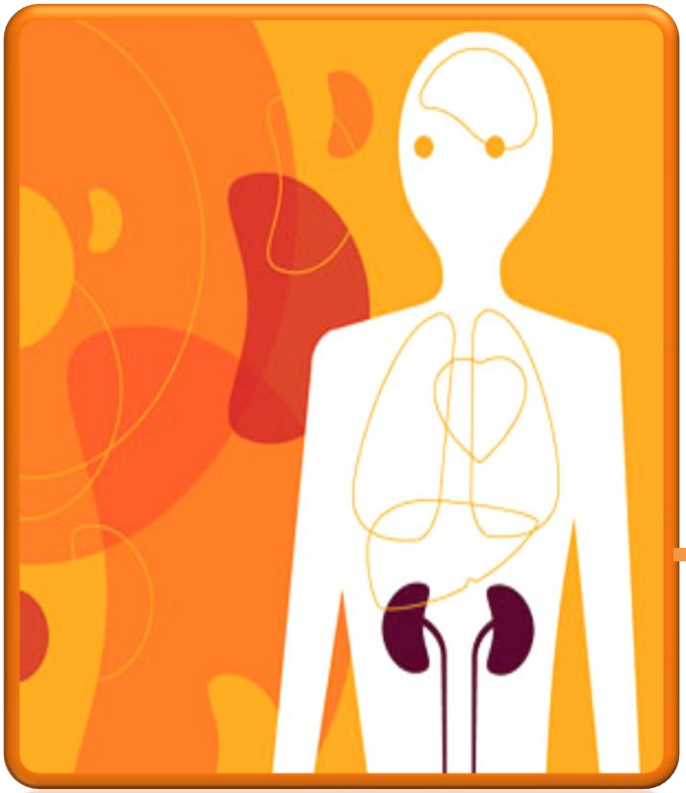


PATHOLOGY TEAM 431

(renal block)

- ACUTE KIDNEY INJURY –

SADEEM AL-DAWAS (LEADER)

Sara Almutairi

Afnan Alhargan

Wala'a Alshehri

Dalal Fatani

Sara Al anzi

Hadeel Helmi

Bayan Alnooh

Lama Al-Shwairkh

Hassah al-fozan

reema al anezi

Raghda Al-AmrI

Eman Al-Shahrani

HAZIM JOKHADAR(LEADER)

Mamdoh Al enezy

Abdulelah Al kapoor

Saad Kashogji

Majed Al shammari

Bader Al ghamdi

Abdullah ALkhowaiter

Objectives

1-Introduction to the renal pathology

2-Acute Kidney Injury

3-Definitions, Types, Clinical Overview, Causes

4-Pathological findings

5-Differential Diagnosis

6-Conclusion

7- Have a working knowledge of the embryology of the kidney and urinary tract.

8- Be able to apply this to the more common abnormalities.

LECTURE ONE:

1- NORMAL ANATOMY AND HISTOLOGY OF THE KIDNEY.
2- PATHOLOGY OF CONGENITAL AND CYSTIC RENAL DISEASES.
3- ACUTE RENAL FAILURE.

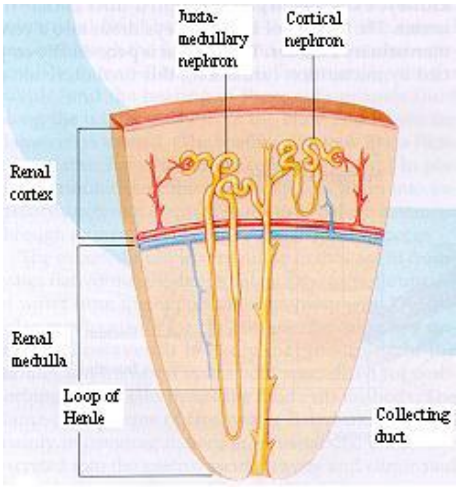
The kidneys

are retroperitoneal organs. Each adult kidney weighs 120 to 150 grams and is covered by a thin capsule of connective tissue and a layer of perinephric fat. Through the hilus of each kidney pass a renal artery and vein, lymphatics, a nerve plexus ,and the renal pelvis which divides into three major and several minor calyces.

On cut section, the kidney reveals two sections: the reddish brown cortex and the lighter medulla. The medulla is formed into medullary rays and 10 to 20 pyramids whose most distal ends(tip) is called the papillae which project into the calyces of the upper collecting system.

