The kidney and UTI – common diseases

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Acute kidney injury (AKI)

- (AKI) is a syndrome characterised by :
- a rapid (hours to days) deterioration of kidney function.
- It is often diagnosed in the context of other acute illnesses
- and is particularly common in critically ill patients.

Acute kidney injury (AKI)

- The clinical consequences of AKI include:
- the accumulation of waste products,
- electrolytes,
- and fluid,
- but also less obvious effects, including:
- reduced immunity
- and dysfunction of non-renal organs (organ cross-talk)

Diagnosis of AKI

- a rise in serum creatinine and/or fall in urine output.

- short- and long-term risk of death
- or renal replacement therapy (RRT)
- were greatest when patients met both criteria for AKI and when these abnormalities persisted for longer than 3 days.

KDIGO definition and classification of AKI

Diagnostic criteria for AKI:
AKI is defined as any of the following:
• Increase in serum creatinine by ≥0.3 mg/dl (≥26.5 μmol/l) within 48 h; or • Increase in serum creatinine to ≥1.5 times baseline, which is known or presumed to have occurred within the prior 7 days; or • Urine volume <0.5 ml/kg/h for 6 h.
AKI staging system:

AKI stage - stage I and stage II

AKI stage	Serum creatinine criteria	Urine output criteria
AKI stage I	Increase of serum creatinine by ≥0.3 mg/dl (≥26.4 μmol/L)	Urine output <0.5 ml/kg/h for 6-12 h
	or	
	increase to 1.5-1.9 times from baseline	
AKI stage II	Increase of serum creatinine to 2.0–2.9 times from baseline	Urine output <0.5 ml/kg/h for ≥12 h

AKI stage - **stage III**

- Increase of serum creatinine ≥3.0 times from baseline
- Urine output <0.3 ml/kg/h for ≥24 h
- or
- serum creatinine ≥4.0 mg/dl (≥354 µmol/L)
- anuria for ≥12 h
- or
- in patients <18 years, decrease in estimated GFR to <35 ml/min per 1.73 m^2

Glomerulonephritis

- **Glomerular disease includes:**
- **glomerulonephritis, i.e. inflammation of the glomeruli**

and

- **glomerulopathies when there is no evidence of inflammation.**

Acute Glomerulonephritis

- Inflammation of the glomeruli which causes the kidneys to malfunction
- also called Acute Nephritis, Glomerulonephritis and Post-Streptococcal Glomerulonephritis
- Predominantly affects children from ages 2 to 12
- Incubation period is 2 to 3 weeks

Glomerulonephritis

- Glomerulonephritis is a subset of glomerulopathies
- Nephrotic syndrome.
- Acute glomerulonephritis (acute nephritic syndrome).
- Rapidly progressive glomerulonephritis.
- Asymptomatic urinary abnormality (haematuria, proteinuria or both).

Acute Glomerulonephritis

- Incidental discovery of occult proteinuria or HTN
- Usually presents as chronic renal failure or occult proteinuria
- Glomerulus has scar tissue
- Diabetes most common cause
- most common cause of renal failure
- glycoproteins deposit in basement membrane
- Vascular disease
- atherosclerosis
- HTN
- vascultitis

Acute Glomerulonephritis

- Heavy proteinuria
- Proteinuria & haematuria
- Predominant haematuria Minimal
- Change Lupus nephritis
- Acute post streptococcus
- Focal sclerosis Membranous
- Diabetes Mellitus
- Amyloidosis Membrano- proliferative Endocarditis
- Henoch-Schonlein purpura Crescentic (RPGN)
- Haemolytic uraemic syndrome

Acute Glomerulonephritis - symptoms

- Fever
- Headache
- Malaise
- Anorexia
- Nausea and vomiting
- High blood pressure
- Pallor due to edema and/or anemia
- Confusion
- Lethargy
- Loss of muscle tissue
- Enlargement of the liver

Acute Glomerulonephritis - symptoms

- **Hematuria: dark brown or smoky urine**
- **Oliguria: urine output is < 400 ml/day**
- **Edema: starts in the eye lids and face then the lower and upper limbs then becomes generalized; may be migratory**
- **Hypertension: usually mild to moderate**

Acute Glomerulonephritis - syndromes

- **urinary (haematuria, proteinuria),**
- **nephritic (edemas, hypertension, gross haematuria, proteinuria),**
- **nephrotic (edemas, proteinuria, hypoproteinemia, hypercholesterolemia),**
- **mixed.**

Acute Glomerulonephritis

- Abrupt onset of:
- glomerular haematuria (RBC casts or dysmorphic RBC).
- non-nephrotic range proteinuria (<2 g in 24 hrs).
- oedema (periorbital, sacral).
- hypertension.
- transient renal impairment (oliguria, uraemia).

Acute Glomerulonephritis

- **Base line measurements: -**
- **↑ Urea**
- **↑ Creatinine**
- **Urinalysis (MSU):**
- **a) Urine microscopy (red cell cast)**
- **b) proteinuria**

Acute Glomerulonephritis

- **COMPLICATION :**
- **Hypertensive encephalopathy,**
- **heart failure and acute pulmonary edema may occur in severe cases**
- **Acute renal necrosis due to injury of capillary or capillary thrombosis**

Acute Glomerulonephritis

- Is characterized by irreversible and progressive glomerular and tubulointerstitial fibrosis.
- ultimately leading to a reduction in the glomerular filtration rate (GFR) and retention of uremic toxins.

- If disease progression is not halted with therapy, the net result is chronic kidney disease (CKD), end-stage renal disease (ESRD), and cardiovascular disease

Acute Glomerulonephritis

- Nearly all forms of acute glomerulonephritis have a tendency to progress to chronic glomerulonephritis.
- The progression from acute glomerulonephritis to chronic glomerulonephritis is variable.

- Whereas complete recovery of renal function is the rule for patients with poststreptococcal glomerulonephritis, several other glomerulonephritides, such as immunoglobulin A (IgA) nephropathy, often have a relatively benign course and many do not progress to ESRD.

Glomerulonephritis

- **Primary - confined to the kidney**
- **Secondary – due to a systemic disease**

Glomerulonephritis -syndromes

- Proteinuria – asymptomatic
- Haematuria – asymptomatic
- Hypertension
- Nephrotic syndrome
- Acute renal failure
- Rapidly progressive renal failure
- End stage renal failure

CHRONIC GLOMERULONEPHRITIS

- Can result from just about ANY of acute ones:
  - THIN CORTEX
  - HYALINIZED (fibrotic) GLOMERULI
  - OFTEN SEEN IN DIALYSIS PATIENTS

Chronic Glomerulonephritis

- Presence of glomerular disease as opposed to tubulointersititial or vascular disease is suspected from history :

- Haematuria (especially dysmorphic red cells)
- Red cell casts
- Lipiduria (glomerular permeability must be increased to allow the filtration of large lipoproteins)
- Proteinuria (may be in nephrotic range of >3.5 g/24hours)

Chronic Glomerulonephritis

- Immune complex disease.
- Named according to:
- etiology ,
- microscopic findings ,
- clinical syndrome
- Most common clinical presentations :
- acute nephritic syndrome ,
- nephrotic syndrome.
- Most common cause is autoimmune.

Chronic Glomerulonephritis

- Autoimmune injury initiated by beta-hemolytic streptococcus
- acute proliferative glomerulonephritis
- Presents as acute nephritic syndrome
- Hematuria
- HT
- increased urea & creatinine
- low urine output
- edema
- Antibodies produced by strep throat deposit in glomerulus
- Most fully recover but about 10% evolve into rapidly progressive glomerulonephritis

Chronic Glomerulonephritis

- Unknown causes or secondary to poststreptococcal glomerulonephritis
- Autoimmune
- Some present as acute nephritic syndrome , others as renal failure

- Caused by deposition of An-Ab complexes
- All but a few progress to renal failure

Chronic Glomerulonephritis

- Autoimmune - Most common cause of nephrotic syndrome in adults
- About 10% proceed to renal failure within 10 yrs,
- 25% recover completely,
- most progress slowly with:
- proteinuria,
- HTN,
- loss of renal function

Urine Microscopy :

- Cells Casts Crystals.
- Cells - epithelial, inflammatory, malignant.
- Casts – Protein cast of nephron –
  - Suggest Kidney pathology – not URT.
  - Protein, lipid, cells or mixed.
- Crystals suggest high concentration or altered solubility.

