Nephropathology

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Anatomical remarks

- Vessels - 90% of blood flow through the cortex
- Afferent arteriole → glomerular capillaries → efferent arteriole → peritubular capillary plexus (from superficial glomeruli) or vasa recta for medulla (from juxtamedullary glomeruli)
- terminal arteries
- glomerular damage commonly leads to damage of peritubular blood flow – risk of ischemia

Possible clinical signs

- Weight gain, edema – fluid retention
- Thirst – chronic renal failure, DM
- Fatigue – acute/chronic renal failure (RF)
- Fever – urinary tract infection (UTI)
- Headache – hypertension, RF
- Hematuria – UTI, glomerulonephritis, tumor, stone
- Polyuria – DM, tubular disorders

Renal diseases commonly clinically silent!

Clinical features

- Diminished renal reserve – GFR ~ 50% of normal
- Renal insufficiency - GFR 20-50% of normal
- Azotemia – increase of blood urea and creatinine due to decreased glomerular filtration (20-30%), or extrarenal cause
- Uraemia - azotemia together with several clinical and biochemical abnormities: metabolic, endocrine, … (uremic gastroenteritis, peripheral neuropathy, fibrinous pericarditis)
- Renal failure - GFR less than 20-25%, oedema, uraemia; causes: *prerenal, postrenal, renal (vascular, glomerular, tubulointerstitial);* acute r.f. (oliguria→anuria) chronic r.f.
- End-stage renal disease - GFR less than 5% of norm
- Anuria <100ml/24hrs

Clinical features

- Nephritic syndrome due to acute glomerular disease; hematuria + mild proteinuria + hypertension; oliguria + azotemia + mineral dysbalance
- Rapidly progressive glomerulonephritis – very rapid (days - a few weeks) nephritic syndrome
- Nephrotic syndrome: usually chronic gl. dis., severe proteinuria (>3,5 g/d) + hypoalbuminemia/oedema + hyperlipidemia + lipiduria; possible ↑ infections (IgG loss)

Clinical features

- Asymptomatic hematuria and/or proteinuria – commonly mild glomerular lesion
- Polyuria + nocturia + electrolyte disorders – renal tubular defects
- Bacteriuria + pyuria – urinary tract infection (UTI)
- Renal colic + hematuria - nephrolithiasis

Renal diseases

- congenital anomalies
- glomerular diseases
- tubulointerstitial diseases
- vascular diseases
- tumors

Congenital anomalies

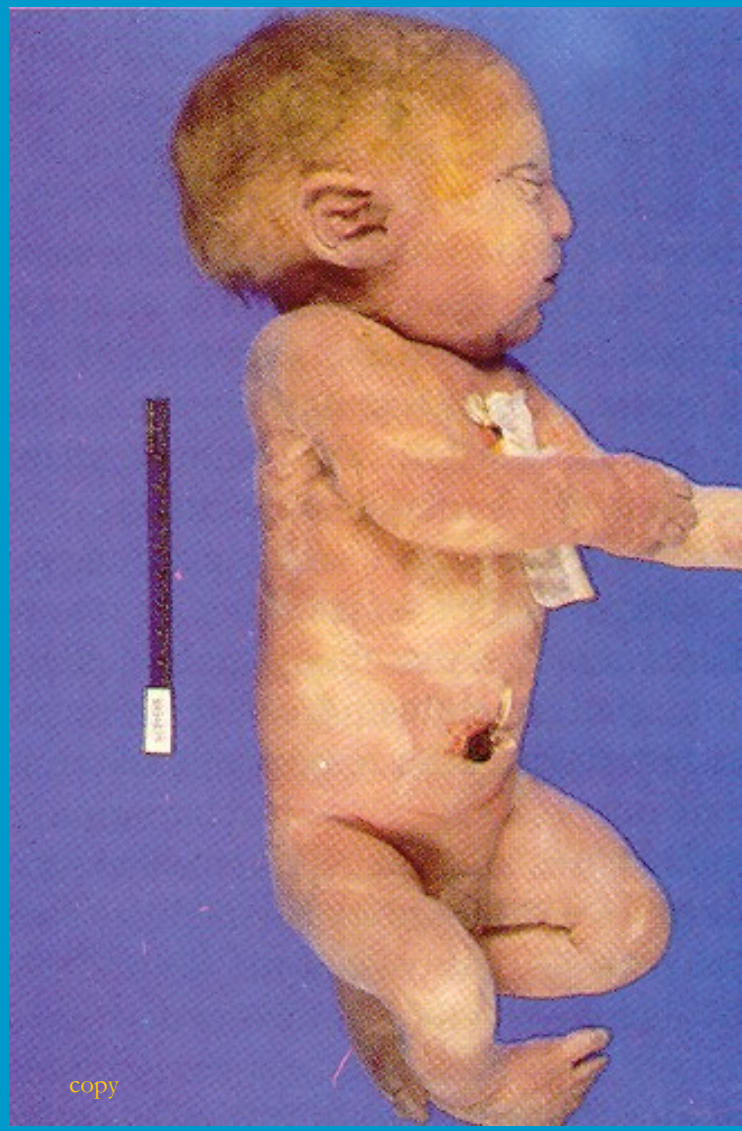
- 10% of all people
- hereditary or acquired developmental defect
- decreased volume of renal tissue (e.g. agenesis)
- disorders of differentiation (dysplasia)
- anatomical abnormalities (ectopy)
- metabolic disorders (cystinuria)

Agenesis

- Bilateral agenesis – incompatible with independent life, usually stillborn, accompanied by characteristic appearance (Potter's syndrome), commonly associated with other congenital defects
- Unilateral agenesis – infrequent, the opposite kidney enlarged by compensatory hypertrophy

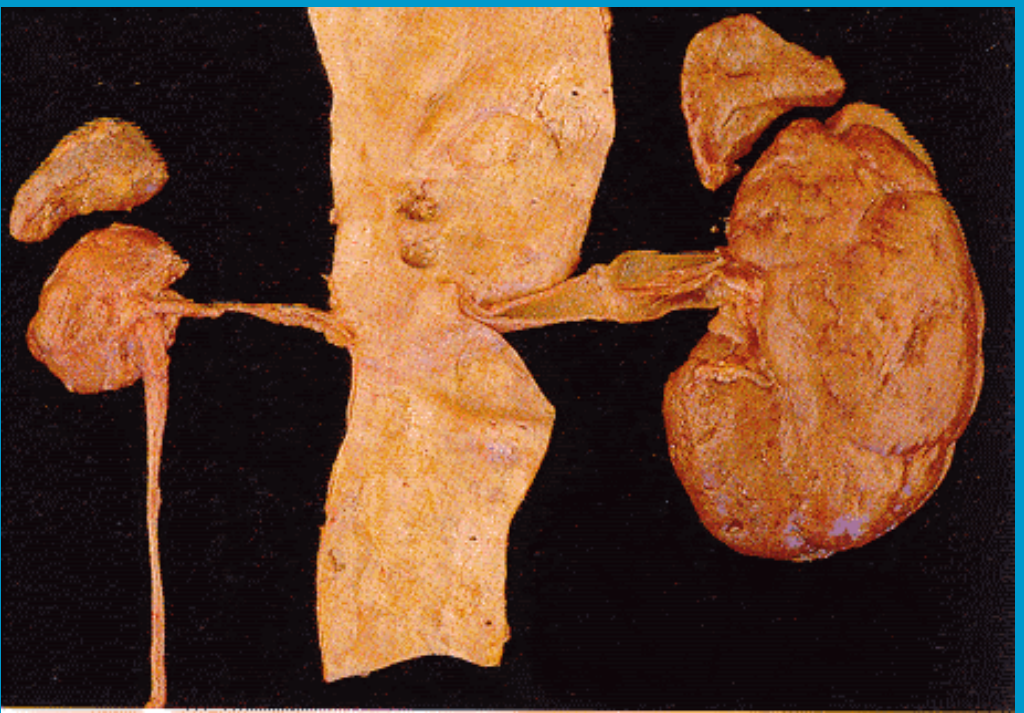
Oligohydramnion (Potter´s syndrome)

decreased amount of amniotic fluid (placental abnormities, renal **agenesis or malformation**



