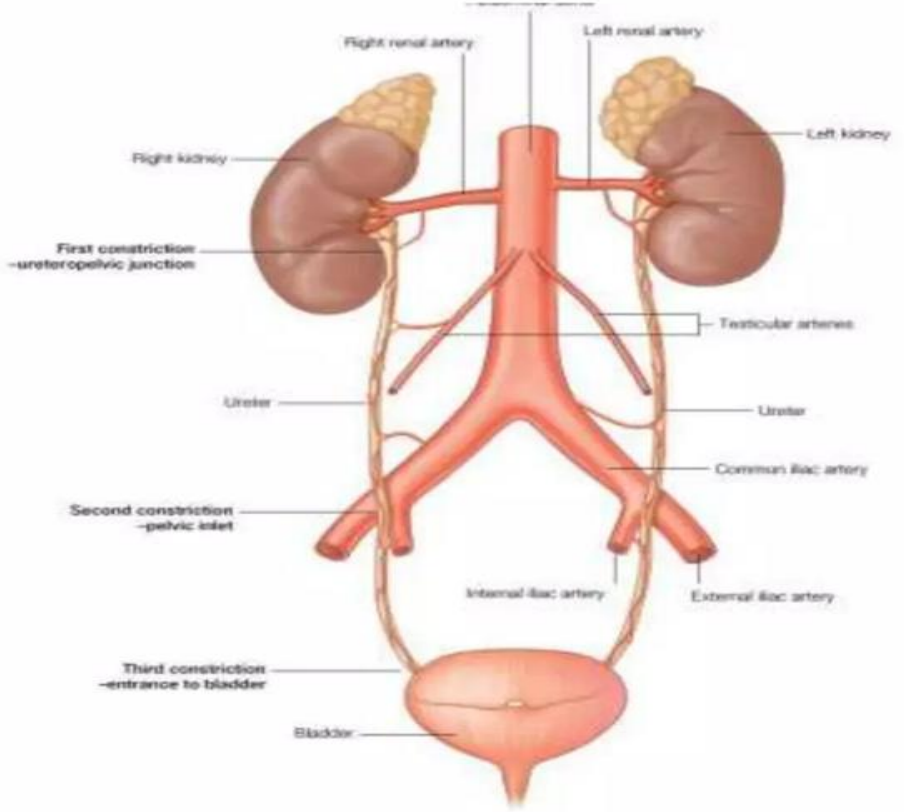
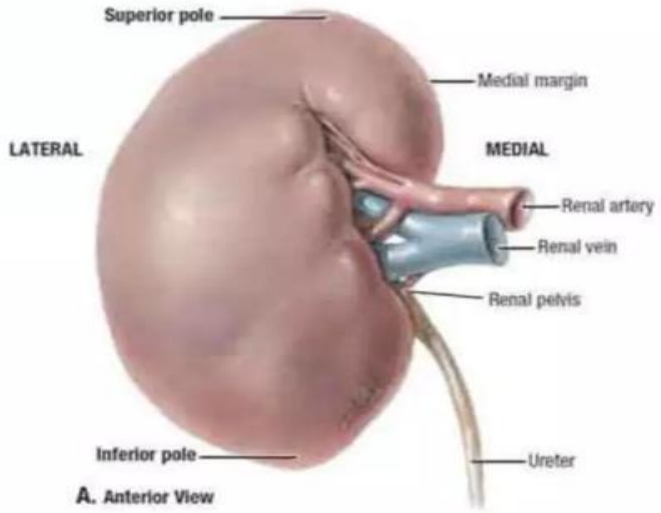
Lec 7
Kidney disease

URINARY SYSTEM

- ***Urinary system consists of***
  - ***Two kidneys***
  - ***Two ureters***
  - ***Bladder***
  - ***Urethra***



KIDNEYS



Size – 3 x 6 x 12 cm

Weight – 130 g

Shape – Bean shaped

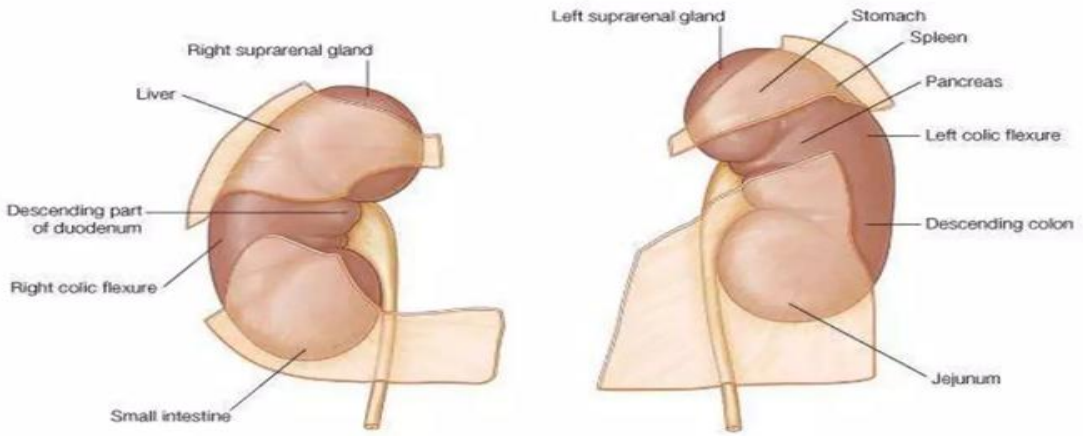
Location – Lie on the posterior abdominal wall, retroperitoneally.

T12 – L3 vertebral level

Right is slightly below than the left.

External Features

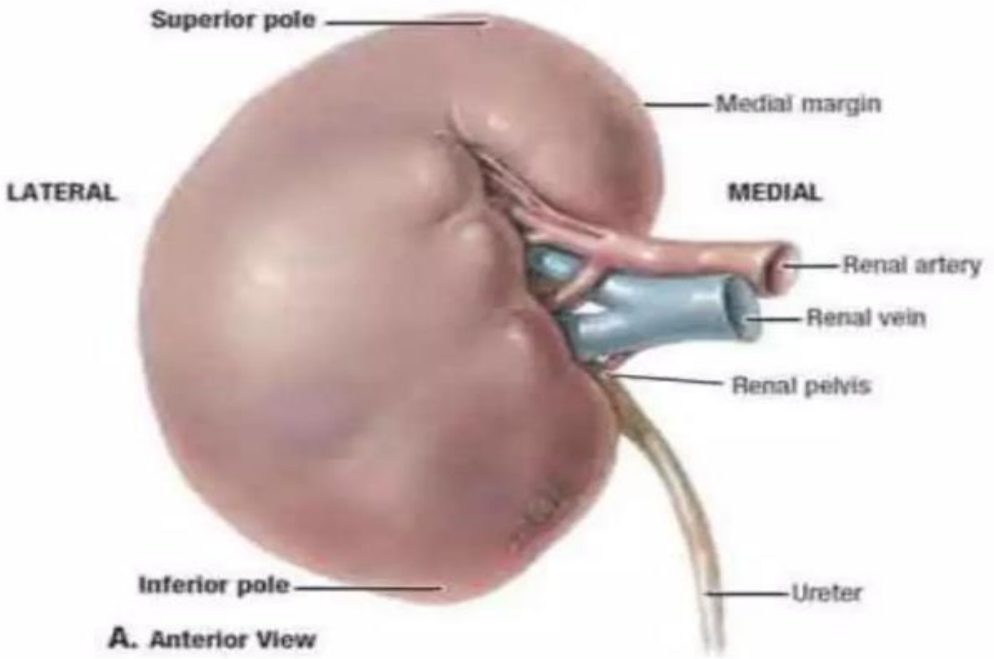
- Each kidney is enclosed by (from inside to outside respectively),
  - Renal capsule – fibrous connective tissue
  - Perirenal fat
  - Renal fascia - fibroelastic connective tissue



External Features

- **Hilum of the kidney,**
  - Concave medial border of the kidney
  - Structures enter / leave through the hilum (from anterior to posterior),
    - Renal vein
    - Renal artery
    - Ureter

    and Renal nerves and Lymphatics.