TUBULOINTERSTITIAL DISEASE

- **Most tubular diseases involve the interstitium**
- **2 distinct types of diseases**
  - **a) inflammatory diseases**
    - **i) *"tubulointerstitial nephritis"***
  - **b) ischemic or toxic tubular injury →**
    - **i) ATN**
    - **ii) acute renal failure**

Tubulointerstitial Nephritis (TIN)

- Inflammatory disease of Interstitium/tubules

- Glomerulus not involved at all or only late in disease
- Infections induced TIN – "pyelonephritis"
- Non infection – interstitial nephritis
    a) Caused by:
        i) drugs
        ii) metabolic disorders (hypokalemia)
        iii radiation injury
        iv) immune reactions

- **TIN divided into 2 categories, regardless of etiology:**

  a) – acute

  b) - chronic

Pyelonephritis **Definition:**

- **Inflammation of the parenchyma**
- **and lining of renal pelvis of kidney**

Pyelonephritis Epidemiology and Risk Fctors:

- Host factor:
- Female :Shorter urethra
- Male : uncircumcised infant ▫ bacterial colonization inside prepuce and urethra
- Catherization ◦ DIRECT: Bacteria carried directly into bladder during insertion ◦ INDIRECT:Facilitation of bacterial access via lumen of catheter . Tracking up between outside catheter and urethral wall

Types of pyelonephritis

- **Pyelonephritis, according to clinical course rate of onset, may be:**

- **acute**

or

- **chronic**

Acute PYELONEPHRITIS

- Acute Pyelonephritis is suppurative (purulent) inflammation involving:
  - the renal tubules ,
  - interstitial tissue,
  - calyices,
  - and pelvis of the kidney.
- One or both kidney may be involved in the disease.

Routes of infection in acute pyelonephritis

- 1- ascending pyelonephritis
- 2- Hematogenous source of the infection

Acute Pyelonephritis

- **2 routes bacteria can reach kidney**

  a) blood stream (not very common)

  b) lower urinary tract (ascending infections)
  i) – catheterization

  ii) - cystoscopy

Acute Pyelonephritis

- Kidney/renal pelvis (distal to collecting ducts)
- Caused by bacterial infections
  - (lower UTI) - cystitis, urethritis and prostatitis
  - upper UTI - (pyelonephritis)
  - both tracts
- Principle causative bacteria are gram - rods

a) E. coli (most common), Proteus, enterobacter, Klebsiella

Routes of infection in acute pyelonephritis

1- ascending pyelonephritis represent **more than 85% of all cases with acute pyelonephritis ,the** causative organisms are Escherichia coli, Proteus, Enterobacter

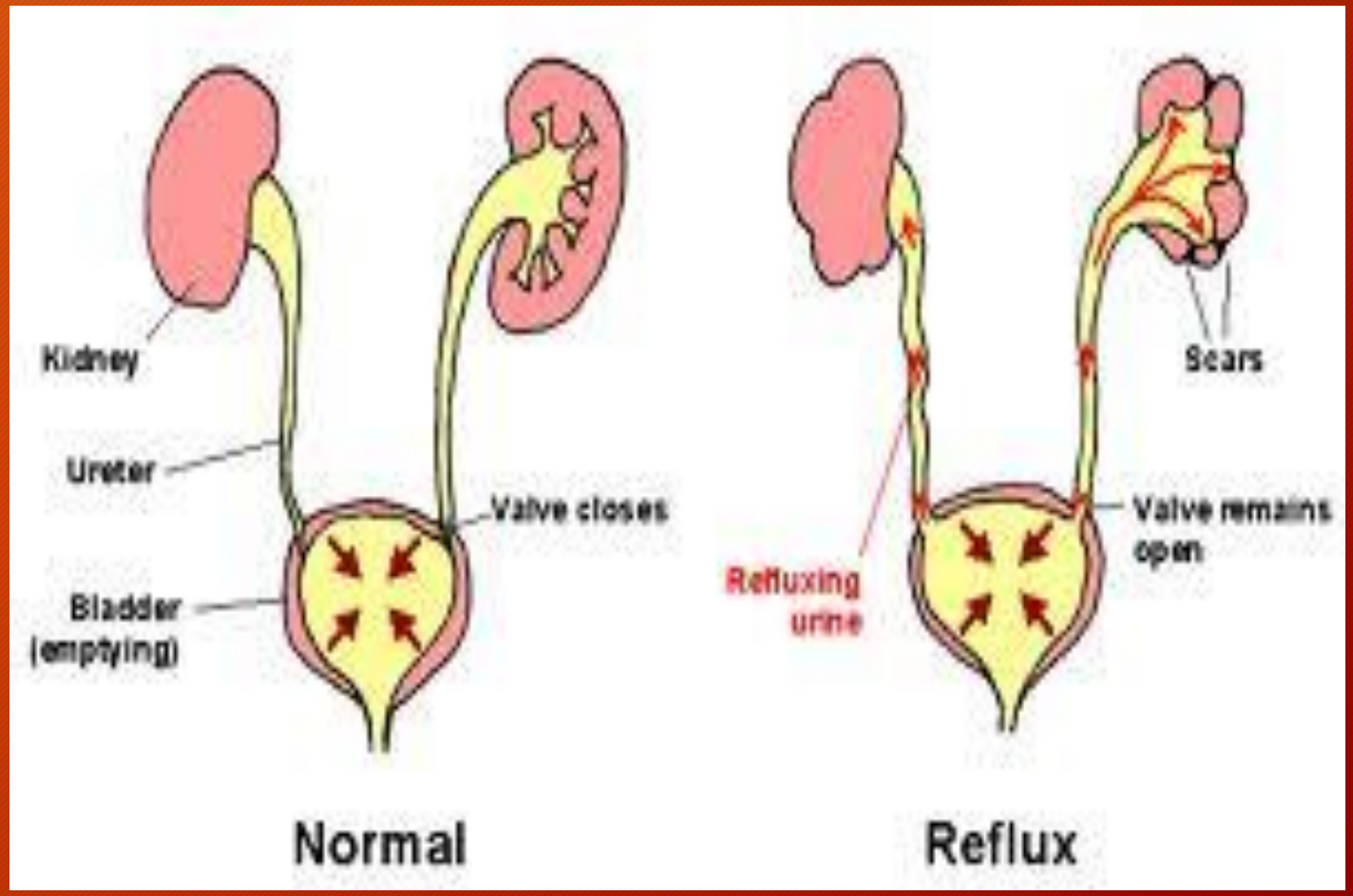
It result from Ascending of the infection from Purulent cystitis helped by:

A-chronic obstructive diseases of urinary tract

B-vesicoureteral and intrarenal reflux

FACTORS

- OBSTRUCTION: Congenital or Acquired
- INSTRUMENTATION
- VESICOURETERAL REFLUX
- PREGNANCY
- AGE, SEX, why sex? F>>>M
- PREVIOUS LESIONS
- IMMUNOSUPPRESION or IMMUNODEFICIENCY



Routes of infection in acute pyelonephritis

2- Hematogenous source of the infection caused by :

- **Staphylococcus,**
- **-streptococcus**

usually produce multiple payemic abscesses.

Acute Pyelonephritis

- Most commonly affect females (in absence of instrumentation)

  a) close proximity to rectum

  b) shorter urethra

  Urine sterile, flushing keeps bladder sterile

- Obstruction increased incidence of UTI:

  i) prostate hypertrophy

  ii) uterine prolapse

  iii) UT obstructions

Host factor:

- Normal urine flow disruption (obstruction);

- Incomplete bladder emptying ;
- > 2-3ml residual urine;
- infection ;
- ascent of infection;
- Pregnancy ;
- Prostatic hypertrophy ;

Host factor:

- Renal calculi ;
- Tumor ;
- Stricture ;
- Loss of neurological control of bladder and sphincter(spina bifida , paraplegia, multiple sclerosis) ;
- Vesicourethral reflux (urine reflux from bladder to ureter, renal pelvis and parenchyma) ;
- Diabetes Mellitus ; diabetic neuropathy; interfere with bladder
- Impaired cytokine secretion

Host factor:

- genetic background of the host;
- familial disposition to pyelonephritis;
- women with recurrent UTI .

