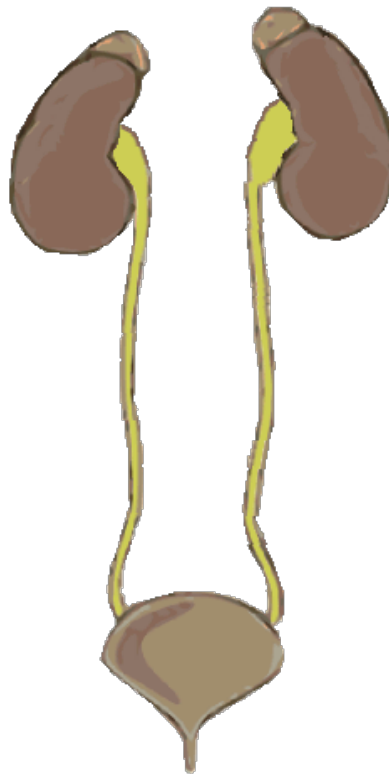


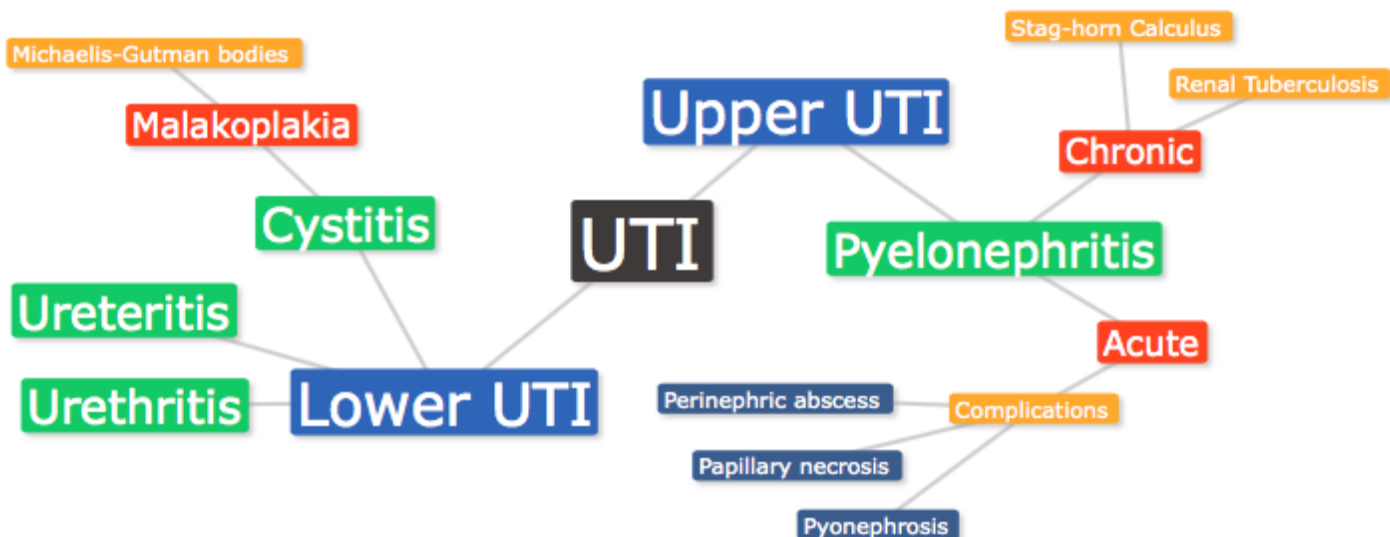
urinary tract infections



Objectives:

- Recognize the predisposing factors for infections of the kidney and urinary tract.
- Describe the different types of infections in the kidney and urinary tract.
- Recognize the clinicopathological features of acute and chronic pyelonephritis.
- Describe the causes of urinary tract obstruction.
- Recognize drug induced nephritis
- Infections of Urinary Tract

Important note: During the previous blocks, we noticed some mistakes just before the exam and we didn't have the time to edit the files. To make sure that all students are aware of any changes, please check out this link before viewing the file to know if there are any additions or changes. The same link will be used for all of our work: [Pathology Edit](#).



Pyelonephritis. Robbins page 533

It is an infection affecting the tubules, interstitium, and renal pelvis. (pyelo- means pelvis. nephritis- inflammation in nephron).

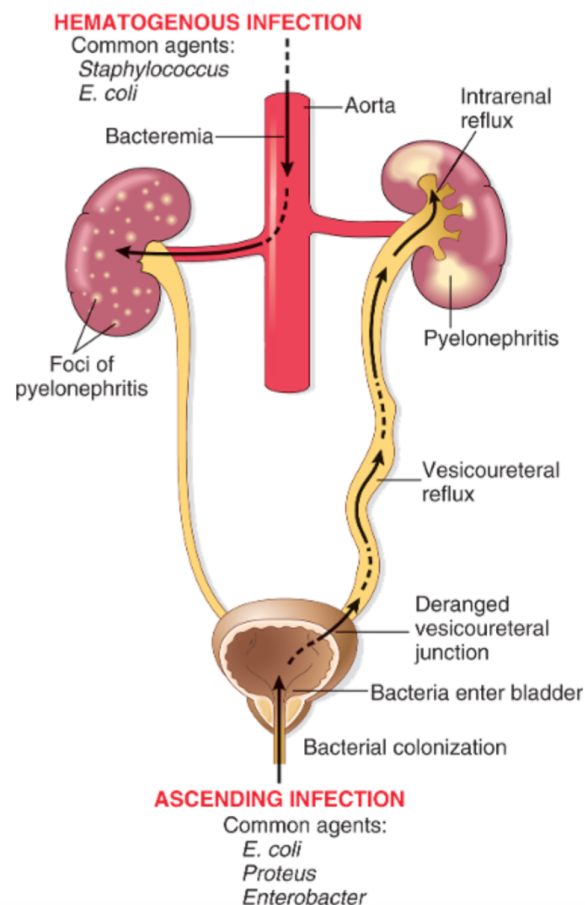
- It is one of the most common diseases of the kidney