Internal features

- **Cortex**
  - A reddish, brown, layer of tissue immediately below the capsule and outside the pyramids.
- **Medulla**
  - The innermost layer consisting of pale conical shape striations - Renal pyramids
  - In between renal pyramids – Renal columns.

Internal features

Pyramids

↓

Papillae

↓

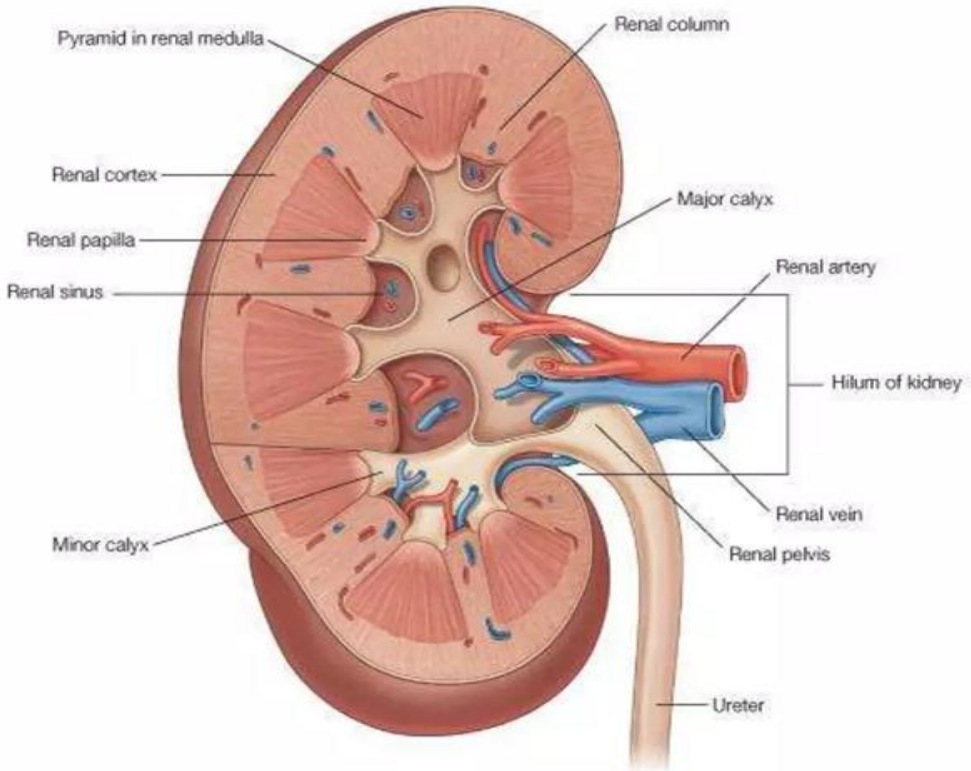
Minor calyces

↓

