

Renal Block

Lecture Two & Three

UTIs

Important Notes & MCQs



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

Simple revision of previous lecture AKI:

At the pathological Level:

- 1- Hours to days.
- 2- Acute tubular necrosis. (Most frequent)
 - Ischemic (Loop of Henle)
 - Toxic (Proximal)

Important Notes:

Drug induced nephritis → it might lead to acute tubulointerstitial nephritis

Hypovolemia and ischemia can also cause an intrarenal injury (Not only prerenal).

Now remember the four elements that we spoke about previously?

- Interstitium
- Glomeruli
- Blood Vessels
- Tubules

Drugs can either give you:

- Acute tubular necrosis.
- Or **more frequently** acute tubulointerstitial nephritis.

What's the difference between acute tubular necrosis and acute tubulointerstitial nephritis?

| Acute Tubular Necrosis | Acute Tubulointerstitial Nephritis |
|------------------------|---|
| No inflammation | Inflammation in tubules and interstitium. |

Thus, Drugs might lead to either acute tubular necrosis or acute tubulointerstitial nephritis.

In this kind of injury, what types of cells do you think are infiltrating?

Eosinophils in acute tubulointerstitial nephritis. Why? We see them in:

- Drugs.
- Fungal, parasitic infections.

What else can we find in a drug induced kidney injury?

- Plasma cells infiltration in the infiltrate.
- Formation of granuloma.

Now if I see granuloma in the kidney what could it be due to?

- Drug induced kidney injury.
- Parasites.
- TB.
- Sarcoidosis.

Drug induced nephritis:

- Most of the time it's acute.
- But it could be chronic:
 - o More lymphocyte.
 - o We still see some eosinophils.

Acute tubulointerstitial nephritis related to drugs we see?

- Eosinophils
- Plasma Cells
- Granuloma (If it was more chronic)

Clinically?

- Acute kidney injury
- High Creatinine & Urea.

Now we start with the infection:

The upper urinary tract infection can be:

- Acute
- Chronic

When you're at a loss, always go back to basic, meaning:

- Pylo = Pelvis
- Neph = Nephrons
- Itis = inflammation

Summary:

AKI Could be?

- Prerenal – Hypovolemia and shock
- Post renal – obstruction
- Intrarenal:
 - o Tubules
 - o Tubules and interstitium
 - o Blood vessels
 - o Glomeruli – crescentic glomerulonephritis

What could drugs give us?

- Acute tubular necrosis.
- Acute tubulointerstitial nephritis

What can we see in a drug-induced injury?

- Eosinophils
- Plasma Cells
- Granuloma. (After few days, one week)

Clinically what do we see?

- AKI
- High creatinine and urea

| Acute Pyelonephritis | Chronic Pyelonephritis |
|---|--|
| <ul style="list-style-type: none">- Duration.- Neutrophils | <ul style="list-style-type: none">- Lymphocytes- Fibrosis |

Lower urinary tract:

- Ureteritis:

Anything can happen if cancer or inflammation occurs. But just keep it mind that this is rarely involved pathologically.

- Cystitis.

Pyelonephritis:

Due to (most of the time):

- Ascending infection.
- [That's why women are more prone to infection, which women?](#)

Babies, why? Because of the anatomy of the girls. And it's usually an ascending infection. Thus, for a baby girl, you allow one infection (UTI) to occur, but for a boy you allow **none**. When a baby boy gets infected you must start your investigations.

- Some patients get a hematogenous infection:

Due to septicemia but that is usually due to a very severe infection and the patient is usually debilitated (Diabetes, pregnancy, instrumentation, immunosuppression...etc.)

Complications:

- 1- Papillary necrosis
- 2- Pyonephrosis – Accumulation of puss in the kidney.
- 3- Perinephric abscess

Not as frequent nowadays why?

Because these days' doctors give appropriate therapy so patients don't reach these complications.

Summary:

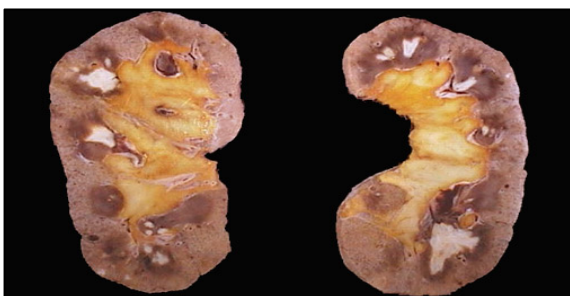
Acute pyelonephritis:

Acute onset with fevers and so on. These patients usually have predisposing factors and most commonly an ascending infection. And they may have complications.



