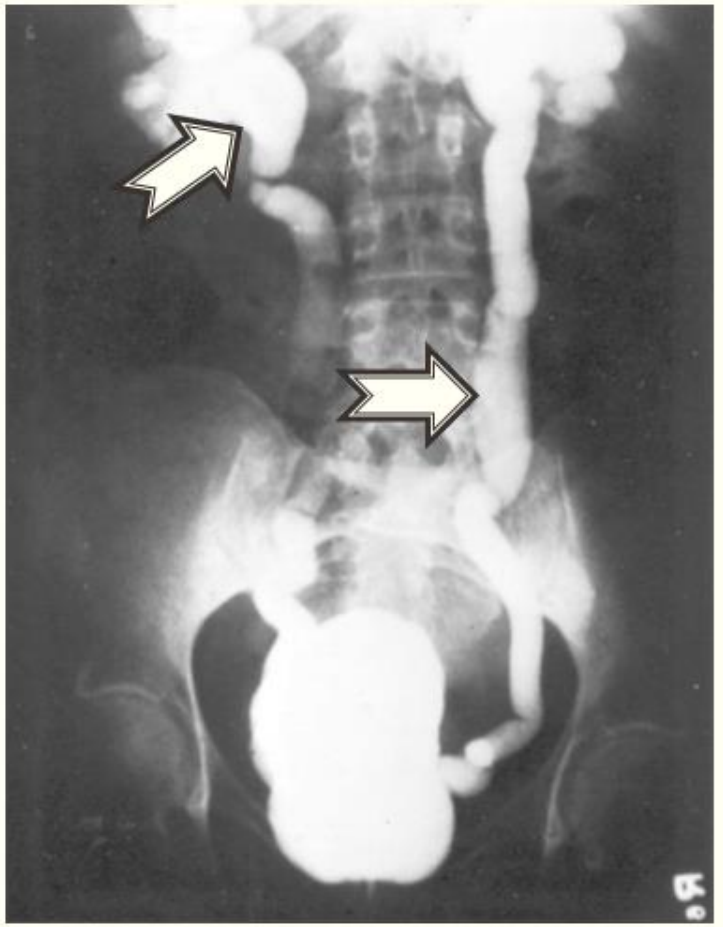
2-Pyonephrosis

3-Perinephric abscess

Chronic pyelonephritisb

- chronic tubulo-interstitial disease resulting from repeated inflammation and scarring.
- Important cause of end-stage kidney disease

What do the arrows indicate ?



Etiopathogenesis

Two forms:

1.Reflux nephropathy(Vesico Ureteral Reflux VUR)

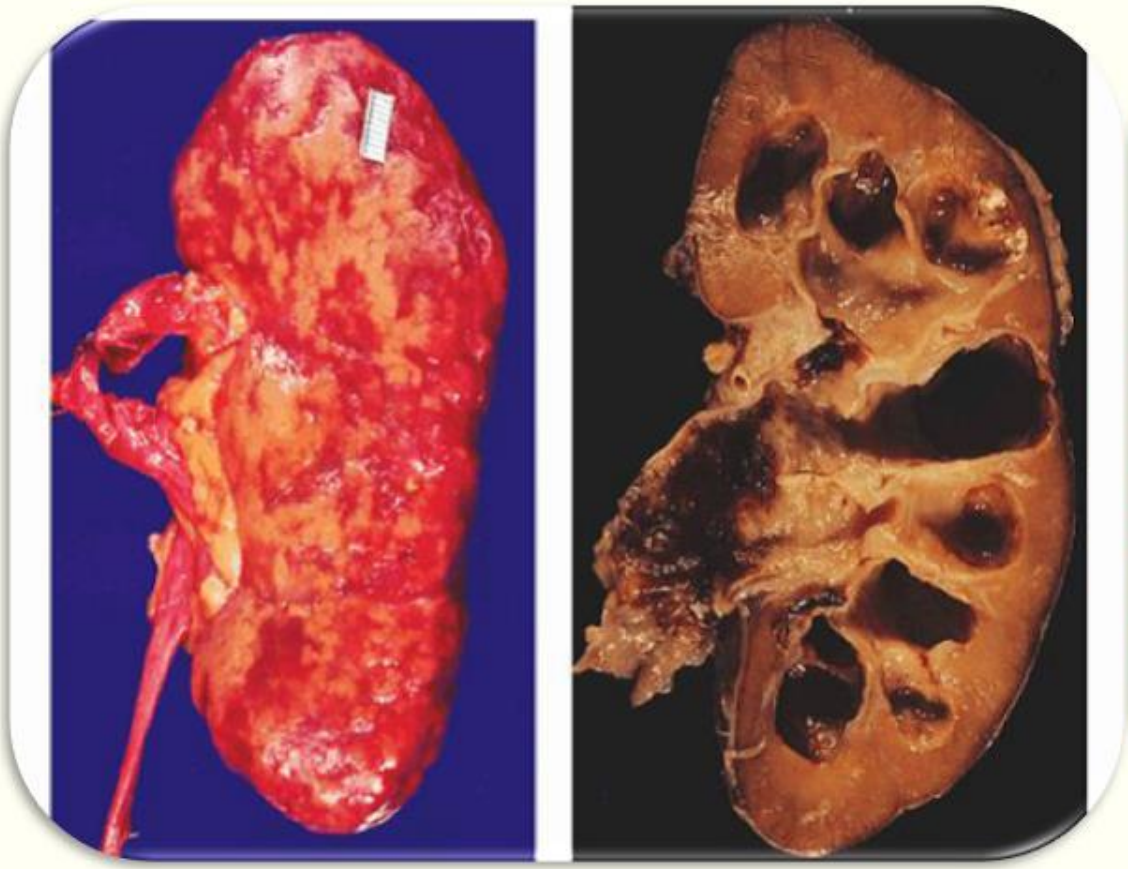
- Characterized by regurgitation of urine from bladder into ureters during micturation.

2.Obstructive pyelonephritis

- Recurrent infections, bouts of renal inflammation and scarring and renal damage.

Morphology

N/E



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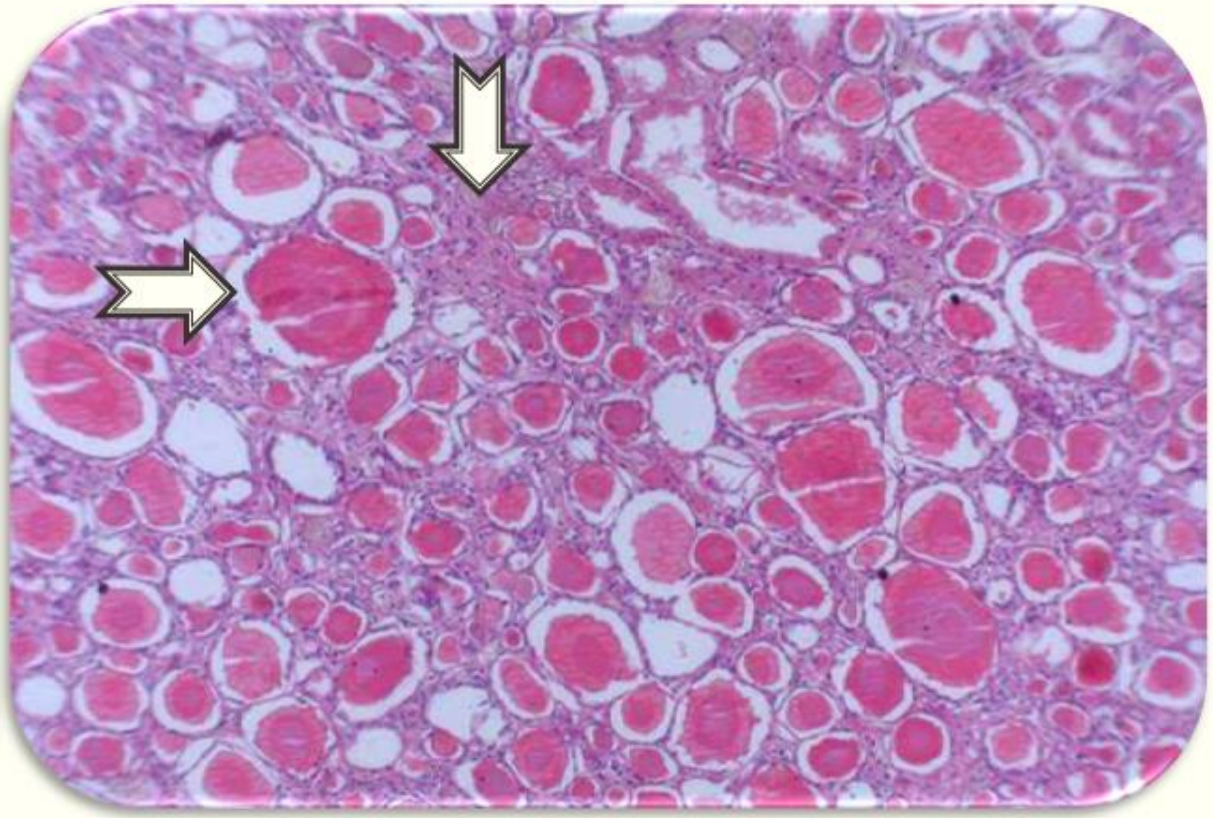
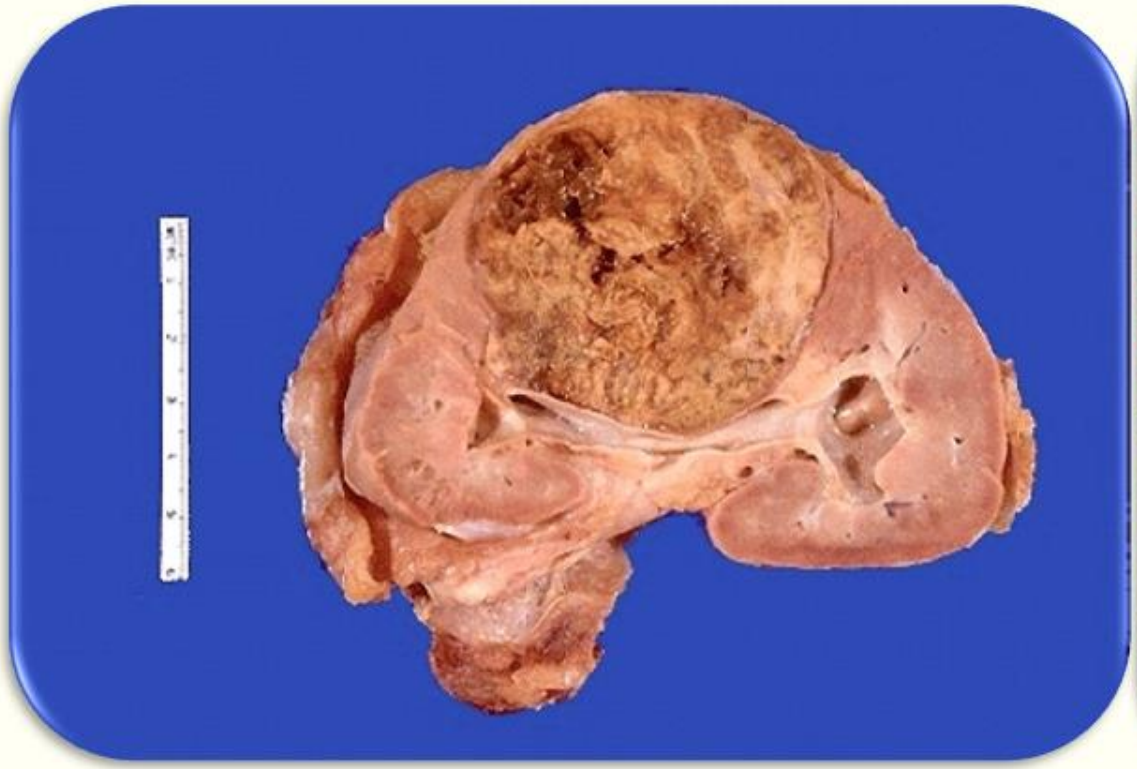