Routes of infection:

1. **Ascending infection:** More than 85% of cases of urinary tract infection are caused by the *gram-negative bacilli* that are normal inhabitants of the intestinal tract.
2. **Hematogenous infection:** In this case patients might have bacteremia or sepsis & the organism would form an abscess in the kidneys.

Recall:

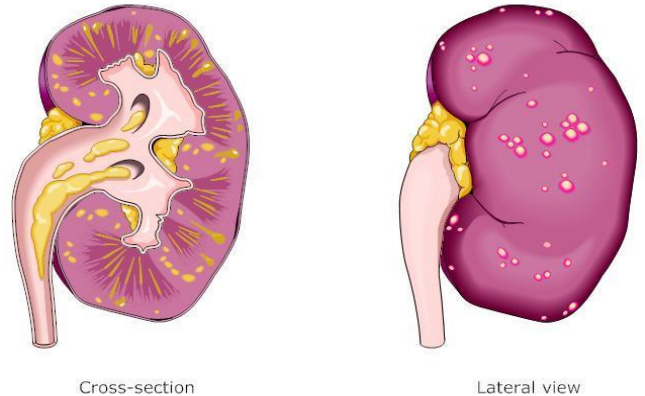
Acute inflammation	Chronic inflammation
Neutrophils	Lymphocytes
Polymorphic cells infiltrate	Fibrosis (<i>Scarring</i>)



1. Acute pyelonephritis.

Predisposing conditions:

- Urinary tract obstruction:
 - i. **Congenital: Vesicoureteral reflux**¹ ([YouTube](#)).
 - ii. **Acquired:** Benign prostatic hyperplasia (BPH).
- Instrumentation of the urinary tract: Using a *catheter*.
- Pregnancy.
- Gender and age:
 - i. Females are most commonly infected².
 - ii. **Postmenopausal women & UTI:** the changes that occur after menopause include hormonal changes. These hormonal changes inhibit the growth of the normal vaginal flora (*Lactobacillus*) & this increases the risk of UTI.
- Preexisting renal lesions, causing intrarenal scarring and obstruction: Certain types of *cancer* may cause obstruction or scarring.
- Diabetes mellitus³.
- Immunosuppression and immunodeficiency



Complications of acute pyelonephritis:

1. **Pyonephrosis** (Pyo= Pus , Nephrosis = in the kidney): Is **liquefactive necrosis** with abscess formation within the renal parenchyma. In the early stages pus formation (suppuration) is limited to the interstitial tissue, but later abscesses rupture into tubules.

How does it happen ? Urinary tract obstruction in the presence of pyelonephritis may lead to the collection of WBCs, bacteria, and debris in the collecting system, which results in pyonephrosis.

2. **Papillary necrosis** (mostly in diabetic): *Coagulative necrosis* of renal pyramids & papillae.
3. **Perinephric abscess:** Collection of pus in the retroperitoneal cavity.

Prognosis: Even without antibiotic treatment, the disease tends to be benign and self-limited.

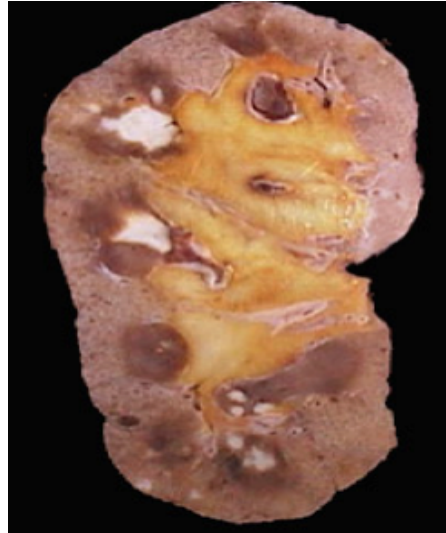
¹ Is an abnormal backward movement of urine from the bladder into ureters or kidneys.

² Because of the close proximity of the female urethra to the rectum, short urethra and trauma to the urethra during sexual intercourse.

³ Because of the increased susceptibility to infection and neurogenic bladder dysfunction, which in turn predisposes to stasis.



