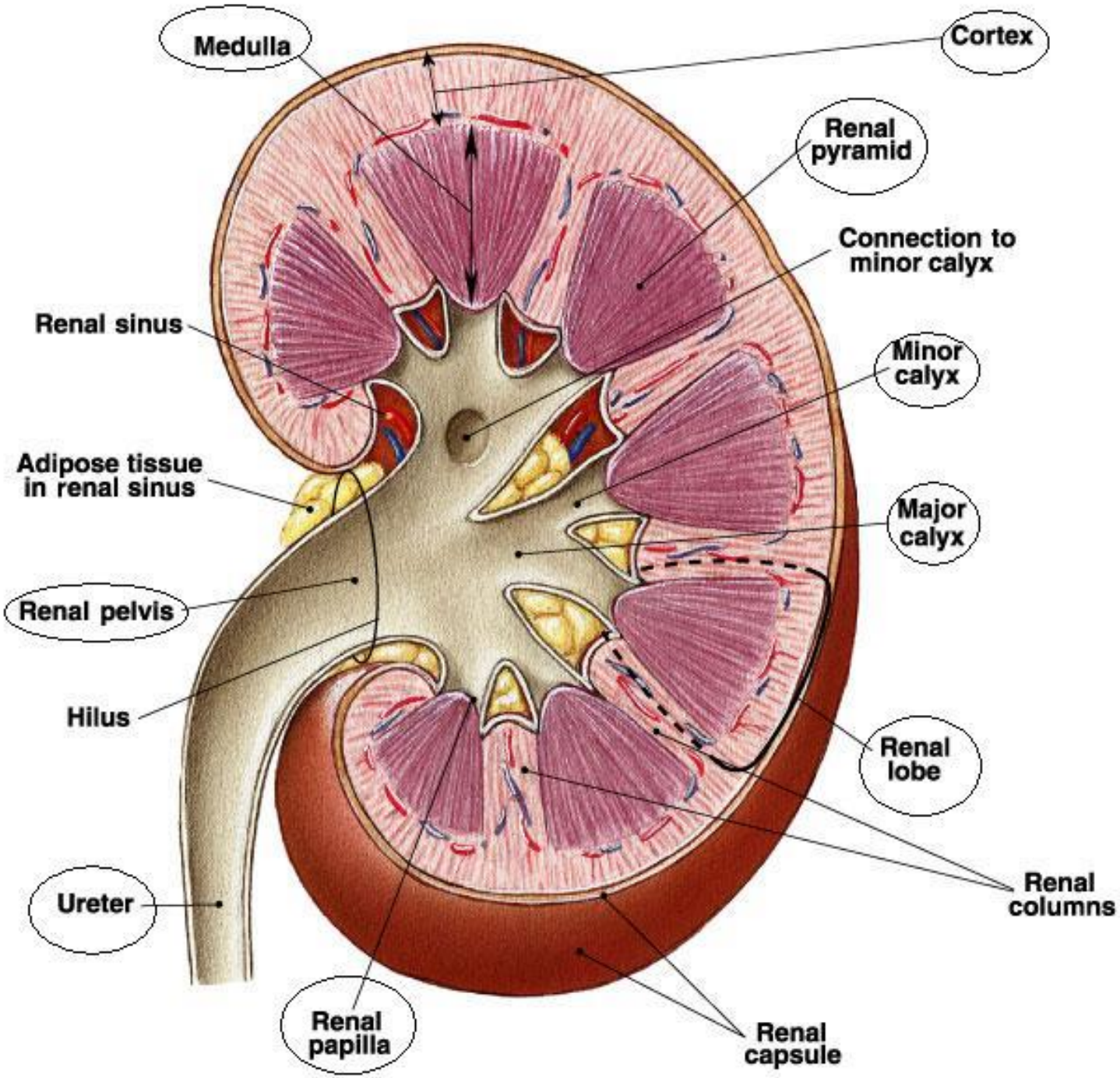
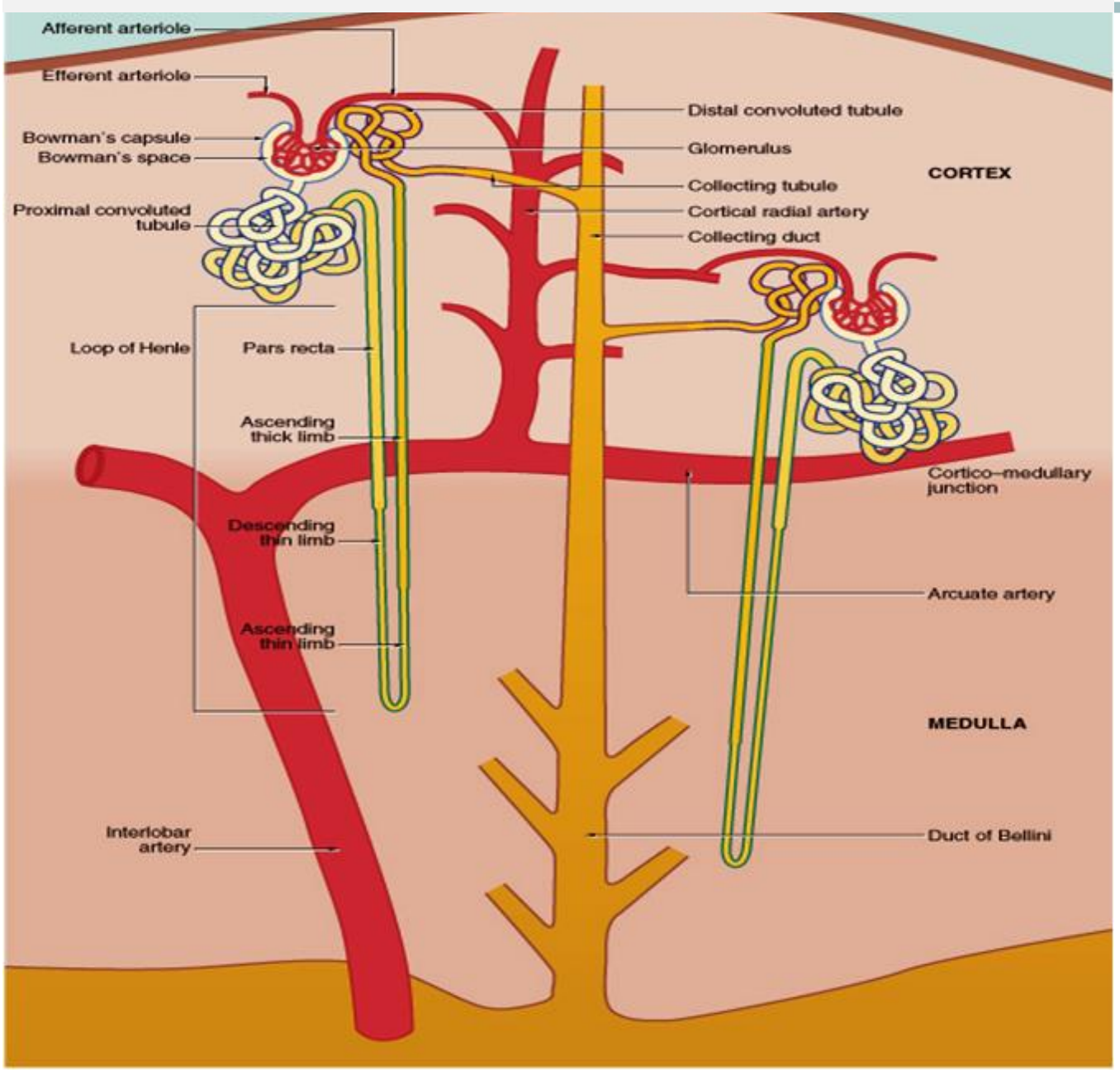
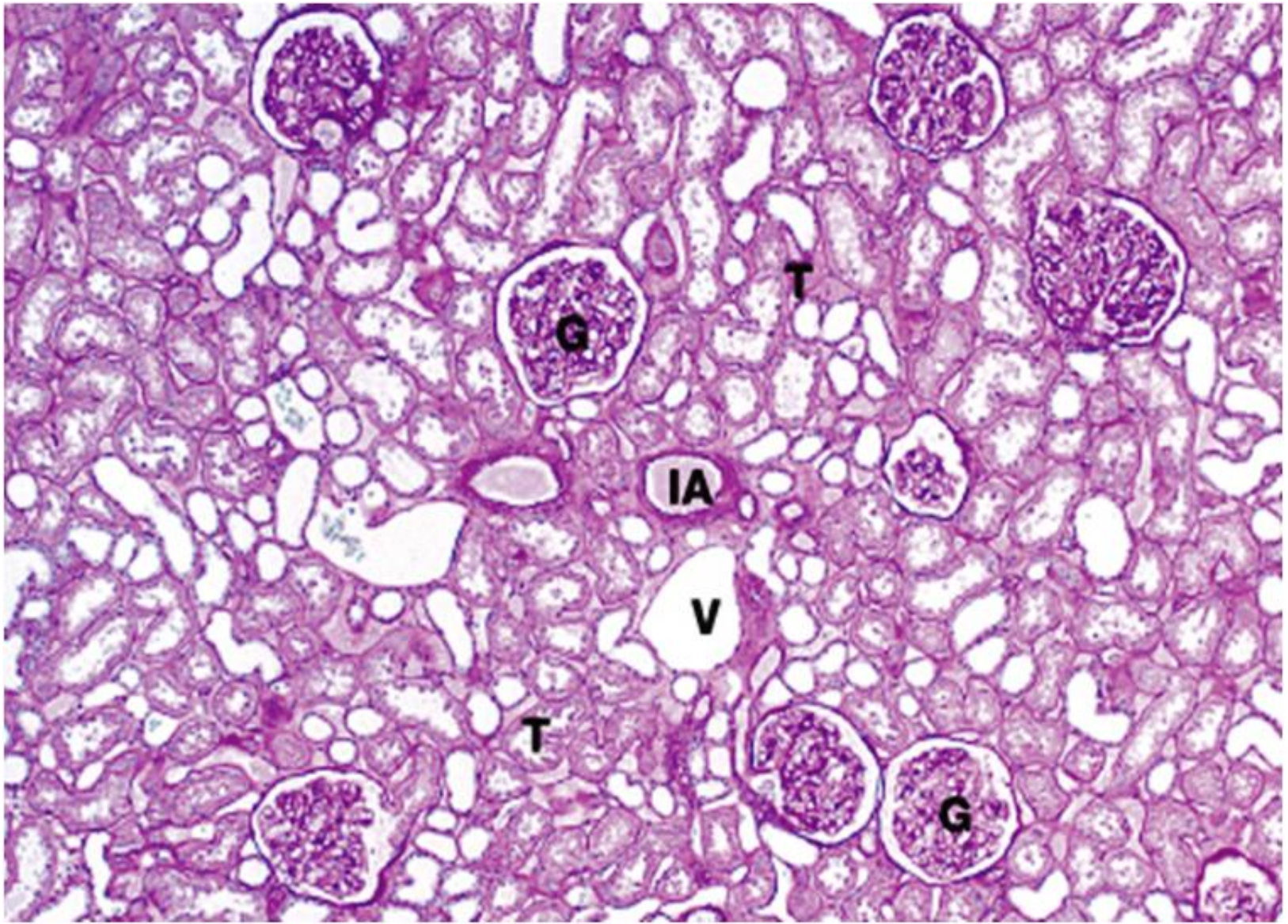
PATHOLOGY OF RENAL SYSTEM