Xanthogranulomatous pyelonephritis

N/E



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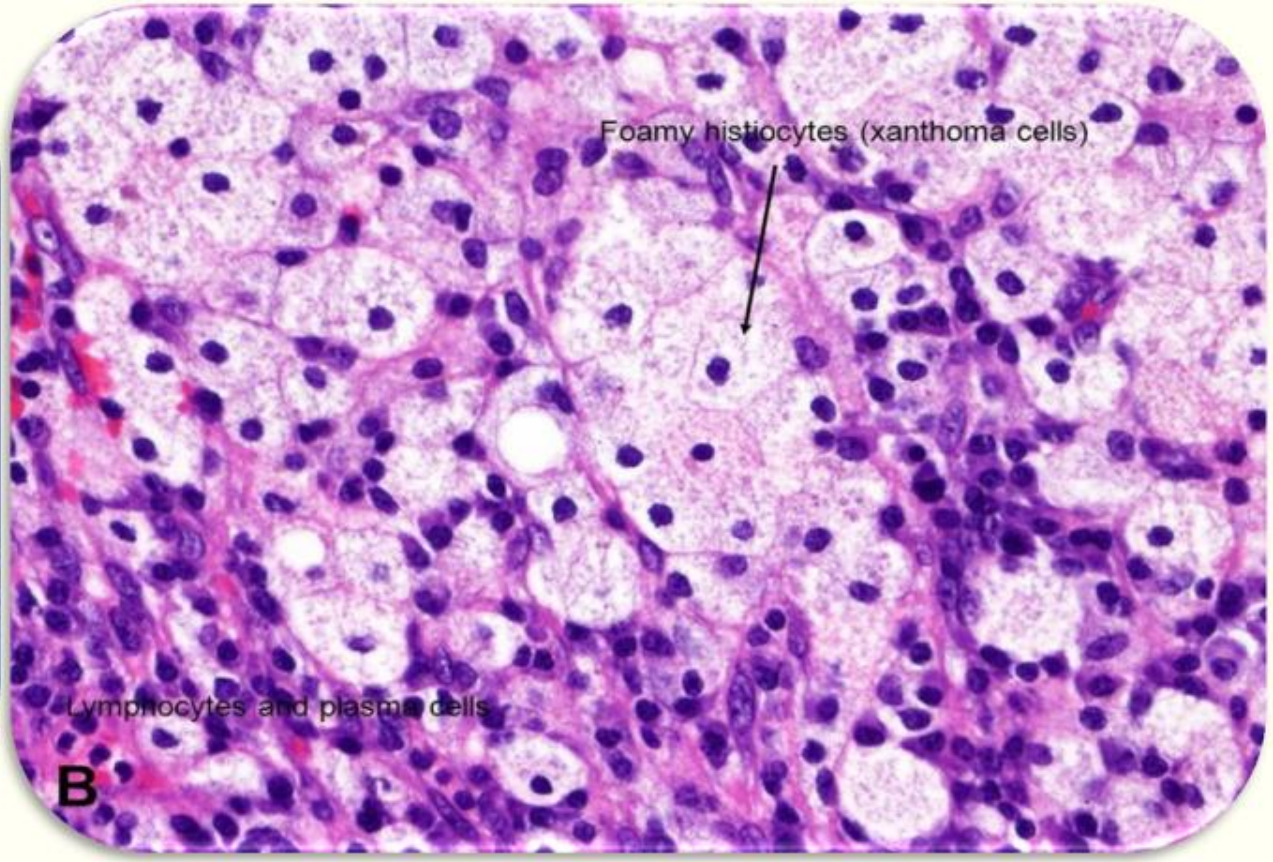


#4

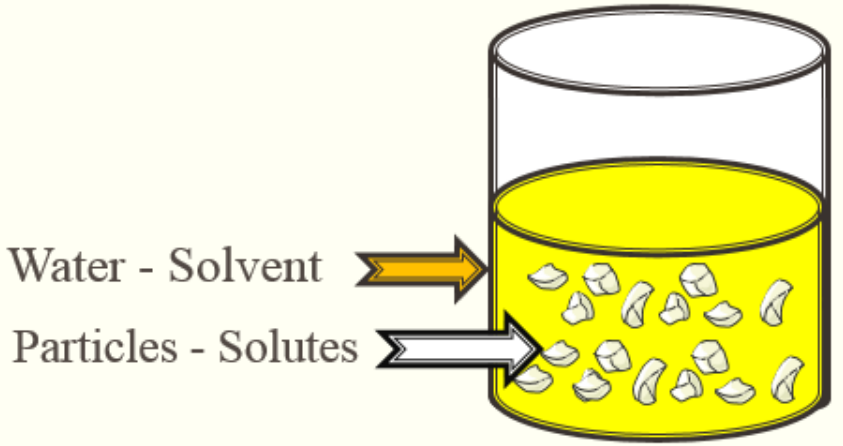
Describe The Causes And Pathogenesis Of Kidney Stones?

Nephrolithiasis

Stones form at any level in the urinary tract, but most arise in the kidney.
Men > women, and age between 20 and 30 years.

Cause and Pathogenesis

- Most important cause is:
  1. Increased concentration of stone constituents,
  2. Changes in urinary pH,
  3. Decreased urine volume
  4. Presence of bacteria
  5. Deficiency in inhibitors of crystal formation in urine.