Hypoplasia

- Abnormally small kidneys (x atrophy)
- reduced number of lobes and pyramids



Renal ectopy

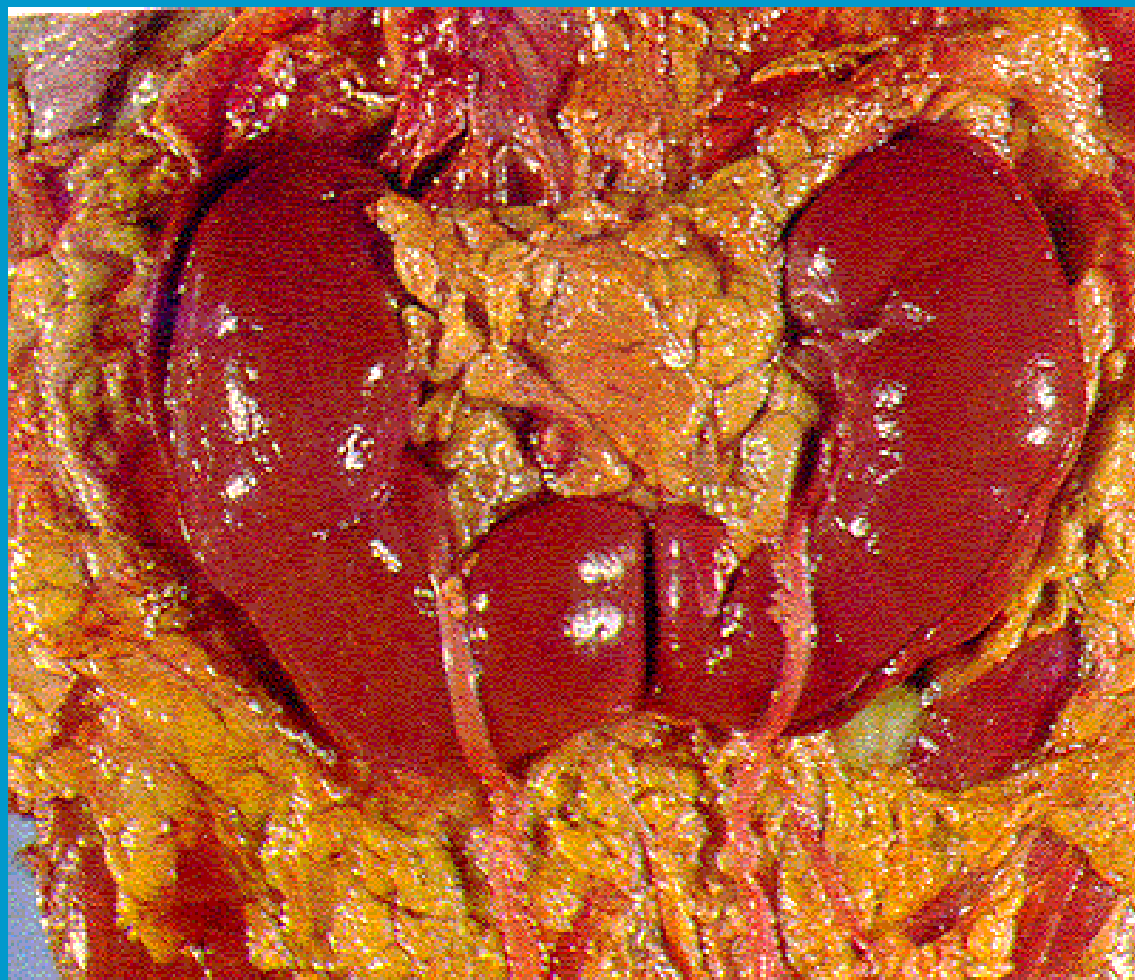
- Abnormal site, usually in pelvis, due to migration stop of the *metanephros*
- *A. renalis* - from lower aorta or *a. ilica communis*
- Short ureter

Ren migrans, ren mobilis

- Not a malformation, normal *a. renalis*
- Secondary renal descensus, usually due to loss of adipous capsule
- Long ureter, risk of obstruction and infection

Horseshoe kidney

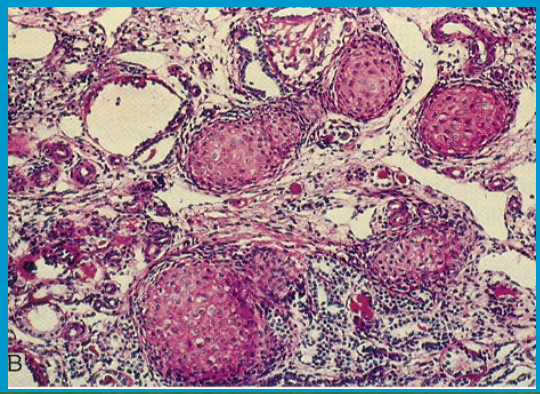
- Renal pole fusion
- Ureteral obstruction



