





# Clinical Nephrology

## General Notes:

- 1- Kidneys are retroperitoneal structures.
- 2- It extends from T12 to L3.
- 3- Can be accessed from behind.
- 4- Pain is usually from posterior.
- 5- Left kidney is higher than the right one which is pushed down by the liver.
- 6- It is concaved medially, bean-shaped organ.
- 7- Has hilum in which ureter and vessels enter.
- 8- Its size ranges between 9.5 and 12cm. (if less than 9cm then it`s abnormal).
- 9- Its weight differ according to person`s age. (~ 150mg)
- 10- Nephron is the functional unit and if we lost any it can`t be regenerated. That`s why with years kidney loses its function.
- 11- When injured, normal tissues are replaced by fibrous ones.

## Kidney`s Functions:

### 1- Regulation of Volume

when you drink a lot of water, you go a lot to the bathroom.

### 2- Acid-Base Balance

Cola is full of acids, if I have a good kidney I can manage. If not, I will suffer from severe acidosis.

### 3- Regulation of electrolytes

Patients with chronic kidney disease can`t eat food full of potassium ions (K<sup>+</sup>). If they do, they will suffer from severe hyperkalemia.

### 4- Controlling blood pressure



For example, if our kidneys can't manage high  $\text{Na}^+$  levels we will end up with high blood pressure.

5- If I took an antibiotic, my kidney can handle it and many of the antibiotics are renally excreted.

If we are dealing with a renal failure patient, we make adjustments to his medications and even doses.

Renal failure patients can't manage multivitamins but normal kidneys can handle regular consumption of substances.

#### 6- Hormonal function

Renal disease patients usually suffer from anemia; they have problems in erythropoietin and bone mineral diseases such as osteoporosis, high PTH levels, high P levels and abnormal vitamin D activation.

\* Remember that Renin- Angiotensin system is kidney regulated.

Conclusion, whenever you face a patient with an abnormality related to the previously mentioned points, you should think of the kidney.

### Clinical Presentation:

In your life you will see young patients suffering from abnormal renal functions and the only manifestation is high kidney function tests where their creatinine reaches 5, for example.

\*\* Creatinine normal level is (0.8)

Signs and Symptoms of abnormal renal functions:

- Uric Symptoms; urea, which is usually cleared by kidneys, accumulates and is accompanied with nausea, vomiting in the morning, decrease appetite, generalized weakness, mental status changes. In male, sexual dysfunction, severe itchiness, yellow earthy color face.

\* In renal failure patients there is accumulation of urea and uremic pericarditis which leads to severe chest pain because pericardium is inflamed due to abnormal accumulation of fluids. Here patient can't sleep on his back, this position is so painful.

**\* Acute kidney injury:**

- Within few hours you can have a presentation (more abrupt).
- Swelled face and legs.
- Decreased level of consciousness.
- Decrease in urine amount and it is dark in color.
- Pain in the lower abdomen.

**\* Chronic kidney injury:**

- Need years
  - High blood pressure, gross blood and protein urea.
- \* Protein urea is the most common presentation of renal failure.

**Notes:**

- **Dysurea:** burning sensation and it is a major symptom of urinary tract infection.
- **Nocturia:** going to the bathroom more than 4 times/ night.
- **Polyurea:** huge amount of urine (>3L of urine). You should check whether urine has only water in it or there are other materials.
- **Oligourea:** presentation of severe renal impairment (<300CC/day). It`s a sign of acute kidney injury. It might be due to the absence of blood reaching the kidney so there is no urine output or it might be due to a renal disease which causes severe renal impairment. If it is in a male patient the renal disease might be **Benign Prostatic Hypertension**. If in female it might be pelvic prolapse or ovarian cancer.
- There is a common presentation called **Hematouria**. It might be gross (ex: in renal stone cases, in men) or microscopic.
- **Proteinurea:** leakage of protein can be glomerular, tubular or due to an overflow.
- Unfortunately chronic kidney diseases are not painful. So you can`t discover their presence unless they are related to other causes, for example renal stone causing a loin pain, cyst rupture, trauma. pain result whenever there's **tension on the capsule** (dull pain).