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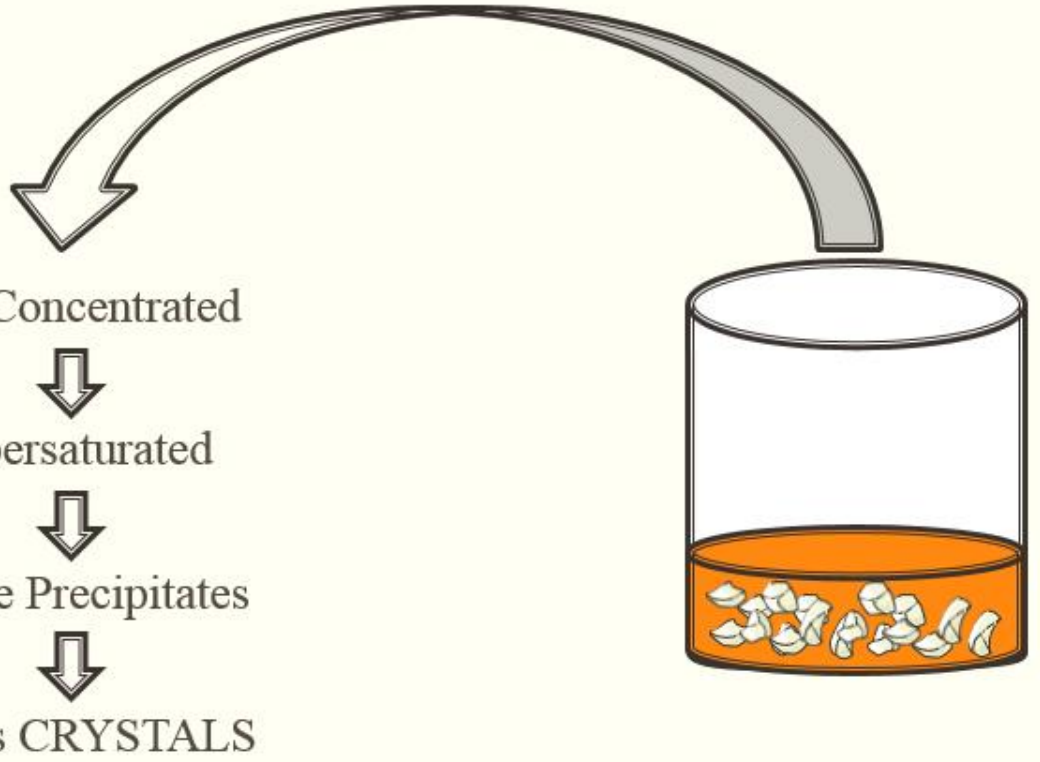
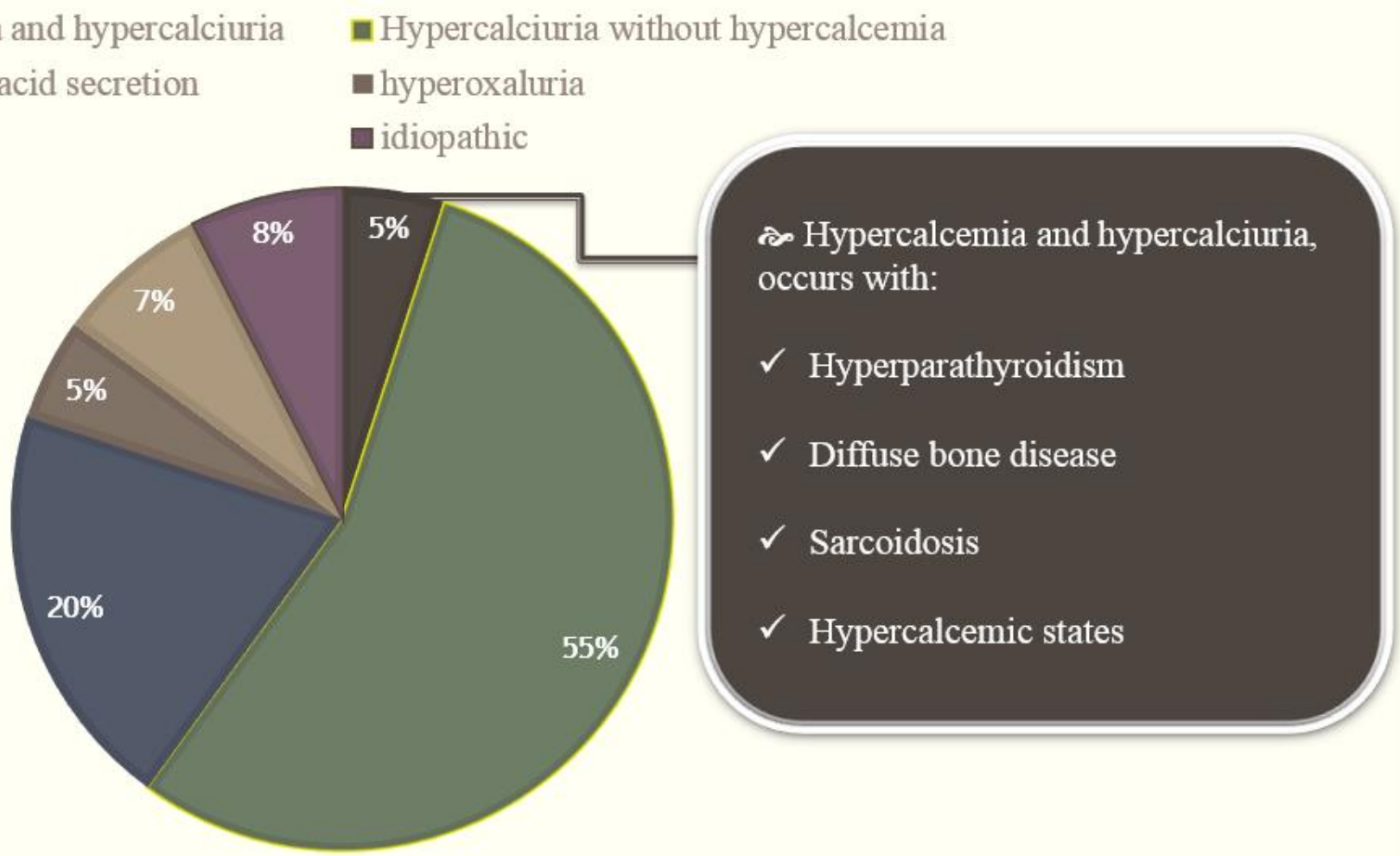


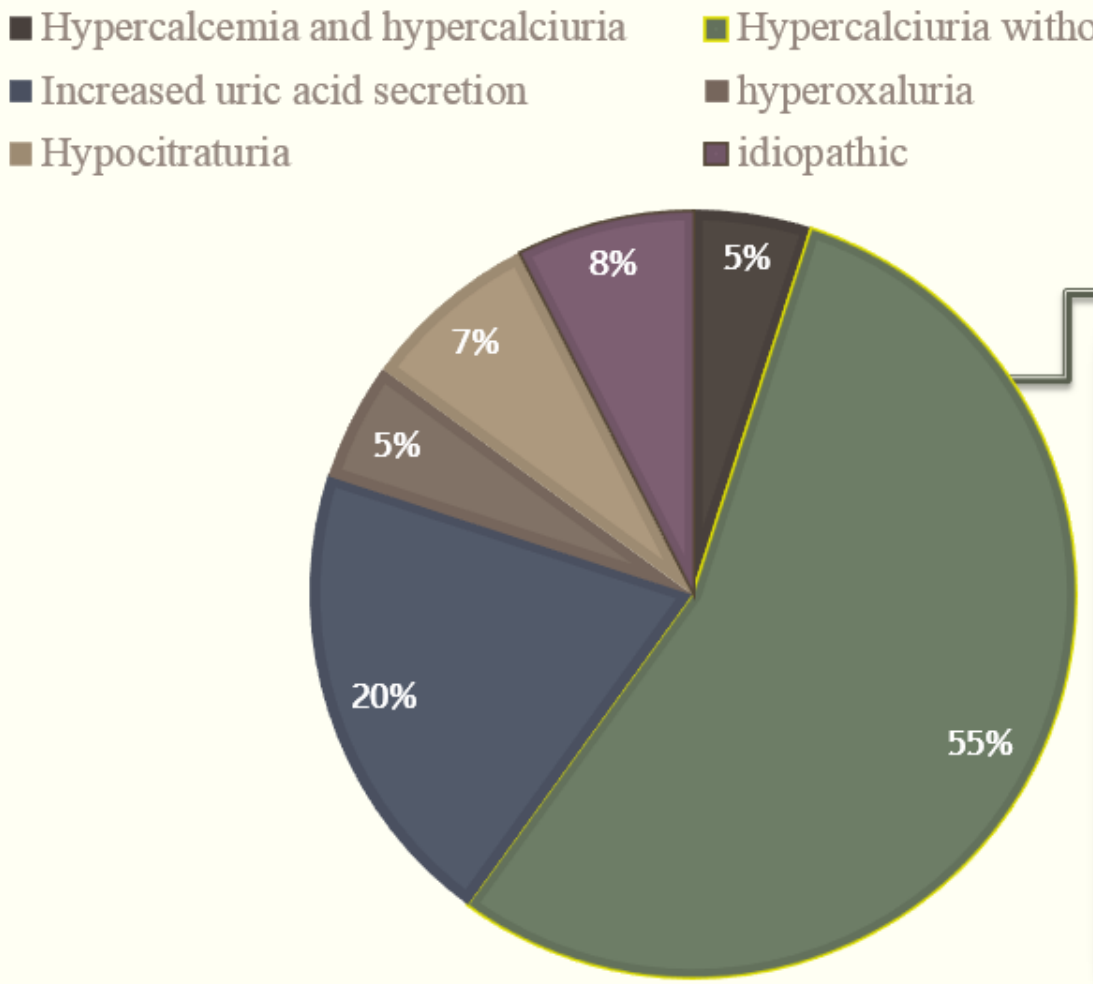
Calcium Oxalate Stones



Hypercalcemia and hypercalciuria, occurs with:

- ✓ Hyperparathyroidism
- ✓ Diffuse bone disease
- ✓ Sarcoidosis
- ✓ Hypercalcemic states