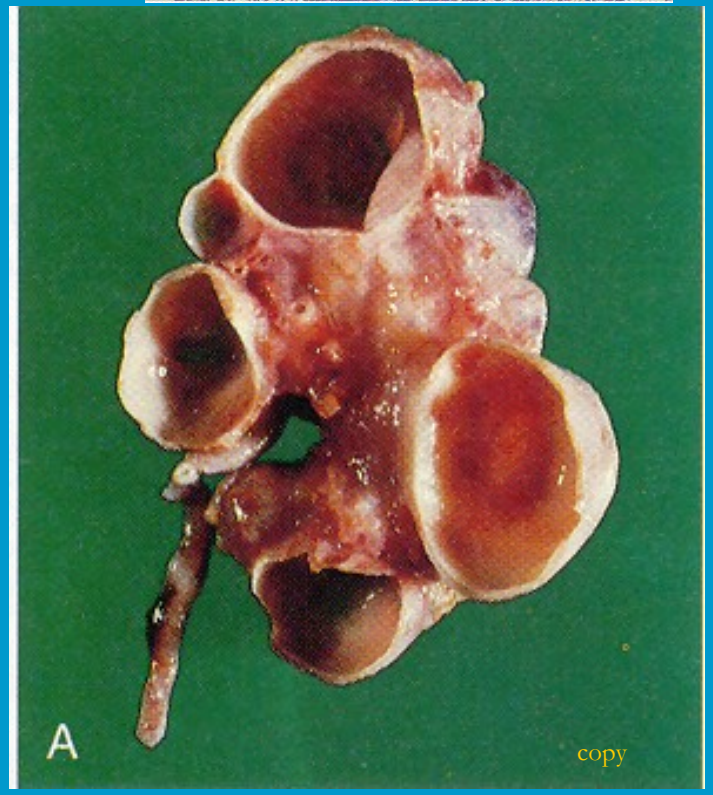
Cystic renal disease

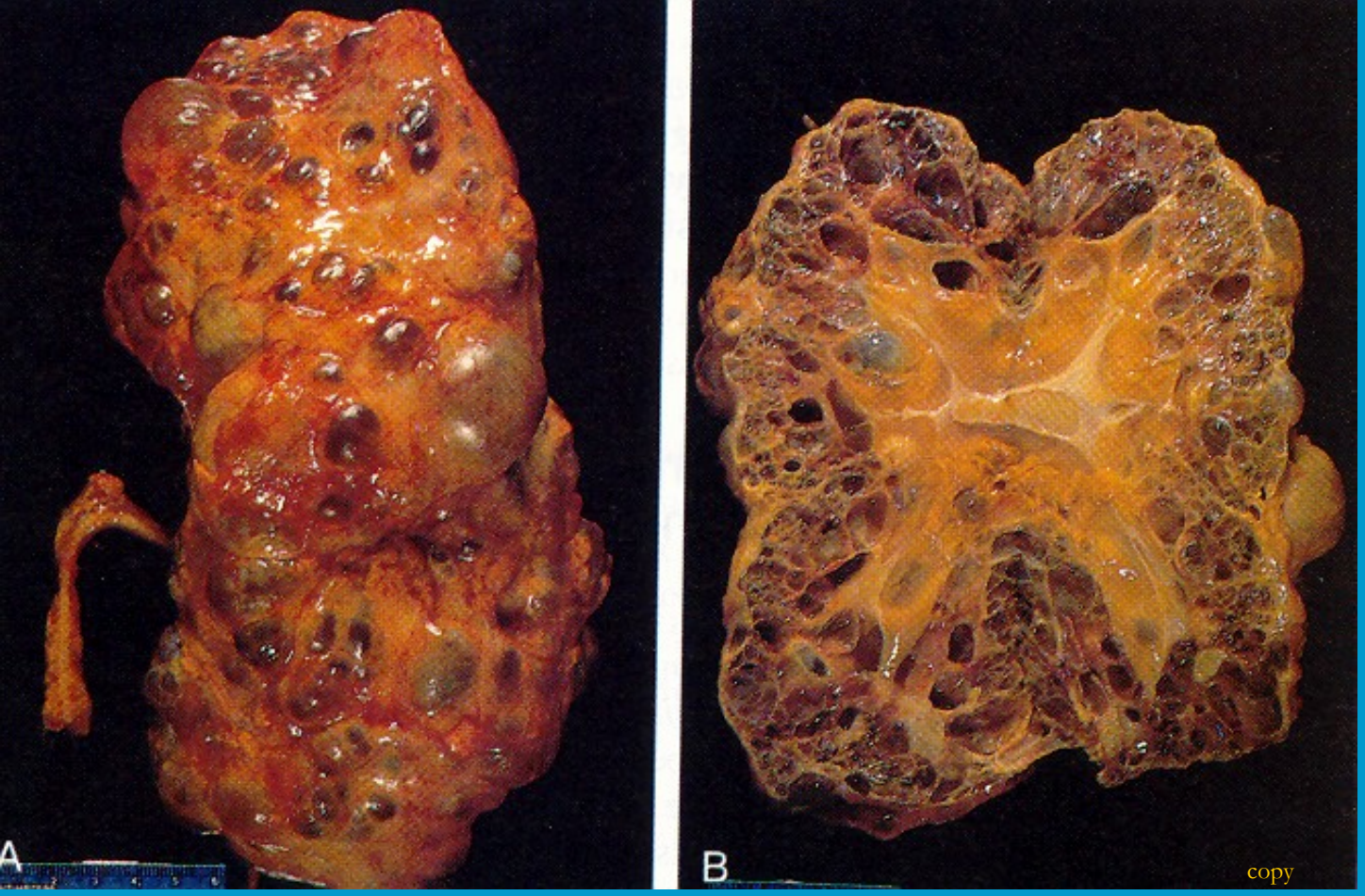
- Hereditary, congenital nonhereditary, acquired
- Pathogenesis: primary defect of tubular epithelial cells and their growth, resulting in tubular dilatation
- Secondary tubular obstruction (oxalate crystals etc.)
- Multiple or solitary
- Affects the whole kidney, or mostly cortex or medulla

Cystic dysplasia



- Uni- or bilateral
- Enlarged multicystic kidney
- Cysts mm-cm.
- Islands of undifferentiated mesenchyme, immature tubules
- Commonly cartilage
- Bilateral - renal insufficiency





Adult polycystic kidney disease (APKD)

Autosomal-dominant, liver cysts, berry aneurysms. Pain, hematuria, UTI, stones, hypertension, chronic RF at 40-60 yrs. ↑risk of ca

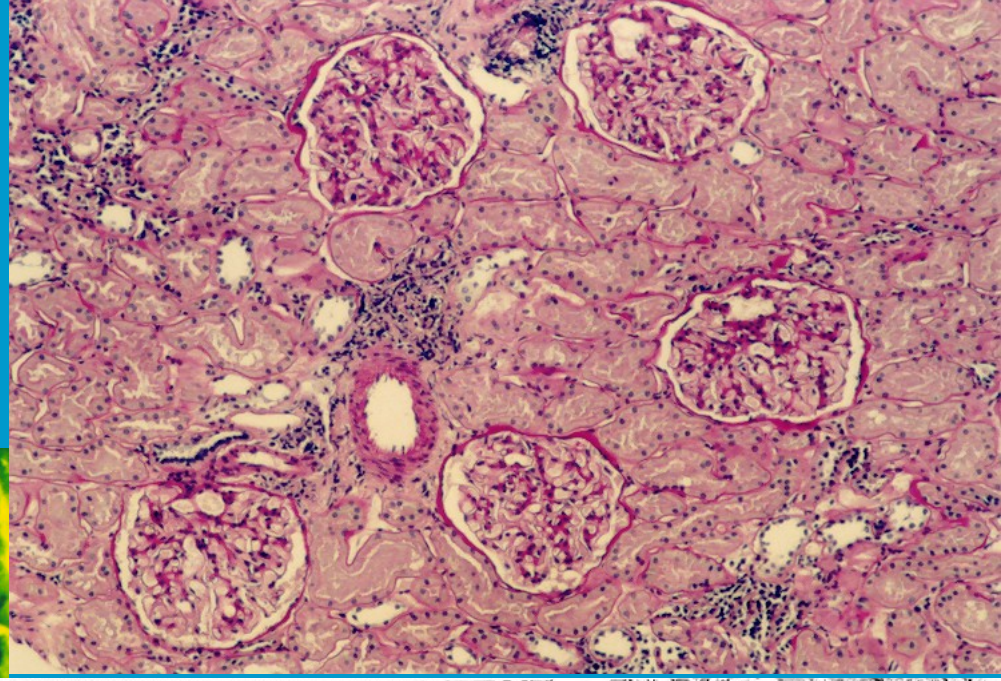
Polycystic kidney - autosomal recessive

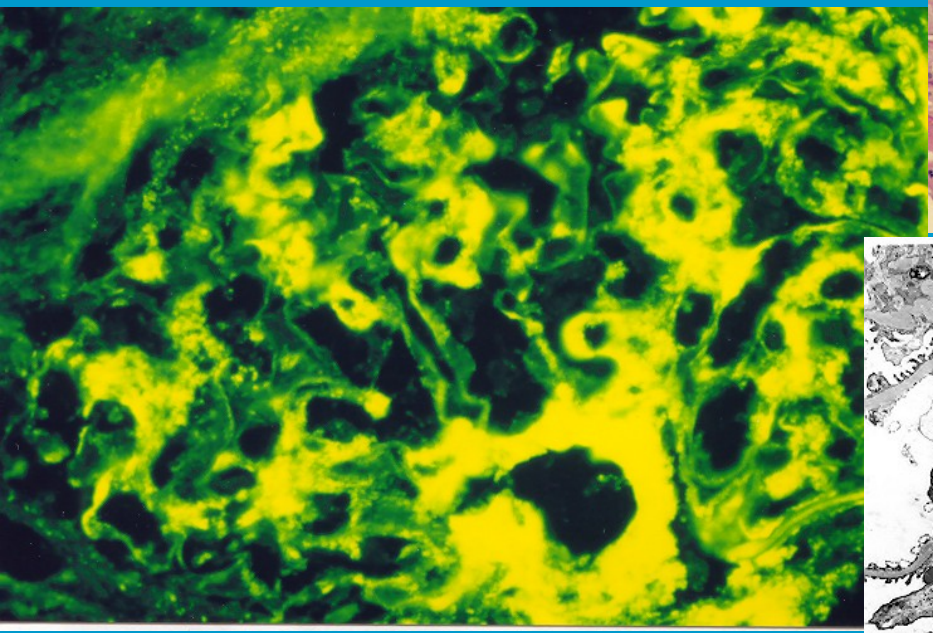
- Childhood
- Enlarged kidney at birth, smooth surface
- Radial elongated cysts and channels
- Congenital hepatic fibrosis
- RF in childhood