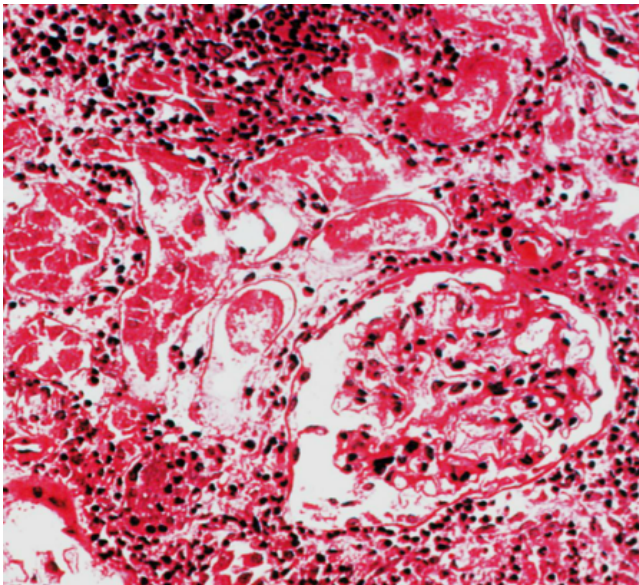
Acute pyelonephritis:
Cortical surface shows grayish white areas of inflammation and **abscess** formation



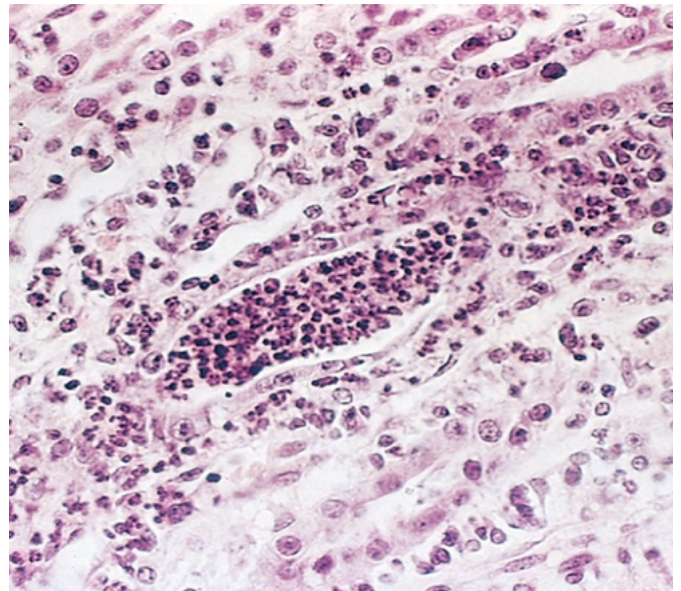
Papillary necrosis:
the pale white areas involving some or all of many renal papillae are areas of papillary necrosis



Acute on chronic pyelonephritis with numerous septic foci present in an already scarred kidney.



There is a diffuse **interstitial infiltrate** with polymorphonuclear⁴leukocytes.



Acute neutrophilic exudate within tubules and interstitium inflammation

⁴ PMN is the same as neutrophils

2. Chronic pyelonephritis and reflux nephropathy.

Chronic pyelonephritis is a disorder in which interstitial inflammation and scarring of the renal parenchyma are associated with visible **scarring and deformity of the pelvicalyceal system** (calyces and pelvis).

- In this case, patients may have an underlying cause that predisposes them to having repeated bouts of acute pyelonephritis; which may progress to chronic pyonephritis.
- It is an important cause of chronic renal failure.

It is divided into two forms:

1) Chronic Reflux-Associated pyelonephritis (reflux nephropathy)

When the chronic pyonephritis is caused by a **vesicoureteric reflux**⁵ or intrarenal reflux, it is called reflux nephropathy. It's the most common form of chronic pyelonephritis. It could be unilateral or bilateral, & it may result in one kidney scarring and atrophy or both, leading to renal insufficiency.

2) Chronic Obstructive pyelonephritis

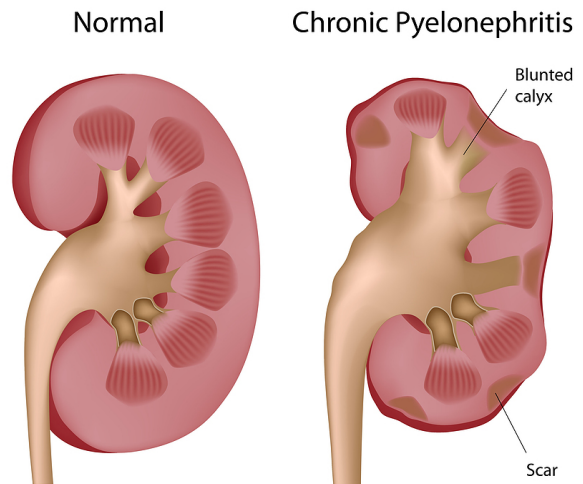
Pathogenesis:

1. Obstruction → leads to stagnation⁶ → predisposes⁷ infection.
2. Recurrent infection → leads to recurrent bouts of renal inflammation and scarring.
 - Unilateral ex: calculi (stones) , obstructive lesions of ureter.

Chronic Pyelonephritis - gross:

- Scarring & fibrosis of the kidney
- The fibrosis involves the capillaries of the glomeruli → glomerular sclerosis⁸.
- If bilateral, the involvement is asymmetric. This means that the areas involved in both kidneys are not identical.

The hallmarks of chronic pyelonephritis are **coarse**⁹, **discrete**¹⁰, **corticomedullary scars** overlying dilated, blunted, or deformed calyces, and **flattening of the papillae** .



⁵ flow of urine from the bladder back into the ureters, arising from defective valves and causing a high risk of kidney infection.