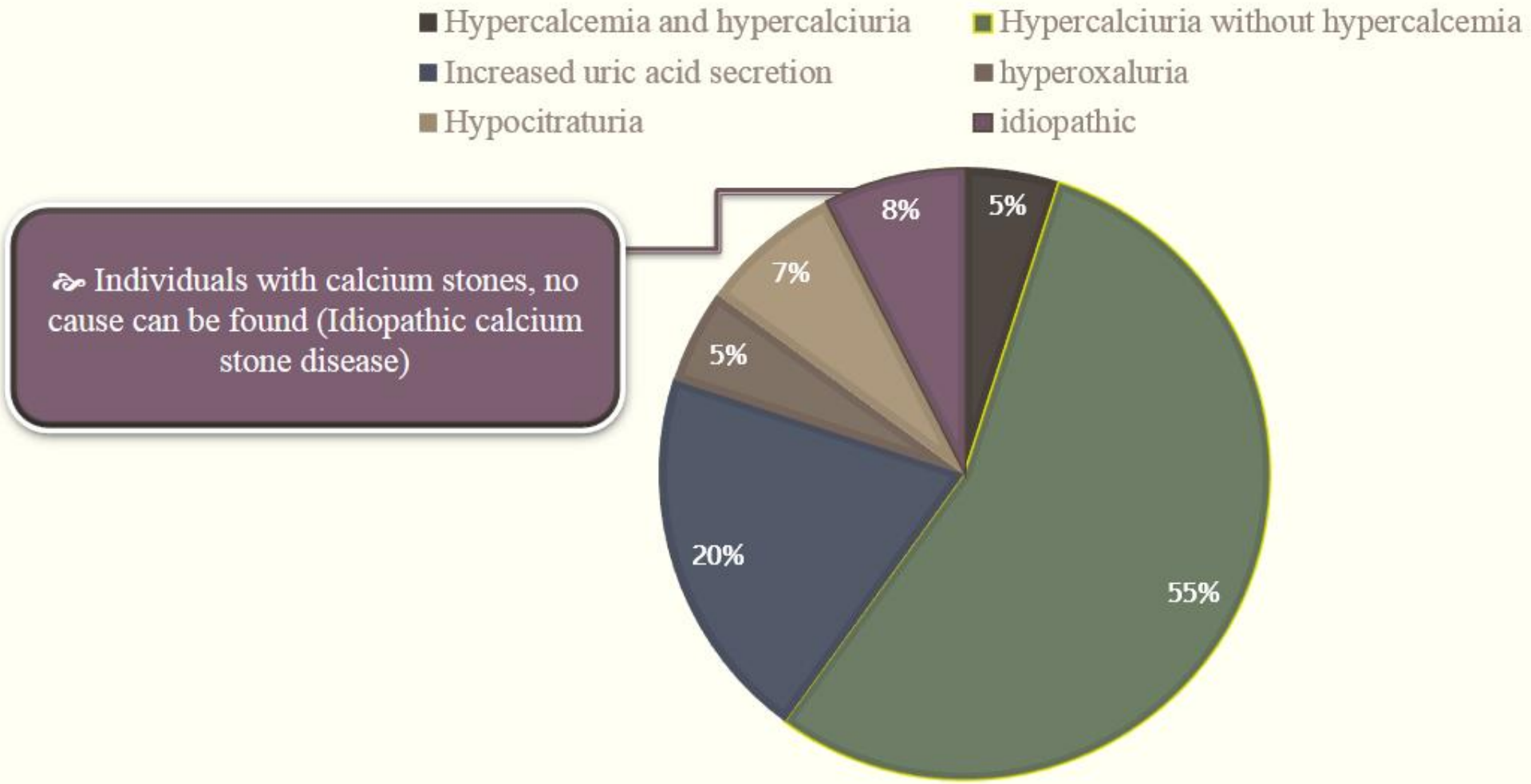
Calcium Oxalate Stones



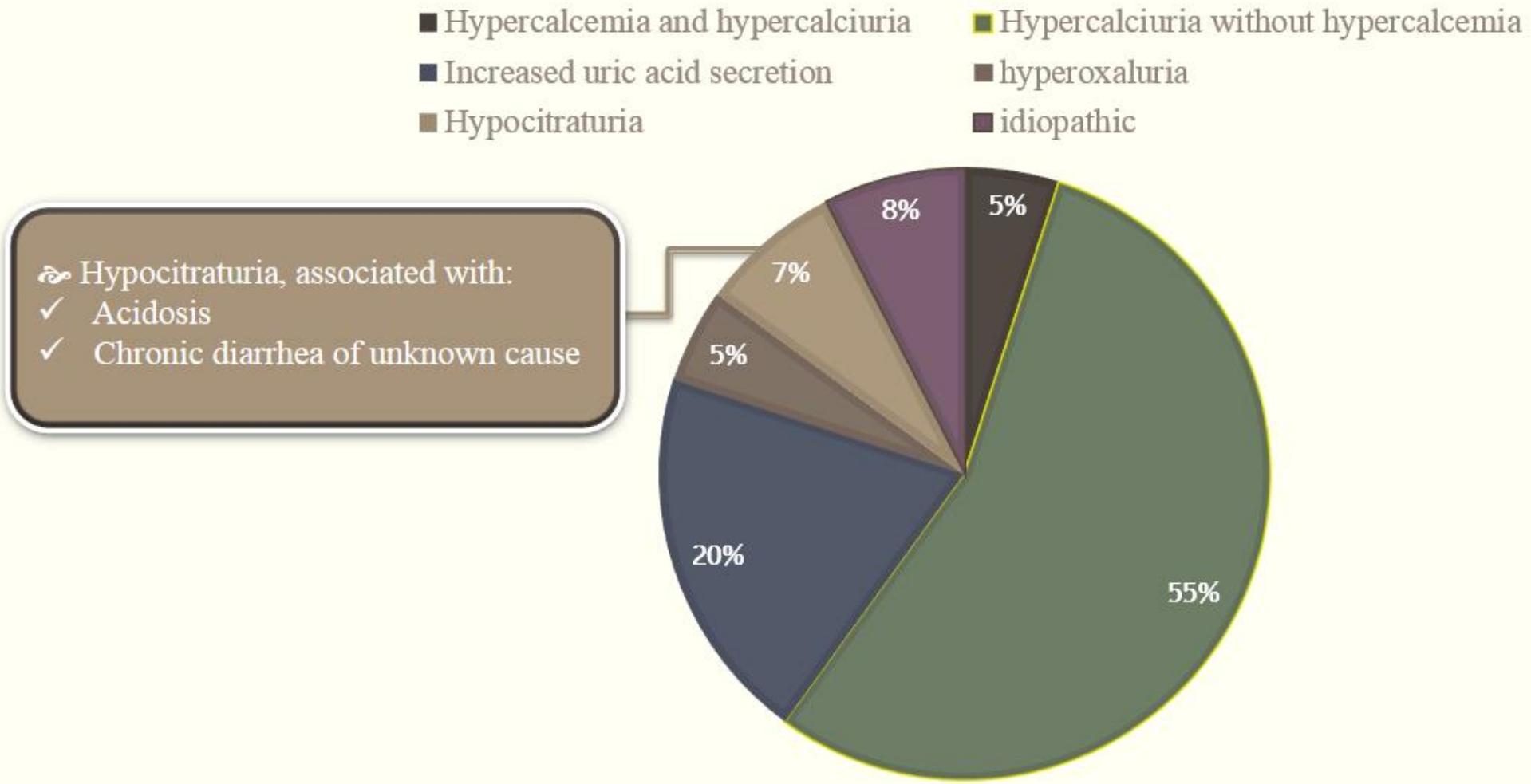
Hypercalciuria without hypercalcemia:

- ✓ Hyperabsorption of calcium from the intestine (absorptive hypercalciuria)
- ✓ Intrinsic impairment in renal tubular reabsorption of calcium (renal hypercalciuria)
- ✓ Idiopathic fasting hypercalciuria with normal parathyroid function