- Acute pyelonephritis.

- This is the cortical surface and whitish area, which is puss (Neutrophils and bacteria)



- This is papillary necrosis (whitish area)
- Secondary complication of Acute pyelonephritis

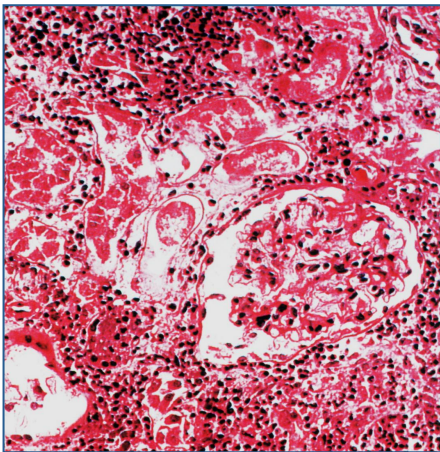
An acute on chronic:



These usually have reflux; urine goes back up rather than down (valvular area is not working properly).

This urine with time will cause stasis (an area of infection). → We can give antibiotics or correct the reflux but that will lead to → scar → another bout of reflux takes place → acute pyelonephritis → acute on top of chronic

So we see an area with puss and an area with fibrosis (scarring)

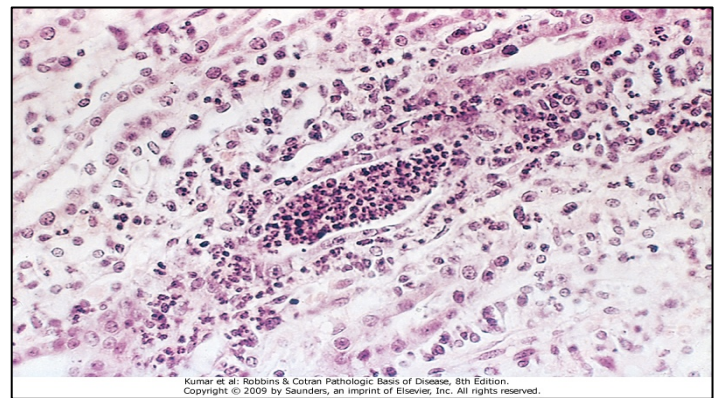
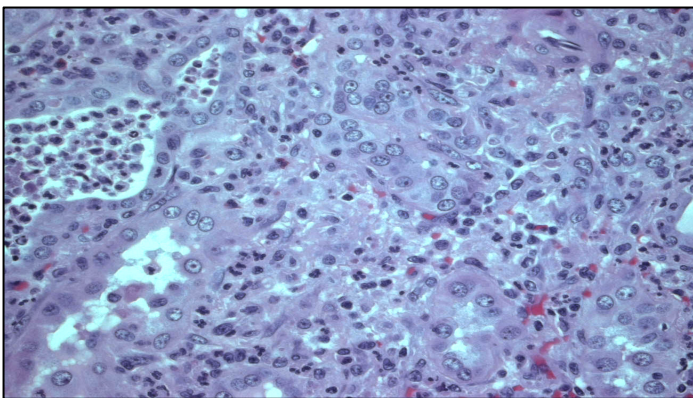


This is just to show you that these are all polymorphs.

But it's mainly in the tubules and interstitium as glomeruli are more resistant.

Acute pyelonephritis:

Infection may be in tubules, interstitium and pelvis with accumulation of puss. With time it will be acute on chronic and no more healing. Chronic pyelonephritis with lymphocytes and fibrosis



The polymorphs are infiltrating into the interstitium.

They can be filling the tubules.

In urine examination what do we see?

Bacterial culture we see – puss.

Here we see acute pyelonephritis.

Chronic Pyelonephritis:

Usually see scarring (most important)

When we say chronic that means **reflux** happens over and over again. And sometimes **the CHILD** reaches **end stage kidney disease** because the parents and the DOCTOR were useless. The child was not treated well; both his kidneys had **chronic pyelonephritis** they were all scarred. He lost his kidney function and now on **dialysis** for something that could have been corrected with **surgery**.