Simple cyst

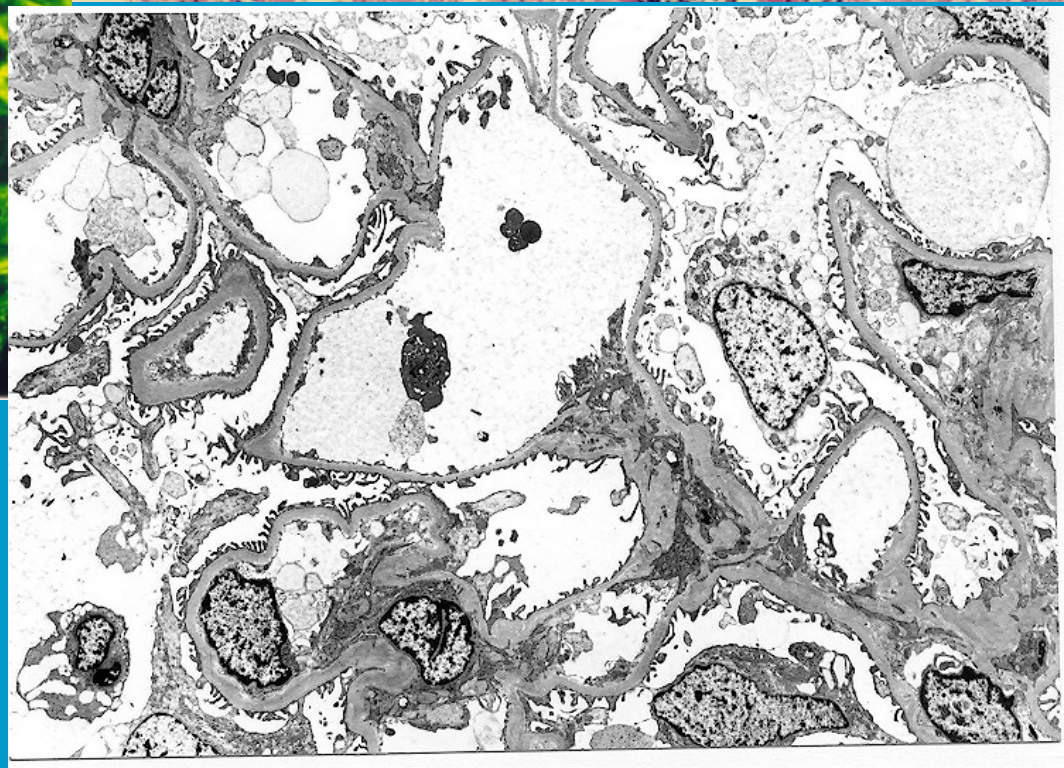
- Single or multiple
- Up to 10 cm
- Haemorrhage posible
- Differential diagnosis x cystic tumors
- „Complicated“ cyst – with regressive changes, diff. dg. x ca

Renal biopsy



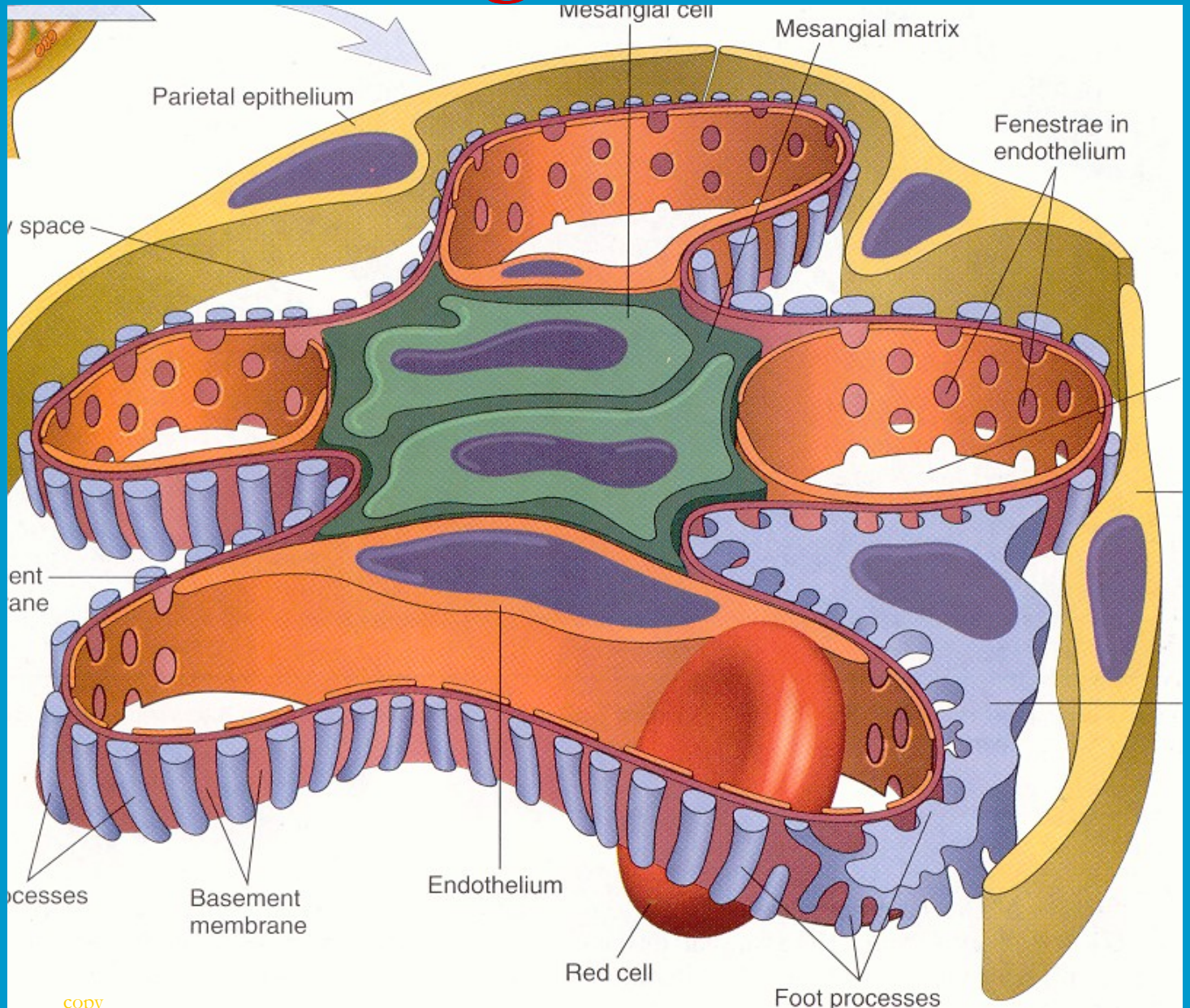


Direct immunofluorescence



Electron microscopy

Normal glomerulus



Glomerular diseases

- Classification by aetiology and mechanisms of injury (primary x secondary; immunological x non-immunological)
- Histological classification (patterns of injury – proliferative, membranous change, membrano-proliferative, crescentic, hyalinosis + sclerosis)
- One disease may have variable morphology/pattern (SLE)
- One pattern may be seen in variable disorders