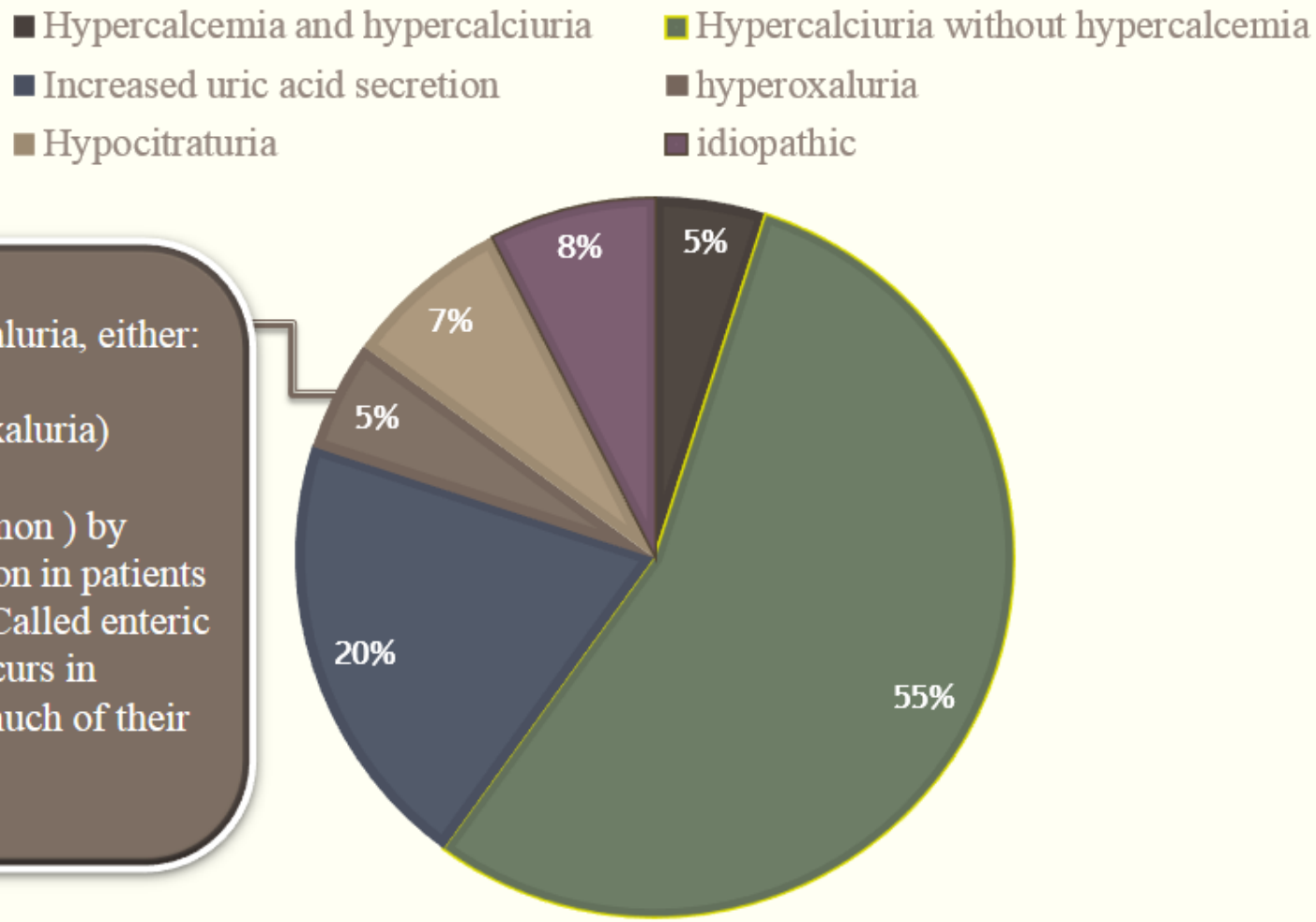
Calcium Oxalate Stones



Calcium Oxalate Stones

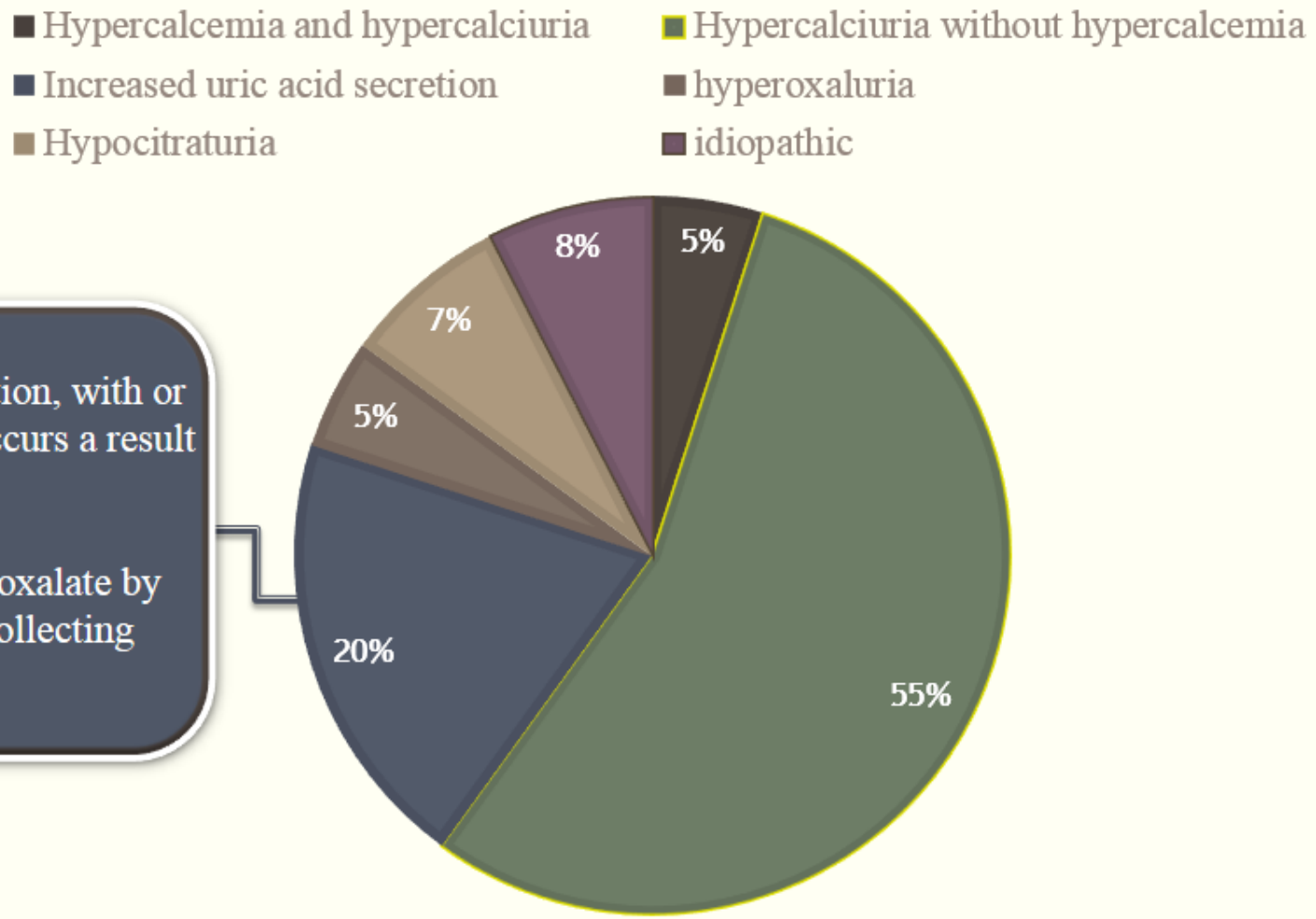


Calcium Oxalate Stones



- Patients have hyperoxaluria, either:
- ✓ Hereditary (primary oxaluria)
- ✓ Acquired (More common) by intestinal overabsorption in patients with enteric diseases. Called enteric hyperoxaluria, also occurs in vegetarians, because much of their diet is rich in oxalates

Calcium Oxalate Stones



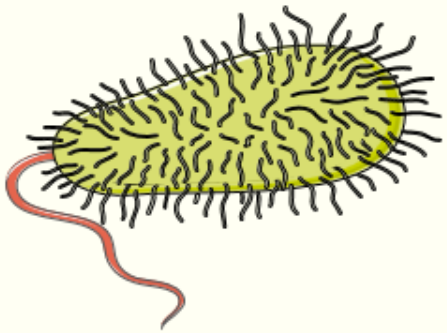
- Increased uric acid secretion, with or without hypercalciuria occurs a result of :

- ✓ "Nucleation" of calcium oxalate by uric acid crystals in the collecting ducts.

Magnesium ammonium phosphate (Struvite) Stones

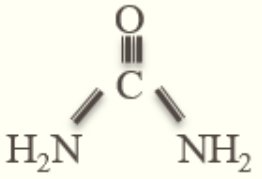
{Mg^{2+} NH_4 PO_4}

Urea-splitting bacteria
(e.g., Proteus and some staphylococci)



Urease

Urea



Convert

CO_2 + NH_3

Carbon dioxide

Ammonia

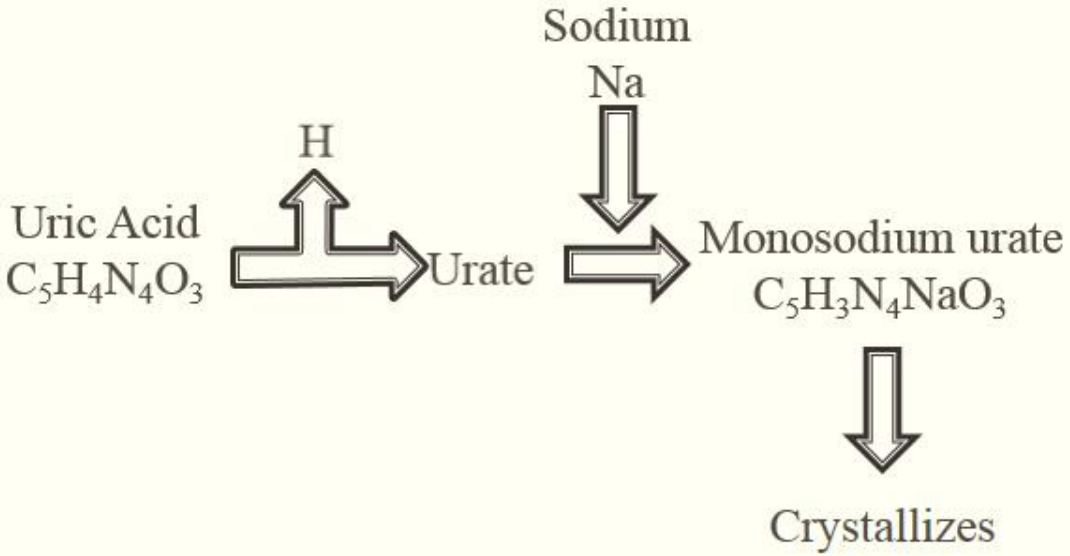
Makes urine more Alkaline

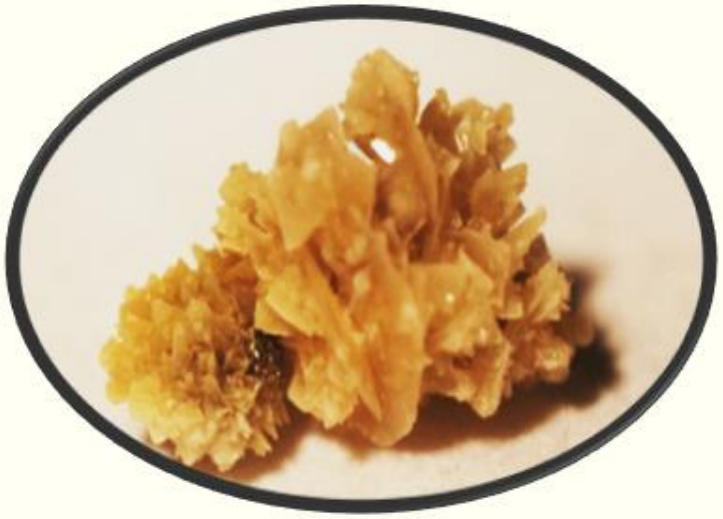
Favors Precipitation

Note : These form largest stones, because very large amount of urea is excreted normally, and called staghorn calculi.