⁶ ركود

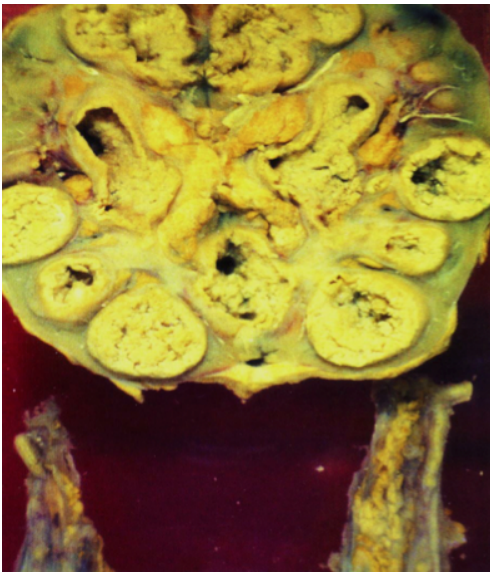
⁷ يهيج

⁸ a severe kidney disease in which glomerular function of blood filtration is lost as fibrous scar tissue replaces the glomeruli. The disease commonly follows an infection or arteriosclerosis.

⁹ خشنة

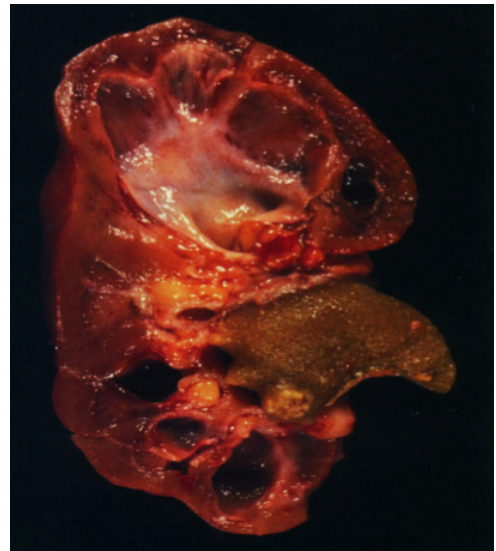
¹⁰ منفصلة

Renal tuberculosis

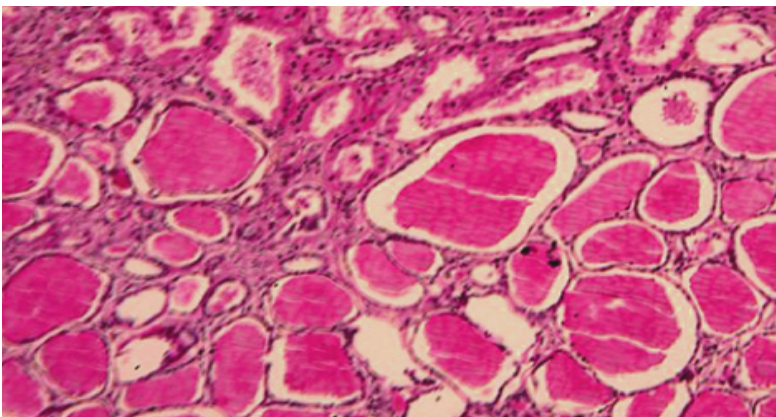


- Renal tuberculosis secondary to hematogenous spread of tubercle bacilli.
- **Caseating necrosis.**

Staghorn calculus



- Staghorn calculus in pelviureteric junction.
- causes obstruction which causes stagnation leading to infection.
- usually associated with "xantho" which is yellow, fat, foamy histiocytes
- Its called xanthogranulomatous pyelonephritis.