Glomerular diseases

- Nephritic syndrome, rapidly progressive GN: inflammation +/- endothelial damage;

Immune complex deposition (acute proliferative GN, SLE)

Antibodies x glomerular basement membrane (Goodpasture sy)

Systemic noninfectious vasculitis: autoantibodies p-ANCA, c-ANCA; (polyangiitis with granuloma)

Glomerular diseases

- Nephrotic syndrome: malfunction/leakage of barrier-filtration system - ↑ increased permeability

Capillary wall: thickening by in situ IC deposits (membranous glomerulopathy; primary, sec.), abnormal substances (DM, amyloid)

Epithelial cells: loss of normal structure (foot processes in minimal change disease; disruption in focal segmental glomerulosclerosis)

Patterns of glomerular injury

- **Proliferative** – increased glomerular cellularity, combination of endogenous proliferation and exogen. infiltration
- **Membranous change** – thickening of loops due to BM expansion
- **Membrano-proliferative**
- **Crescentic** – florid prolif. of cells in Bowman‘s capsule + infiltration, later fibrotic changes
- **Hyalinosis** – extracellular/intramural amorphous material
- **Sclerosis** – extracellular collagenous matrix

Immune mechanisms of glomerular injury

Antibody-mediated injury

- **In situ immune complex deposition** (fixed intrinsic tissue antigens incl. GBM; planted antigens – exo- or endogenous
- **Circulating immune complex deposition**
- **Cytotoxic antibodies**

Cell-mediated immune injury

Activation of alternative complement pathway

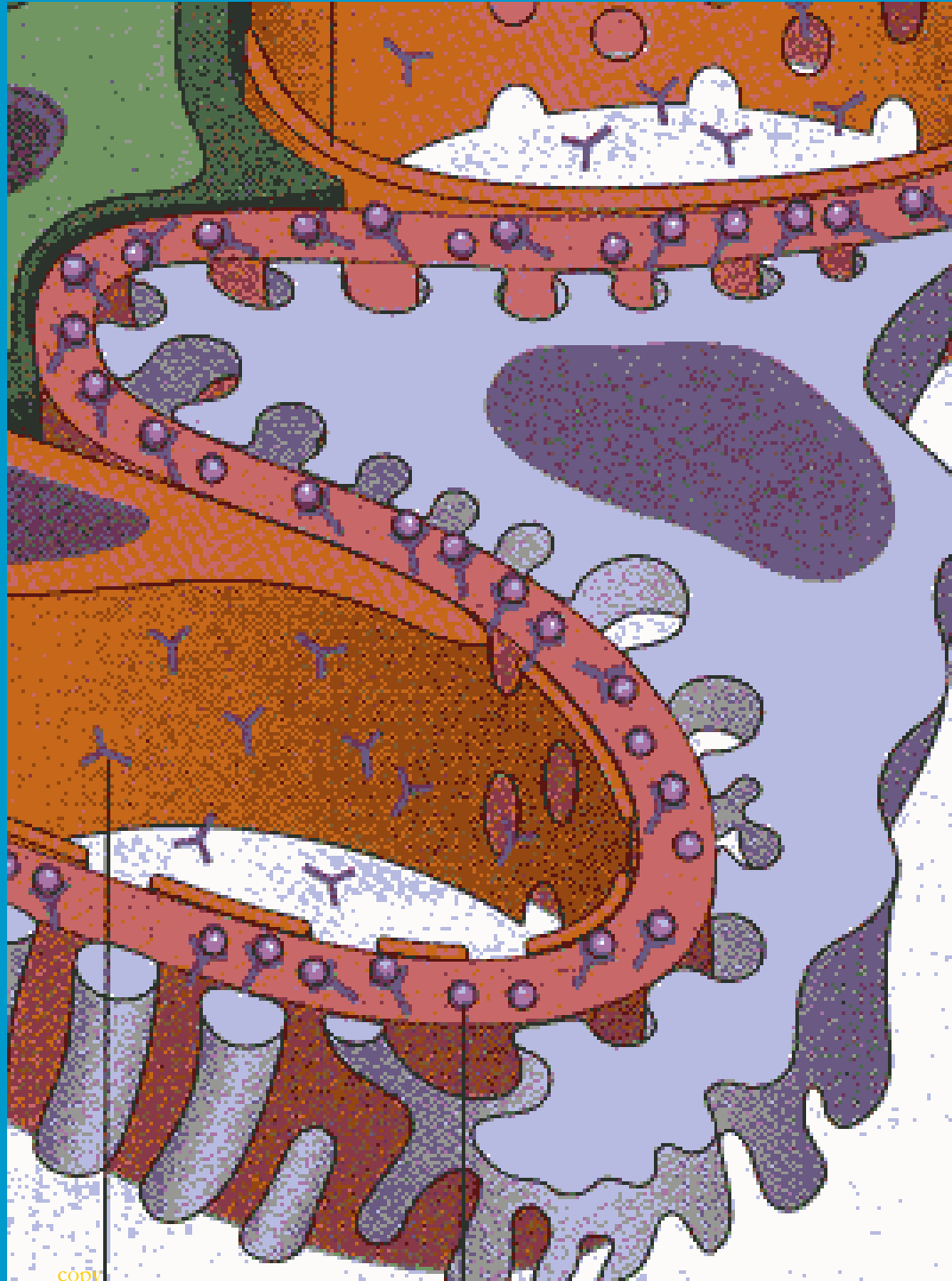
IMMUNOLOGIC PROCESSES in PATHOGENESIS

1) **Nephrotoxic antibodies against an antigen within the glomerular BM; Ag binds with Ab *in situ***