Rare Types

- Uric acid stones:
  - Common in individuals with hyperuricemia, such as patients with gout, and diseases involving rapid cell turnover, such as the leukemias.
  - Patent have neither hyperuricemia nor increased urinary excretion of uric acid. It's a result of excrete urine of pH below 5.5 , because uric acid is insoluble in acidic urine.



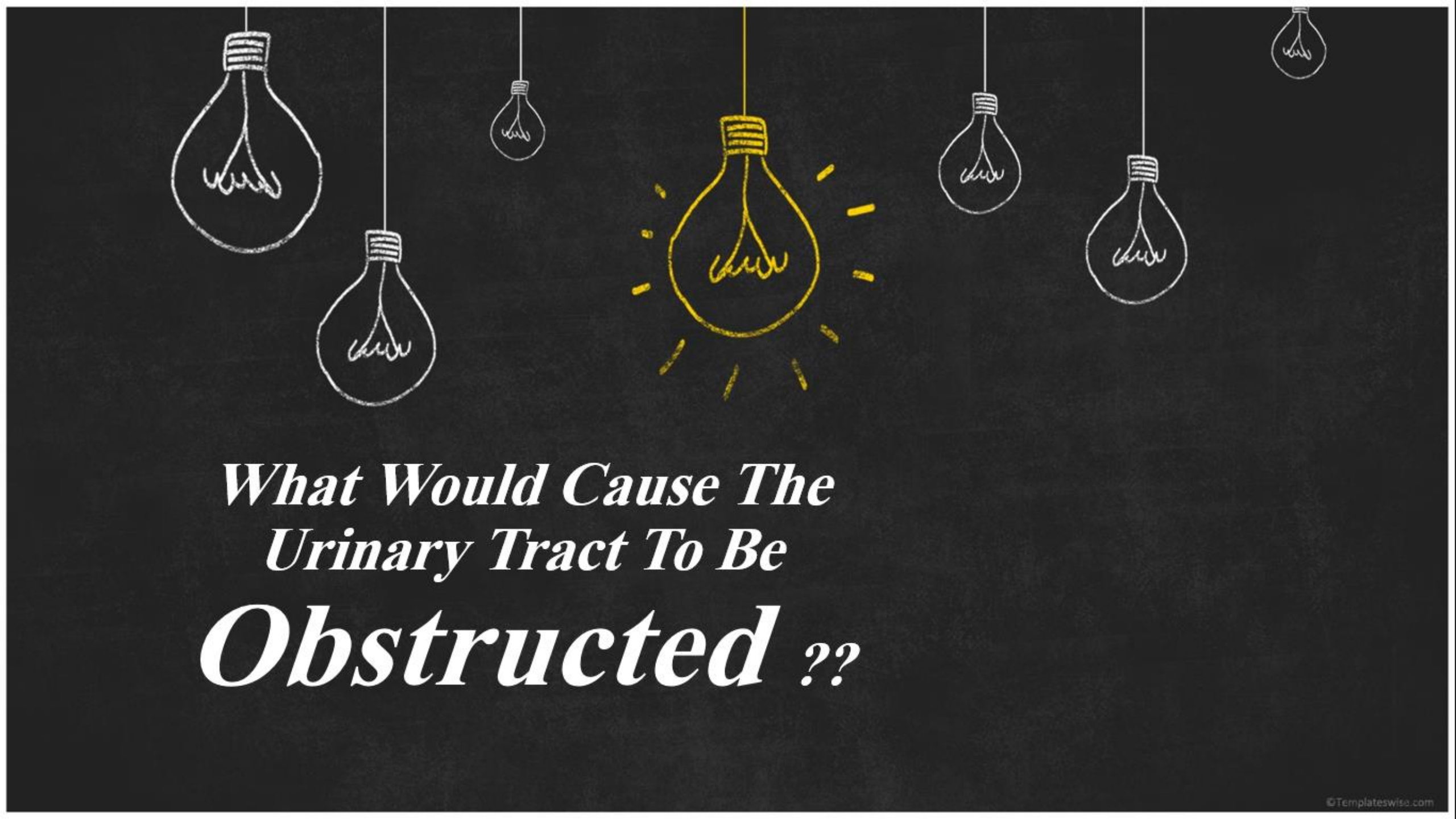


Rare Types

- Cystine stones:
  - ∞ Caused by genetic defects in the renal reabsorption of amino acids, including cystine, leading to cystinuria.
  - ∞ These stones also form at low urinary pH.

#5

Outline causes and complications of Obstructive Uropathy?


What Would Cause The
Urinary Tract To Be
Obstructed ??
©Templateswise.com

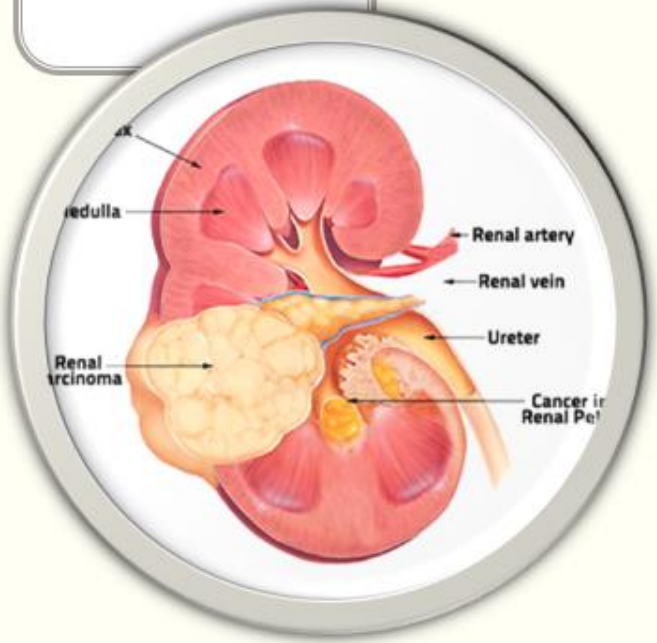
Causes:

- *Intra-luminal*
- *Intra-mural*
- *Extra-mural*

Intra-luminal

Calculi

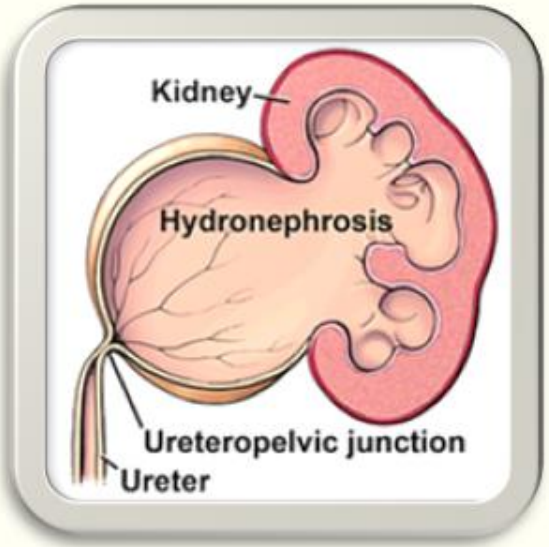
Tumors

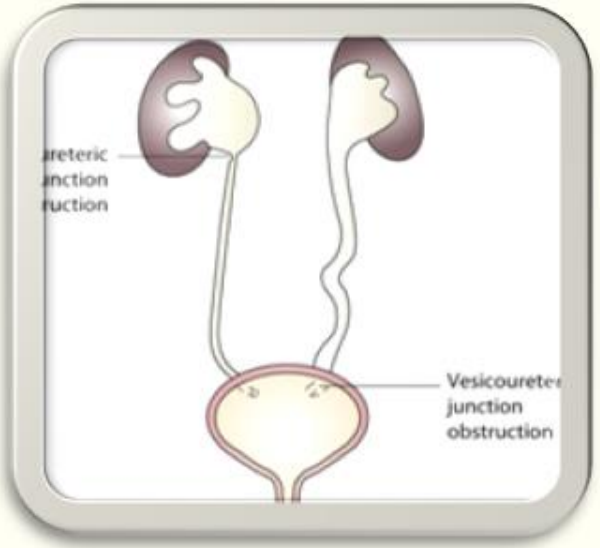


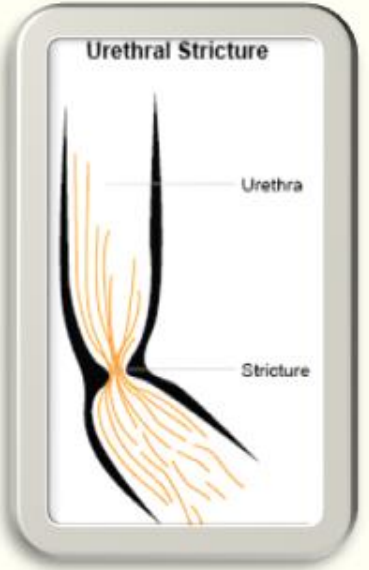
Blood clot

Intra-mural

- **Pelvi-ureteric junction Obstruction**
- **Vesico-ureteric Obstruction**
- **Inflammation**
- **Urethral stricture**