- When stone descends to the ureter, patient will suffer from severe pain. Pain increases with ureter movement. If an obstruction happens, tension in kidney happens so more prominent pain.
- Renal pain is associated with specific disease rather than general disease.
- Ureteric pain is the worst pain.
- think about kidney problems when you have a patient with:

periorbital edema, bilateral lung crepitations (fluid overload), uremic pericarditis, anemia, shortness of breath related to anemia or to volume problems and finally other causes suggestive of renal disease ex: DM,BP, SLE, rheumatism patients taking analgesics for long periods such as: voltaren, diclogesic and ibuprofen.

- Take care of family history and drug history, eg:Adult polycystic kidney.

Recent antibiotic use should be considered. Ciprofloxacin and proxacin might cause interstitial nephritis. Bisphosphonate which is used to treat bone diseases should be considered too.

### **\*\* Common Renal disease:**

- 1- Glomerular Nephritis.
- 2- Interstitial Disease.
- 3- Urinary tract infection.
- 4- Urinary tract obstruction.
- 5- Renal failure.
- 6- Hereditary disease such as polycystic disease (autosomal dominant diseases).

### **\*Clinical Cases:**

#### **Case #1:**

25 year old man with no significant past medical Hx , presented with acute severe left loin pain associated with ( blood in his urine ) gross hematuria for last few hours. Has normal blood pressure. What do you think?

- 1- Loin pain + hematuria so it might be renal stone.



The right kidney is still working so he might not have renal impairment.

2- It might be pyelonephritis, or trauma (here it should be associated with other signs such as abnormal high electrolytes levels or high LDH).

3- It might be vascular related disease ex. Thrombosis in renal vein or artery. Here he will also suffer from high kidney function test and severe pain.

\* note sometimes pain raise blood pressure.

4- Malignancy or tumor.

Most probably it is renal stone.

### Case #2:

40 year old man presented with intermittent dark color urine, with no loin pain.. Found to have high blood pressure 2 years ago. his father and his older brother are on dialysis. What do you think?

- The key here is his family history, may be Alport disease or thin basement disease... It`s not renal stone since he`s not complaining from any pain.

Not Renal cell carcinoma,RCCpateints usually don't present with high blood pressure and family history.

### Case #3:

A 70 years old male complains of hematuria for the last 4 months. He has been heavy smoker for the last 20 years. He experiences difficulty in urination, nocturea, frequent urination with minimal output. He is also hypertensive.

Smoker+ old age+ urinary symptoms >> always think of carcinoma or BPH first.

Differential diagnosis:

- Prostate abnormality: Benign prostatic hyperplasia leads to obstruction of urinary flow. Bleeding can occur due to its congested venous system which could leak blood.



- Hypertension can cause chronic kidney disease, but it usually doesn't cause significant bleeding. This patient has gross hematuria, which indicates a local cause.
- Malignancy:
  - Bladder: heavy smoker + gross hematuria + old age >> high risk for urinary bladder carcinoma.
  - Prostatic cancer.
  - Renal cell carcinoma.
  - Urethral carcinoma
  - Ureter carcinoma.
- Bleeding tendency:
  - 1) dDue to drugs: need to know if he is taking warfarin or high doses of aspirin or Plavix (antiplatelet agent).
  - 2) Bone marrow malignancy: causes severe thrombocytopenia.

#### Case #4:

A patient presents with dark urine and decreased urine output. He has been doing heavy lifting exercises.

Not all dark urine is blood. It could be caused by myoglobin due to **Rhabdomyolysis** caused by muscle injury from the heavy lifting. The acute kidney injury and reduced urine output in this case is most likely associated with rhabdomyolysis.

**\*\* Important to know:** not all dark urine is due to hematuria. It can also be due to hemoglobinuria or myoglobinuria.

There is also something called **Martial hematuria**: people who walk like those in the army or who drum for a long time, could have gross hematuria after because of microhemolysis or hemoglobin in the kidney. Gross hematuria which is associated with renal impairment could lead to acute kidney injury.

All the above cases have different causes of hematuria/dark urine.

Differential diagnosis of hematuria:

- Hematuria (Most common)
- Hemoglobin/myoglobinuria
- Food related (blackberries, meat)



- Heavy metal related
- Antibiotics

We must ask about all of the above when a patient presents with dark urine.