- Have had their first UTI before the age of 15 years
- persistent vaginal colonization
- Mutations in host response genes(those coding forToll- like receptors and the interleukin 8 receptor)

Host factor:

- Factors independently associated with pyelonephritis in young healthy women include:
- Frequent sexual intercourse
- New sexual partner,
- UTI in the previous 1 2 months,
- Maternal history of UTI,
- Diabetes
- Incontinence.
- spermicide use
- And Factors independently associated with pyelonephritis in postmenopausal women: cystoceles ,incontinence and residual urine

Etiology

- The uropathogens causing Pyelonephritis vary by clinical syndrome but are usually enteric gram-negative rods that have migrated to the urinary tract.
- -Gram negative organism : E.coli (common); Proteus mirabilis, Citrobacter, klebsiella, enterobacter, proteus pseudomonas aeruginosa .
- Gram positive organism : Staph.saprophyticus, Staph. Epidermidis enterococcus, Corynebacteria and lactobacilli

Etiology

- Virus Parasite Rare
- Virus Human polymaviruses
- Cytomegalovirus and rubella
- Korean hemorrhagic fever virus
- Mumps and HIV
- Recovered in urine in absence of UTI
- Fungi : candida spp and histoplasma capsulatum
- Protozoa : trichomonas vaginalis
- Helminth: schistosoma haematobium

Pathogenesis:

- The urinary tract can be viewed as an anatomic unit united by a continuous column of urine extending from the urethra to the kidneys.
- In the majority of UTIs bacteria establish infection by ascending from the urethra to the bladder.
- Continuing ascent up the ureter to the kidney is the pathway for most renal parenchymal infections.

Clinical picture of pyelonephritis

- Fever
- Flank pain
- Nausea ,vomiting
- Turbid urine due to Presence of pus
- Cystitis manifestations may be present (urgency,frequency,dysuria)

Signs and Symptoms:

a) **hypertension**

b) seen following normal physical exam

c) slowly progressive → late in disease

d) can cause loss of concentrating mechanisms (if bilateral and progressive)

- **i) - polyuria**
- **ii) - nocturia**

Clinical Features

- Mild pyelonephritis:
- low-grade fever
- with or without lower-back or costovertebral-angle pain .

- Severe pyelonephritis:
- High fever “picket-fence” 72hr
- Nausea
- Vomiting
- flank and/or loin pain

ACUTE PYELONEPHRITIS

- Leukocyte infiltration
- within interstitial tissue of the kidney
- with neutrophils predominance

COMPLICATIONS of ACUTE PYELONEPHRITIS

- 1- papillary necrosis due to inflammatory thrombosis of the blood vessels supplying the renal papilla
- 2 -pyonephrosis which mean filling of the dilated calyces and pelvis by pus due to obstruction at pelviureteric junction
- 3 -perinephric abscess due to spread of the inflammation to the perinephric fat.
- 4 - Transformation to chronic pyelonephritis

CHRONIC PYELONEPHRITIS

- Chronic pyelonephritis is termed chronic tubular and interstitial inflammatory disease
- with asymmetric irregular sclerosis(fibrosis)
- and deformation of calyices and adjacent parenchyma .

Causes of CHRONIC PYELONEPHRITIS

- 1 - infection (viral, fungal ,bacteria)
- 2- calcular pyelonephritis caused by obstructing stone and back reflux of urine.
- 3 - toxins
- 4 - metabolic diseases
- 5 - physical factors
- 6 - tumors
- 7 - immunologic reaction
- 8 - vascular diseases
- 9- **Xanthogranulomatous chronic pyelonephritis**

Microscopic picture of CHRONIC PYELONEPHRITIS

- Stroma is infiltrated by lymphocytes, plasma cells and macrophages.

- tubules may be filled with colloid protein
Casts so the Enlarged tubules are like thyroid follicle a Phenomenon is termed thyroidisation(i.e renal tubules containing colloid casts simulate thyroid follicles containing colloid inside it).

- Periglomerular fibrosis may end with complete glomerular fibrosis and hyalinosis.

Laboratory Diagnosis

- **Rapid diagnostic test:**
- **Appearance of WBC in urine;**
- **test for nitrite & leukocyte esterase ;**
- **Urinalysis:**
- **WBC in Cast shape due to of pyelonephritis**

Urine Culture:

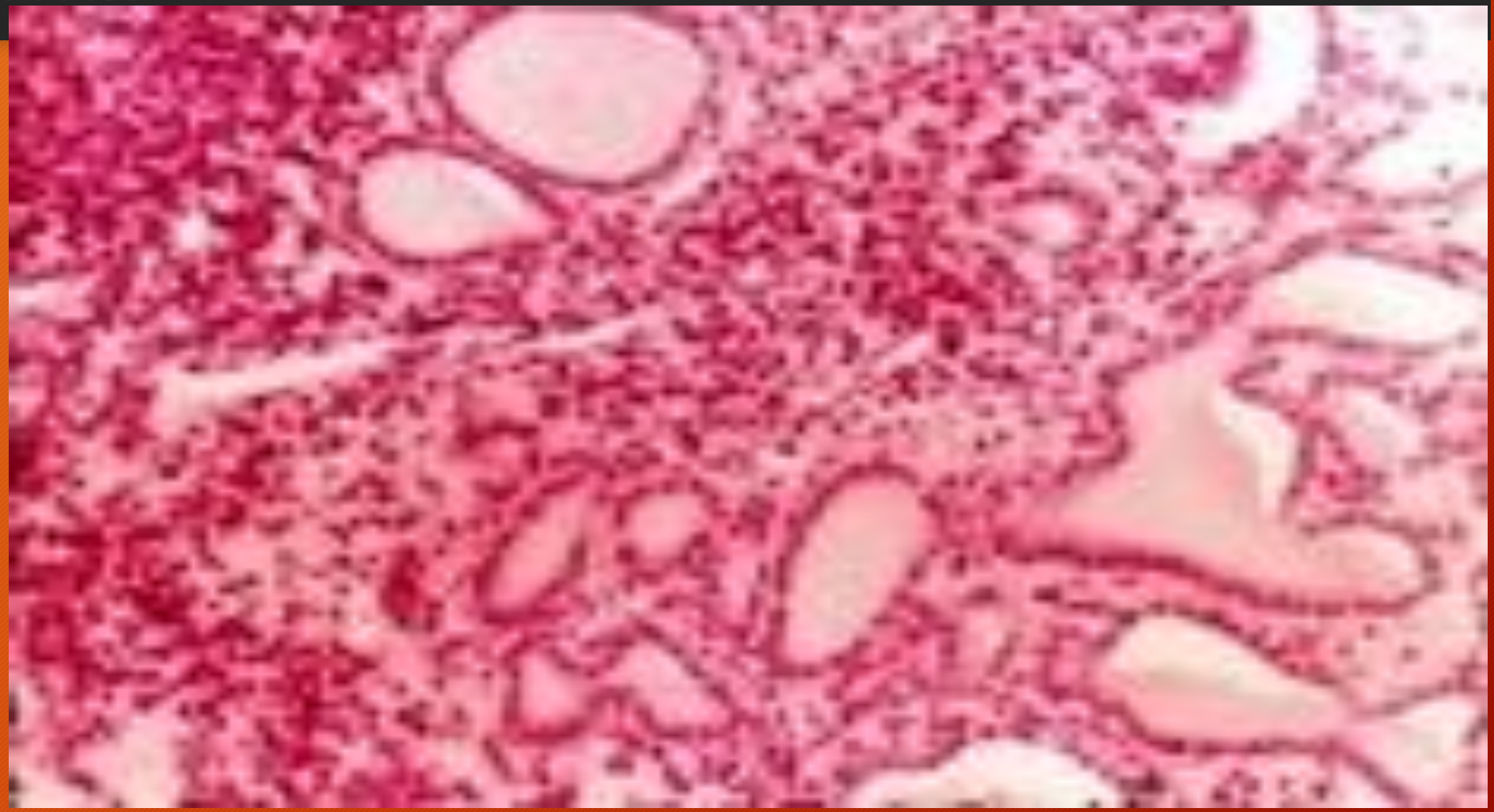
- **Method of Sampling: Clean Catch: Straight Catheterization: foley cathatere: Suprapubic Aspiration:**

- **Urine culture interpretation:**

- It is positve with colony count equal or more than 10 power 2 In women with dysuria & pyuria

- It is positve with colony count > 10 power 3 In Men

CHRONIC PYELONEPHRITIS: Stroma is infiltrated by lymphocytes,plasma cells and macrophages, with thyroidisation of the tubules



Pyelonephritis

- Emphysematous pyelonephritis: exclusively in diabetic patients production of gas in renal and perinephric tissues bilateral papillary necrosis rise in the serum creatinine level ;

- Xanthogranulomatous pyelonephritis chronic urinary obstruction (often by staghorn calculi) , chronic infection , Suppurative destruction of renal tissue

Xanthogranulomatous chronic pyelonephritis

- Etiologic agent is Proteus

- There are a lot of macrophages with pale pink foamy cytoplasm filled with:

- lipid,
- -plasma cells,
- lymphocytes,

and

- granulocytes

Pyelonephritis

- Pyelonephritis can also be complicated by intraparenchymal abscess formation;
- this situation should be suspected when a patient has:
- continued fever
- and/or bacteremia despite antibacterial therapy.