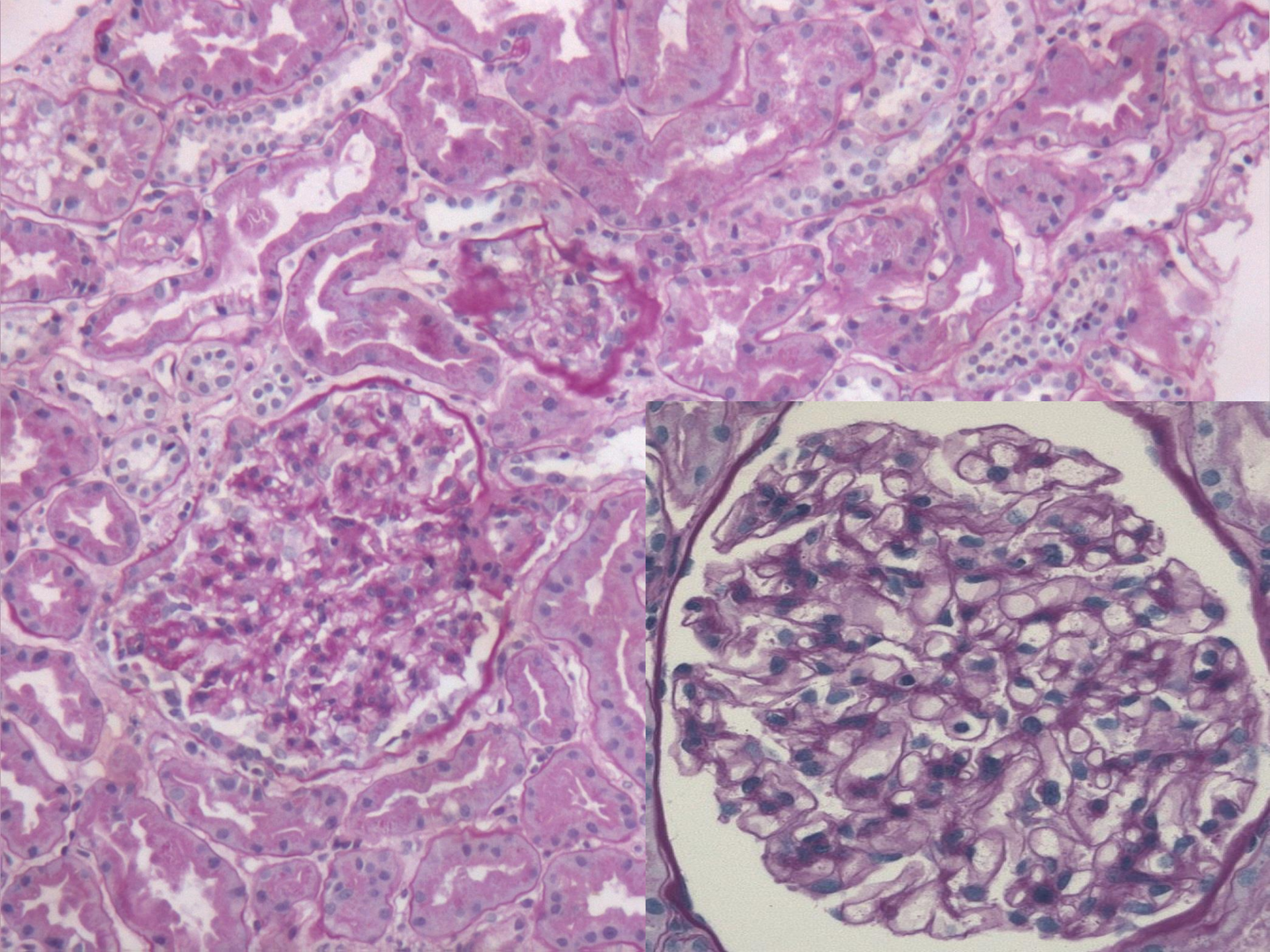

Medulla
Cortex
Renal pyramid
Connection to minor calyx
Renal sinus
Minor calyx
Adipose tissue in renal sinus
Major calyx
Renal pelvis
Hilus
Renal lobe
Renal columns
Ureter
Renal papilla
Renal capsule

BVs

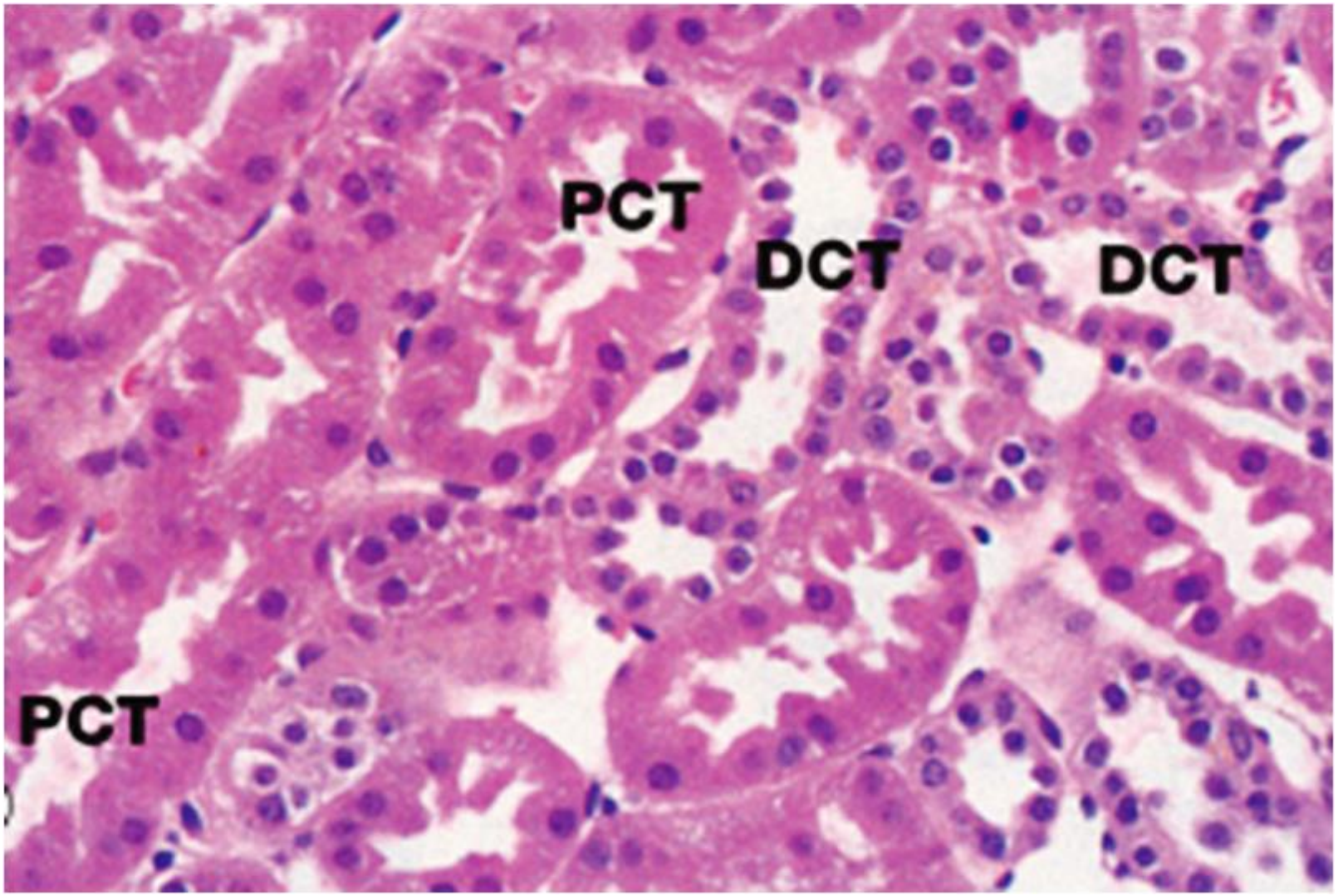


Renal cortex





Tubules



Lectures Outline

- Congenital anomalies & cystic diseases
- Glomerular diseases
  - The nephrotic & nephritic syndromes
- Tubulointerstitial disease
  - Tubulointerstitial nephritis & ATN
  - Urinary outflow obstruction
- Vascular disease
- Urinary tract infections
- Neoplastic disease

Function of the kidney

- The kidney is a structurally complex organ that has evolved to carry out a number of important functions.
  - Excretion of the waste products.
  - Regulation of body water and salt.
  - Maintenance of appropriate acid balance.
  - Secretion of a variety of hormones.

Renal Diseases

- **NOT** a major cause of *death*
  - RENAL ---------- 70,000 deaths / year (USA)
  - HEART ---------- 700,000 = = (USA)
  - CANCER ---------- 550,000 = = (USA)
  - STROKES ----------170,000 = = (USA)
- **BUT** responsible for great deal of *morbidity*
  - UTI
  - Stones
  - Obstructive uropathy
  - Dialysis & transplant
  - Many deaths occur in the young

Classification of kidney diseases

1) Glomerular diseases.
2) Tubulointerstitial diseases.
3) Vascular diseases.