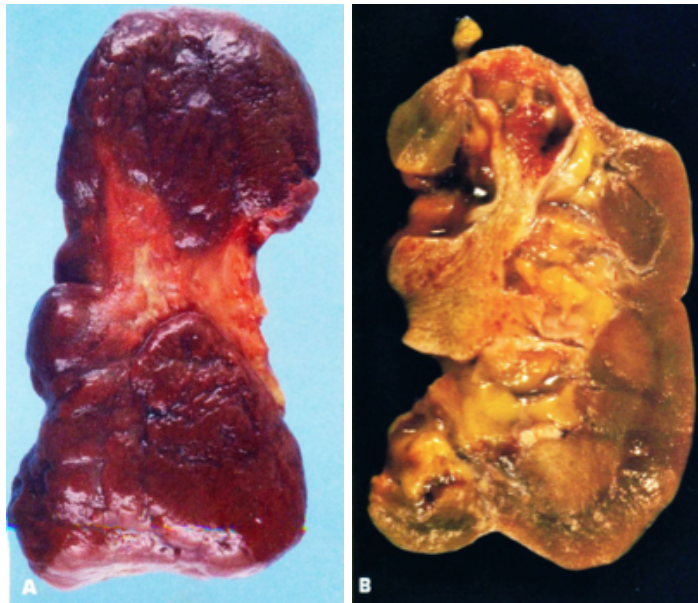


Thyroidization of the kidney occurs due to chronic pyelonephritis



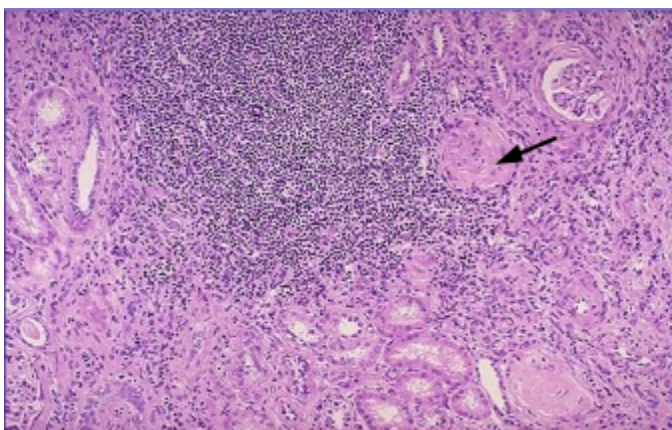
A. Bilateral **hydronephrosis** (hydro= urine, its pressing and causing *dilatation of pelvis and calyces* due to obstruction) with acute on chronic pyelonephritis in a child due to urinary tract obstruction.

B. Hydronephrosis with thinned renal parenchyma in an adult kidney.



A. Scar of healed pyelonephritis

B. Healed pyelonephritis associated with vesicoureteral reflux has produced scarring of both poles of the kidney with calyceal distortion due to infection of the peripheral compound papillae.



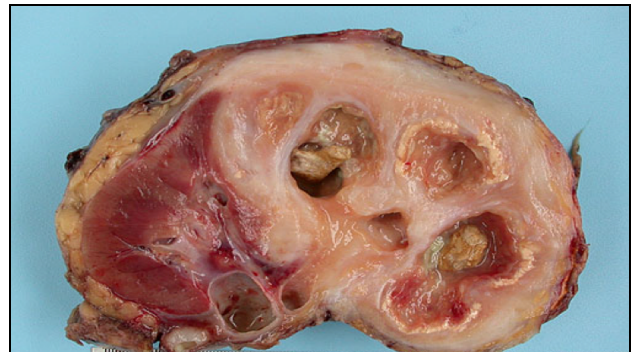
Collection of chronic inflammatory cells in a patient with a history of multiple recurrent UTIs.

Note the sclerosis and shrinking of glomeruli

Urolithiasis¹¹.

Symptoms urolithiasis:

- Pain in the lower back part or in the lower abdomen “**flank pain**”, which might move to the groin. Pain may last from hours to minutes.
- Nausea, vomiting.
- Hematuria.
- Burning during urination (dysuria), foul smell in urine, chills, weakness and fevers for urinary tract infection.



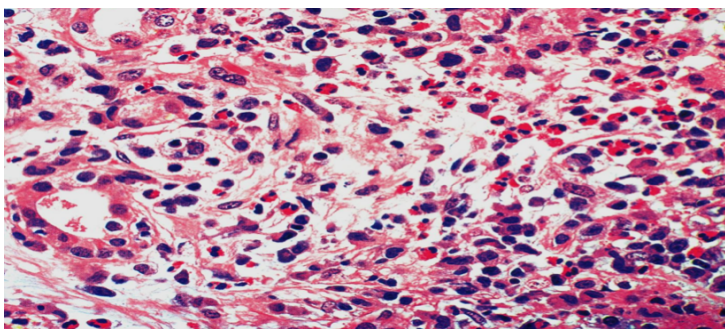
Types of stones in urinary tract

- CALCIUM OXALATE and PHOSPHATE (70%).
- Magnesium ammonium phosphate (15-20%) - (Struvite stone).
- URIC ACID & URATE (5-10%).
- CYSTINE (1-2%).

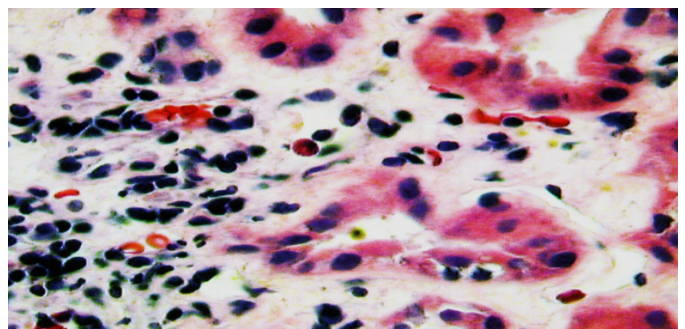
Tubulointerstitial Nephritis.

This group of renal diseases involves inflammatory injuries of the tubules and interstitium that are often have an insidious onset and are manifest by *azotemia*. Common causes include **infection** & **drugs** (analgesics such as NSAIDs or antimicrobials such as methicillin)

- This is explained as type 1 hypersensitivity to any of these agents (expect eosinophils involvement).



The mononuclear infiltrate is accompanied by abundant **eosinophils** and may have a **granulomatous appearance**.



Higher power of tubulitis demonstrating **interstitial edema** and **invasion of the tubular epithelium by lymphocytes**.

¹¹ the formation of stony concretions in the bladder or urinary tract.

Cystitis.