Complication of CHRONIC PYELONEPHRITIS

- nephrosclerosis involving

Stroma, calyces, pelvis, then vascular and periglomerular sclerosis

secondary contracted kidneys due to fibrosis

chronic renal failure

Differential diagnosis for pyelonephritis

- cystitis which is inflammation of the urinary bladder characterized by: urgency,frequency,dysuria.

- While pyelonephritis characterized by inflammation of the kidney characterized by:

- flank pain ,
- tenderness,
- fever,
- Chills
- and increase WBCs.

Chronic pyelonephritis and reflux nephropathy

- Interstitial inflammation with scarring of renal parenchyma
- Important cause of chronic renal failure

- Two forms:

  a) - Chronic obstructive pyelonephritis

  b) - Chronic reflux-associated pyelonephritis

Chronic obstructive pyelonephritis

- **Can be bilateral (congenital disease)**

- **Obstruction predisposes kidney to infection**
- **recurrent infections on obstructive foci causes scarring – chronic pyelonephritis**

chronic reflux-associated pyelonephritis (reflux nephropathy)

- More common form of chronic pyelonephritis

reflux nephropathy

Occurs from superimposed of a UTI on vesiculouretheral and intrarenal reflux

a) reflux may be bi- or unilateral

i) unilateral causes atrophy

ii) bilateral can cause chronic renal insufficiency

iii) diffuse or patchy

- - Unclear if sterile vesiculouretheral disease causes renal damage

reflux nephropathy

Hallmark is scarring involving pelvis/calyces, leading to papillary blunting and deformities

- **Renal papillae – area of kidney where opening from collecting ducts enters renal pelvis**
- **Kidneys are asymmetrically contracted**

Drug-induced interstitial nephritis

- Acute TIN – seen with synthetic penicillins, diuretics (thiazides), NSAID

  a) disease begins ~15 days (2-40 range)
  i) fever
  ii) rash (25% cases)
  iii) renal findings: hematuria, leukouria
  iv) increased serum creatinine or acute renal failure with oliguria (50% of cases)

Drug-induced interstitial nephritis

- **Immune mechanism is indicated (suggested)**

  a) IgE increased (hypersensitivity – Type I)

  Injury produced by IgE and cell-mediated immune reactions

Analgesic Nephropathy

- Patients who consume large quantities of analgesics may develop chronic interstitial nephritis, often associated with renal papillary necrosis
- Usually result from consumption of a mixture for long periods of time:
  - a) - aspirin
  - b) - caffeine
  - c) - acetaminophen
  - d) - codeine
  - e) - phenacetin

- Primary pathogenesis is
  - a) papillary necrosis followed by
  - b) interstitial nephritis is secondary
  - c) acetaminophen – oxidative damage
  - d) aspirin inhibits prostaglandins – vasoconstriction
  - e) all the above leads to papillary ischemia
- Chronic renal failure, hypertension and anemia
- Complications may be incidence of "transitional cell carcinoma" of renal pelvis or bladder.

ATN (Clinical entity)

- Destruction of tubular epithelial cells
- Acute suppression of renal function
- Most common cause of acute renal failure(ARF):
  Acute suppression of renal function , oliguria (400 ml/day)

Other causes of ARF

b) severe glomerular disease (RPGN
c) diffuse vascular disease (Polyarteritis nodosa)
d) diffuse cortical necrosis
e) interstitial nephritis (acute drug-induced)
f) acute papillary necrosis

Diseases of Blood Vessels

- Nearly all diseases of kidney involve blood vessels.
- Kidneys involved in pathogenesis of essential and secondary hypertension
- Systemic vascular disease (i.e. arteritis) also involve kidney

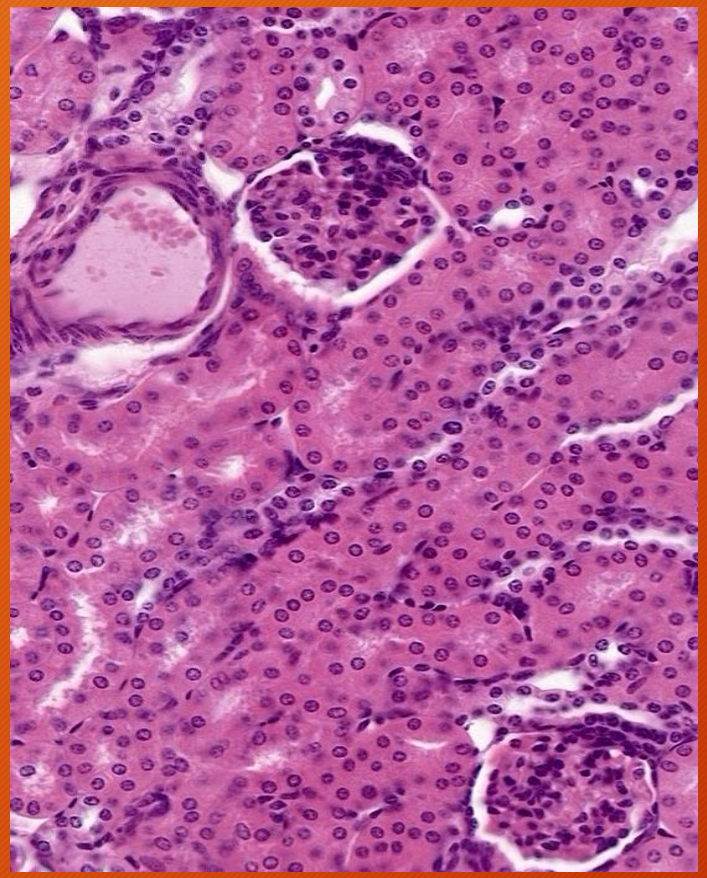
Benign nephrosclerosis

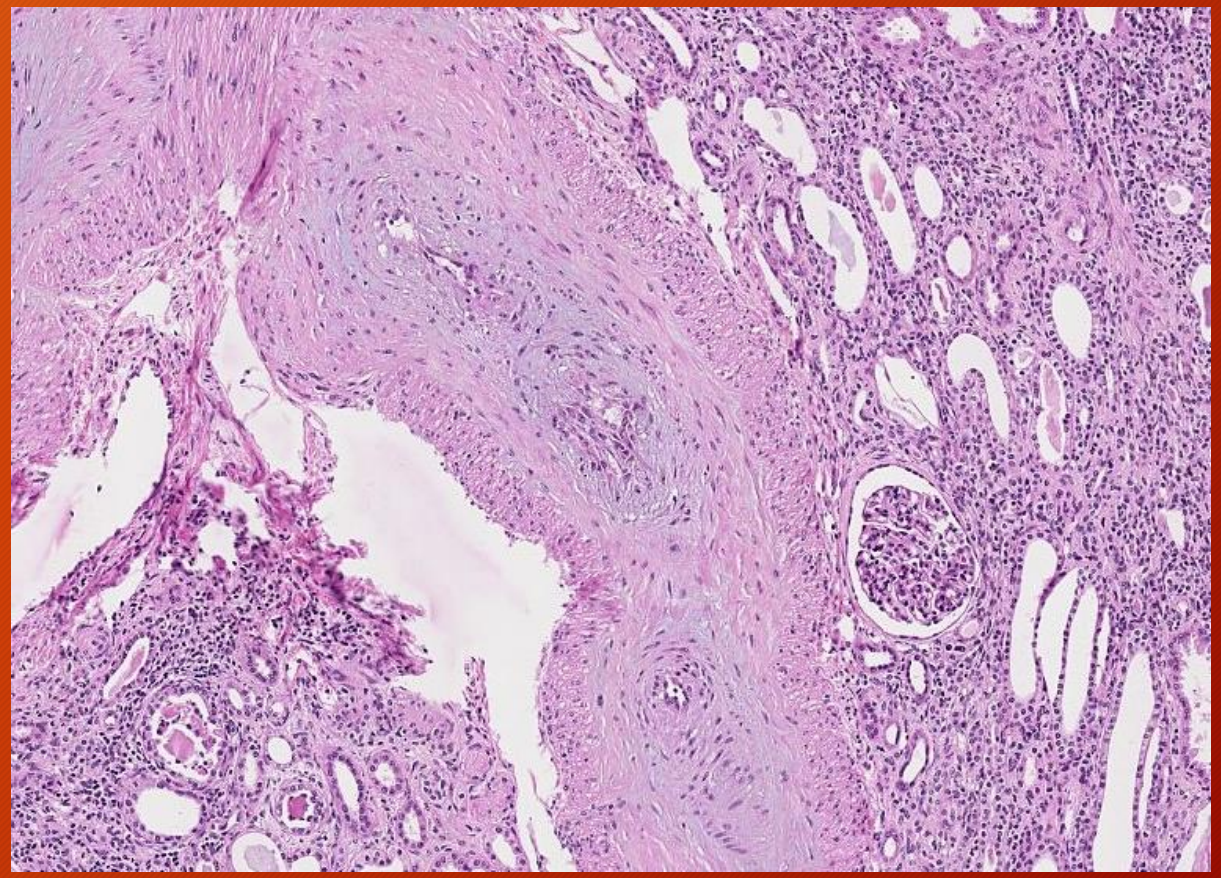
- Renal changes associated with benign hypertension
  a) always associated with hyaline arteriosclerosis
- Kidneys are atrophic
- Many renal diseases cause hypertension which in turn may lead to benign nephrosclerosis.
- Therefore this disease seen simultaneously. with other diseases of kidney