- **EARLY** stages in the above could be separated on clinical and morphological grounds.
- **LATER** all components are involved leading to End Stage Renal Disease (ESRD)
  - Small contracted kidney. Obsolete glomeruli, tubular & vascular changes.
  - Clinical --- CRF

Definitions

- **Azotemia**
  - Biochemical term linked to ↑BUN (N 7-18 mg/dL) & creatinine levels (N0.6-1.2 mg/dL).
  - Usually due to decrease in GFR.
  - Azotemia may be *prerenal, renal, postrenal.*

- **Uremia**
  - When azotemia progresses to *clinical manifestations and systemic biochemical abnormalities* → due to failure of renal excretory function

Clinical syndromes (manifestations) of renal diseases

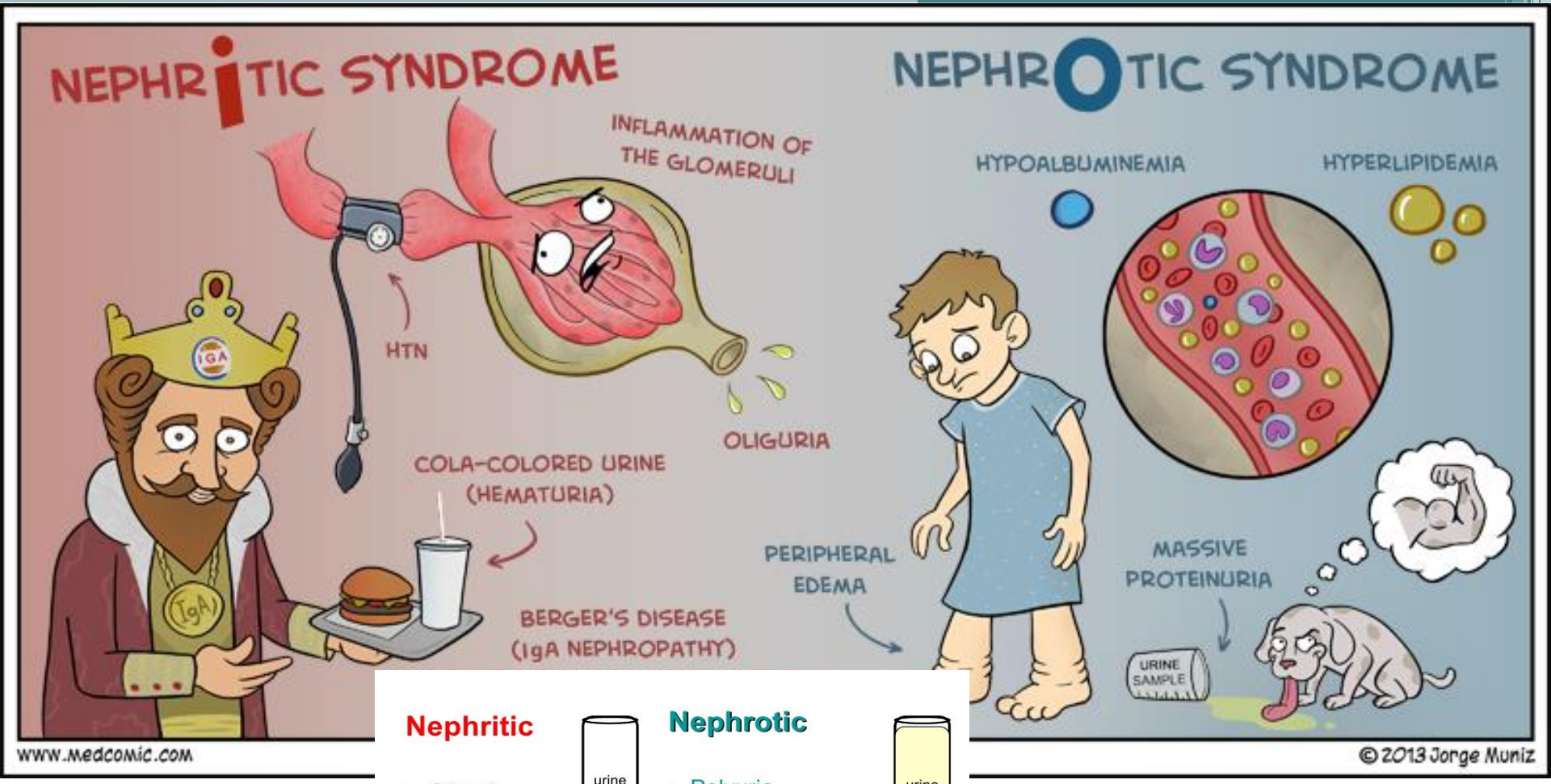
1- Nephrotic syndrome:

- Results from **glomerular** injury.
- Heavy *proteinuria* (excretion of >3.5 gm of protein/day in adults), *hypoalbuminemia*, *severe edema*, *hyperlipidemia, and lipiduria* (lipid in the urine).

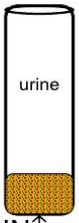
2- Acute nephritic syndrome:

- Results from **glomerular** injury.
- Acute onset of usually grossly visible *hematuria* (red blood cells in urine), *mild to moderate proteinuria, azotemia, edema, and hypertension.*

  -it is the classic presentation of acute poststreptococcal glomerulonephritis.



Nephritic



- Oliguria
- Hematuria
- Non selective Proteinuria.
- GFR↓, Cr↑, BUN↑
- Edema (salt and water retention)
- Hypertension
- RBC & Protein casts.

Nephrotic

- Polyuria
- Proteinuria ("nephrotic range" >3.5g/24h)
- Edema (Hypoalbuminemia)
- Hyperlipidemia
- Lipiduria
- Protein casts.

3- Asymptomatic hematuria &/or non-nephrotic proteinuria:

- Results from **mild glomerular** injury.

4-Rapidly progressive GN.

- Results from **severe glomerular** injury leading to loss of renal function in a few days or weeks and is manifested by microscopic *hematuria*, *dysmorphic red blood cells and red blood cell casts* in the urine sediment, and mild-to-moderate proteinuria.

5- Acute renal failure

- Oliguria or anuria (no urine flow), with recent onset of azotemia. Has many forms:
  - ❖Pre-renal: due to ↓ renal blood flow.
  - ❖Renal: due to glomerular (as crescentic glomerulonephritis), tubular (ATN), interstitial or vascular injury (such as thrombotic microangiopathy).
  - ❖Post-renal: due to obstruction.

6- Chronic renal failure:

- Results from progressive scarring in the kidney from *any cause*.
- Characterized by prolonged symptoms and signs of uremia.
- May lead to end-stage kidney disease (ESTD).

7. Urinary tract infection:

- May be symptomatic or asymptomatic.
- Ass. with bacteriuria & pyuria (bacteria and leukocytes in the urine).
- e.g. *pyelonephritis*, *cystitis* …

8. Nephrolithiasis:

- Manifested by renal colic, hematuria (without red cell casts), and recurrent stone formation.

9. Others:

- Obstruction, tumors …

Congenital and cystic renal diseases

Congenital anomalies of the kidney

- **Renal Dysgenesis:**
  - May be associated with other congenital anomalies.
  - May lead to CRF in childhood.

1. **Agenesis:**
   - Unilateral *OR*
   - Bilateral (*incompatible* with life → oligohydrominos & **potter's sequence**).
2. **Hypoplasia:**
   - Failure to develop the normal size.
   - Reduced lobes and pyramids (< 6) with NO signs of scarring.

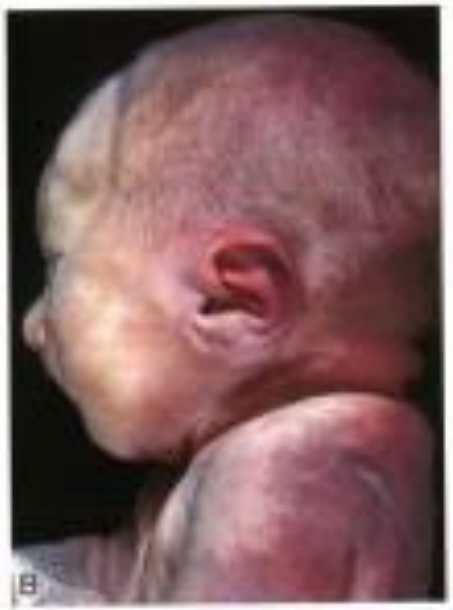
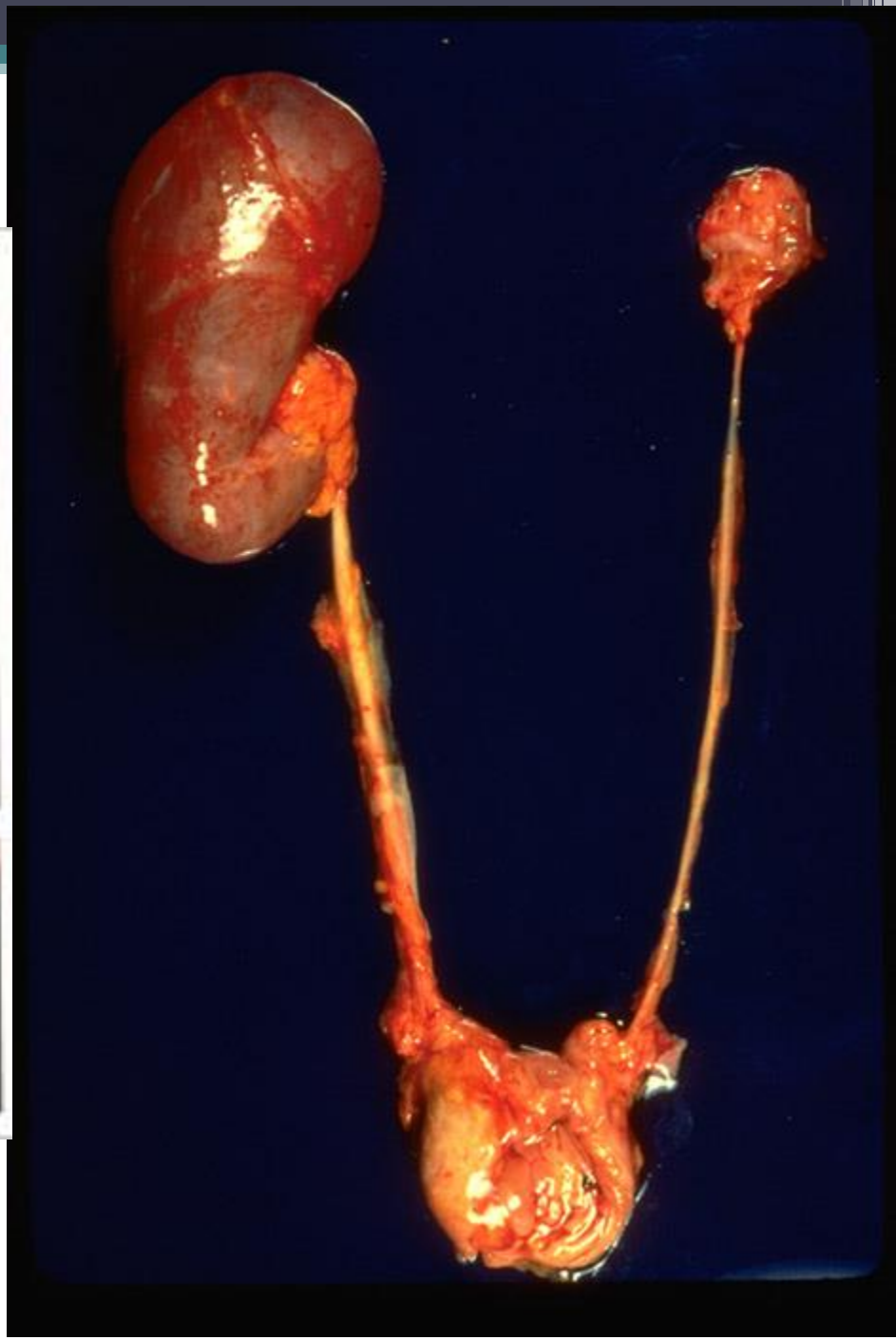