We also need to observe the blood under the microscope to see how the RBCs look like:

- **Dysmorphic:** small and destroyed RBCS or RBC casts. Usually indicates glomerular disease.
- **Normal RBC shape and size:** causes other than glomerular disease, like: anticoagulation, infarction in kidney, tumors, infections, cystitis, stones.

Important things to consider about hematuria:

- Painful (stone, UTI, Injury) vs. painless
- gross vs. microscopic hematuria
- hematuria at the beginning vs. end of stream vs. throughout urination (this is hard to determine as patients only notice hematuria once they are finished urinating)
- always there vs. periodic
- dysmorphic vs. normal RBCS

## **CASES ASSOCIATED WITH PROTEINURIA:**

### **Case #1:**

24 year-old female presents with generalized edema, periorbital edema (swollen eyes in the morning, gets better at night), joint pain, malar rash, mouth ulcers. Urine analysis has protein and RBCs. Urine sample shows high grade proteinuria.

Indication of systemic disease involving the kidneys (due to joint pain, rashes and mouth ulcers). It could be **SLE** because of the young age group this patient belongs to. The proteinuria and hematuria, in addition to dysmorphic RBCs indicate glomerular disease/ glomerulonephritis.

**\*\* In Jordan, the most common cause of proteinuria with no other systemic disease is Diabetes Mellitus.**

### **Case #2:**

20 year-old female, usually experiences painful periods. She takes NSAIDs for the pain. Her urine analysis shows: WBC casts, protein, RBCs, glucose. She has high creatinine which indicates mild renal impairment.

**Tubular interstitial injury** secondary due NSAIDS. The problem is tubular and not glomerular because it is associated with proteinuria and with WBCs, RBCs, and glucose in the blood.

### Case #3:

70 year-old male complaining of severe lower limb edema. His ESR is very high, RBCs in urine, negative for protein in urine. This presentation seems a little weird (because no protein in urine) so the doctor orders a 24 hour urinalysis. The 24-hour urinalysis is positive for proteinuria. Why? The dipstick was negative for protein because it is specific for albumin. So we have non-albuminic proteinuria, indicating high level of immunoglobulins in the urine. Hence, we should suspect **multiple myeloma**. Too much Ig>>tubules can't handle it so it presents in urine. This is called overflow. The kidney function is fine, but there is too much Ig, so we get overflow proteinuria.

The high ESR indicates malignancy, the patient will be hypercalcemic with multiple osteolytic lesion.

We don't think of autoimmune disease in this case, as autoimmune diseases are associated with hyperalbuminuria.

\* \*There are primary and secondary glomerular disease. In the hospital we usually look for secondary first. Drugs play a very important role.

## **HYPERTENSION:**

- Essential (95%): in 50 year-olds, hypertensive for a long time.
- Secondary (5%): **NEED TO KNOW CAUSE OF THIS**. Usually in young patients with high blood pressure or old patient with sudden rise in pressure.

Causes:

- 1) If workup shows low potassium in a young hypertensive patient>> primary hyperaldosteronism.
- 2) Abnormal renal artery/ renal artery stenosis
- 3) renal impairment
- 4) drugs: heroin and cocaine. Can present as a hypertensive emergency.
- 5) severe anemia
- 6) HRT old females (postmenopausal)
- 7) OCP in older females