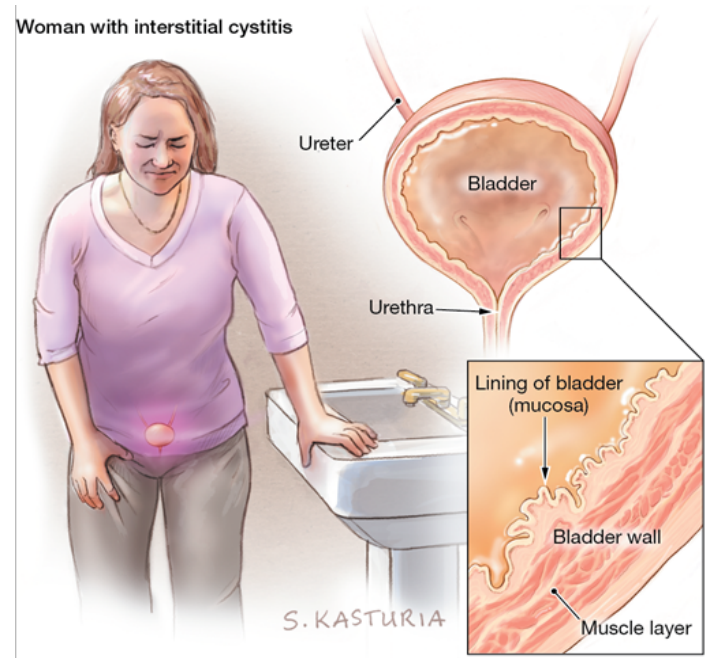
It's recommended that you study the microbiology lecture with this part.

The finding of microorganisms in the bladder with or without clinical symptoms

Significant bacteriuria: the number of bacteria in the voided urine exceeds the number that can be expected from contamination (i.e. $\geq 10^5$ cfu/ml)

Clinical features:

- Frequency.
- Urgency¹².
- Dysuria¹³.
- Suprapubic Pain.
- Cloudy or foul-smelling urine¹⁴.



Etiology of Acute and Chronic Cystitis:

- Women are more likely to develop cystitis due to the short urethra.
- *Tuberculous cystitis* is always a continuation to renal TB
- *Candida albicans*.
- Schistosomiasis (*Schistosoma haematobium*) more common in people from south of Saudi Arabia, farmers.
- *Chlamydia*, and *Mycoplasma* may also cause cystitis.
- bladder calculi, urinary obstruction, diabetes mellitus, instrumentation, and immune deficiency.
- Finally, irradiation of the bladder region gives rise to *radiation cystitis*.

¹² Can't hold it

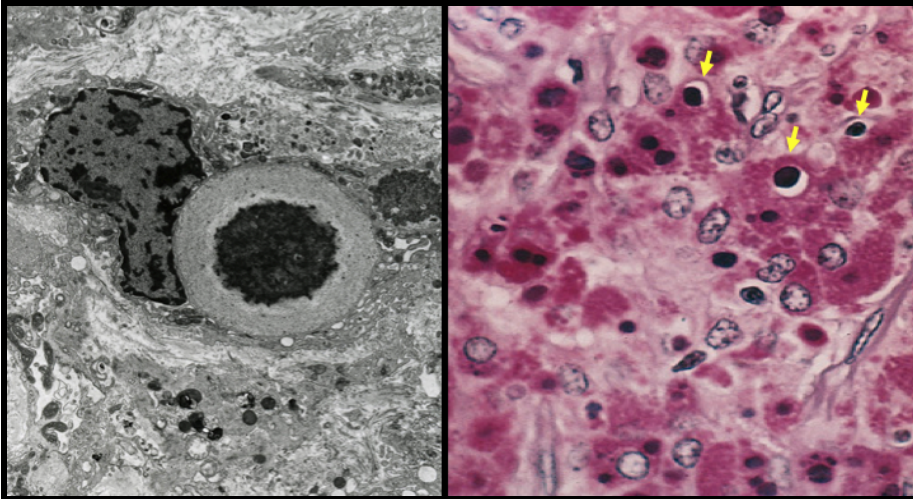
¹³ painful voiding

¹⁴ Smells awful

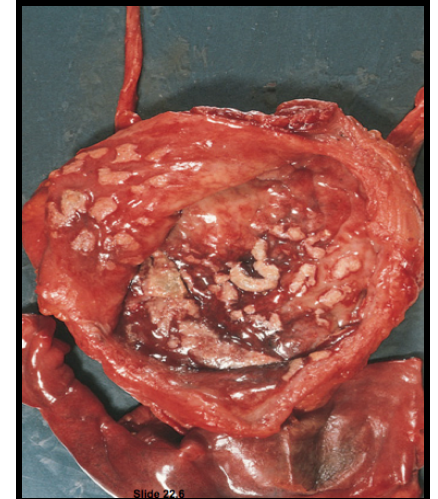
Cystitis with malakoplakia ¹⁵.

Malakoplakia is a peculiar - strange - inflammatory reaction. Most commonly occurs in the bladder and results from **defects in phagocytic** or degradative function of macrophages, such that phagosomes become overloaded with undigested bacterial products.

Michaelis Gutmann bodies: Dark bodies (contain iron & calcium). Found within the macrophages in malakoplakia.



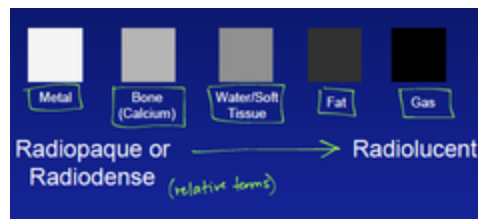
Michaelis Gutmann bodies



Soft, yellow, plaques 3-4 cm in diameter.