Figure 2-1

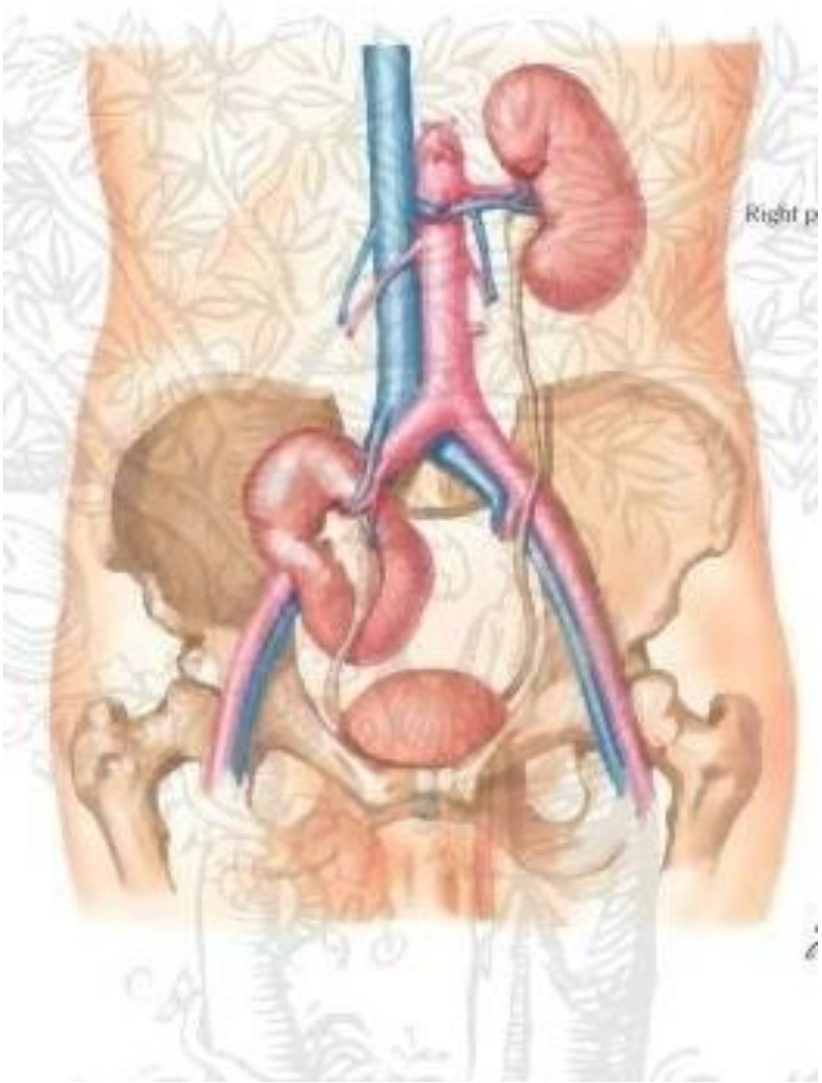
POTTER'S SEQUENCE
(OLIGOHYDRAMNIOS SEQUENCE)

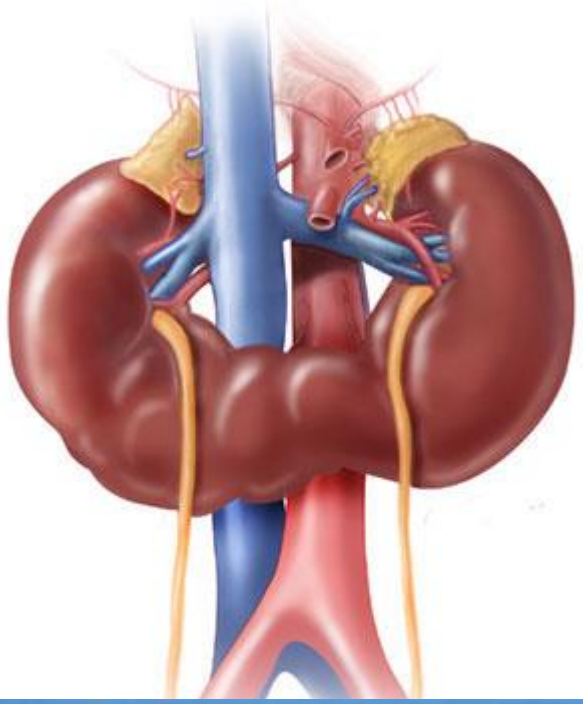
Manifestations include a beak-like nose (A,B), receding chin (B), low-set ears (B), and abnormally bent lower extremities (C).

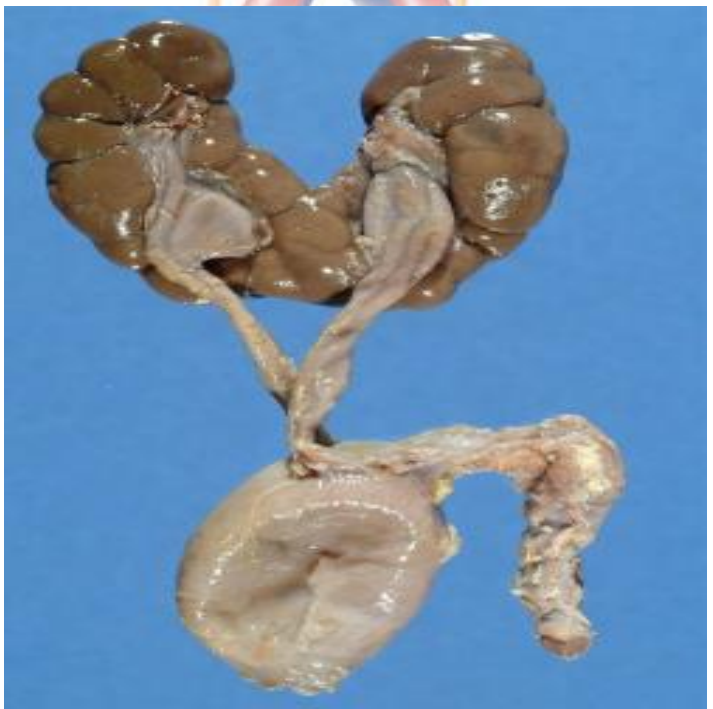


Congenital anomalies of the kidney

- **Ectopic kidney :**
  - Usually located **lower** than normal (often at **pelvic brim** or within pelvis).
- **Horseshoe kidney:**
  - Due to fusion of kidneys (90% lower poles), anterior to aorta & IVC.
  - Main complications are obstructive uropathy & stones.
- **Congenital cystic diseases**







Cystic diseases of the kidney

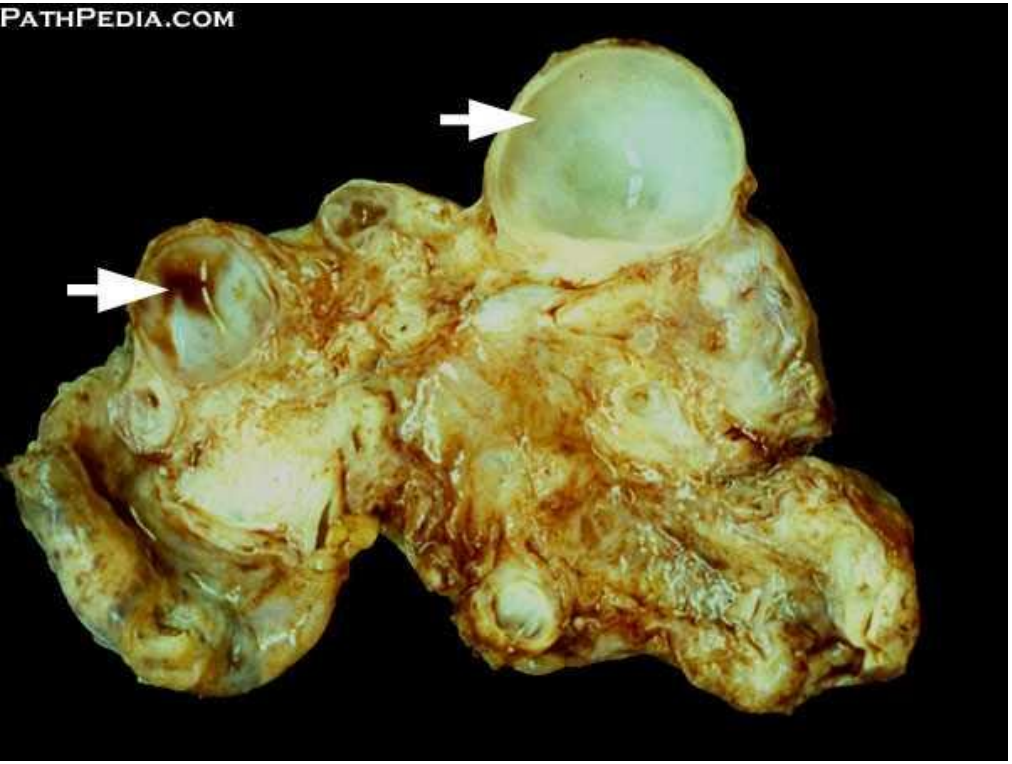
- Heterogeneous group of *hereditary, developmental & acquired* disorders that include:
  - Cystic renal dysplasia
  - Simple renal cyst
  - Acquired (dialysis associated) cystic disease
  - Polycystic kidney disease (adult & childhood types)
  - Medullary cystic diseases.

Why they are important?