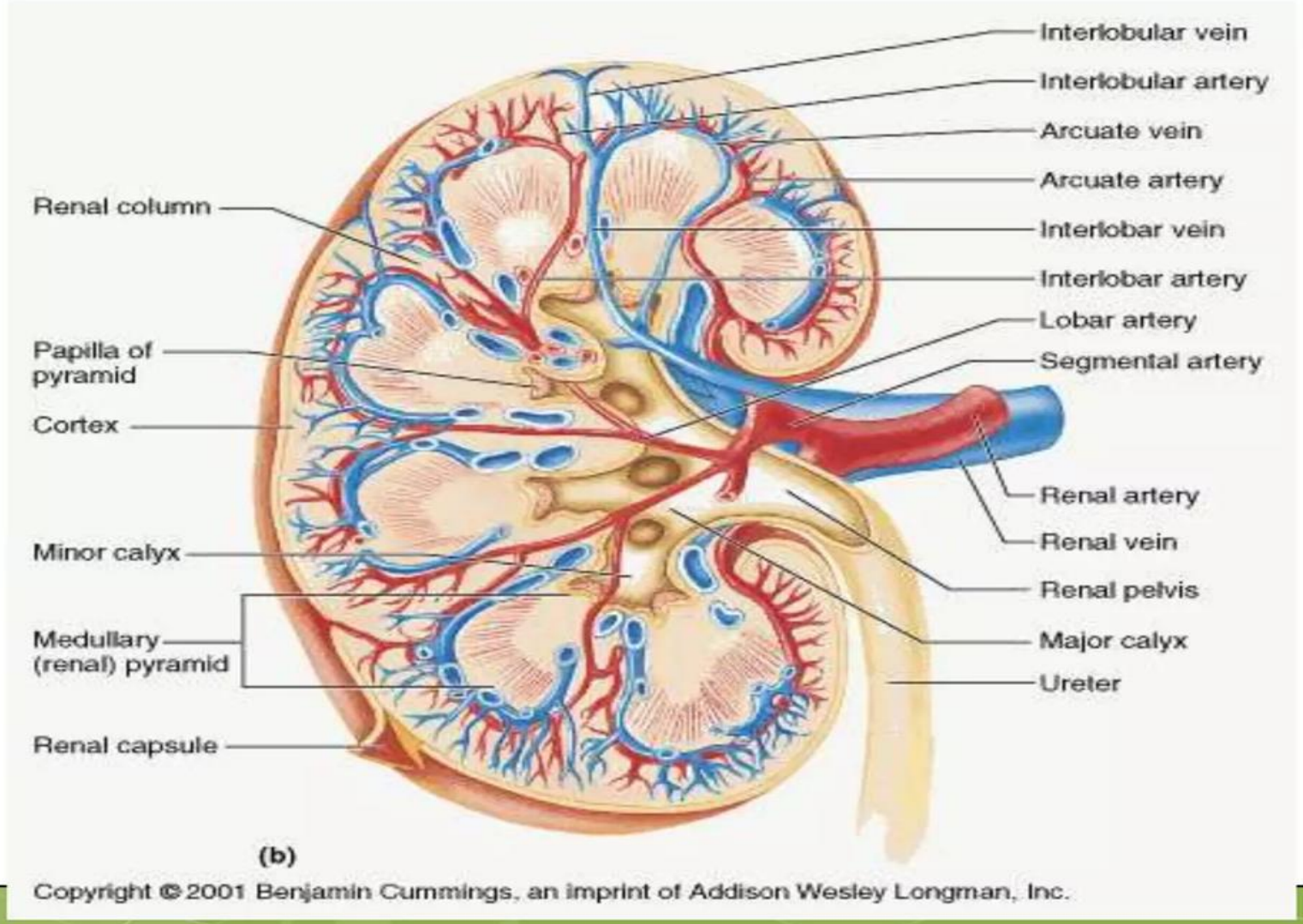
Major calyces

↓

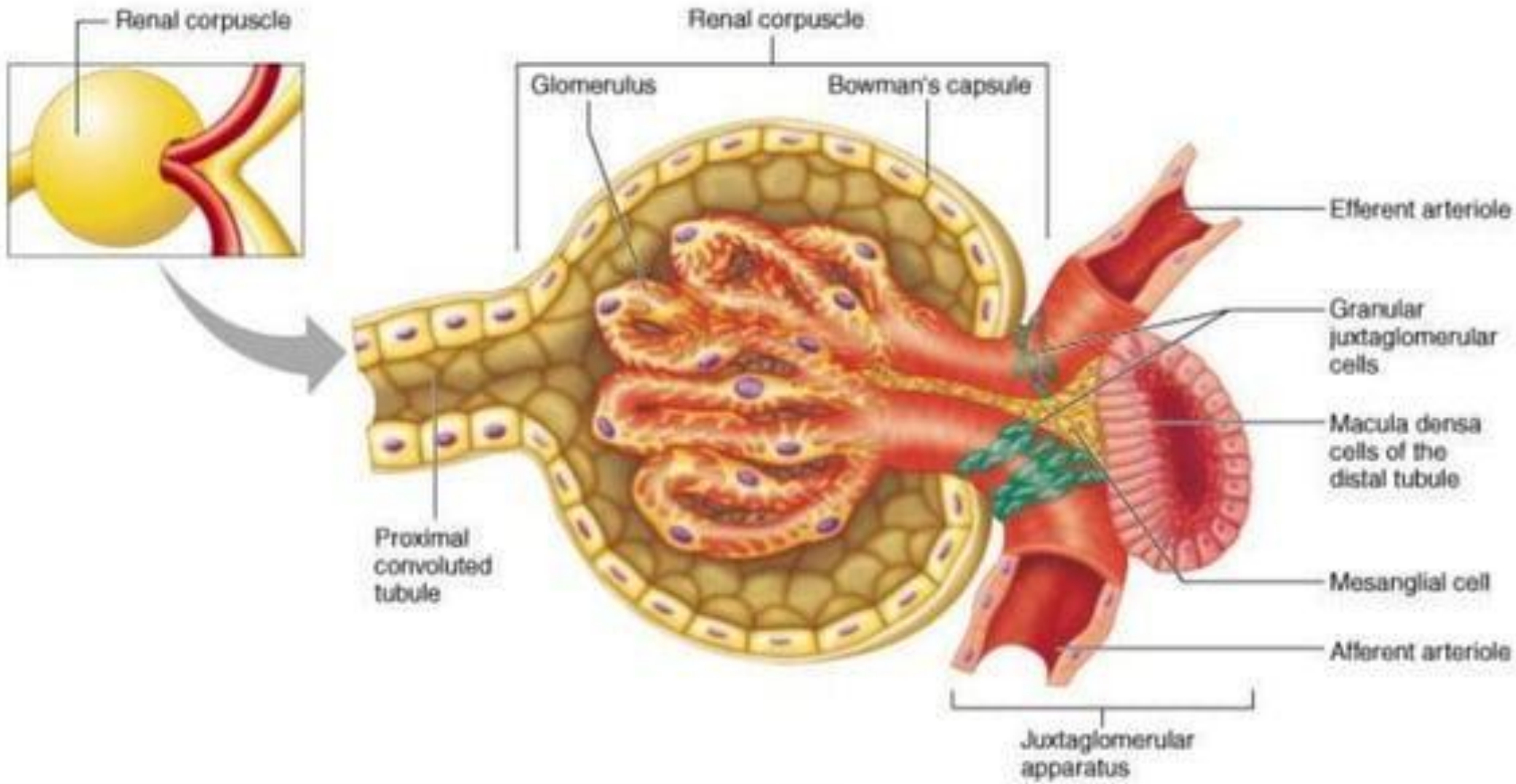
Renal pelvis



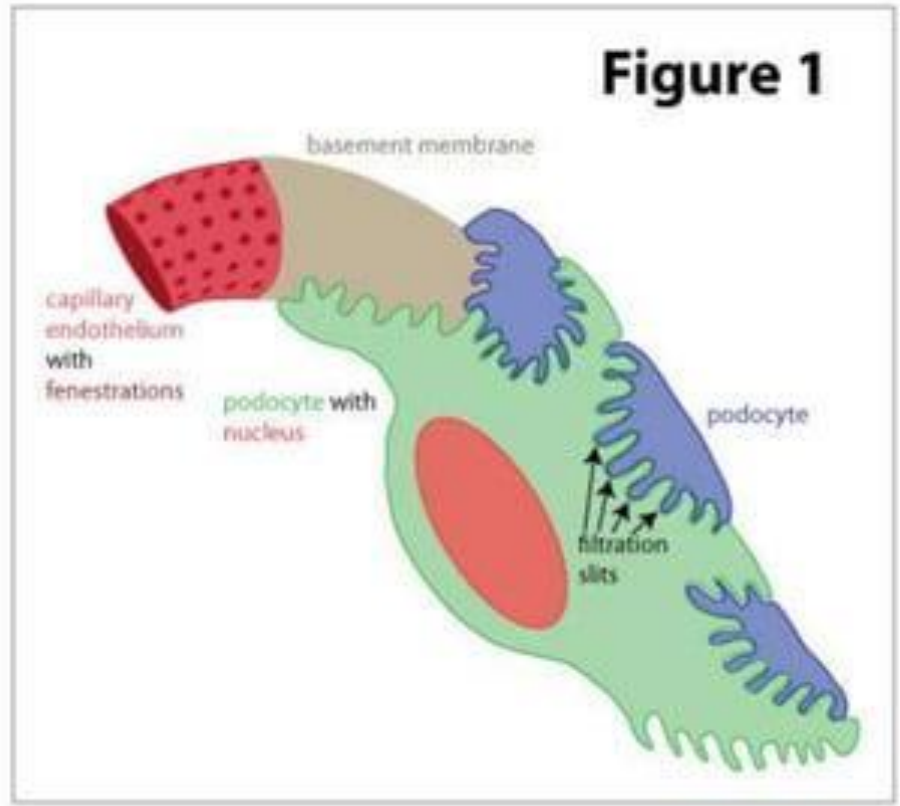
HISTOLOGY OF THE KIDNEY

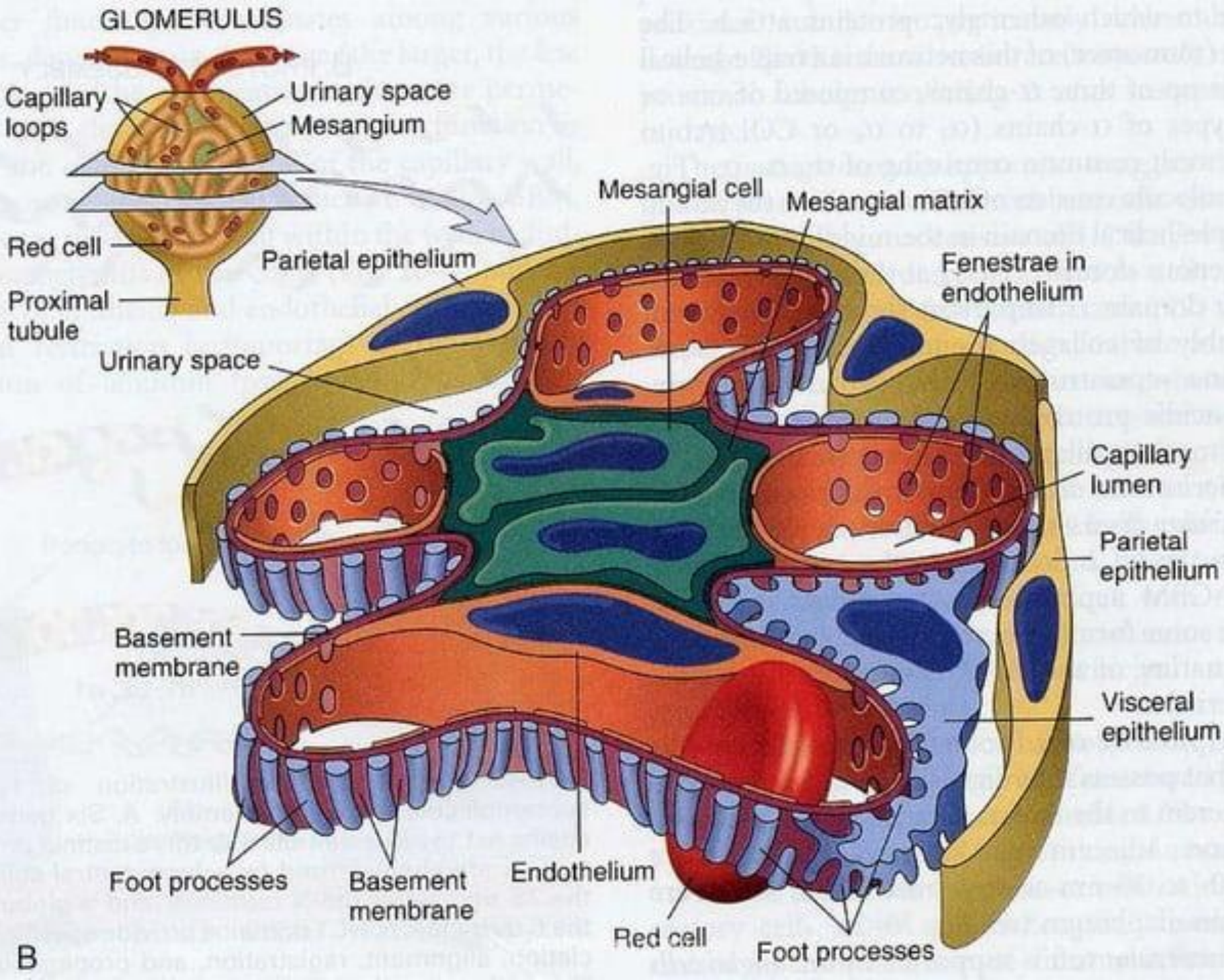


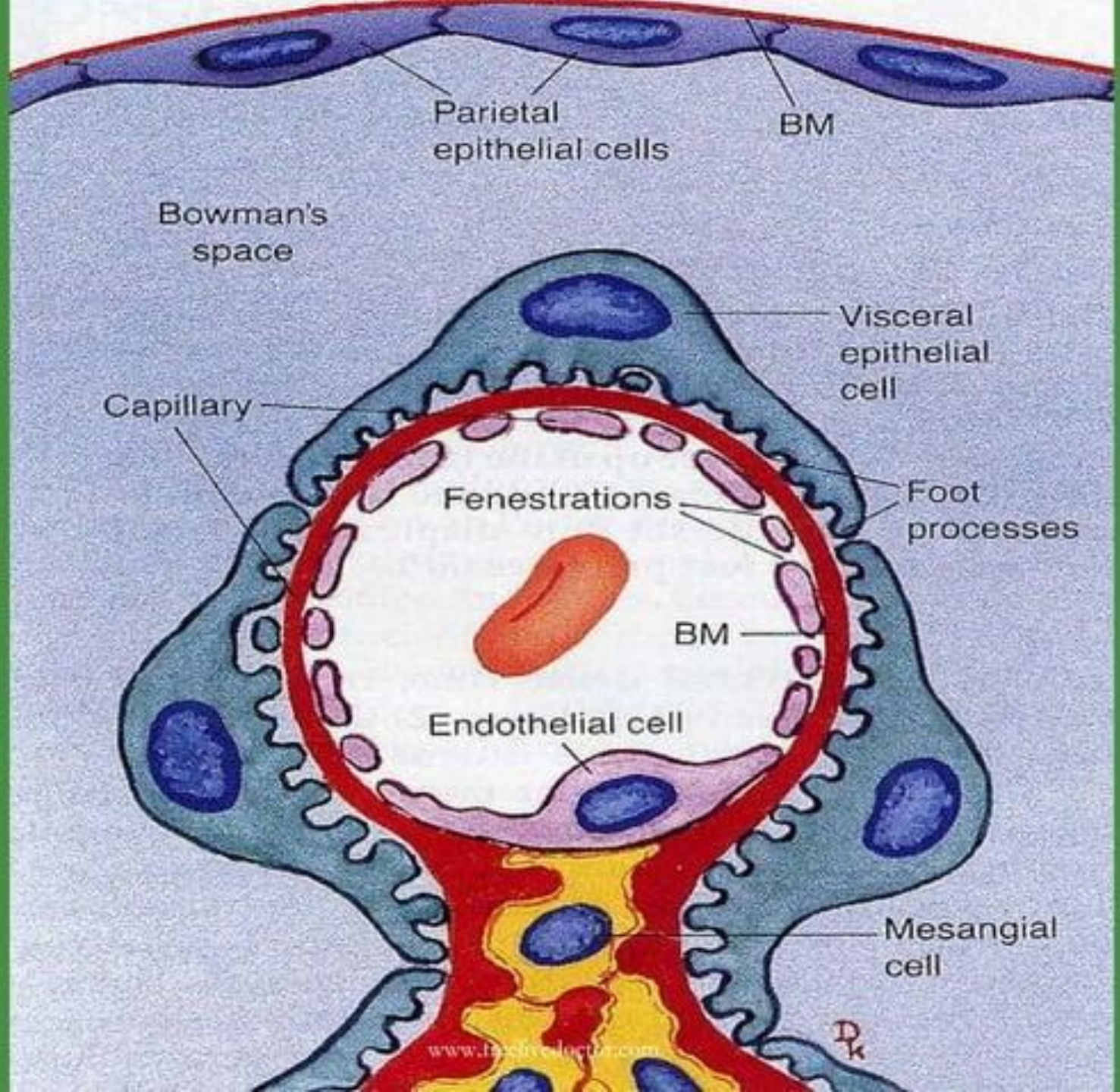
Renal Corpuscle



3 Layers of the Glomerulus

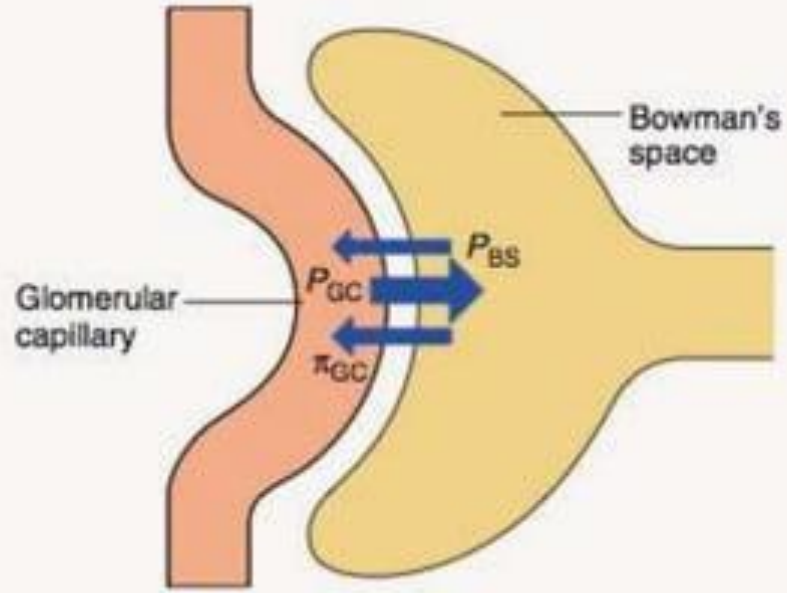



GLOMERULUS
Capillary loops
Urinary space
Mesangium
Red cell
Proximal tubule
Parietal epithelium
Urinary space
Mesangial cell
Mesangial matrix
Fenestrae in endothelium
Capillary lumen
Parietal epithelium
Basement membrane
Visceral epithelium
Foot processes
Basement membrane
Endothelium
Red cell
Foot processes
B


Parietal epithelial cells
BM
Bowman's space
Visceral epithelial cell
Capillary
Fenestrations
Foot processes
BM
Endothelial cell
Mesangial cell