Chronic pyelonephritis is related to:

1- Reflux nephropathy:

Of which urine goes back up rather than down

2- Obstruction:

Let's say there's a pregnant women (6 - 7 months pregnant) when her uterus starts compressing the ureters they might have pyelonephritis and you have to be very careful when you treat her as she might lose her kidney function.

When you say chronic pyelonephritis in your mind what do you have? **Fibrosis.**

Summary:

Drug related:

- Acute
- Chronic

What cells do we see?

- Eosinophils
- Plasma cells
- Granuloma (More in chronic)

Clinically:

- Increase in serum creatinine and urea
- Acute kidney injury.

What type of intrarenal lesion could lead to AKI?

- Acute tubular necrosis
- Acute tubulointerstitial nephritis.
- Acute vasculitis
- Crescentic Glomerulonephritis



This is a specific type of pyelonephritis.

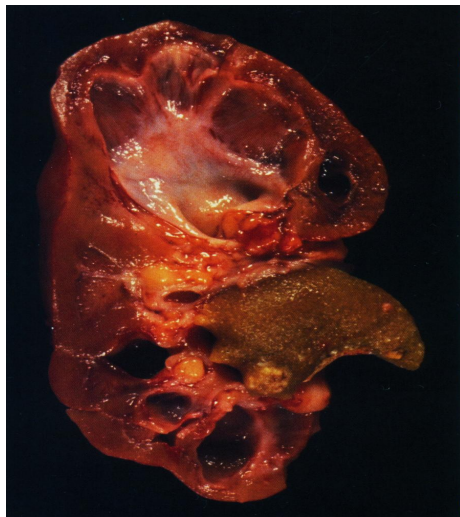
TB, what will we see?

Caseating necrosis and granuloma.

Not always (Caseating necrosis) sometimes we can see the granuloma without it.

So we can't rule out TB just because we don't see caseating necrosis.

In our area, any infectious granuloma is TB unless proven otherwise.



Staghorn:

Is a form of calculus taking the shape of the pelvis and calyces.

Associated with chronic pyelonephritis.

Usually associated with xanthogranulomatous pyelonephritis.
(Foaming macrophages)

Xantho = yellow (What makes it yellow? Fat)

Summary:

Chronic pyelonephritis:

Specific type of pyelo:

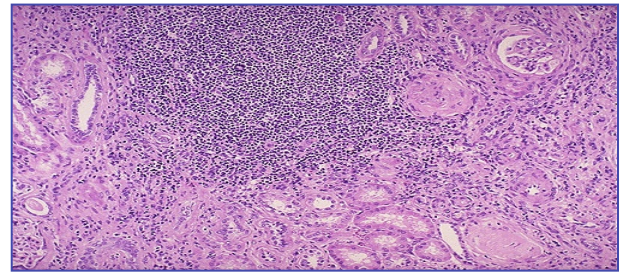
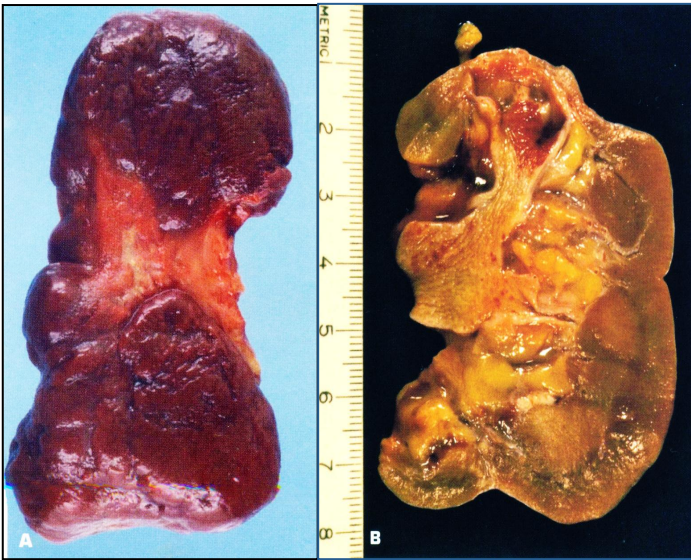
- Could be related to TB – caseating granuloma
- Related to intracellular bacteria or other kind of bacteria giving us staghorn
- Or extracellular bacteria giving us xanthogranulomatous = foamy histiocytes and granuloma.