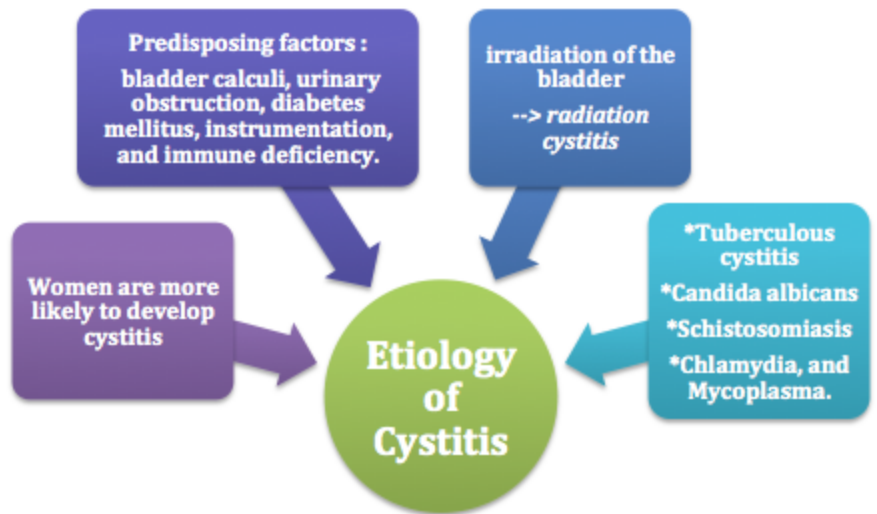
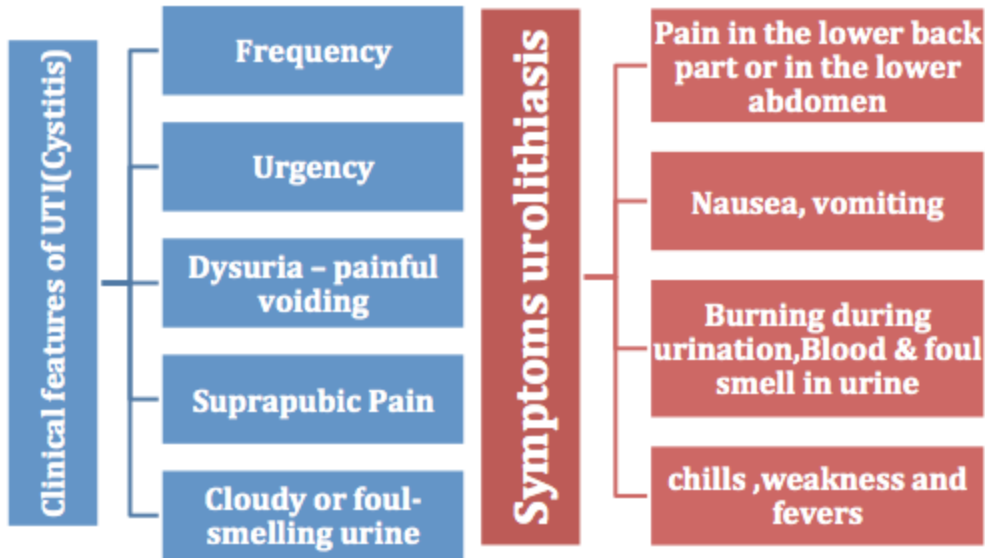
Radiodensity (Homework)

Radiopaque calculi	Radiolucent calculi
Referring to a material or tissue that blocks passage of X-rays, and has a bone or near-bone density; radiopaque structures are white or nearly white on conventional X-rays.	(<i>lucere</i> , to shine) pertaining to materials that allow x-rays to penetrate with a minimum of absorption.



¹⁵ A granulomatous disease due to infection (aerobic anaerobic, fungal, etc.) it is very rare.

Summary.



Cystitis with malakoplakia

can occur in kidney

soft yellow, plaques

foamy macrophages

Michaelis Gutman bodies

MCQs.

1- A 28-year-old woman has had dysuria, frequency, and urgency for the past 2 days. On physical examination, her temperature is 37.6°C. A urine culture grows greater than 100,000 colonies/mL of *Escherichia coli*. She is treated with antibiotic therapy. If the problem continues to recur, the patient is likely to be at greatest risk for development of which of the following renal diseases?

- A. Diffuse glomerulosclerosis
- B. Chronic glomerulonephritis
- C. Membranous glomerulonephritis
- D. Chronic pyelonephritis

Ans:D, Most cases of pyelonephritis result from ascending bacterial infections, which are more common in women. Recurrent UTI complicated by vesicoureteral reflux cause progressive interstitial damage and scarring, which can lead to chronic pyelonephritis* with renal failure

*Repeated or persistent attacks

2- A 50-year-old woman has had fever and flank pain for the past 2 days. On physical examination, her temperature is 38.2°C, pulse is 81/min, respirations are 16/min, and blood pressure is 130/80 mm Hg. Urinalysis shows no protein, glucose, or ketones. The leukocyte esterase test is positive. Microscopic examination of the urine shows numerous polymorphonuclear leukocytes and occasional WBC casts. Which of the following organisms is most likely to be found in the urine culture?

- A. *Mycobacterium tuberculosis*
- B. *Staph. Aureus*
- C. *Escherichia coli*
- D. Group A streptococcus

Ans:C, The clinical features in this patient are typical of urinary tract infection (Acute pyelonephritis), and *Escherichia coli* is the most common cause. While the hematogenous spread by staph and TB less common.