- Many patients severing from liposarcoma and it is arising from the retroperitoneum , because the retroperitoneal space is filled with fat.
- The Perinephric fat has on his outer surface fascia called " Gerota's Fascia "

NEPHRON



Each kidney is composed of approximately 1 million nephrons, the basic functional unit of the kidney.

The nephron components are as follows:

1. **The glomerulus** with its afferent and efferent arterioles, consists of a tuft of capillary loops that protrude into Bowman's capsule.
The glomerular tuft has several components :
(a) The mesangium is a supporting structure composed of cells and matrix.
(b) The glomerular capillary loops are endothelial-lined tubes, which are covered with basement membrane and visceral epithelium and held in place by the mesangium.
(c) The glomerular basement membrane (GBM) and visceral epithelial cells together comprise the ultrafiltration barrier necessary for urine formation.

2. **The renal tubule** begins as Bowman's capsule and consists of the proximal convoluted tubule. Loop of Henle, distal convoluted tubule and collecting duct (the last of which conveys urine to the renal pelvis and ureter).

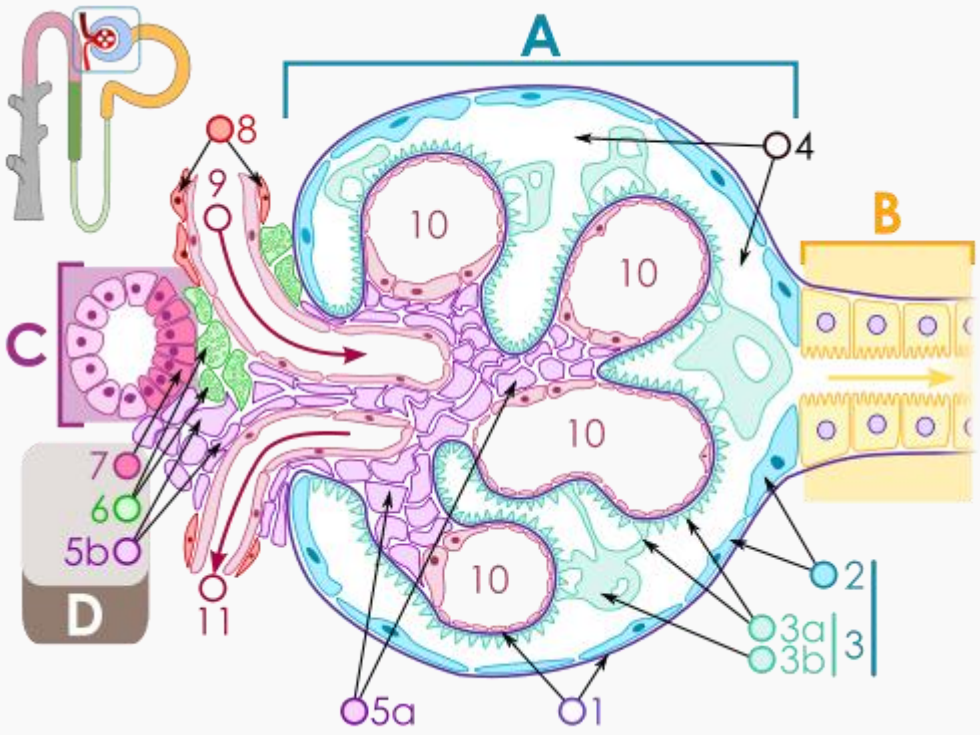
3. **The interstitium** is a connective tissue consisting of reticular fibers and interstitial cells, lymphatics, blood vessels and nerves.

There are two distinct types of nephrons:

(1) **Cortical nephrons:** they are the predominant type and have glomeruli situated in the outer cortex .
(2) **Juxtamedullary nephrons:** have glomeruli located at the corticomedullary junction. These nephrons have very long loops of Henle penetrating deep into the medulla.

URINARY TRACT STRUCTURE

The urinary tract connects to the kidney at the renal pelvis and consists of the ureters, urinary bladder and urethra.



A - Renal corpuscle
B - Proximal tubule
C - Distal convoluted tubule
D - Juxtaglomerular apparatus
1. Basement membrane (Basal lamina)
2. Bowman's capsule - parietal layer
3. Bowman's capsule - visceral layer
3a. Pedicels (podocytes)
3b. Podocyte or sometimes called Bowman's cells
4. Bowman's space (urinary space)
5a. Mesangium - Intraglomerular cell
5b. Mesangium - Extraglomerular cell
6. Granular cells (Juxtaglomerular cells)
7. Macula densa
8. Myocytes (smooth muscle)
9. Afferent arteriole
10. Glomerulus Capillaries
11. Efferent arteriole

Most of the diseases which affect the glomeruli are immune mediated "immunological reaction " , usually type 2 and 3 immune reaction .