Ultrafiltration Barrier

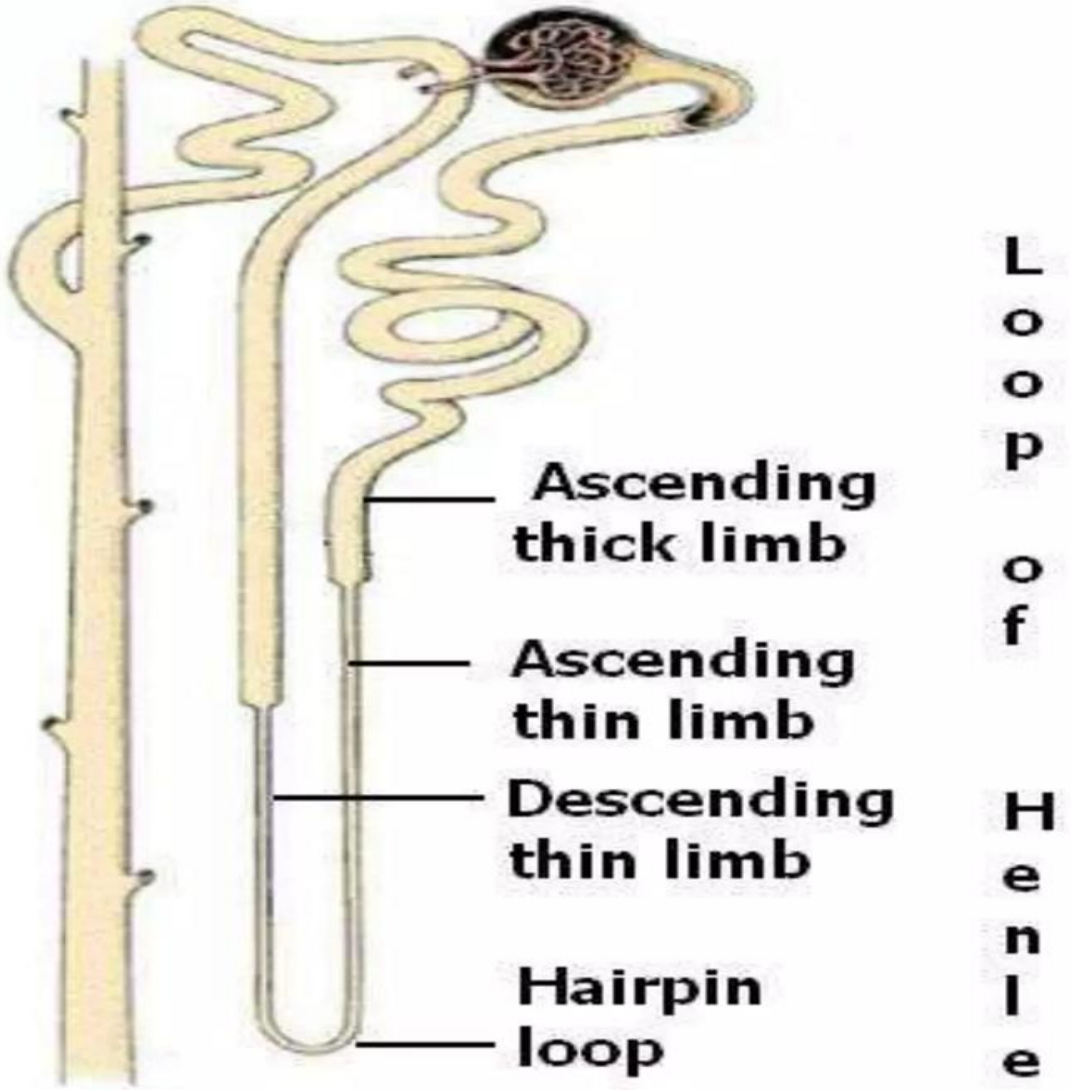
- **Capillary Endothelium** with fenestration pores filters everything except blood cells
- **Basement membrane** prevents filtration of large proteins
- **Podocytes** make the outer layer, and they have pedicels that allow only small molecules to pass through.



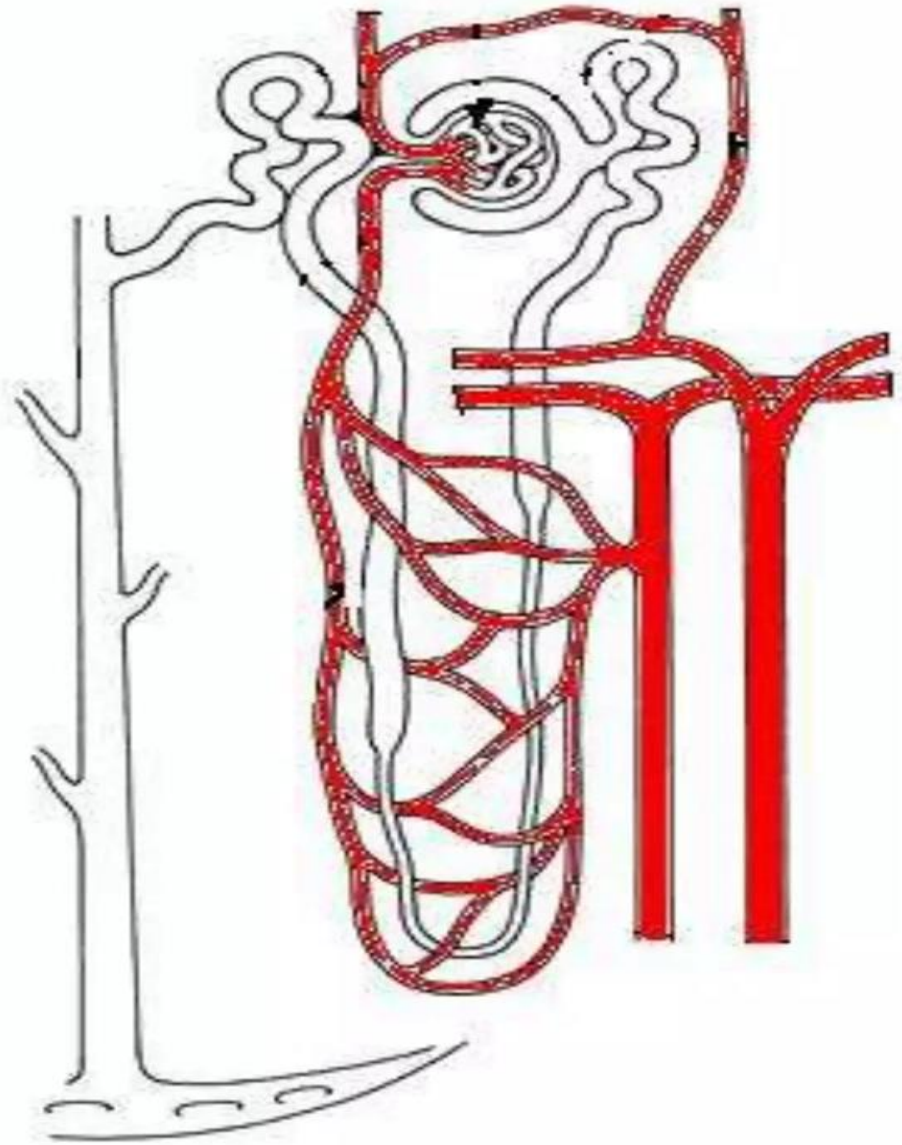
Forces	mmHg
Favoring filtration:	
Glomerular capillary blood pressure (P_{GC})	60
Opposing filtration:	
Fluid pressure in Bowman's space (P_{BS})	15
Osmotic force due to protein in plasma (π_{GC})	29
Net glomerular filtration pressure = $P_{GC} - P_{BS} - \pi_{GC}$	16

RENAL TUBULES

- Extend from Bowmen's capsule to collecting duct.
- PCT
- Loop of Henle
- DCT



Loop of Henle



Renal pathology

.Normal
.Congenital
.cyst
.Glomerular
.tubular /interstitial
.blood vessels
 .obstruction
 .tumors

. Congenital anomely

.Agenesis(complete absence of one or both kidney)
.Hypoplasia (congenital underdevelopment of the kidney)
.Ectopic (one or both kidneys are located in an abnormal position
.Horse shoe(congenital fusion)

CYSTIC DISEASES

- hereditary (genetic form)
- Autosomal dominant polycystic kidney disease (adult)
- Autosomal recessive poly cystic kidney disease (children)
- MEDULLARY

-Medullary Sponge Kidney (MSK)

Congenital (not hereditary) disorder where collecting duct in renal medulla are dilated give shape of spongy appearance

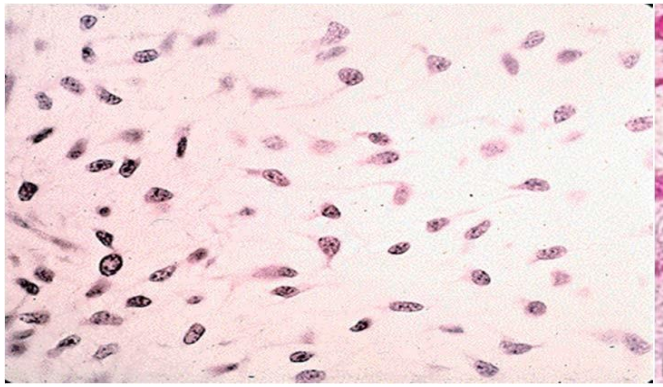
-Nephronophthisis(AR) tubulointerstitial fibrosis,and cyst formation in the kidney tubules