- Reasonably **common.**
- Some forms (as APCD) are major cause of **chronic renal failure.**
- Present **diagnostic problems** for clinicians, radiologists, and pathologists.
- Occasionally can be **confused with malignant tumors.**

1. Cystic Renal Dysplasia:

- Due to abnormal *metanephrotic* differentiation.
- **Gross:**
  - Enlarged cystic kidney → Unilateral or bilateral (worse).
- **Microscopic:**
  - Abnormal lobar organization with the presence of large cysts surrounded by (cartilage, undifferentiated mesenchyme, and immature collecting ducts).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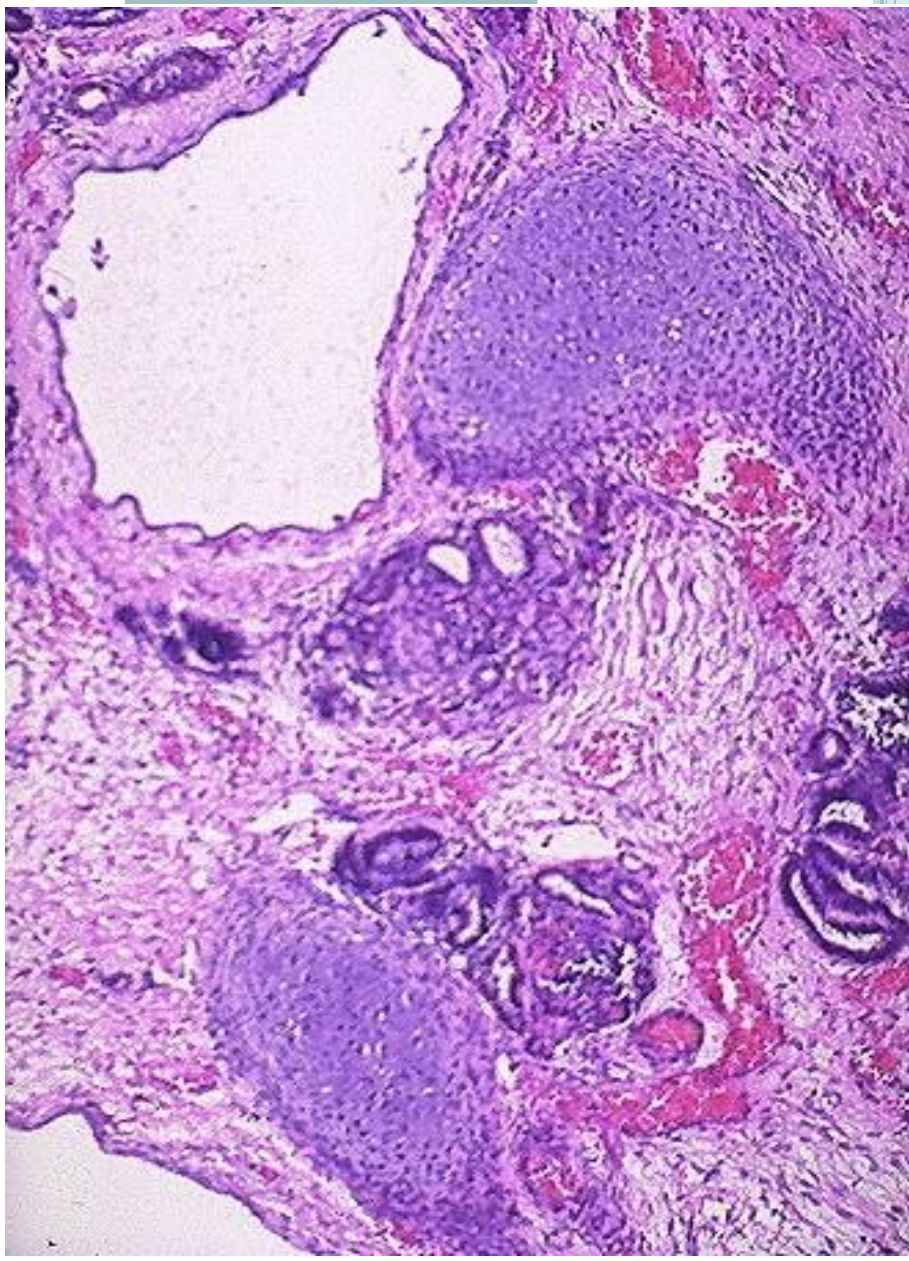
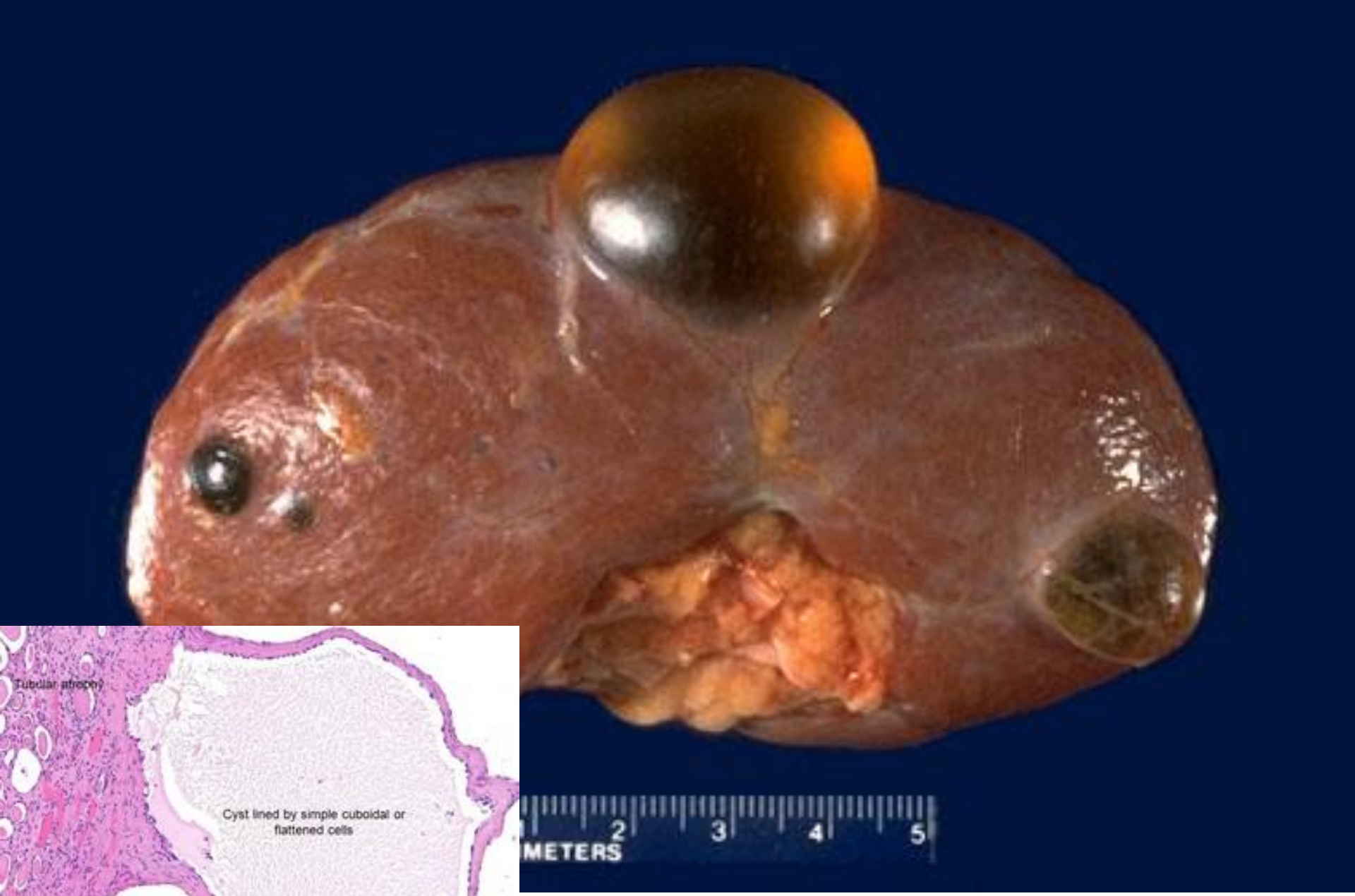


2. Simple renal cyst(s):

- A common *post-mortem finding*.
- **Gross:**
  - Single or multiple.
  - Usually *small & cortical*.
  - Translucent & filled with clear fluid.
- **Microscopic:**
  - Cysts lined by a single epithelial layer.
- **Clinical:**
  - **NO** clinical significance
  - Rarely may bleed into it → distends & cause pain.
  - Main importance is to differentiate them from ***renal tumors.***

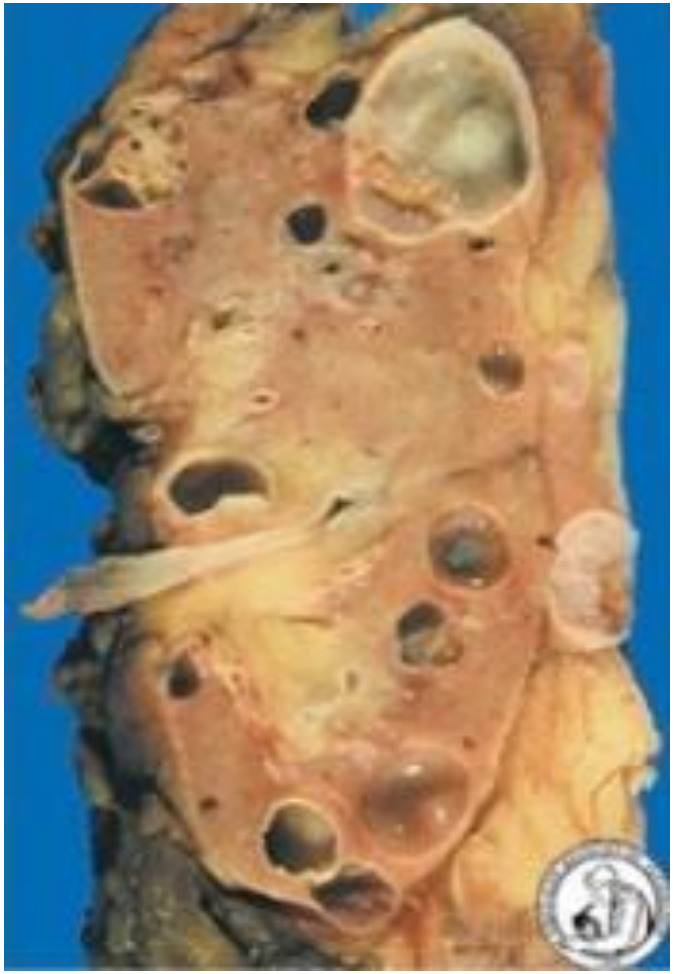

Tubular atrophy
Cyst lined by simple cuboidal or flattened cells
B
2
3
4
5
METERS