3- A 53-year-old woman has had dysuria and urinary frequency for the past week. On physical examination, her temperature is 38°C, and she has pain on palpation over the left costovertebral angle. Microscopic examination of the urine shows numerous neutrophils, and a urine culture is positive for *Escherichia coli*. Which of the following complications is most likely to develop in this patient?

- A. Necrotizing papillitis
- B. Acute tubular necrosis
- C. Crescentic glomerulonephritis
- D. Cystitis

Ans:A, Necrotizing papillitis with papillary necrosis is a complication of acute pyelonephritis, and diabetic patients are particularly prone to this development. In the absence of diabetes mellitus
Additional: Papillary necrosis develops when acute pyelonephritis occurs in combination with urinary tract obstruction.

4- A 32-year-old man has developed a fever and skin rash over the past 3 days. Five days later, he has increasing malaise and visits his physician. On physical examination, the maculopapular erythematous rash on his trunk has nearly faded away. His temperature is 37.1°C, and blood pressure is 135/85 mm Hg. Urinalysis shows 2+ proteinuria; 1+ hematuria; and no glucose, ketones, or nitrite. The leukocyte esterase result is positive. Microscopic examination of urine shows RBCs and WBCs, some of which are eosinophils. What is the most likely cause of this patient's condition?

- A. Urinary tract infection
- B. Antibiotic use
- C. Congestive heart failure
- D. Streptococcal pharyngitis

Ans:B, These findings are typical of drug-induced interstitial nephritis. Various drugs can cause this condition, including sulfonamides, penicillins, cephalosporins or NSAIDs

5- The majority of urinary tract infections in hospital settings are associated with use of a urinary catheter.

- a) True, a catheter compromises the function of the flushing mechanism and increases the chance of introducing pathogens to the urinary tract.
- b) False, the hospital environment is full of potential urinary pathogens and all patients are equally at risk.

Answer : a

6- Which of the following are possible indicators of a urinary tract infection?

- a) Pain and tenderness around the region of the kidneys.
- b) Blood passed while urinating.
- c) An increased need to go to the toilet.
- d) Cloudy or opaque urine.
- e) All of these are possible symptoms of urinary tract infections.

Answer: E

7- Urinary tract infections are often caused by microorganisms that can be classified as normal flora of the urogenital tract. Which of the following urinary tract sites is normally colonised by normal flora?

- a) The urinary bladder
- b) the external urethra
- c) The kidneys
- d) The ureters

Answer: b

8- Inflammation of the bladder is referred to as:

- A. cystitis.
- B. urethritis.
- C. asymptomatic bacteruria.
- D. pyelonephritis.

answer : A

9- Which of the following is not a factor which predisposes an individual to urinary tract infections?

- A. High intake of fluids.
- B. Pregnancy.
- C. Kidney stones.
- D. Benign prostatic hyperplasia.

Answer: A

10- The most common cause of community-acquired UTIs is:

- A. Staphylococcus aureus.
- B. Pseudomonas aeruginosa.
- C. Escherichia coli.
- D. Enterococcus faecalis.
- E. Proteus species.

Answer: c

11- A patient with acute urinary tract infection (UTI) usually presents with:

- A. Chills and fever.
- B. Flank pain.
- C. Nausea and vomiting.
- D. 5 to 10 white blood cells per high-power field (hpf) in the uncentrifuged urine specimen.
- E. Painful urination.

Answer: E, Cystitis or infection of the bladder is the most common UTI. Lower UTI, or cystitis, is an infection in the bladder. Painful urination and frequency are the most common presenting complaints. Hematuria may occur, but is associated with painful urination and frequency. Flank pain, fever, chills, nausea, and vomiting usually occur only when the infection involves the kidney (pyelonephritis). An acute UTI is identified in unspun urine only when there are more than 10 leukocytes per hpf in the unspun urine. The normal urine may have as many as 10 WBC/per hpf without being infected.

12- Ureteral obstruction:

- A. Is associated with hematuria.
- B. Is associated with deterioration of renal function and rising blood urea nitrogen (BUN) and creatinine values.
- C. Is commonly caused by a urinary tract calculus.
- D. Usually requires open surgical relief of the obstruction.
- E. Is usually associated with infection behind the obstruction.

Answer: C

13- Lower urinary tract infections include:

- a) Pyelonephritis
- b) Urethritis
- c) Cystitis
- d) Prostatitis

Answer : B-C

14- A 46 year old male who has chronic gouty arthritis for the last 2 years. Recently has developed Urolithiasis what most likely it formed of ?

- a) Calcium oxalate stones
- b) Magnesium ammonium phosphate
- c) Cystine
- d) Uric acid

Answer: d

15- Malakoplakia is Characterized histologically by :

- a) Aschoff bodies
- b) Michaelis Gutmann bodies
- c) Neutrophilic casts
- d) Smooth muscle hyperplasia

Answer : b

16- Which of the following histological findings is not included in Tubulointerstitial Nephritis:

- a) Interstitial necrosis
- b) Inflammatory infiltrate in the renal tubules
- c) Glomerular fibrosis
- d) Tubular fibrosis

Answer : c

Contact us on: Pathology434@gmail.com
@Pathology434 , [Ask us!](#)

Good Luck!

Done by:

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