- This disease by itself usually does not cause severe damage
  a) mild oliguria
  b) loss (slight) of concentrating mechanism
  c) decreases GFR
  d) mild degree of proteinuria is a constant finding
- These patients usually die from hypertensive heart disease or cerebrovascular disease rather than from renal disease

BENIGN NEPHROSCLEROSIS

- Sclerosis, i.e., “hyalinization” of arterioles and small arteries, i.e., arterio-, arteriolo-
- Is this part of “routine” atherosclerosis????
- VERY VERY VERY common





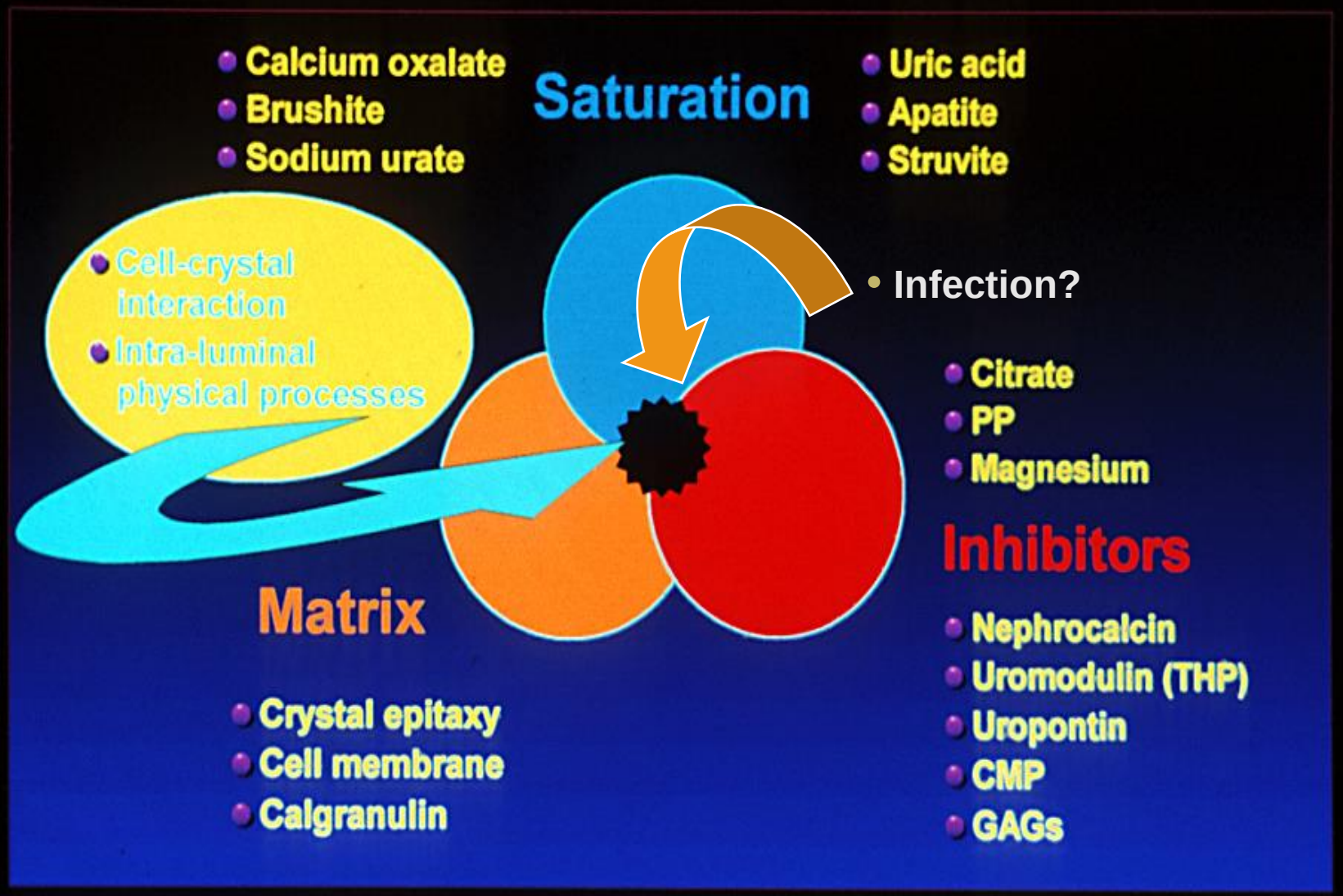
Renal stone disease

- Nephrolithiasis refers to renal stone disease;
- Urolithiasis refers to the presence of stones in the urinary system.
- Stones, or calculi, are formed in the urinary tract from the kidney to bladder by the crystallization of substances excreted in the urine•

Risk Factors

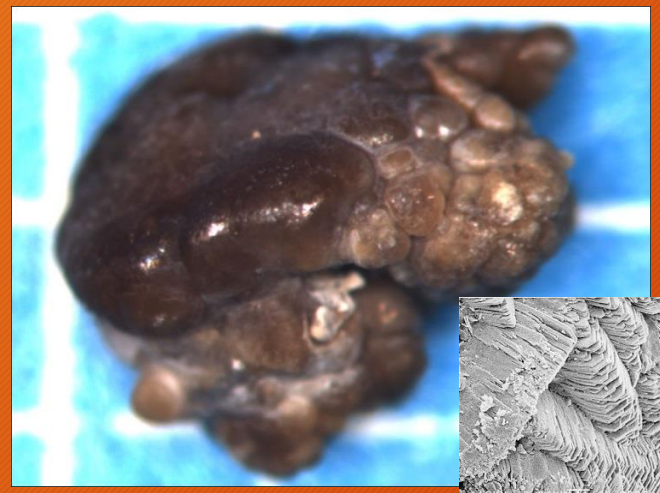
- Prevalence: 2-3% in the U.S., geographic variations
- Gender: Male/Female ratio 4:1
- Life-time risk: Males: 12 % Females: 7 %, incident is rising
- Peak age 20-50 years
- Family History
- Genetic factors
  - Medullary sponge kidney
  - CaSR or FGF 23 polymorphism
- Caucasians more than blacks or hispanics
- Recurrence 30%- 40% at 5 years, 50%- 60% at 10 years