Anti-GBM glomerulonefritis

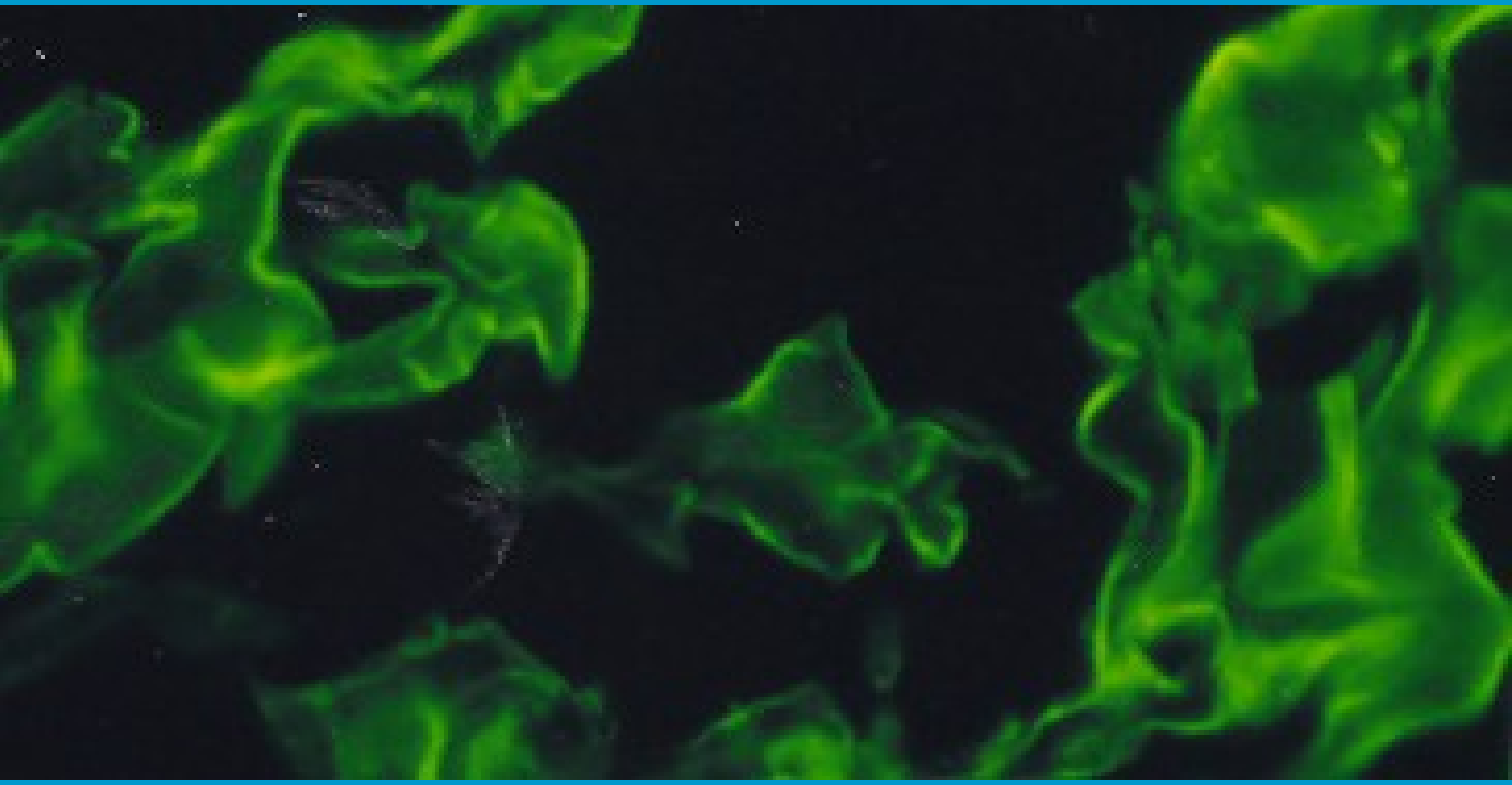
Nephrotoxic anti-GBM antibodies react with Goodpasture antigen in GBM

uncommon cause of GN



Anti-GBM glomerulonefritis

Linear positivity of IgG along glomerular basal membranes

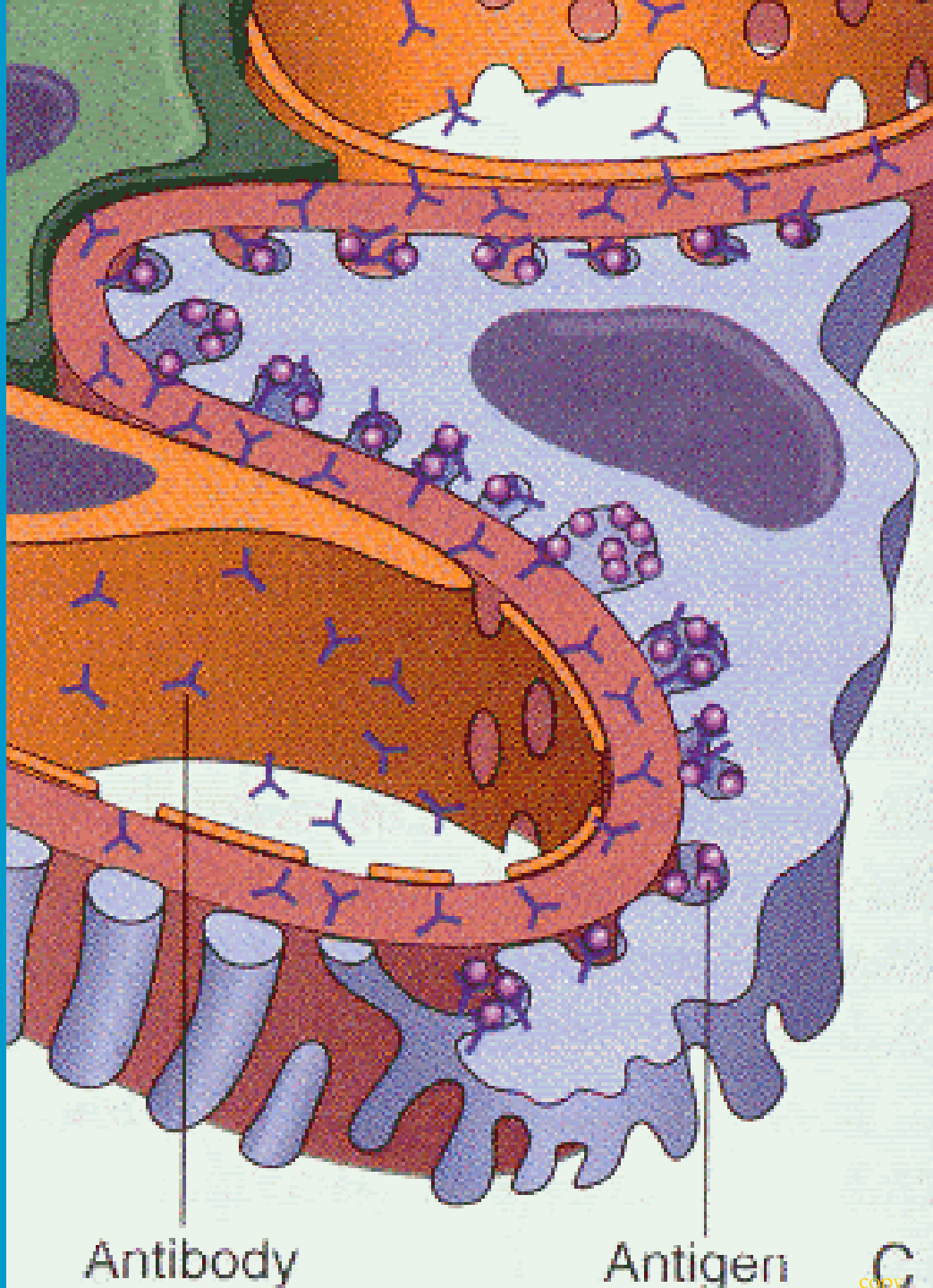


IMMUNOLOGIC PROCESSES in PATHOGENESIS

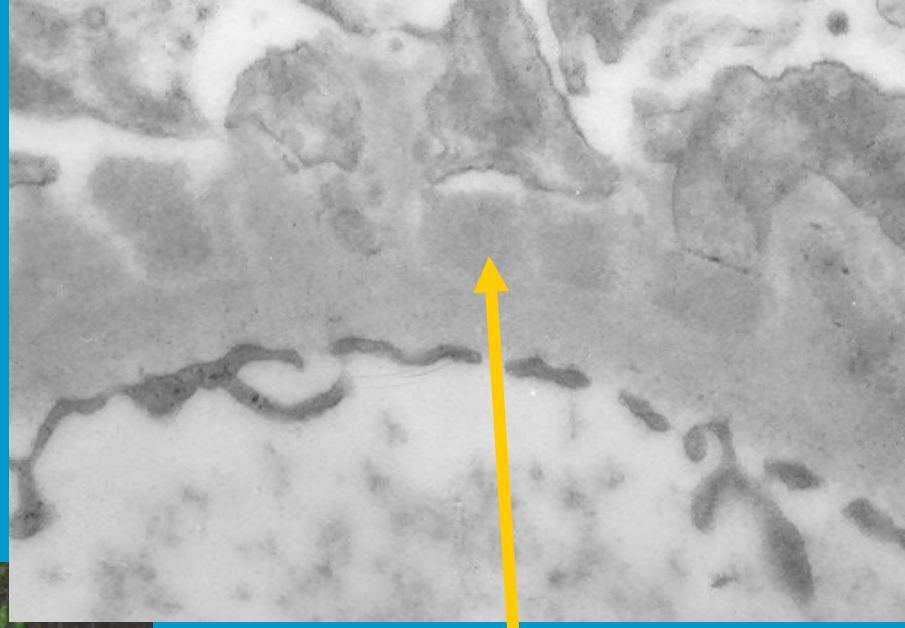
2) Antibodies reacting with epithelial Ag *in situ.*

subepithelial aspect of BM, membranous pattern – primary membranous GN – podocyte injury + loss of pedicles, but no inflammation (?complement)