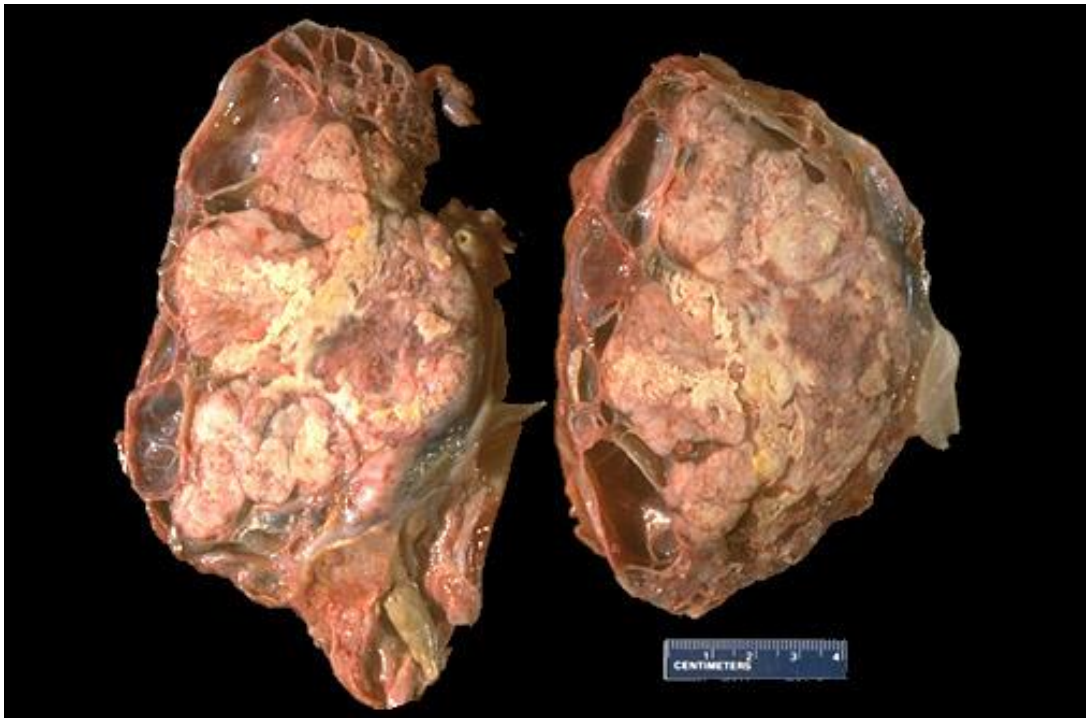
3. Acquired (dialysis-associated) renal cysts:

- Numerous cortical & medullary cysts in patients with CRF who have undergone **long term dialysis.**

- Usually *asymptomatic* but sometimes patients have hematuria.

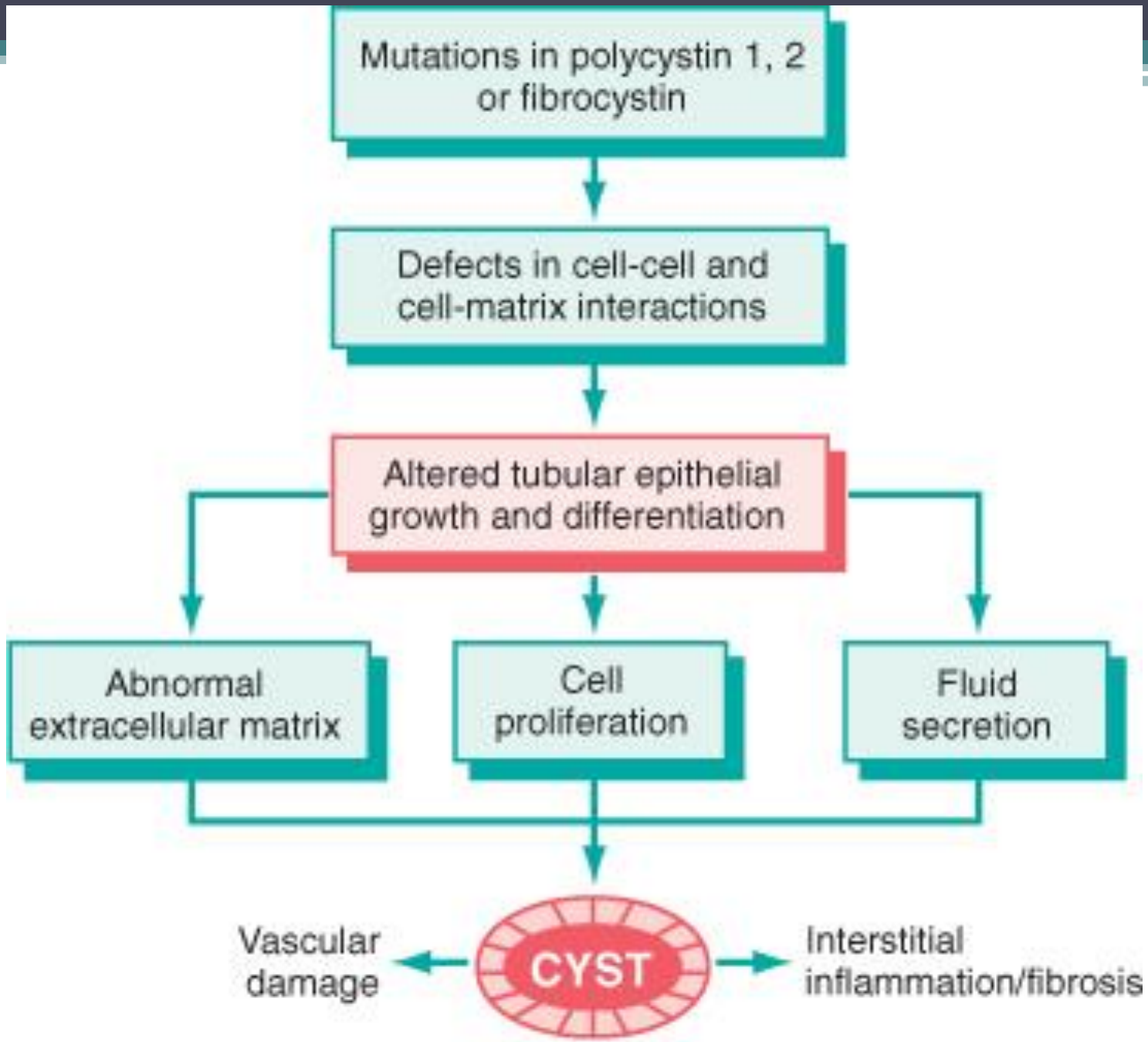
- Main complication is development of **renal cell carcinoma*** in cyst walls (7% over 10 years).




CENTIMETERS

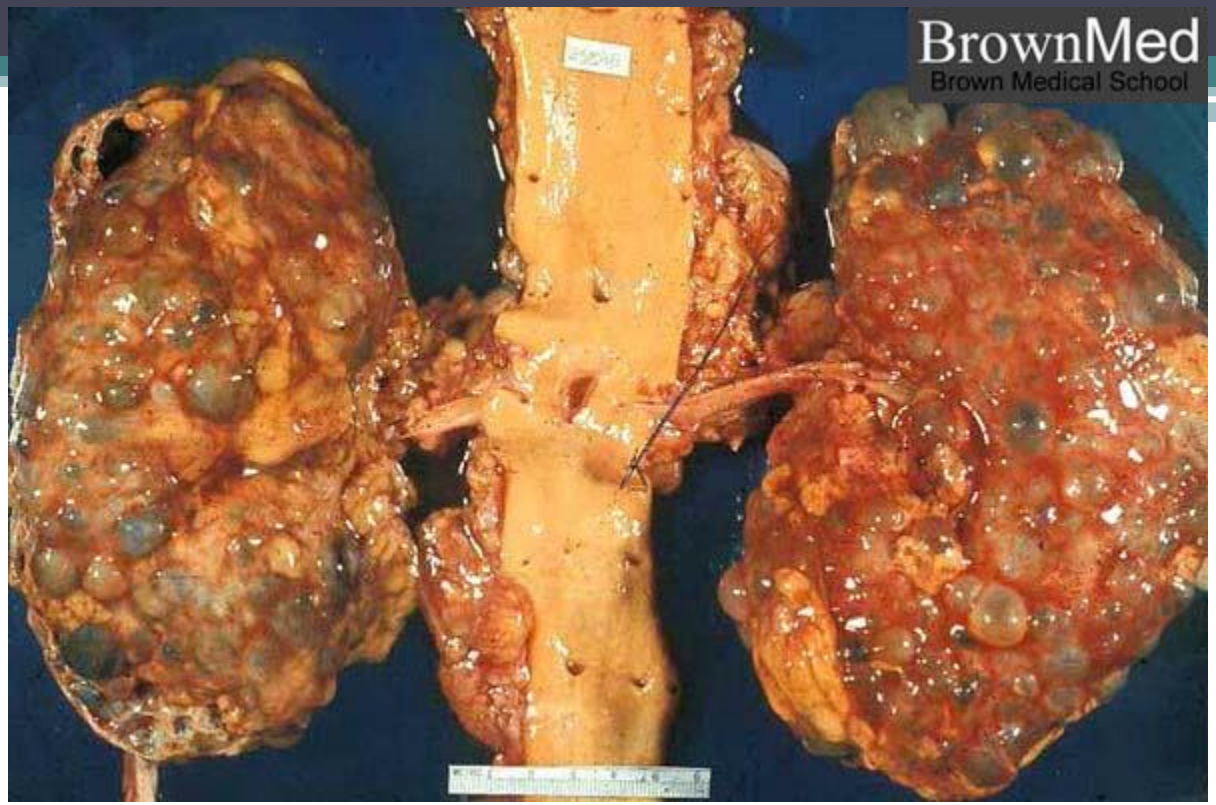
4. ADULT polycystic kidney disease:

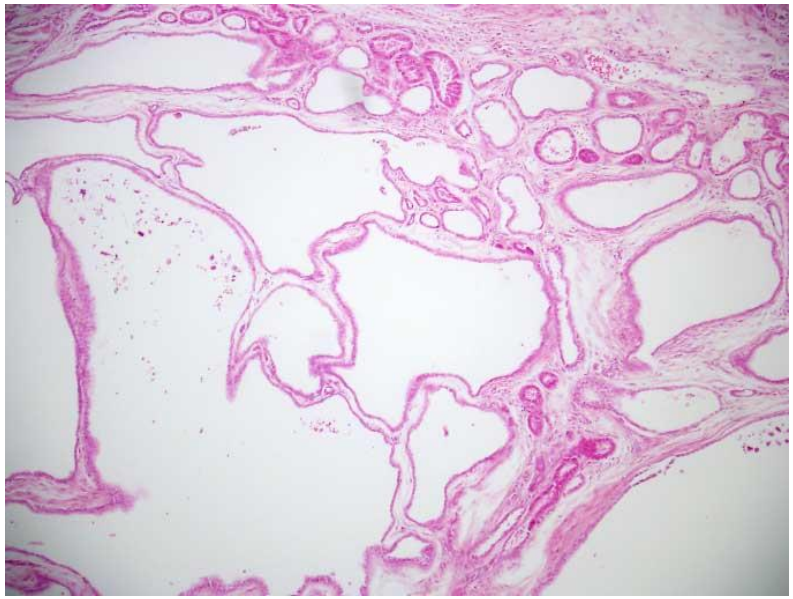
- Multiple expanding cysts in **BOTH** kidneys that eventually destroy intervening parenchyma.
- Common **AD** disease (1 per 500-1000).
- Responsible for about **10%** of CRF.
- Presentation is delayed up to **4th** decade.
- **Genetics:** Mutations in 3 separate genes may cause disease:
  - **PKD1** (*Chr 16*) that encodes for ***POLYCSYTIN 1*** (90%).
  - **PKD2*** (*Chr 4*) that encodes for ***POLYCYSTIN 2*** (10%).
  - **PKD3** (in few cases).

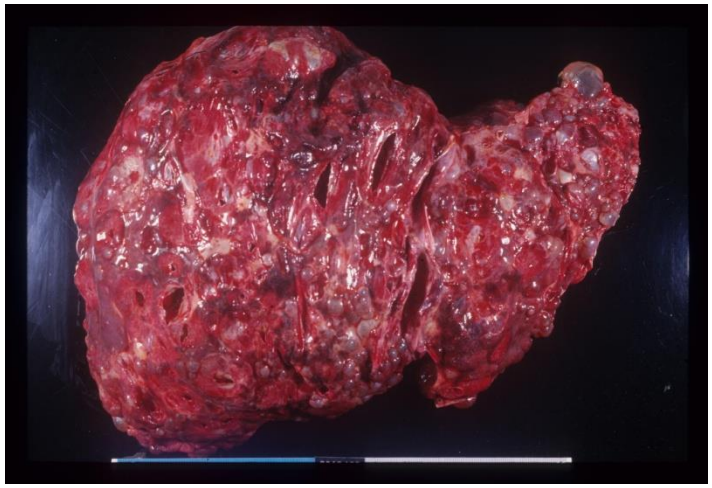


- **Gross & microscopic features:**
  - **Bilateral** markedly enlarged kidneys (up to 4 Kg!).
  - Numerous cysts up to 4cm in diameter, containing clear or hemorrhagic fluid.

- **Associated lesions:**
  - Polycystic liver disease - 40%.
  - Berry aneurysms* – 10-30%.
  - Mitral valve prolapse – ~25%.


BrownMed
Brown Medical School



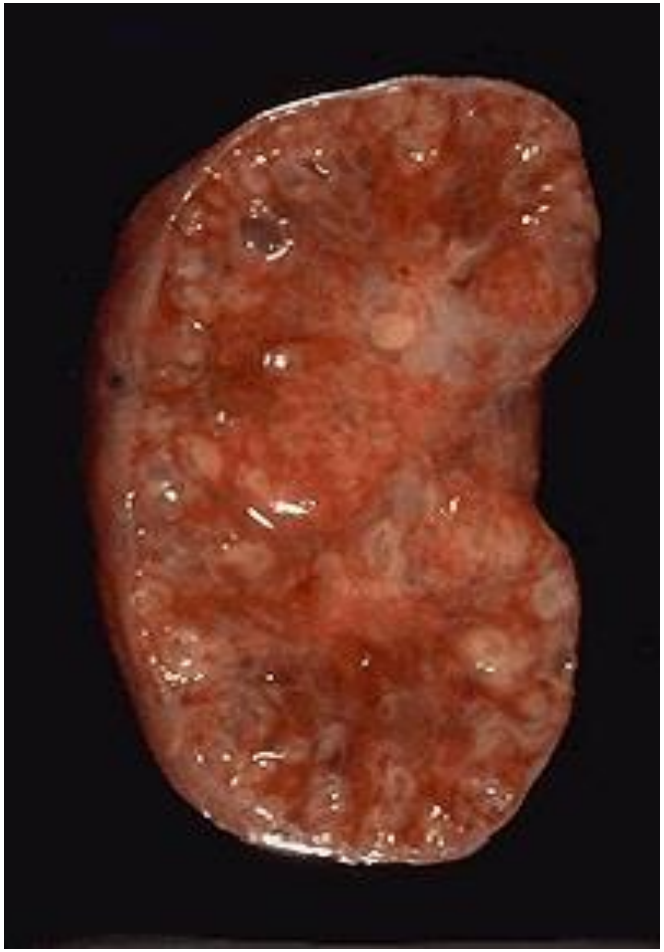


- **Clinical features:**
  - Flank pain – ***most common presentatio***n.
  - Abdominal mass or dragging sensation.
  - Intermittent gross *hematuria*.

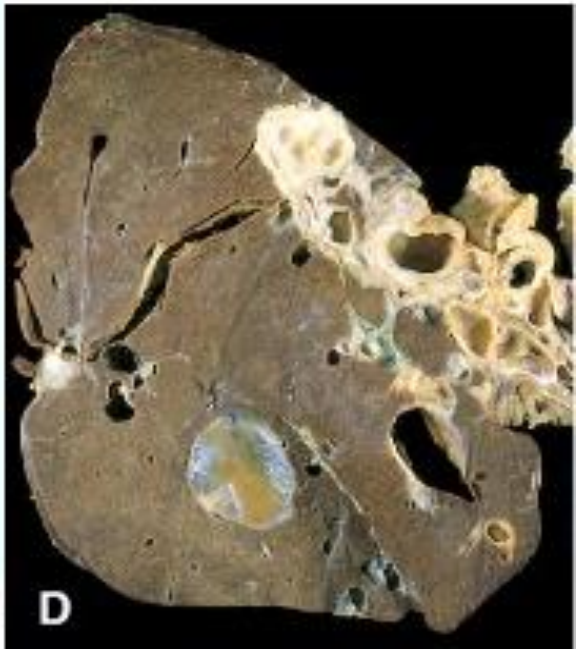
- **Complications:**
  - Hypertension (in 75%).
  - UTI.
  - Gradual onset of CRF (ESRD at 50 yrs).