Theories of Stone Formation



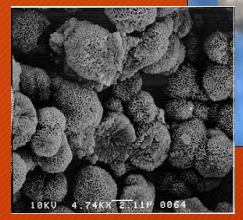
Stone types

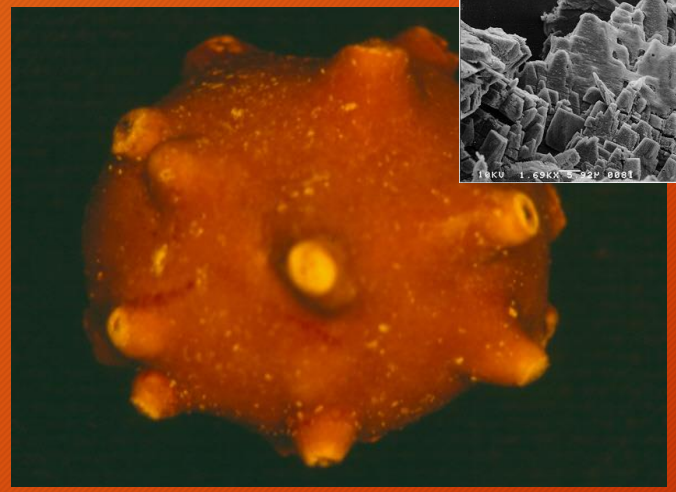
Calcium Oxalate

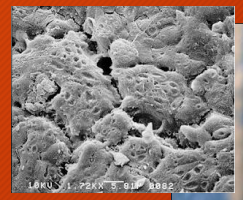


(60-70%)

Calcium Phosphate



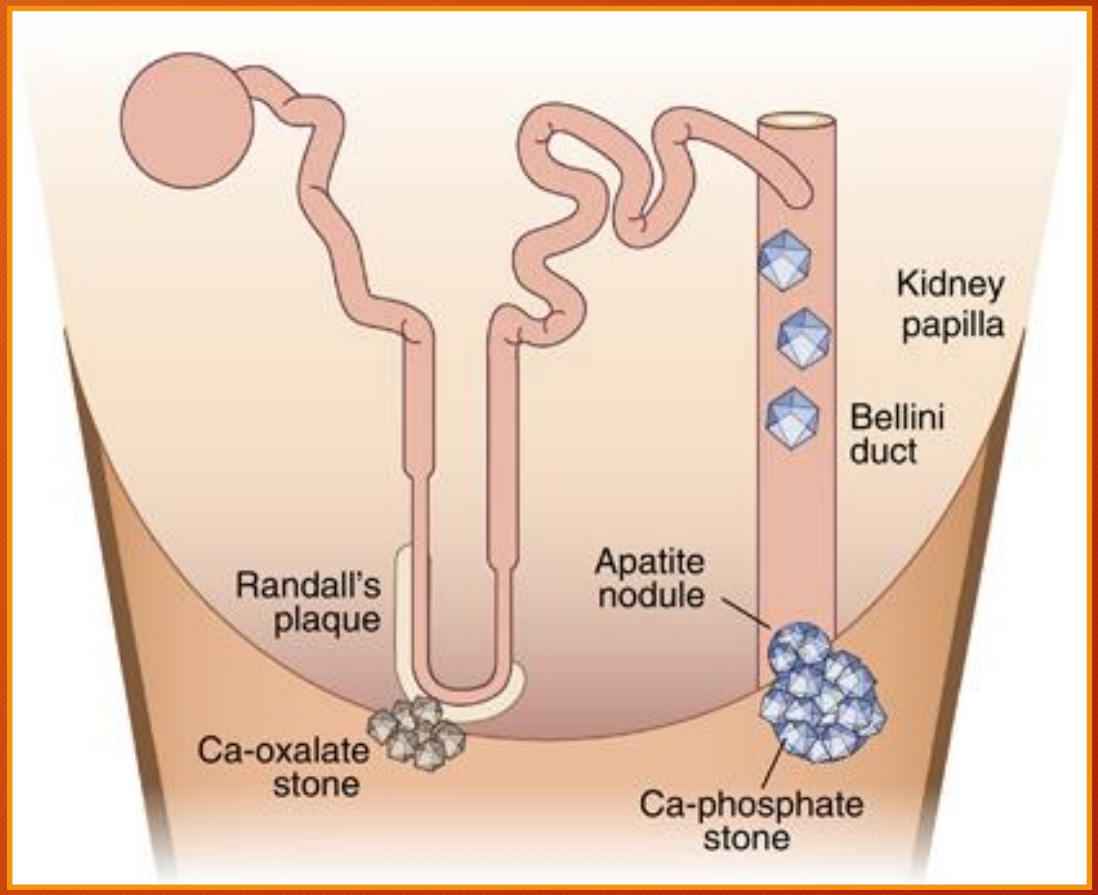




Uric Acid (10-15%)

Struvite (10-15%)

Site of stone formation



- Stones, also known as renal calculus or nephrolith, are small, hard deposits of mineral and acid salts on the inner surfaces of the kidneys.
- If stones grow to sufficient size they can cause blockage of the ureter.

- There is seasonal variation with stone occurring more often in the summer months suspecting the role of dehydration in this process.

INCIDENCE

- Urinary calculi are more common in men than in women.
- Incidence of urinary calculi peaks between the 3rd and 5th decades of life.
- 80% of stones under 2mm in size
- 90% of stones pass through the urinary system spontaneously

STONE FORMATION

- Highly concentrated urine constituents crystallize and harden to form calculi.
- Kidney stones form when urine contains more crystal- forming substances — such as calcium, oxalate and uric acid.
- At the same time, our urine may lack substances that prevent crystals from sticking together, creating an ideal environment for kidney stones to form.

STONE FORMATION

- The crystals get deposited on the nucleus and continue to grow.
- These can some times adhere to the renal papillae.
- TYPES OF KIDNEY STONES:

- Calcium oxalate
- Calcium phosphate
- Struvite
- Uric acid
- Cystine

Renal stones

- Calcium stones: Most kidney stones are calcium stones, usually in the form of calcium oxalate and calcium phosphate.
- Oxalate is a naturally occurring substance found in food. Some fruits and vegetables, as well as nuts and chocolate, have high oxalate levels. Our liver also produces oxalate.

- IN ALKALINE URINE →▫ ENLARGES RAPIDLY → TAKE SHAPE OF CALYCES →▫ STAGHORN →CALCIUM PHOSPHATE

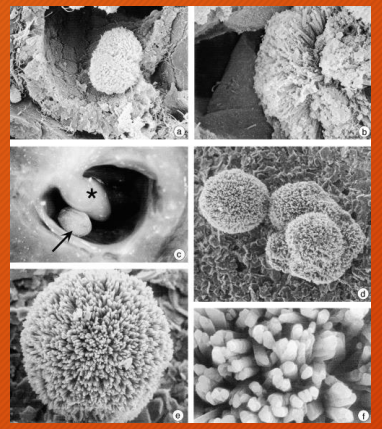
Renal stones

- Uric Acid: This type of kidney stone is more common in men than in women.
- They can occur in people with gout or those going through chemotherapy.

- Struvite: This type of stone is found mostly in women with urinary tract infection. These stones can be quite large and cause urinary obstruction.
- Cystine: Cystine stones are rare. They occur in both men and women who have the genetic disorder cystinuria.
- Other: Other, rarer types of kidney stones also can occur. Such as XANTHINE STONES, DIHYDROXY ADENINE STONE, SILICATE STONES etc.
-

Hereditary Disorders

Xanthine



2,8-dihydroxyadenine

adenine phosphoribosyltransferase (APRT)