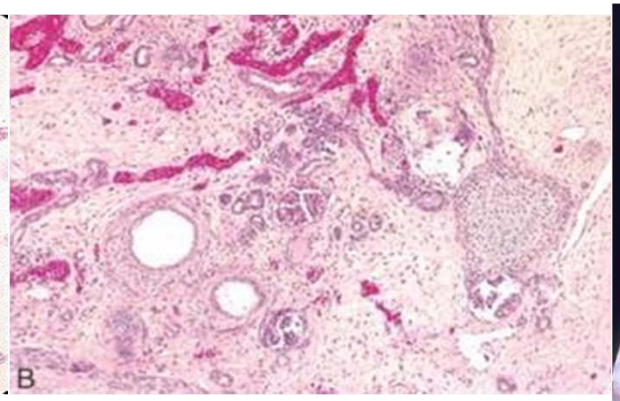
-Medullary

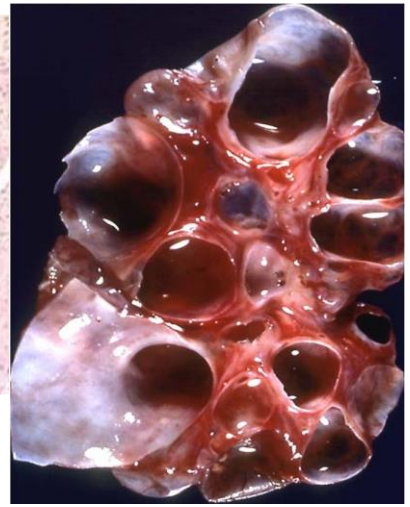
- ACQUIRED
- SIMPLE

CYSTIC RENAL “DYSPLASIA” (multicystic dysplastic kidney)

.Enlarged
.Unilateral
.Cystic
.Have mesenchyme
.Newborns
.Viral, Genetic (rare)



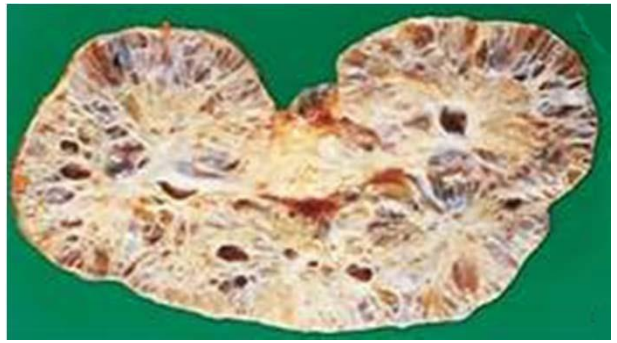




AUTOSOMAL RECESSIVE

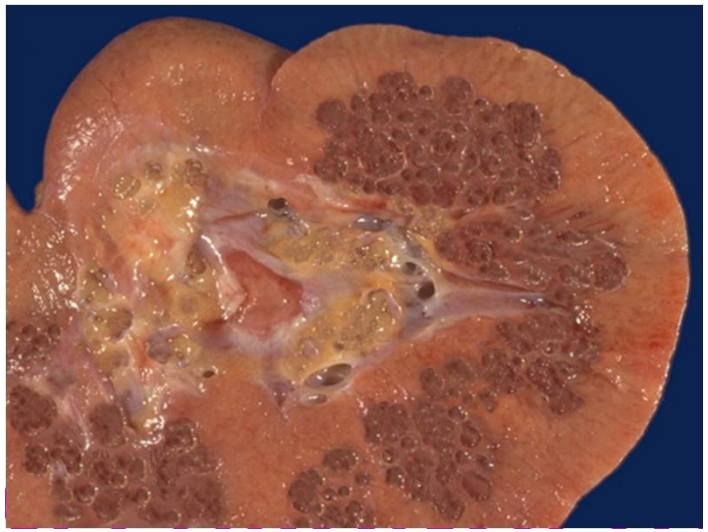
- Childhood
- Kidneys look exactly like the adult type
- PKHD1
- Patient who survive

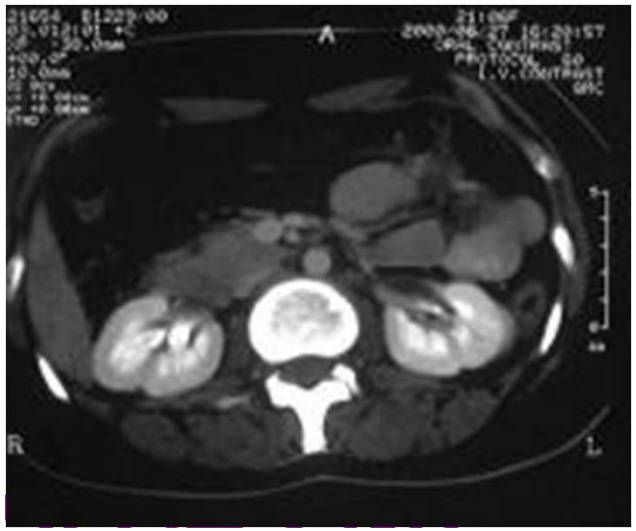
CHILDHOOD OFTEN DEVELOP HEPATIC fibrosis



MEDULLARY CYSTS

- **MEDULLARY SPONGE KIDNEY (MSK), usually an incidental finding on CT or US**





“SIMPLE” CYSTS

. Cortical
. **Also called “retention” cysts**
.Also “acquired”
.Incidental, asymptomatic
.very very common

Clinical Manifestations

- **Termimology**
  - a) *Azotemia*: ↑ BUN and ↑ creatinine
    - i) related to ↓ GFR
      - prerenal azotemia: ↓ RBF, hypoperfusion w/out parenchymal damage
      - postrenal azotemia: obstruction of urine flow below level of kidney

b) when azotemia becomes associated with a variety of clinical S & S and biochemical abnormalities → ***UREMIA***

- **Major Renal Syndromes**
  a) *Nephritic syndrome*: glomerular disease, hematuria, mild → moderate proteinuria, azotemia, edema, ↑ BP
     i) classic presentation of post streptococcal GN
  b) *Nephrotic syndrome*: heavy proteinuria (> 3.5 g/day), hypoalbuminemia, severe edema, hyperlipidemia and lipiduria

c) *Acute renal failure*: oliguria/anuria, recent onset of azotemia, can result from GN, tubular or interstitial disease

d) *Nephroliathiasis*: renal stones, renal colic, hematuria, recurrent stone formation

e) *Chronic renal failure*: 4 stages

i) ↓ renal reserve: GFR ~ 50% normal BUN & creatinine normal, pt. asymptomatic, more susceptible to develop azotemia

ii) renal insufficiency: GFR 20-50% of normal, azotemia, anemia, ↑ BP, polyuria/nocturia (via ↓ concentrating ability)

iii) renal failure: GFR less than 20-25% kidneys cannot regulate volume, ions: edema, hypocalcemia, metabolic acidosis, uremia with neurological, CV and GI complications

iv) end stage renal disease: GFR < 5% of normal, terminal stage of uremia

GLOMERULAR DISEASES

(gomerulonephropathies)

CLINICAL MANIFESTATIONS

- ACUTE NEPHRITIC SYNDROME
- RAPIDLY PROGRESSIVE GLOMERULONEPHRITIS
- NEPHROTIC SYNDROME
- CHRONIC RENAL FAILURE
- ASYMPTOMATIC HEMATURIA or PROTEINURIA

TABLE 20–4 The Glomerular Syndromes

Acute nephritic syndrome	• Hematuria, azotemia, variable proteinuria, oliguria, edema, and hypertension
Rapidly progressive glomerulonephritis	• Acute nephritis, proteinuria, and acute renal failure
Nephrotic syndrome	• >3.5 gm proteinuria, hypoalbuminemia, hyperlipidemia, lipiduria
Chronic renal failure	• Azotemia → uremia progressing for years
Asymptomatic hematuria or proteinuria	• Glomerular hematuria; subnephrotic proteinuria

- **GN characterized by one or more of the following (inflammatory diseases of glomerulus)**
    a) hypercellularity:
        i) cell proliferation of mesangial cells or endothelial cells
        ii) leukocyte infiltration (neutrophils, monocytes and sometimes lymphocytes)
        iii) formation of crescents
            - epithelial cell proliferation (from immune/inflammatory injury)
            - fibrin thought to elicit this injury (TNF, IL-1, IFN-γ are others)

b) basement membrane thickening

i) deposition of immune complexes on either the endothelial or epithelial side of GBM or w/in GBM itself

ii) thickening of GBM proper as with diabetes mellitus (diabetic glomerulosclerosis)

c) hyalinization (hyalinosis) and sclerosis

i) accumulation of material that is eosinophilic and homogeneous

- obliterates capillary lumen of glomerulus (sclerotic feature)

b) basement membrane thickening

i) deposition of immune complexes on either the endothelial or epithelial side of GBM or w/in GBM itself

ii) thickening of GBM proper as with diabetes mellitus (diabetic glomerulosclerosis)

c) hyalinization (hyalinosis) and sclerosis

i) accumulation of material that is eosinophilic and homogeneous

- obliterates capillary lumen of glomerulus (sclerotic feature)