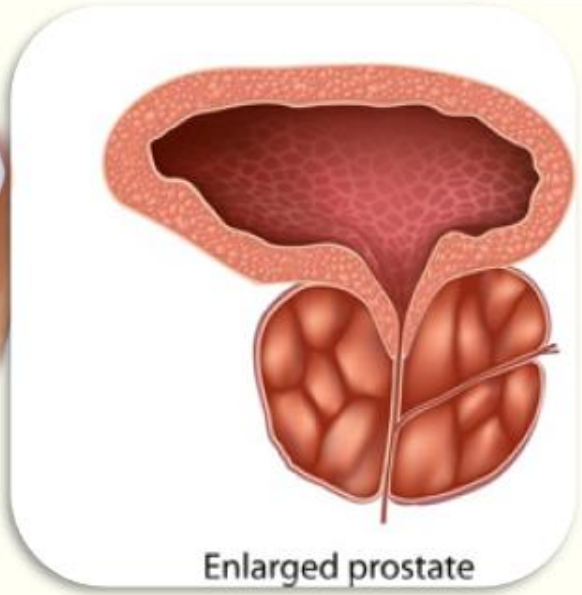




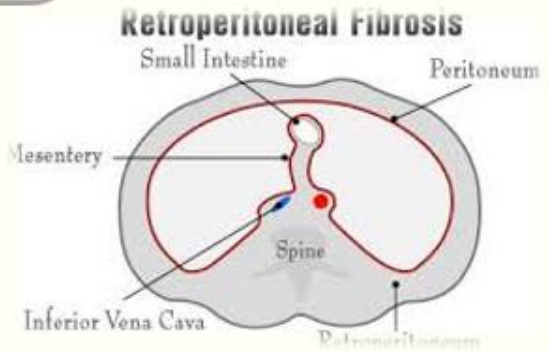


Extra-mural

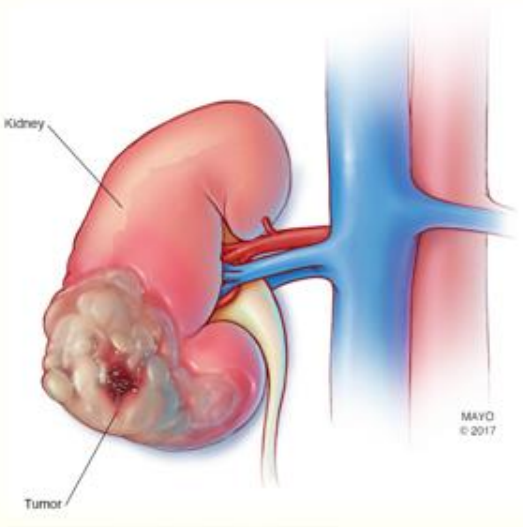
Pregnancy or Prostatic enlargement



Retro-peritoneal fibrosis



Tumors

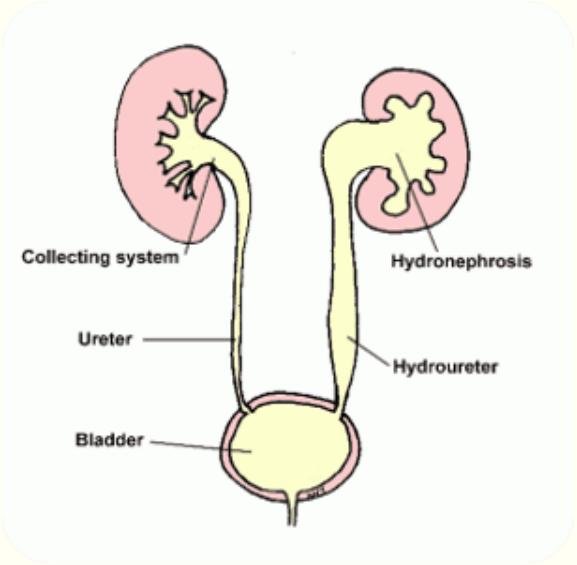


Complications

1- Unilateral Hydronephrosis :

- ❑ Complete
- ❑ Partial

The human body CAN function with one healthy kidney



Complications

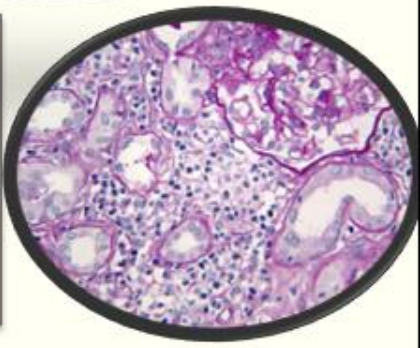
2- Bilateral Obstruction

- **Partial Obstruction**

Renal calculi

Hypertension

Tubulointerstitial nephritis



Complications

2- Bilateral Obstruction

- **Complete Obstruction**

Oliguria ↓ 400ml/day

Anuria ↓ 100ml/day

Complications

2- Bilateral Obstruction

- **Complete Obstruction**

Post-Obstructive diuresis

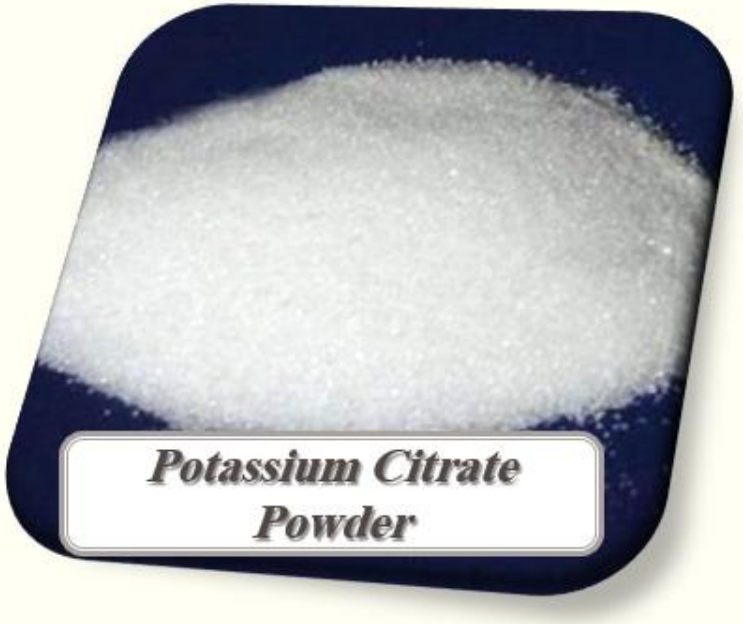
The kidneys are excreting large amounts of urine that is rich in sodium chloride

#6
Outline The Role Of Potassium Citrate In Renal Stones?

What is potassium citrate??

Potassium citrate

- ✓ It is a potassium salt of citric acid.
- ✓ It is a white, hygroscopic crystalline powder.
- ✓It is odorless with a saline taste.
- ✓It contains 38.28% potassium by mass.



Potassium citrate

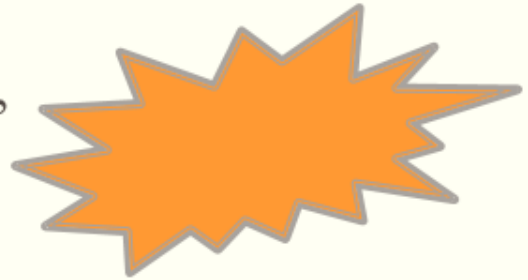
- It is Used to prevent the formation of:

1. *Calcium stones in people who have too little citrate in their urine.*
2. *Uric acid stones or cystine stones in people who have urine that is too acidic.*

It may also be used to replace potassium that is lost when a thiazide medicine is used to prevent kidney stones.

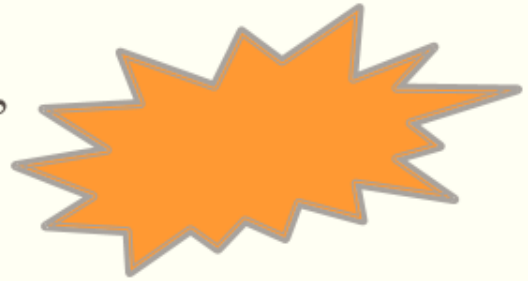
How It Works ?

Kidney stones



How It Works ?