According to the site of these immune complex deposition the patient get the disease.

Bowman's space : is the space between the parietal layer and the visceral layer of the bowman's capsule .

We can see the podocyte only by using the electron microscope.

electron microscope is using a lot in the diagnosis of renal diseases .

Cortical nephrons: have shorter loops of Henle and a little pit shorter proximal and distal tubules.

Juxtamedullary nephrons: have very long loops of Henle.

CONGENITAL AND CYSTIC RENAL DISEASES

There are numerous possible congenital abnormlaties of the kdieny from non- formation of one kidney (unilateral agenesis), which is compatible **with a normal life** (and may only be discovered incidentally at autopsy) to congenital absence of both kidneys (renal agenesis), which usually leads to death in utero. Sometimes the upper or lower poles of the kidneys are fused(forming a so-called "horseshow kidney). This type of kidney malformation may be found in fetuses/children who have **chromosomal abnormalities** such as Turner's syndrome (45x).

Congenital cystic disease of the kidney is clinically very important and include:

cystic diseases of the kidneys are :

1- Congenital : aggressive and make problems to the kidneys
2- Acquired : may does not make any problem .

(1) Cystic renal dysplasia

- Commonest cystic renal disease in children.
- Caused by disorganized renal development.
- Can be unilateral or bilateral.
- Often associated with poorly formed ureter.
- Rarely part of a syndrome.

- Appearance :
  - Elongation cyst (sticks like)
- Common & silent : patient + abdominal mass + abnormal parenchyma

(2) Autosomal dominant polycystic kidney disease

presentation : hypertension , renal failure , abnormal mass

- zotemia(abnormal level of creatinine and urea in the blood)

- Progressive distention of kidney by enlarging cysts.
- 1-2 cases per 1000 live births.
- Usually present in **adults**.
- Caused by **mutation in two genes** PKD1 (85% of cases: chromosome 16) and PKD2 (155 of cases, chromosome 4) (also PKD3 in rare cases).
- 10% new mutations.
- Maybe associated with cysts in liver, pancreas, spleen and cerebral/ coronary artery and aneurysms.
- About 10% require dialysis/ transplantation.

Autosomal dominant polycystic:

- Discovered during adult life .
- compatible with life .

(3)Autosomal recessive polycystic kidney disease(ARPKD)

- Rare, 1 case per 20,000 live births.
- Gene on chromosome 6
- Liver also always affected.
- Large kidneys at birth or **early life** (may cause death soon after birth due to renal failure).

- Autosomal recessive polycystic :
- both medulla (parenchyma) & cortex are involved and replaced by small cysts of variable sizes.
- dilated tubule
- discover in early life

(4) Medullary sponge kidney

- Dilated collecting ducts give "spongy" appearance.
- 1 case per 5000 population.
- May present with **renal infections in adult life**.
- No obvious genetic link.

Acute renal failure or (acute renal injury)

Sometimes called " acute tubular necrosis "

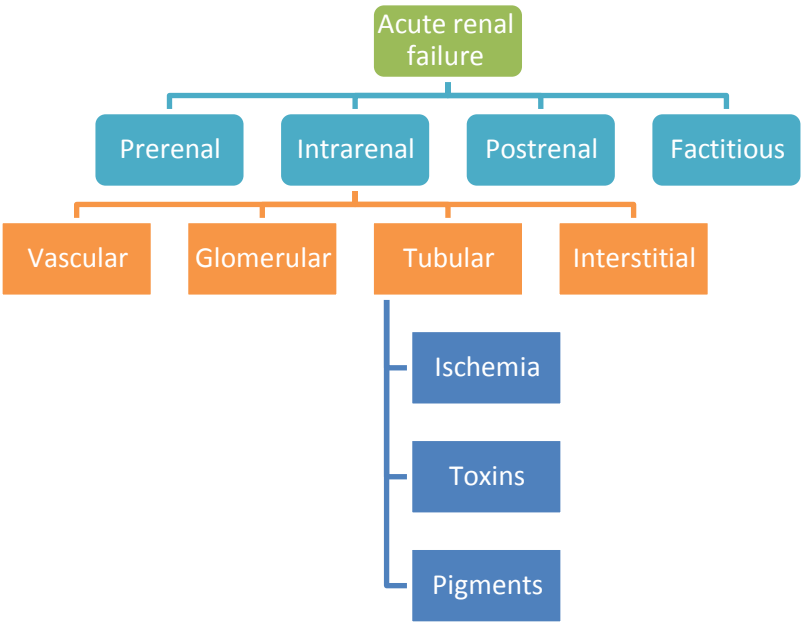
They are synonyms:

having the same meaning

is a syndrome defined by a sudden loss of renal function over several hours to several days.