PATHOGENESIS

- Antibodies against inherent GBM
- Antibodies against “planted” antigens
- Trapping of Ag-Ab complexes

- Antibodies against glomerular cells, e.g., mesangial cells, podocytes, etc.
- Cell mediated immunity, i.e., sensitized T-cells as in TB

MEDIATORS

- **NEUTROPHILS, MONOCYTES**
- **MACROPHAGES, T-CELLS, NK CELLS**
- **PLATELETS**
- **MESANGIAL CELLS**
- **SOLUBLE: CYTOKINES, CHEMOKINES, COAGULATION FACTORS**

Acute glomerulonephritis

- **Hematuria, Azotemia, Oliguria, in children following a strep infection**
- **Old streptococcal infection (old term)**
- **Hyper cellular glomeruli**
- **Increased endothelium and mesenchyme**
- **Igg and Igm (not IgA) C3 along GMB focally**
- **95% full recovery**

(Rapidly progressive)glomerulonephritis

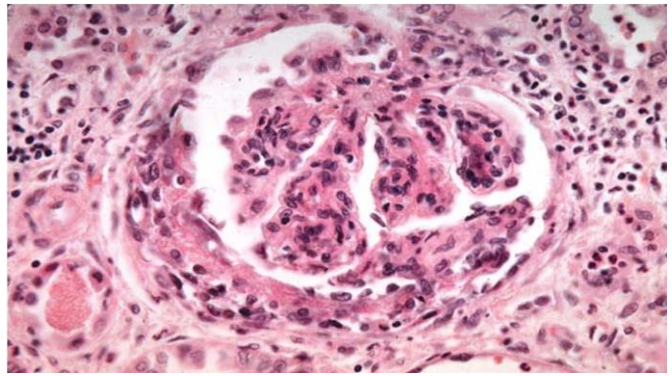
. Clinically definition ,not specific pathologic form

- "CRESCENTIC

. Anti GBM Ab

. Immune complex

. Anti- neut Ab



(i) Nephrotic syndrome

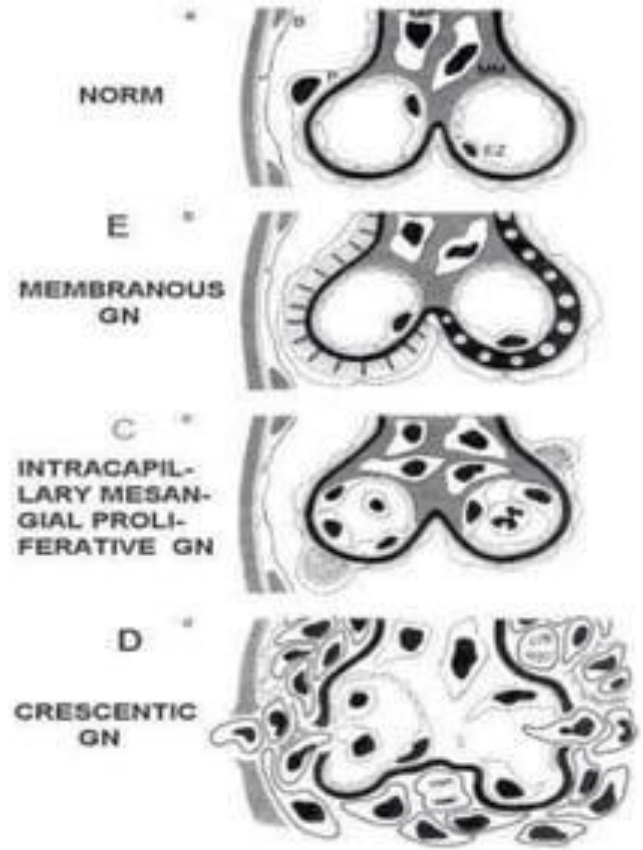
A nonspecific disorder in which the kidneys are damaged, causing them to leak large amounts of protein from the blood into the urine.

Clinical state characterised by:

- Heavy proteinuria, 50mg/kg
- Hypoalubinaemia, 25gm/l
- Oedema
- Generalised hyperlipaedaemia

Nephrotic syndrome

- **Primary causes**
  - Minimal-change nephropathy
  - Focal glomerulosclerosis
  - Membranous nephropathy
  - Hereditary nephropathies



Nephrotic syndrome

- **Secondary causes**
  - Diabetes mellitus
  - Amyloidosis and paraproteinemias
  - Post infectious-
  - Group A beta haem strep and other bacteria eg. Typhoid and syphilis
  - Malaria
  - Viral-chickenpox, HIV, Hep B, EBV
  - Renal vein thrombosis
  - Collagen vascular-SLE,

Causes Cont’

- Hereditary nephritis- nail patella and Alport’s
- Sickle cell disease
- Malignancy: leukaemia, lymphoma, wilm’s
- Toxins: Bee stings, poison ivy, oak, snake vernom
- Drugs: probrnicid, captopril, heroin, mercury, gold, penicillamine etc

NEPHROTIC SYNDROME

. Massive proteinuria
.Hypoalbuminemia
.oedema
.lipidemia and lipiduria

**** NUMEROUS CAUSES:

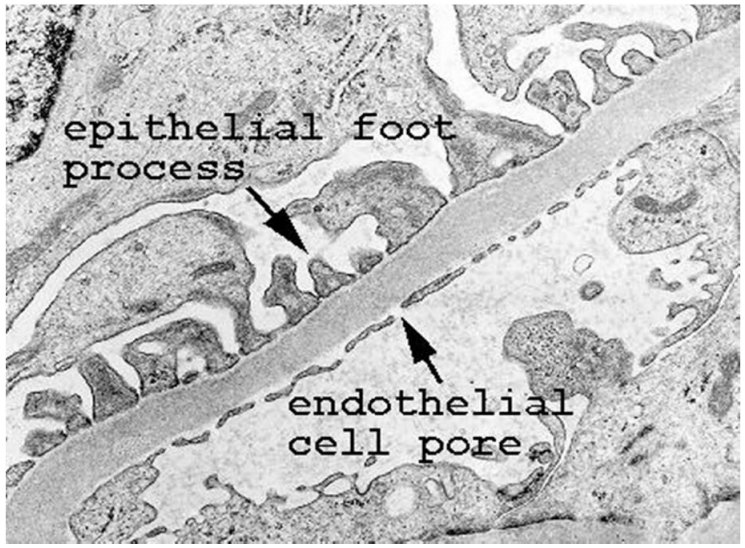
- MEMBRANOUS, MINIMAL CHANGE, FOCAL SEGMTL.
- DIABETES, AMYLOID, SLE, DRUGS

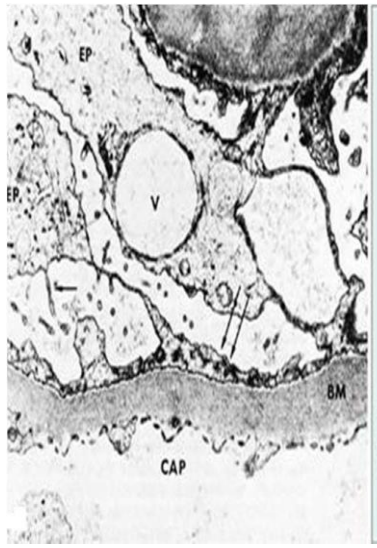
Membranous

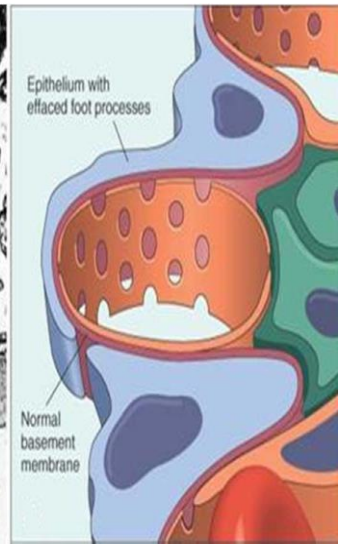
- Drugs, Tumors, SLE, Infections
- Deposition of Ag-Ab complexes
- Indolent, but >60% persistent proteinuria
- 15% go on to nephrotic syndrome