Next is hydronephrosis (dilatation of calyces):

We see dilatation and pyelonephritis.

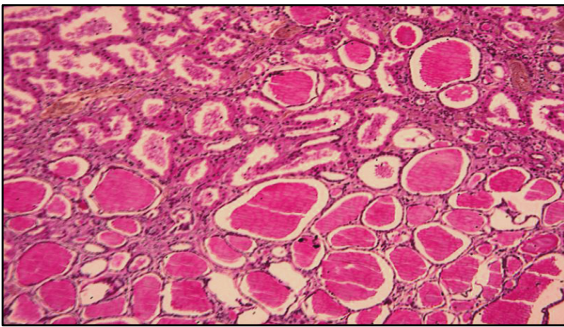
We see thinning of the parenchyma due to the reflux.



Here we can see chronic pyelonephritis:

- Lymphocytes
- **Fibrosis.**

When it's healed this is the scar.



Now when you see this what do we think of?

Thyroid.

What is it called?

Thyroidization of the kidney because the tubules look like thyroid.



Stones:

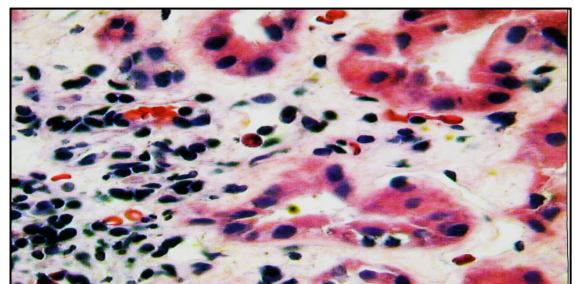
Calcium oxalate and phosphate – Radiopaque.

Uric acid – we don't see it.

Tubulointerstitial nephritis:

Could be acute or insidious (Doesn't present itself) For example a patient taking NSAIDs without prescription for a month → tubulointerstitial nephritis without them even knowing it happened.

- Eosinophils
- Plasma cells (Nucleus to one side and a perinuclear halo)



Lower urinary tract infections:

Cystitis:

- They have infection (Symptomatic or asymptomatic), most of the time we will see all the symptoms.
- The number of bacteria colony is $\geq 10^5$ cfu/ml.

When our body fights infection you can see how our body is strong enough to eliminate this much of bacteria in urine.

Someone having a urinary tract infection, what will he feel? (Clinical features)

- Urgency.
- Burning sensation.
- Dysuria (Painful voiding, passing urine).
- Frequency (most important).
- Fever, shivers, rigors.

What can triggers the infection?

- Stones (Obstructions)

Symptoms?

- Pain may last from hours to minutes.
- Nausea, vomiting
- Blood in urine
- Burning during urination, chills, weakness and fevers for urinary tract infection.

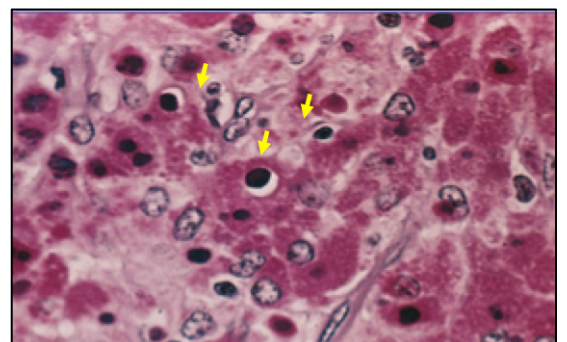
Etiology:

- Women have it more frequently
- Candida is yeast coming from vagina
- Schistosomiasis (*Schistosoma haematobium*) – in South of KSA.
 - So if in the exam they mention Abha or Najran, keep it in mind that it could be this kind.
- Stones, prostate hypertrophy, diabetes... any obstruction could cause cystitis
 - Stones can happen without infection.

Cystitis with Malakoplakia:

What does Malakoplakia mean?