Alcaptonuria

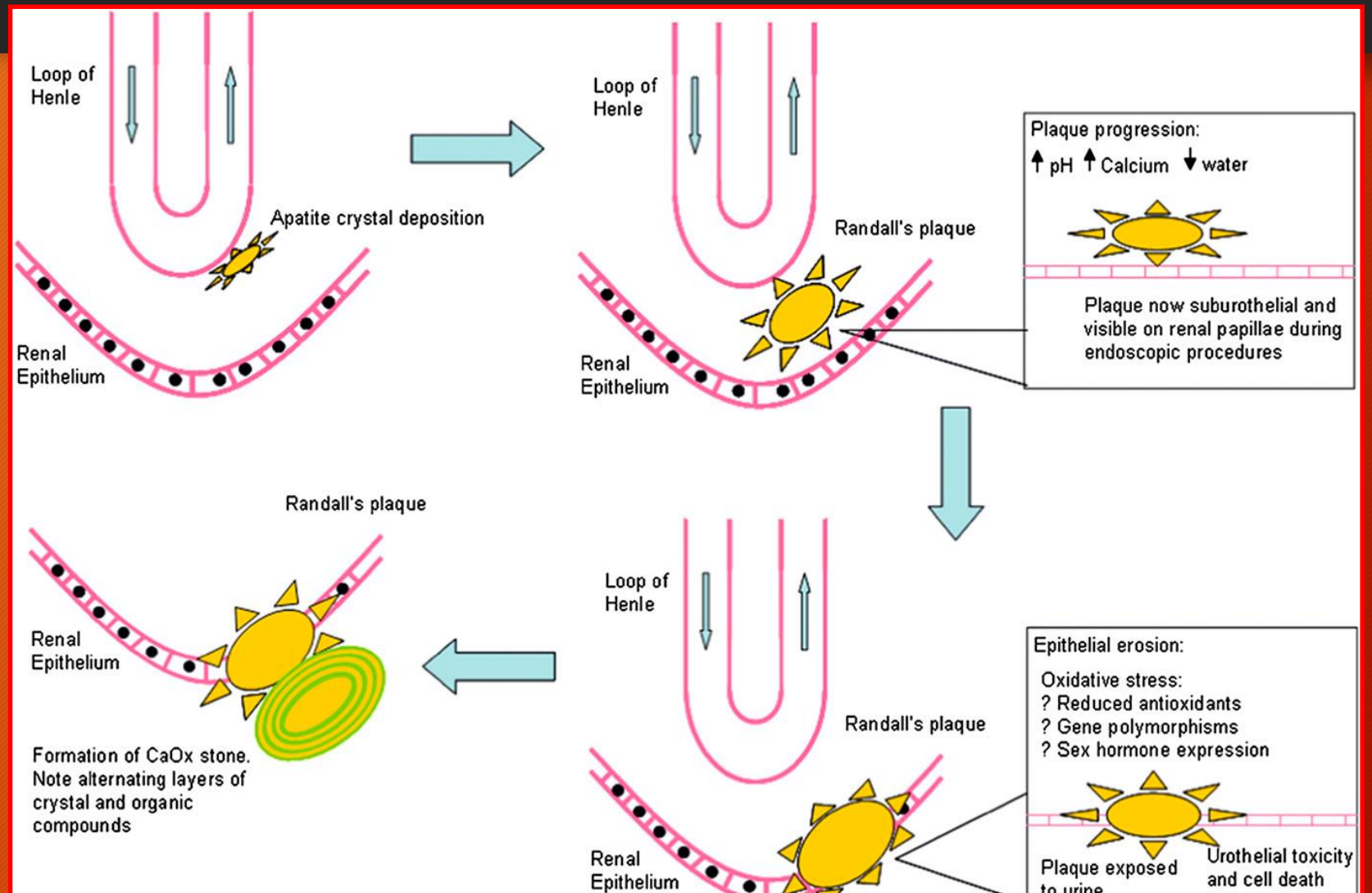
homogentisate 1,2-dioxygenase

- Polycystic kidney Disease
- Medullary Sponge Kidney
- Horseshoe kidney

Cystine (1%)

dibasic AA transporter

Pathobiology of stone formation



CAUSES

- Supersaturation of urine is the key to stone formation
- Imbalance of pH in urine
- Gout
- Hyperparathyroidism
- Inflammatory Bowel Disease
- UTI (Urinary Tract Infections)
- Dehydration
- Crystal aggregation

Hyperuricosuria:

- 20-40% of stone formers.
- Elevated RBC urate transport.
- Uric acid may interact with glutamic acid and act as a promoter.
- Reduces inhibitory activity of urinary macromolecular inhibitors.
- "Salting out" phenomenon.
- Solubility enhanced by urine pH > 6.5.
- Dietary purine intake is the major source.

RISK FACTORS

- HIGH MINERAL CONTENT IN DRINKING WATER
- DEHYDRATION
- FAMILY OR PERSONAL HISTORY DIETARY INTAKE BEING OBESE
-

PATHOPHYSIOLOGY

- Slow urine flow, resulting in super saturation of the urine.
- Damage to the lining of the urinary tract
- Decreased inhibitor substances in the urine that would otherwise prevent super saturation and crystalline aggregation.

CLINICAL MANIFESTATION

- Severe flank pain
- Abdominal pain
- Nausea and vomiting
- Fatigue
- Elevated temperature, BP, and respirations
- Steady Pain
- Pain on urination;
- Pink, red or brown urine
- Oliguria and anuria in obstruction →Hematuria → Renal colic→Hydronephrosis

Metabolic abnormalities: Urinary excretion values

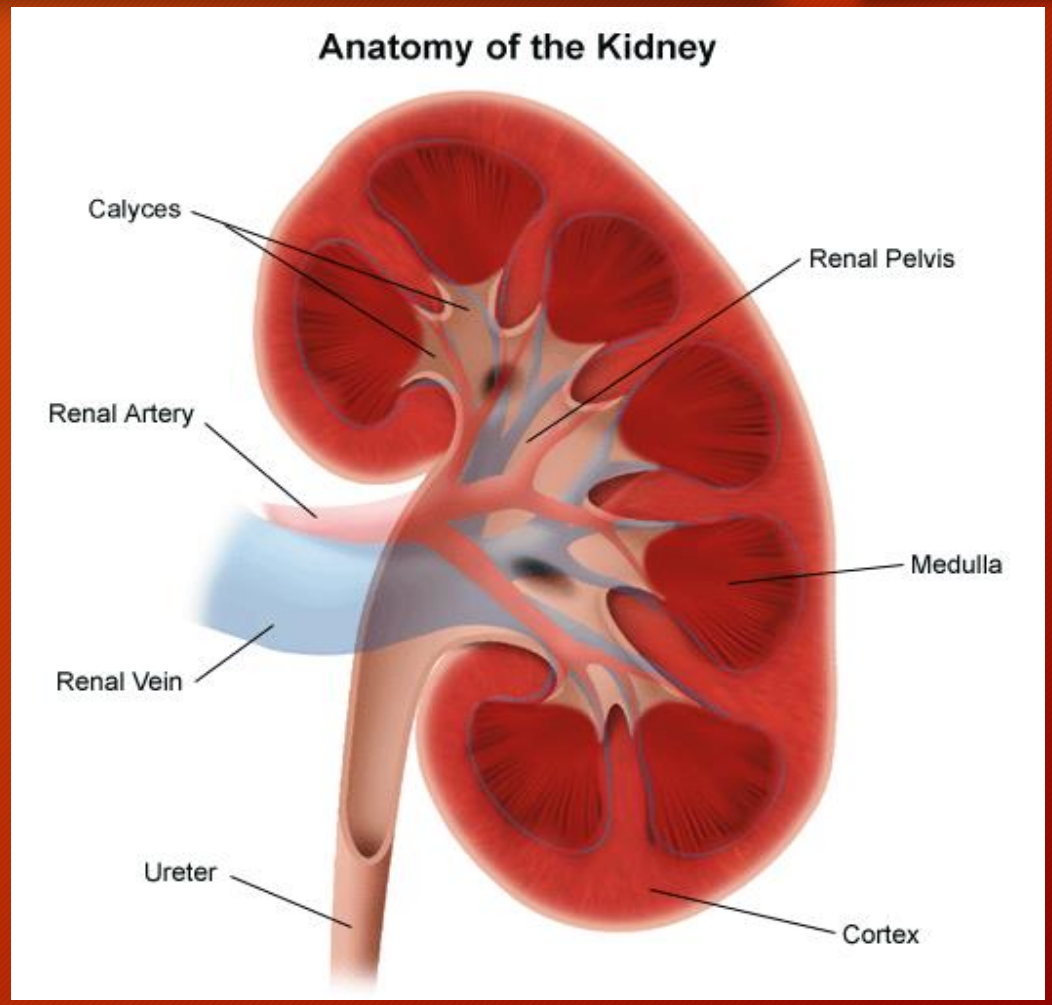
• Hypercalciuria	• > 4 mg/kg/d or > 140 mg/gm Cr
• Hyperoxaluria	• > 40 mg/d
• Hyperuricosuria	• 800 mg/d (M), 750 mg/d (F) or 300 mg/L
• Hypocitrituria	• < 320 mg/d
• Hypomagnesuria	• < 60 mg/d