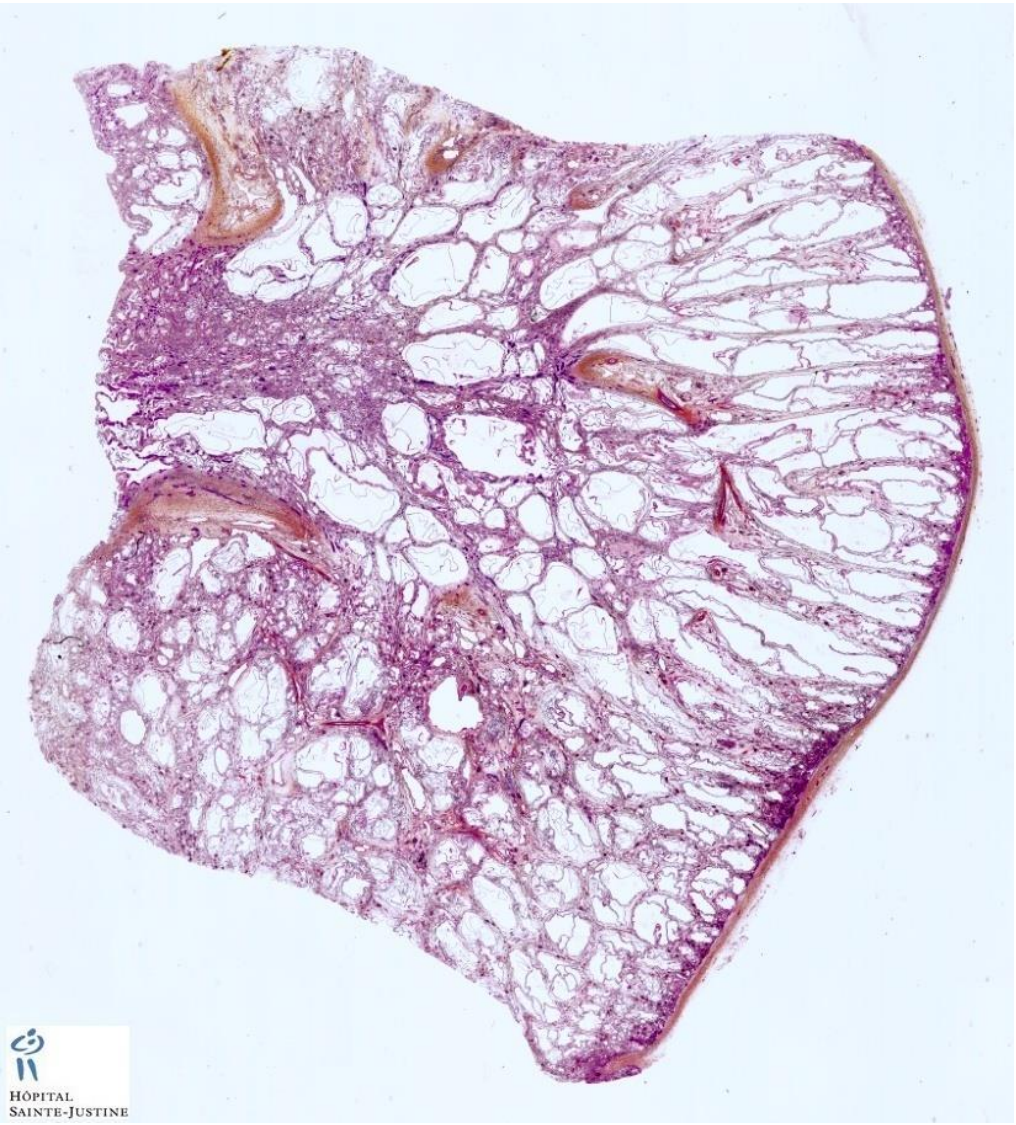
5. CHILDHOOD polycystic kidney disease

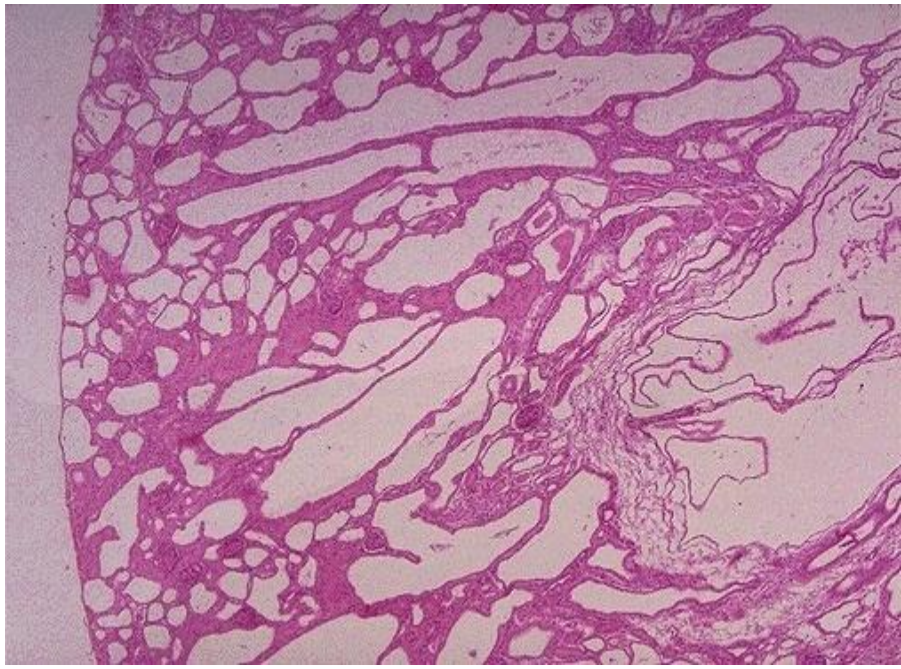
- **AR** disease → mutations in the gene encoding **FIBROCYSTIN** (on chr. 6).
- Presents very **early** & eventually causes CRF.
- Smooth kidney surface with numerous small cysts as well as dilated channels **perpendicular to surface.**
- Nearly **all** cases have associated **liver cysts.**
  - Older children who have milder disease may develop *congenital hepatic fibrosis*.




C
CM


D


Hôpital
Sainte-Justine

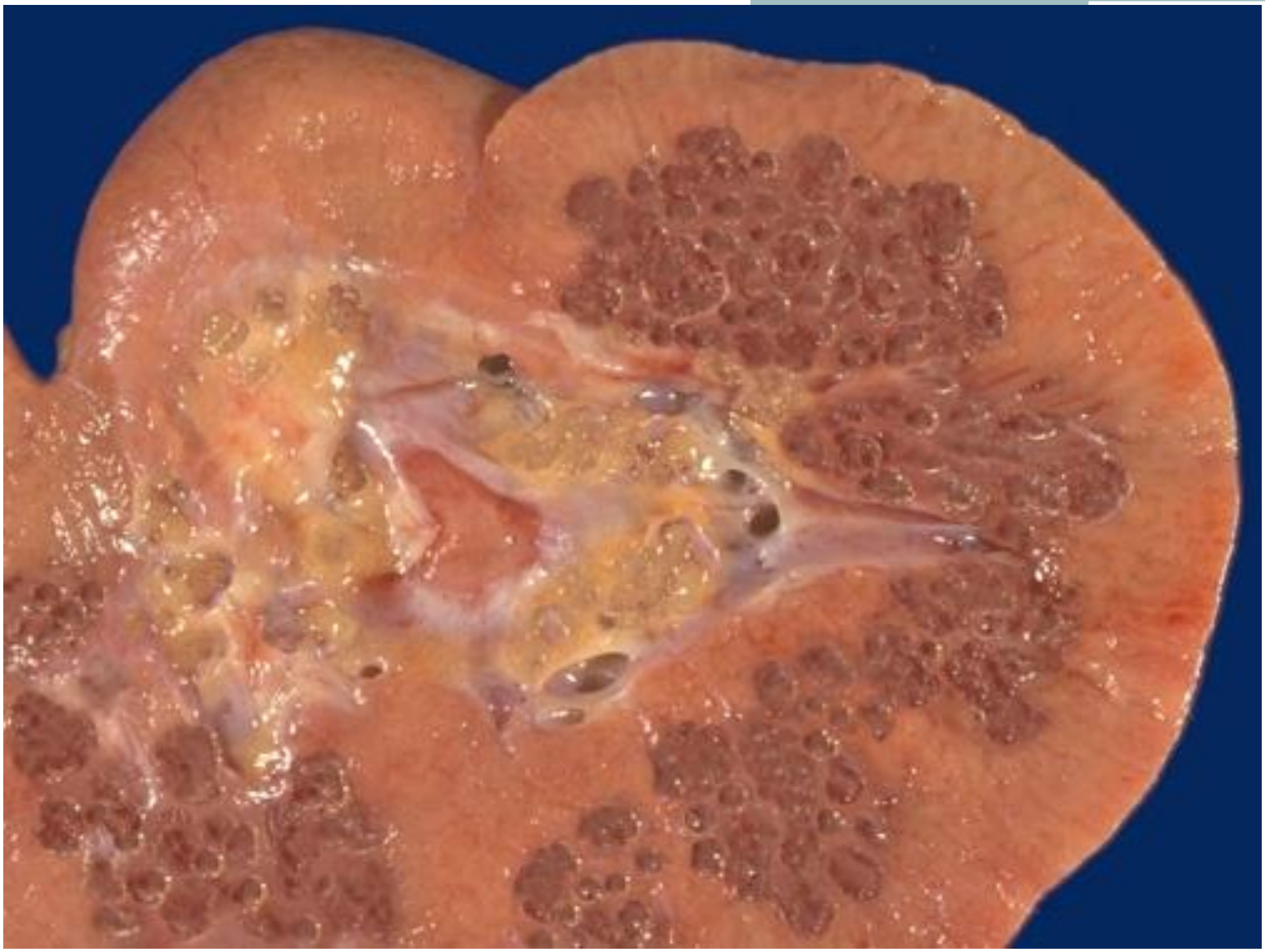


6. Medullary cystic diseases

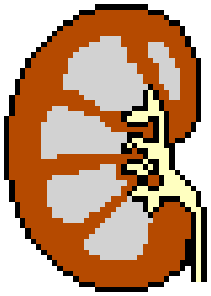
A. Medullary sponge kidney.

B. Nephronophthisis–medullary cystic disease complex: is

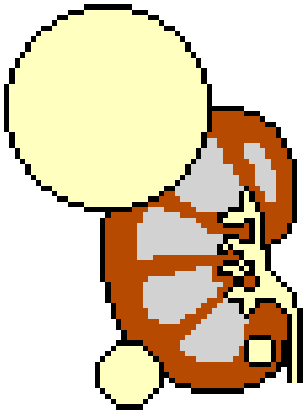
- Increasingly recognized cause CRD in children and young adults.
- **AR** disease → mutations in **NEPHROCYSTINS** (imp. in ciliary function)
- Kidneys are contracted and contain multiple small cysts → typically at **the corticomedullary junction**



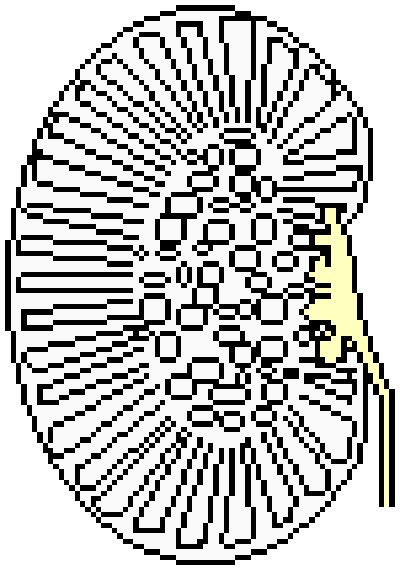
Kidney Cysts



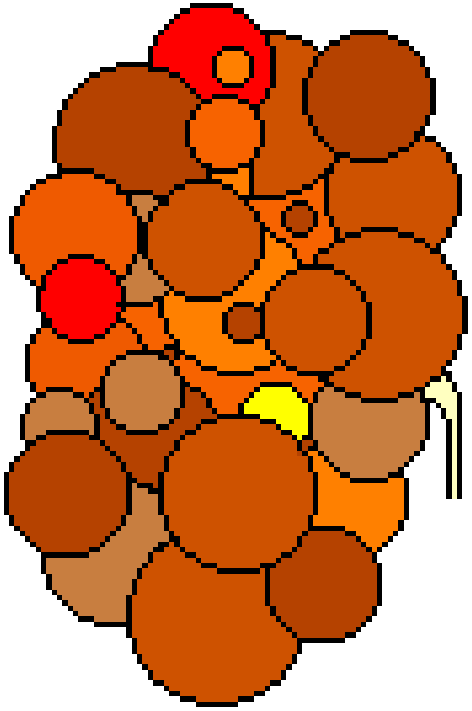
No cysts



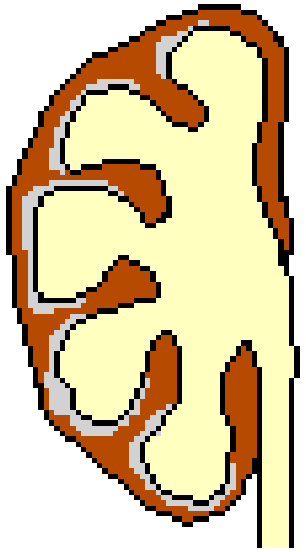
Simple cysts



Recessive polycystic

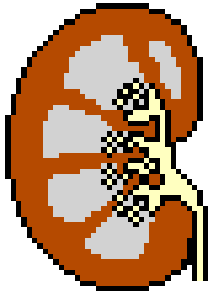


Dominant polycystic

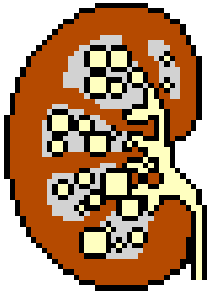


Hydronephrosis is not cysts

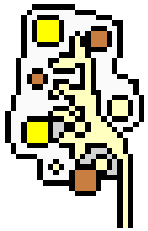
"Dysplasia"



Medullary sponge



Medullary uremic



Dialysis cystic