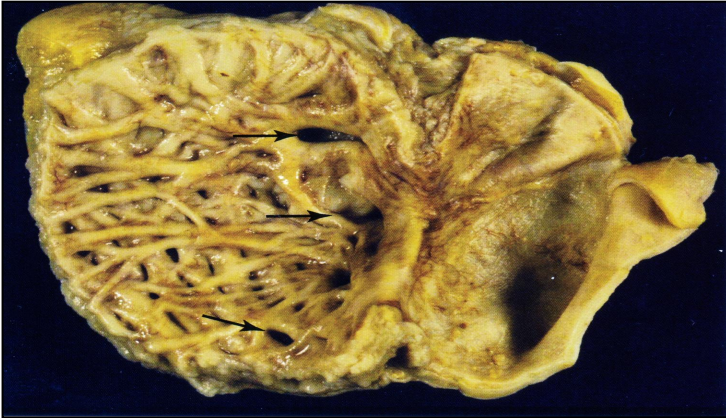
An infection which is frequent, associated with foamy macrophages but most importantly Michaelis Gutmann bodies (Yellow arrows) (Dark with a halo around it)



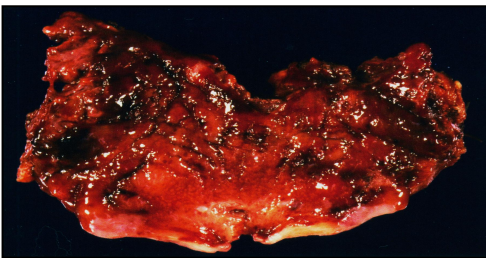
When we see Michaelis Gutmann bodies → Malakoplakia

Where do we mostly see foamy histiocytes?

Xanthogranulomatous nephritis, we might see it in Malakoplakia as well but most importantly in xanthogranulomatous nephritis.



- Chronic
 - Hypertrophy
 - Multiple acquired diverticula (arrows)
- Hard as it tries to take out urine but because of the obstruction it can't



- Bladder infection
- Red hemorrhagic mucosa

Last Lecture Homework:

Renal Dysplasia:

Multicystic **dysplastic kidney** (MCDK) is a condition that results from the malformation of the **kidney** during fetal development. The **kidney** consists of irregular cysts of varying sizes. Multicystic **dysplastic kidney** is a common type of **renal** cystic disease, and it is a cause of an abdominal mass in infants.

Summary:

Tubulointerstitial nephritis:

- o Related to drugs.
- o Most cells found are eosinophils and plasma cells
- o Chronic type could be insidious (not acute or noticed)

Acute pyelonephritis:

- Polymorphs in the interstitium + tubules

Chronic:

- Fibrosis + lymphocytes.
- Reflux
- Obstruction

Xanthogranulomatous pyelonephritis:

- Staghorn + mainly foamy histiocytes

Malakoplakia:

- Might occur in the kidney + all urinary tract. But most frequent in the bladder.
- Michaelis gutman body.

Lower UTI:

Bladder + Acute cystitis + Chronic obstruction in cystitis (Diverticula). + Stones.

Caseating granuloma:

- In drugs & In different places as well.
- Eosinophils

Now Check Your Understanding:

- 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

- 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

- 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

- 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

- 5- The majority of urinary tract infections in hospital settings are associated with use of a urinary catheter.
- True, a catheter compromises the function of the flushing mechanism and increases the chance of introducing pathogens to the urinary tract.
 - False, the hospital environment is full of potential urinary pathogens and all patients are equally at risk.
- 6- Which of the following are possible indicators of a urinary tract infection?
- Pain and tenderness around the region of the kidneys.
 - Blood passed while urinating.
 - An increased need to go to the toilet.
 - Cloudy or opaque urine.
 - All of these are possible symptoms of urinary tract infections.
- 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 colonized by normal flora?
- The urinary bladder
 - The external urethra
 - The kidneys
 - The ureters
- 8- Inflammation of the bladder is referred to as:
- Cystitis.
 - Urethritis.
 - Asymptomatic bacteriuria.
 - Pyelonephritis.
- 9- Which of the following is not a factor that predisposes an individual to urinary tract infections?
- High intake of fluids.
 - Pregnancy.
 - Kidney stones.
 - Benign prostatic hyperplasia.
- 10- The most common cause of community-acquired UTIs is:
- Staphylococcus aureus.
 - Pseudomonas aeruginosa.
 - Escherichia coli.
 - Enterococcus faecalis.
 - Proteus species.