Kidney stones

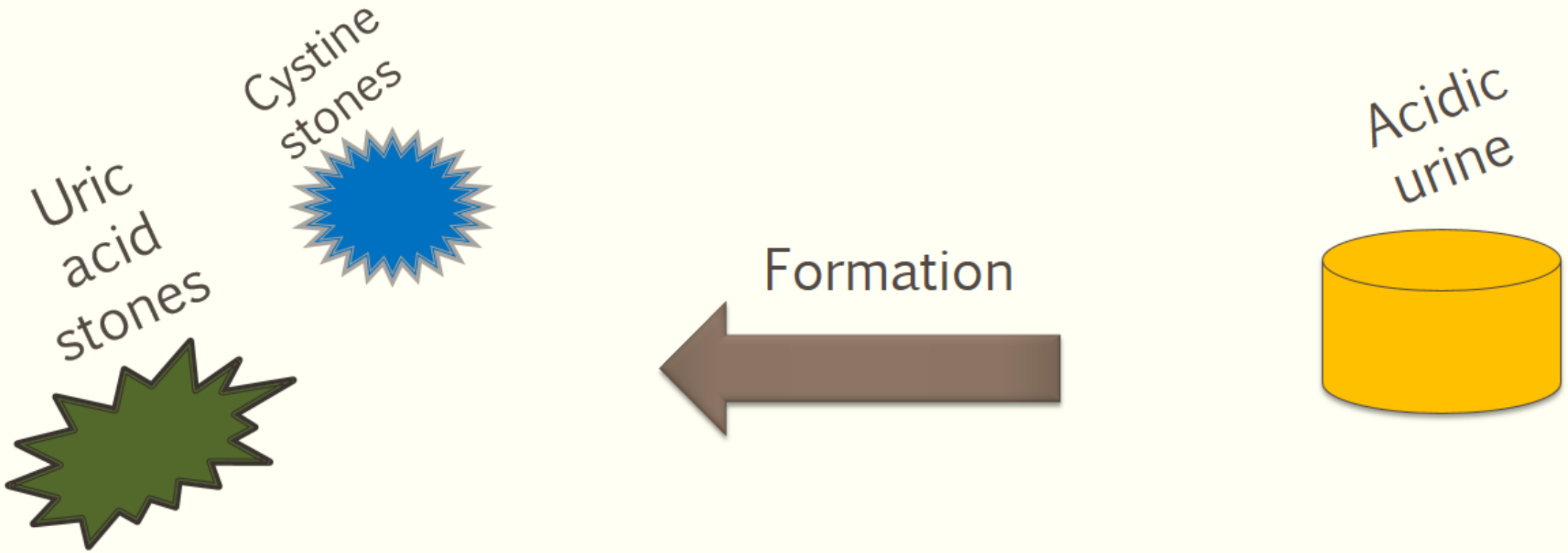


How It Works ?

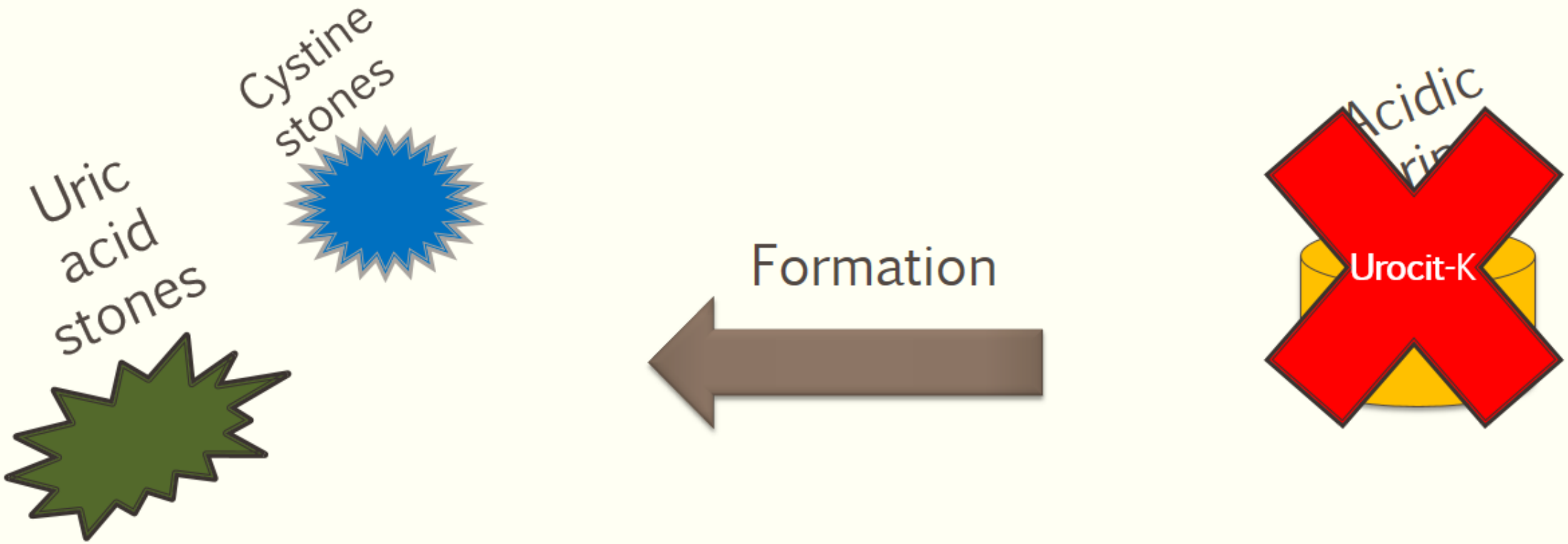
Potassium citrate attaches to calcium in the urine, preventing the formation of mineral crystals that can develop into kidney stones.

NO stones

How It Works ?

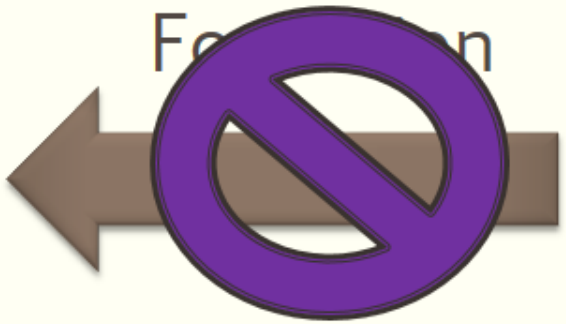


How It Works ?



How It Works ?

Potassium citrate also prevents the urine from becoming too acidic. This helps prevent uric acid or cystine kidney stones from forming.



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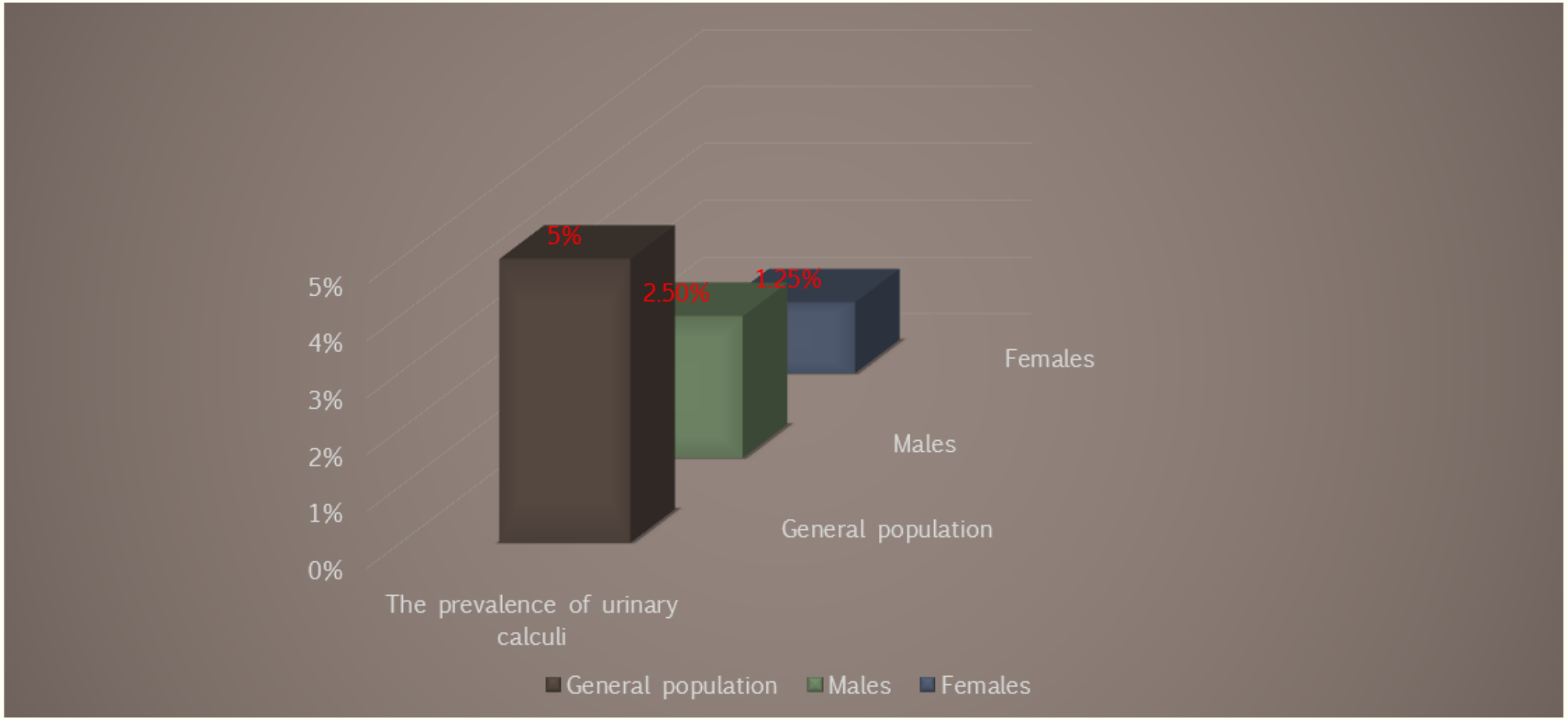

Keywords:

- Histology of Urinary Passages:
  - ✓ Ureter.
  - ✓ Urinary Bladder.
  - ✓ Urethra.
- Proteus Bacteria:
  - ✓ Important Properties.
  - ✓ Epidemiology.
  - ✓ Pathogenesis.
- Pyelonephritis:
  - ✓ Causes.
  - ✓ Morphology.
- Nephrolithiasis:
  - ✓ Definition.
  - ✓ Causes.
  - ✓ Pathogenesis (According To Types).
- Obstructive Uropathy:
  - ✓ Causes.
  - ✓ Complication.
- Potassium Citrate:
  - ✓ Role In Renal Stones.

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- **Pharmacology:**
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Thanks