The Pathophysiology of ARF :

- *It is an acute medical emergency*
- *the injury that affect the kidney is reversible .*
- *The tubules capable to regenerate*



Prerenal mostly due to a shock

Intrarenal :

- Blood vessel : mainly due to vasculitis

- Glomerular (**mostly immune mediated**)

- inflammation > acute tubular nephritis

  - cause : maybe a drug (e.g aminoglycoside)

- Interstitial : Urinary findings **Eosinophiluria**

~ diagnosis depend on : drug history + size of kidney (swelling)

Oliguria : decrease in urine amount

The diseases of the tubules:

1.Acute tubular necrosis

2.Tubulointerstitial disease

ACUTE TUBULAR NECROSIS

-Is the most common cause of **acute renal failure** **(acute renal shutdown).**

Acute renal failure is manifested clinically by **oliguria**(amount of urine produced is less than 400ml\day) or **anuria** (no urine flow) with recent onset of **azotemia** (elevated urea and creatinine). The condition is mainly manifested by acute tubular necrosis and usually occur after 36 hours after the injury.

Acute renal failure can be caused by prerenal, renal or postrenal causes.

1. This condition is **reversible**. Necrotic renal tubular cells are replaced by new cells in approximately 2 weeks, with complete return of renal function to normal if the patient is maintained on dialysis. Proper medical management results in **complete recovery**, otherwise the syndrome is potentially fatal.

2. This condition can also lead to cardiac standstill from hyperkalemia, most often during the initial oliguric phase. Oliguria from acute tubular necrosis must be distinguished from oliguria due to prerenal causes: such as reduced blood volume or dehydration.

Causes and predisposing factors: The acute condition is most frequently precipitated by **renal ischemia,** which is often caused by prolonged hypotension (hypovolemia) or shock,

most often induced by gram-negative sepsis, trauma or hemorrhage, major surgery. Another associated condition is crush injury with myglobinuria. Myoglobinuria also can be observed after intense exercise, but this is not of clinical consequence.

Other causes may include **direct injury to the proximal renal tubules** from mercuric chloride, gentamicin, and several other **toxic substances**. Ethylene glycol (antifreeze) is extremely toxic when ingested and can result not only in acute tubular necrosis but also in renal oxalosis with massive intratubular oxalate crystal deposition that can be visualized under polarized light.

Main causes of ATN are :