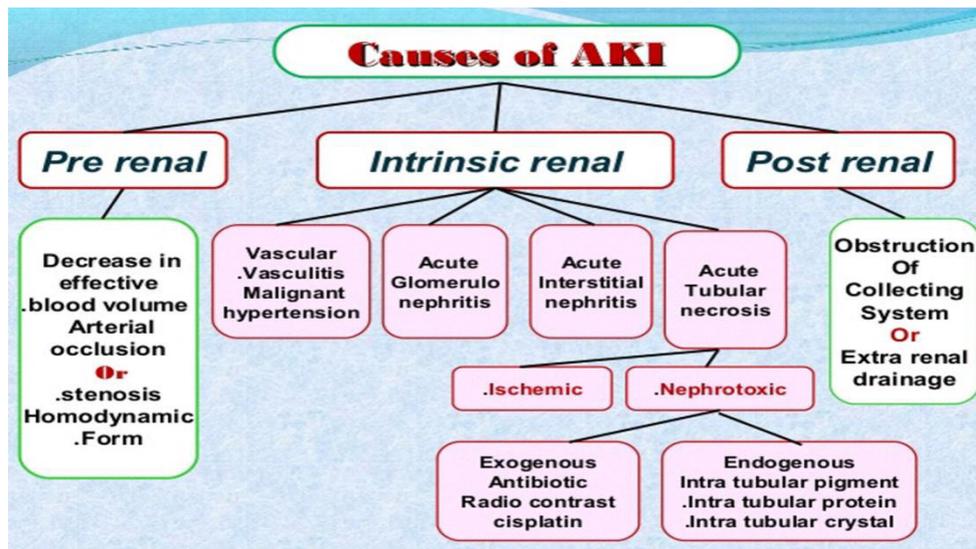
\* \*HTN in young patients: not normal. In older patients it's usually more acceptable.

## RENAL FAILURE:

Decreased urine output, wakes up at night to urinate, urine stream poor, red urine. Creatinine levels are high which suggests a renal impairment/ acute renal failure.

The major causes are:

- Pre-renal (low blood flow to kidney).
- Renal (glomerular or tubular problems).
- Post-renal (kidney functions well but poor output).



### Case #1:

An elderly patient came to your clinic saying he has not been urinating for 3-4 days. He had difficulties in urination before, but lately he hasn't been urinating at all. When you put your hand on his abdomen to palpate his urinary bladder, you found it reaches mid abdomen and has severe tenderness. His creatinine level is very high reaching 7,8 ,or even 10. You put a Foley catheter to relieve obstruction to find a huge amount of urine came out.

This means renal failure is related to volume of urine output , we have obstruction of the outlet called **post obstruction cause of renal impairment**.

### Case #2:

A patient has nausea and vomiting many times a day, he's not eating or drinking the whole day. He has concentrated urine. If this happens frequently then the patient would have hypointravascular fluid, he becomes hypovolemic leading to low kidney perfusion causing acute renal injury called **prerenal azotemia**. He should be given fluids and things would be back to normal, because the kidney is normal. If you restore normal intravascular volume you'll restore normal kidney functions.

**Case #3:**

A patient uses Ibuprofen frequently and develops abnormal renal function..tubular injury, interstitial nephritis. NSAID. His blood pressure is normal, circulation is good, urine coming out>> no prerenal or post renal causes. The issue is in kidney itself>>Interstitial nephritis and acute tubular necrosis which could lead to acute kidney injury. Stopping the medication and allowing the kidney to heal will lead to recovery.

**Some additional things to keep in mind:**

- Chronic kidney disease rates are increasing in Jordan, because of the high proportion of elderly in the population. Non compliant patients who have hypertension or diabetes, drug abusers and those who take NSAIDs frequently, all can develop chronic kidney disease. Usually we underestimate the number of cases of chronic kidney disease in Jordan.
- Chronic kidney disease outcome is either death or dialysis.
- Our goal is to prolong kidney health. DM and HTN are the most common causes of renal failure in the world. Diabetes is the commonest cause of renal failure worldwide. 50% of those who undergo dialysis are diabetic.
- Chronic kidney disease is usually due to structural or functional abnormalities.
  - Structural: e.g. glomerulonephritis (injury in kidney leads to this and causes proteinuria and hematuria), single kidney ( donated other kidney, trauma results in loss of a kidney, or born with only one kidney).
  - Functional: Kidney isn't working enough, so the blood is not cleaned properly and results in high creatinine levels in blood.
- Abnormal renal function>> chronic kidney disease. It is something you live with for the rest of your life. We can only reduce the risk factors to avoid progression to end stage renal disease.
- 1/3 of those with DM have renal failure.
- Tumor and nephritis is very rare to have because its mostly obstruction [I have no idea what this means]. A child with enuresis (uncontrolled urination) doesn't see a doctor. In his twenties he develops renal failure because the obstruction causes backpressure and causes loss of nephrons which leads to end stage renal failure.