Chronic Kidney Disease

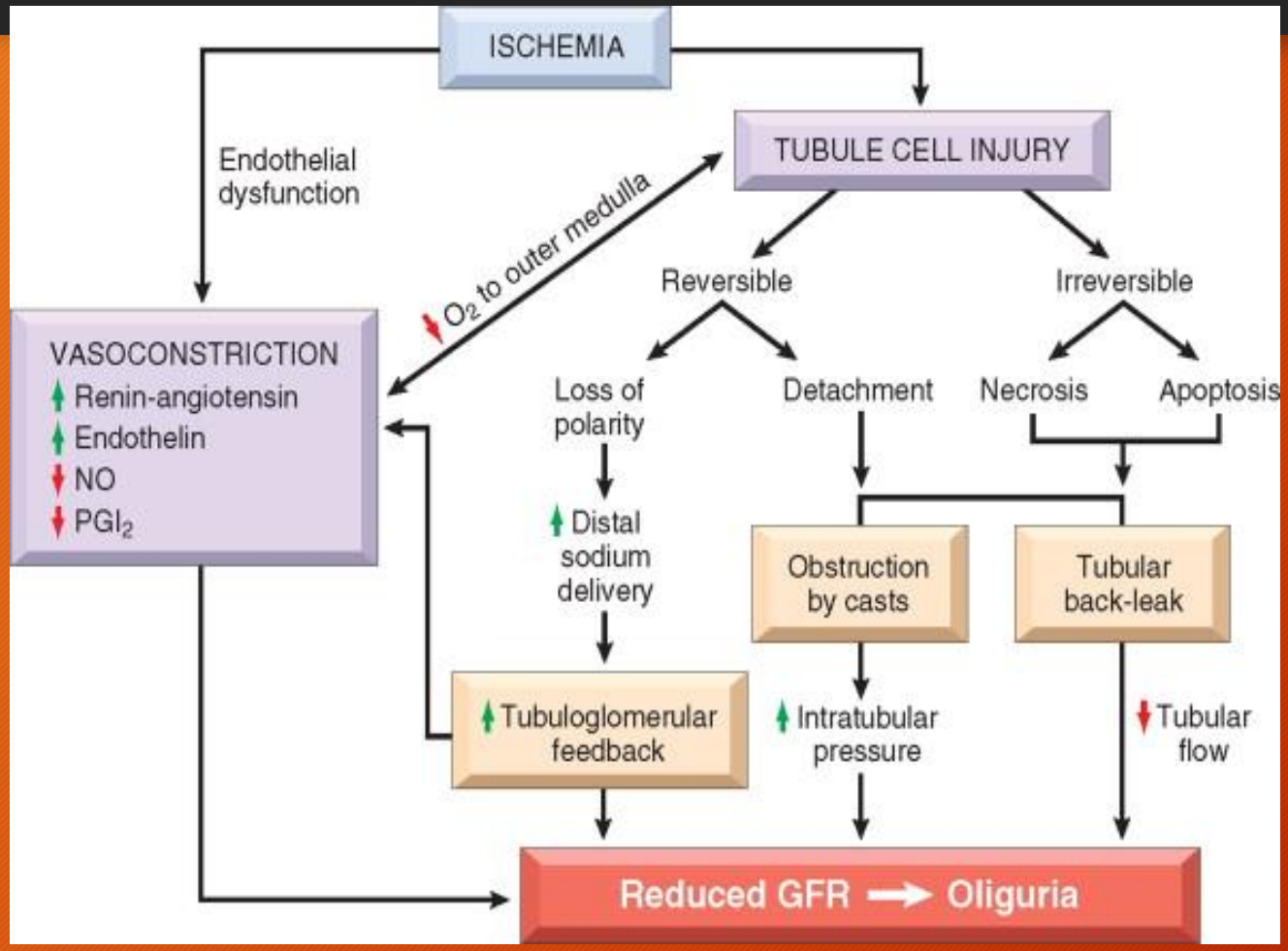
Chronic Kidney Disease is defined as a slow lose of renal function over time. This leads to a decreased ability to remove waste products from the body and perform homeostatic functions.

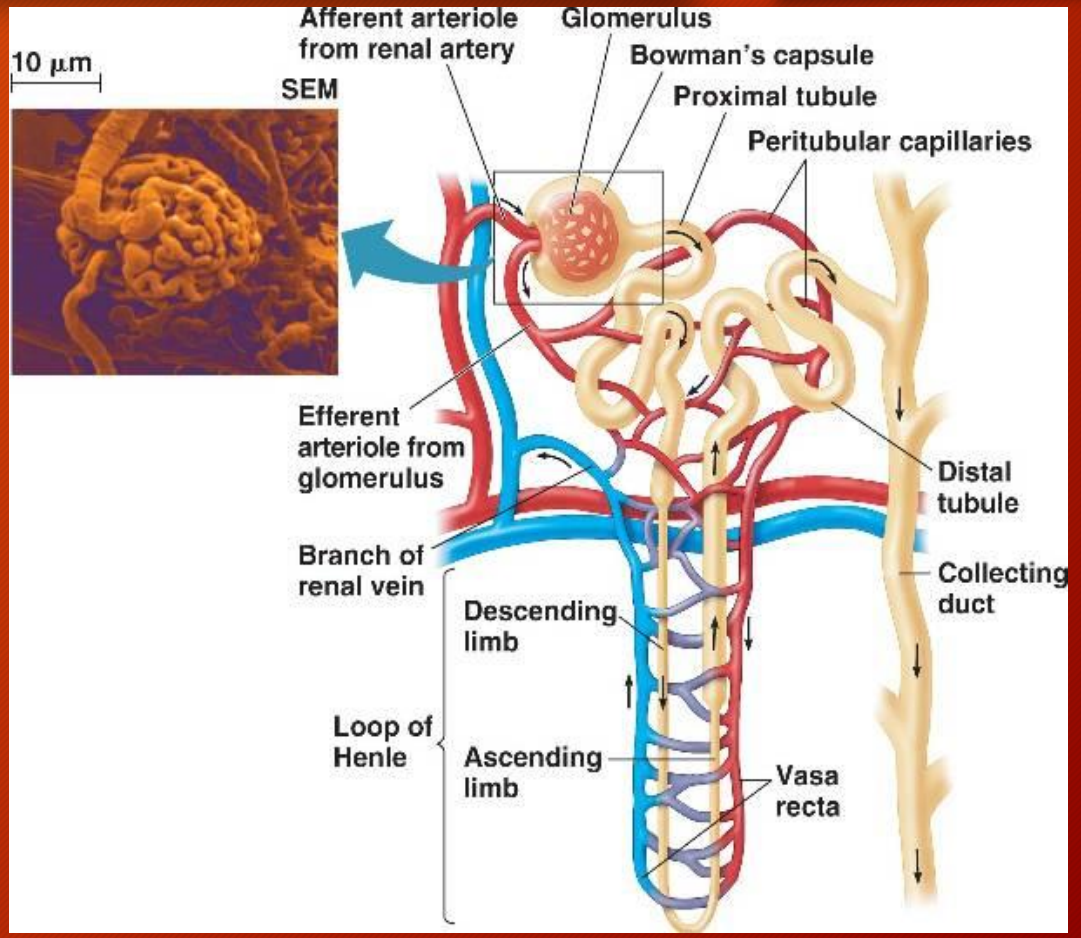
Clinical Definition

- GFR of less than 60 ml/minute per 1.73m^2 per body surface area (normal is 125ml/min) .
  - GFR Calculator: http://www.kidney.org/professionals/kdoqi/gfr_calculator.cfm
- Presence of kidney damage, regardless of the cause, for three or more months



Pathophysiology





Symptoms

- Hematuria
- Flank pain
- Edema
- Hypertension
- Signs of uremia
- Lethargy and fatigue
- Loss of appetite
- If asymptomatic may have elevated serum creatinine concentration or an abnormal urinalysis

Risk Factors

- Age of more than 60 years
- Hypertension and Diabetes
  - Responsible for 2/3 of cases
- Cardiovascular disease
- Family history of the disease.
- Race and ethnicity
  - Highest incidence is for African Americans
  - Hispanics have higher incidence rates of ESRD than non-Hispanics.

Convergence of Genetic Factors

- Genes for heart and vascular disease
- Genes that maintain ionic balance
- Genes for glomerulonephritis
- Genes for diabetes
- Genes that may be involved in inherited renal diseases

Prevention

- Keep diabetes and blood pressure controlled
- If at risk perform screening tests
- Reduce exposure to nephrotoxic drugs
- Eat right and exercise
- Know your family history
  - If you have a positive family history ask doctor to perform common screening tests for kidney function.