Minimal changes glomerulonephritis (lipoid nephrosis)

- **Most common cause of nephrotic syndrome in children**
- **EFFACEMENT of FOOT PROCESSES**
- **Possible preceding viral infection**

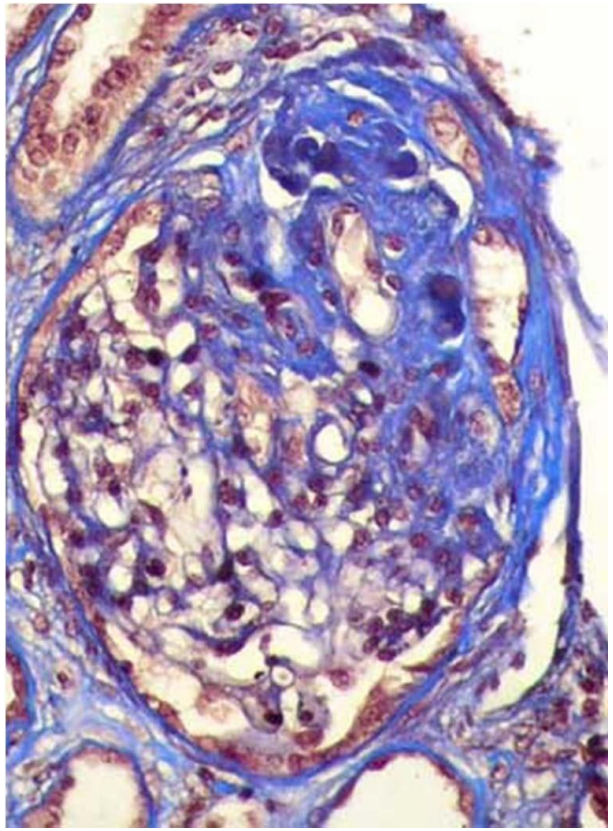






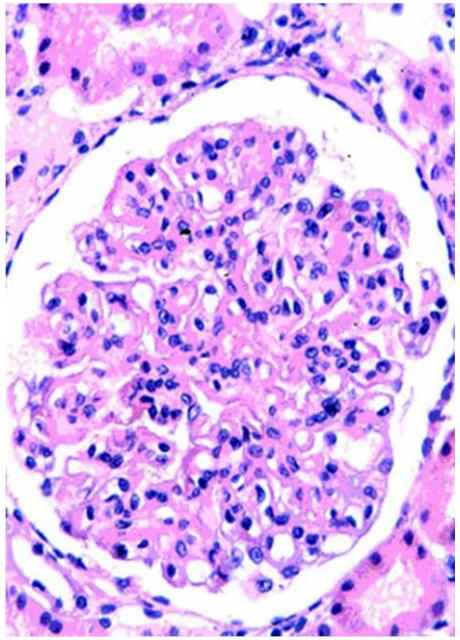
Focal segmental glomerulosclerosis:

- **Just like its name**
  - **Focal**
  - **Segmental**
  - **Glomerulo-SCLEROSIS (NOT –itis)**
- **HIV, Heroine, Sickle Cell, Obesity**
- **Most common cause of ADULT nephrotic syndrome**



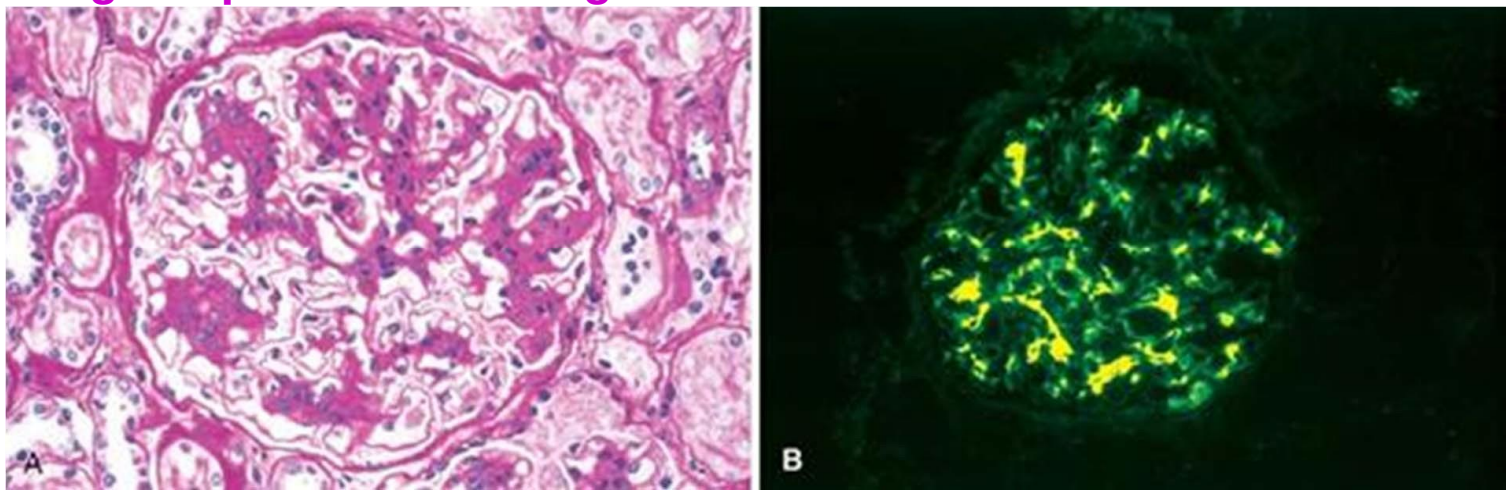
Membranous proliferative glomerulonephritis :

- **MPGN can be idiopathic or 2º to chronic immune diseases Hep-C, alpha-1-antitrypsin, HIV, Malignancies**
- **GBM alterations, subendo.**
- **Leukocyte infiltrations**
- **Predominant MESANGIAL involvement**



IgA nephropathy (berger disease)

- **Mild hematuria**
- **Mild proteinuria**
- **IgA deposits in mesangium**



Hereditory haematuria syndrome (Alport syndrome)

- **–Progressive Renal Failure**
- **–Nerve Deafness**
- **–VARIOUS eye disorder**

–DEFECTIVE COLLAGEN TYPE IV

THIN GBM (Glomerular Basement Membrane) Disease, i.e., about HALF as uniformly thin as it should be

Chronic glomerulonephritis :

Can result from just about ANY of the previously described acute ones

-THIN CORTEX

-HYALINIZED (fibrotic) GLOMERULI

-OFTEN SEEN IN DIALYSIS PATIENTS

SECONDARY (2º) GL0MERULONEPHROPATHIES

- **SLE**
- **Henoch-Schonlein Purpura (IgA-NEPH)**
- **BACTERIAL ENDOCARDITIS**
- **DIABETES (Nodular Glomerulosclerosis, or K-W Kidney)**
- **AMYLOIDOSIS**
- **GOODPASTURE**
- **WEGENER**
- **MYELOMA**

CHRONIC RENAL FAILURE

***Fluid and Electrolytes*: Dehydration, Edema, Hyperkalemia, Metabolic acidosis**

***Calcium Phosphate and Bone*: Hyperphosphatemia, Hypocalcemia, Secondary hyperparathyroidism, Renal osteodystrophy**

***Hematologic*: Anemia, Bleeding diathesis**

***Cardiopulmonary*: Hypertension, Congestive heart failure, Pulmonary edema, Uremic pericarditis**

***Gastrointestinal*: Nausea and vomiting, Bleeding, Esophagitis, gastritis, colitis**

***Neuromuscular*: Myopathy, Peripheral neuropathy, Encephalopathy**

***Dermatologic*: Sallow (greenish-yellow) color, Pruritus, Dermatitis**

The END