- 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.
- 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.
- 13- Lower urinary tract infections include: (you can choose more than one) *
- A. Pyelonephritis
 - B. Urethritis
 - C. Cystitis
 - D. Prostatitis
- 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
- 15- Malakoplakia is Characterized histologically by:
- A. Aschoff bodies
 - B. Michaelis Gutmann bodies
 - C. Neutrophilic casts
 - D. Smooth muscle hyperplasia
- 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

- 17- A 34-year-old female presents to her primary care physician with complaints of fevers, nausea/vomiting, and severe left flank pain that has developed over the past several hours. She denies any prior episodes similar to her current presentation. Physical examination is significant for a body temperature of 39.1 C and costovertebral angle tenderness. A urinalysis and urine microscopy are ordered. Which of the following findings on kidney histology would be expected in this patient?
- A. Interstitial fibrosis and lymphocytic infiltrate
 - B. Neutrophils filling the lumens of the renal tubules
 - C. Thickening of the capillaries and glomerular basement membrane
 - D. Scarring of the glomeruli
 - E. Enlarged, hypercellular glomeruli with 'wire-looping' of capillaries
- 18- A 33-year-old female presents with recent onset of painful urination, fever, and right flank pain. Urinary sediment analysis is positive for the presence of white blood cell casts and Gram-negative bacteria. She has not recently started any new medications. What is the most likely diagnosis in this patient?
- A. Pelvic Inflammatory Disease
 - B. Acute Interstitial Nephritis
 - C. Pyelonephritis
 - D. Cystitis
 - E. Appendicitis
- 19- A 22-year-old sexually active, otherwise healthy female presents to her primary care physician complaining of several days of dysuria, frequency, urgency, and suprapubic pain. She denies fever, flank pain, vaginal itching, or vaginal bleeding/discharge. Which organism is most likely responsible for this patient's symptoms?
- A. TB
 - B. Chlamydia trachomatis
 - C. Proteus mirabilis
 - D. Klebsiella pneumoniae

Answers & Explanations:

- 1- 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- 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- 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- Ans: B. These findings are typical of drug-induced interstitial nephritis. Various drugs can cause this condition, including sulfonamides, penicillins, cephalosporins or NSAIDs
- 5- Answer: A
- 6- Answer: E
- 7- Answer: B
- 8- Answer: A
- 9- Answer: A
- 10- Answer: C
- 11- Ans: 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- Answer: C
- 13- Answer: B-C
- 14- Answer: D
- 15- Answer: B

16- Answer: C

17- Answer: B. This patient's presentation is most consistent with acute pyelonephritis. The histology of acute pyelonephritis consists of neutrophils filling the renal tubular lumens.

In addition to neutrophilic inflammation filling the renal tubules, more severe cases of acute pyelonephritis may exhibit suppurative necrosis or abscess formation on histology. In contrast to acute pyelonephritis, chronic pyelonephritis may show the following on histology: blunting and/or atrophy of papillae, interstitial fibrosis with accompanying inflammation, contracted or dilated tubules, and fibrosis surrounding Bowman's capsule.

18- Answer: C. This patient is suffering from acute pyelonephritis. In the setting of systemic febrile illness, white blood cell casts on urinary sediment analysis are pathognomonic for pyelonephritis. Acute pyelonephritis is most common in pre-menopausal females and *Escherichia coli* is the most common causative organism. Vesicoureteral reflux with secondary ascending infection from the bladder is the mechanism by which bacteria gain exposure to the kidney and may result in acute pyelonephritis. Clinical clues to pyelonephritis include nausea/vomiting, fever, flank pain, costovertebral angle (CVA) tenderness, urinary frequency/urgency, and dysuria.

19- Answer: D. The patient in this question is exhibiting symptoms classic for a urinary tract infection, or cystitis. The most common cause of uncomplicated cystitis and pyelonephritis is *E. coli*.

75% – 95% of uncomplicated cystitis in women is caused by *E. coli*. If *E. coli* is not the causative bacterium, *S. saprophyticus* (second most common), *K. pneumoniae*, and *P. mirabilis* are most commonly encountered. Risk factors include recent sexual intercourse, spermicide use, and a personal or family history of previous UTIs.

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دعواتنا لكم بالتوفيق.