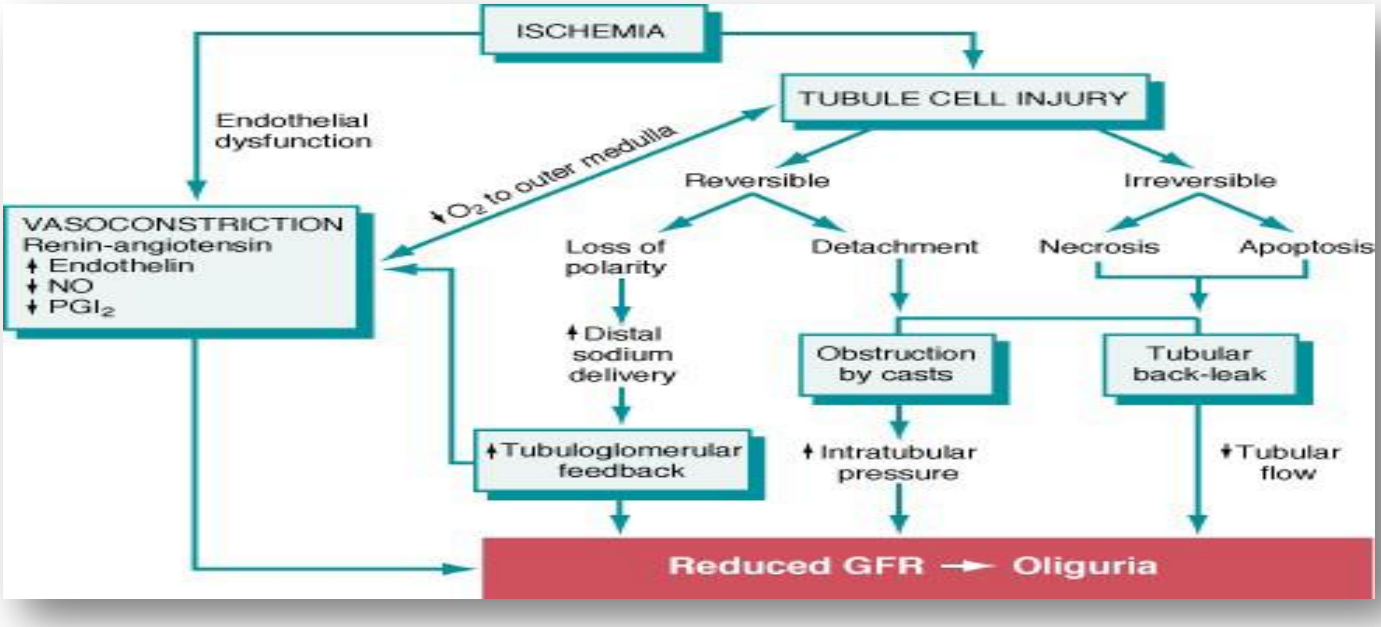
1.Ischemic

2. Toxic

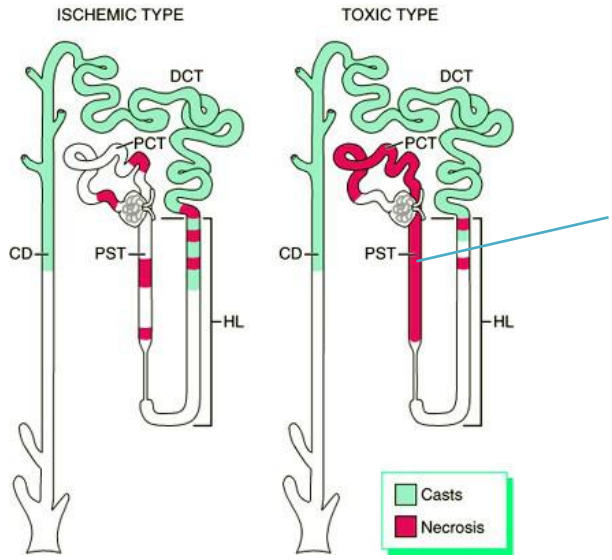
- Why necrosis first in tubules ? Because glomeruli are more resistant to necrosis

- Recovery : can be treated in tubules (reversible) , but when reaches the glomeruli it becomes irreversible (fibrosis)

- Hydronephrosis is due to obstruction in the urethra .



ATN :Acute tubular necrosis



Proximal tubule mainly

Acute tubular necrosis, there are a lot of cortical edema with congestion, we may see also areas of hemorrhage (**important as a morphology**)

In the microscope:

The glomeruli are normal

Necrosis , loss of renal tubules , vacuolation , plibs, hyaline cast .

Investigations and tests in general :

- renal biopsy : - histology (routine) – immunofluorescence – **Electron microscope**

  - Electron microscope is much better than biopsy

Summary of ATN

- ✓ ATN is the most common cause of acute renal failure , its clinical manifestations are oliguria , uremia , and signs of fluid overload .
- ✓ ATN results from ischemic or toxic injury to rental tubules , associated with intrarenal vasoconstriction resulting in reduced GFR and diminished delivery of oxygen and nutrients to tubular epithelial cells .
- ✓ ATN is characterized morphologically by necrosis of segments of the tubules (typically the proximal tubules) , proteinaceous casts in distal tubules , and interstitial edema .

Questions

1- Which one of the following is the most common cause of acute renal failure :

A. Autosomal recessive polycystic kidney disease
B. ACUTE TUBULAR NECROSIS
C. Autosomal dominant polycystic kidney disease
D. Cystic renal dysplasia

2- Ischemic acute tubular necrosis occurs most commonly in association with:

A. A. septic shock
B. B. ruptured aneurysm
C. C. carcinoma of prostate
D. D. hydronephrosis and pyelonephritis
E. E. malignant hypertension

3- Which one of the following is the Commonest cystic renal disease in children :

A. Autosomal recessive polycystic kidney disease
B. ACUTE TUBULAR NECROSIS
C. Autosomal dominant polycystic kidney disease
D. Cystic renal dysplasia

4- Which one of the following is the mutation gen in Autosomal recessive polycystic kidney disease:

A. Chromosome 8
B. Chromosome 6
C. Chromosome 7
D. Chromosome 11