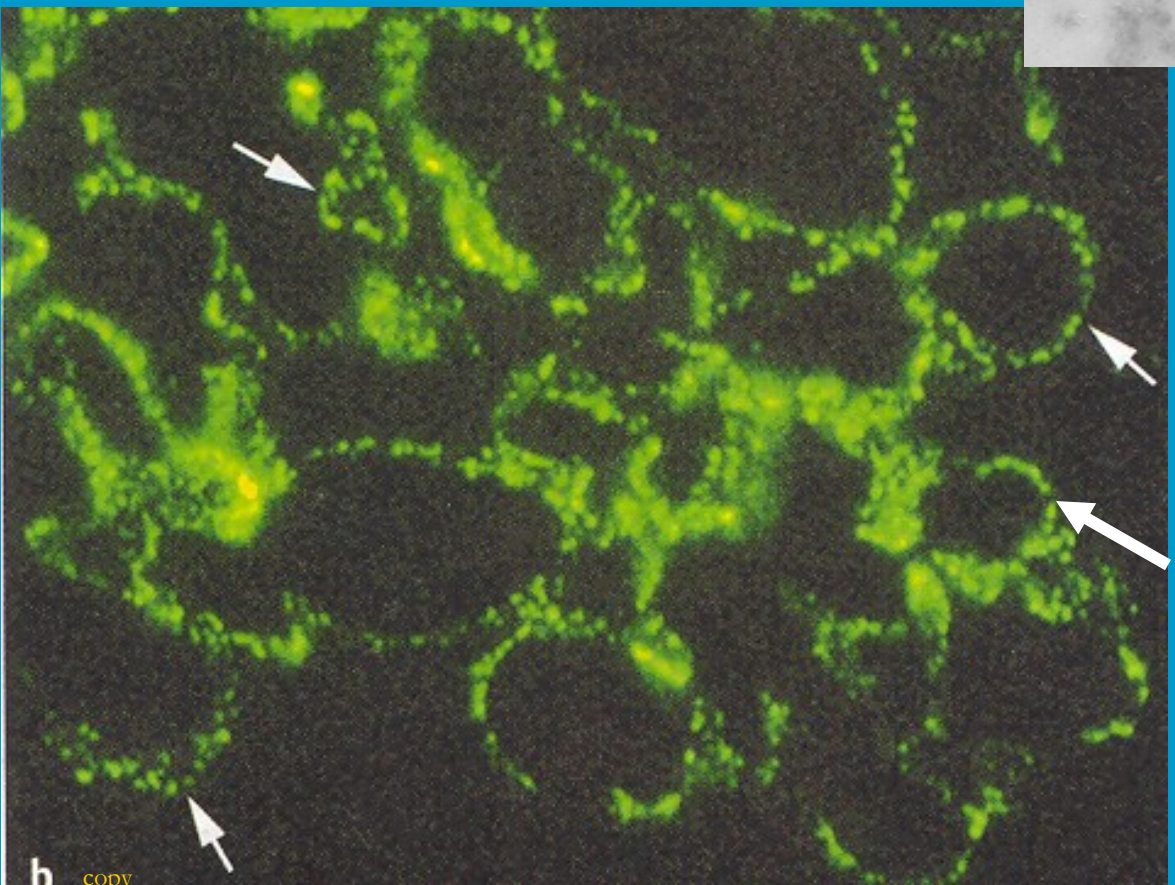
- Autoimmune membranous glomerulopathy



Autoimmune membranous glomerulopathy



ELMI



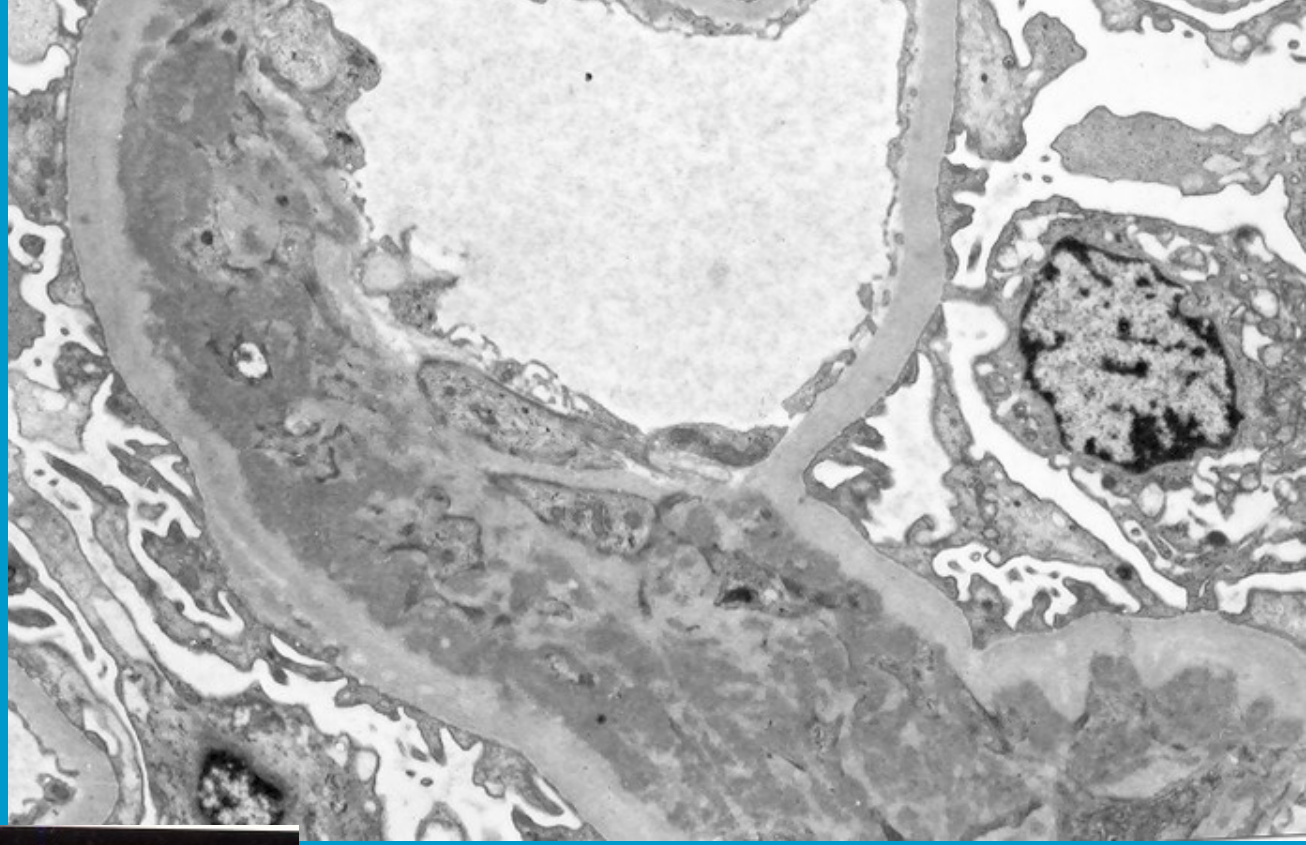
Subepithelial deposits

Immunofluorescence – granular deposits

IMMUNOLOGIC PROCESSES in PATHOGENESIS

3) Antibodies reacting with **implanted** nonglomerular antigens ***in situ.***

Planted antigenes



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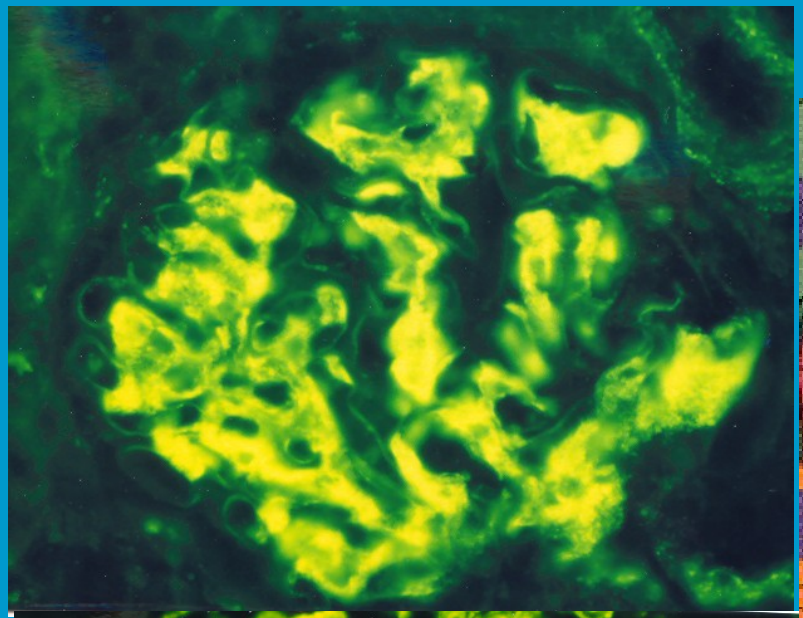
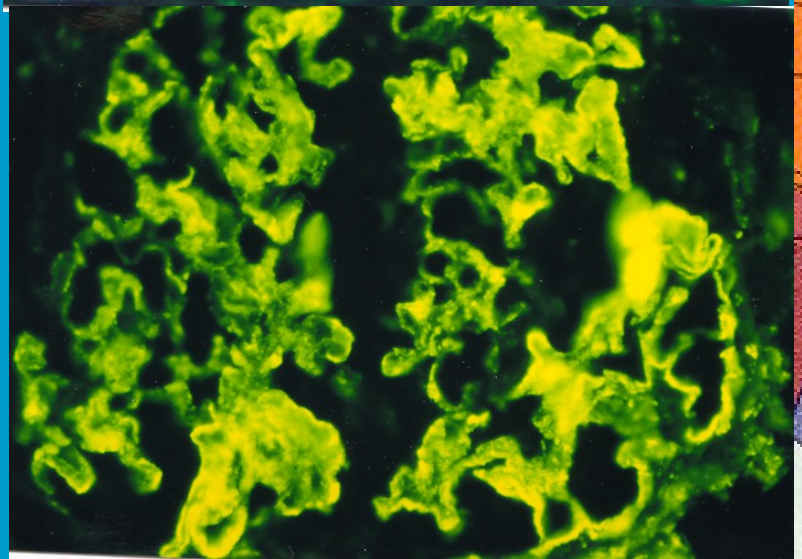
Immune deposits granular, similar to circulating immune complex nephritis

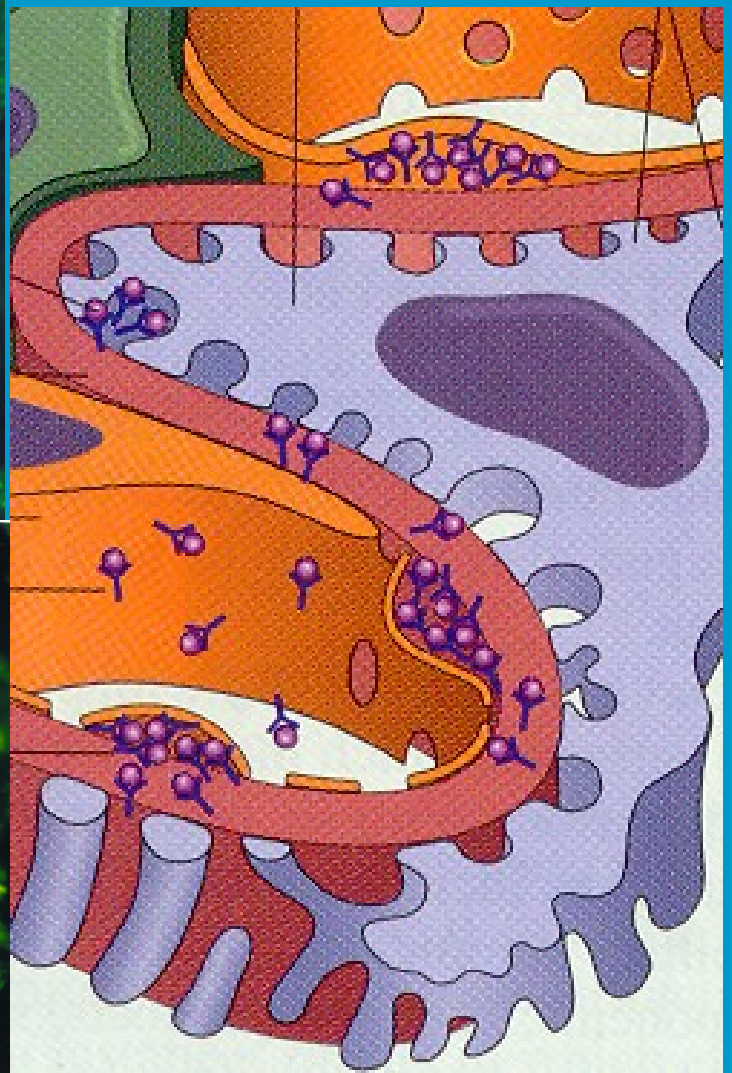
IMMUNOLOGIC PROCESSES in PATHOGENESIS

4) Trapping or binding of circulating antigen-antibody immune complexes within glomeruli, Ag **nonglomerular**.

Variable deposition of IC in the glomerulus







Immune complex GN

- Injury by: complement activation, leukocytic infiltration, renal cells (mesangial, endothelial) activation + proliferation
- Deposits localization according to size/charge of complexes, local changes:

  subendothelial (SLE, membranoproliferative GN)

  epimembranous (membranous GN)

  subepithelial (acute proliferative GN)

  mesangial (IgA nephropathy)

IC site → type of lesion

- mesangial, subendothelial → contact with blood → complement activation + inflammatory/proliferative reaction → nephritis + hematuria (IgA disease, membrano-proliferative GN)
- subepithelial → no direct contact with blood → no inflammation → nephrotic sy (membranous glomerulopathy)

Cytotoxic antibodies

- AB x mesangial cells → damage → repair by mesangial cell proliferation
- AB x endothelial cells → e. injury → thrombosis

Cell mediated damage

- Sensitized T lymphocytes release chemokines activating and attracting macrophages
- Macrophages act as effector cells

Progression in glomerular disease

- ↓ GFR (30-50% of normal) → independent progression to RF – ablation nephropathy
- Focal segmental glomerulosclerosis – adaptation – compensatory glomerular hypertrophy (glomerular + systemic hypertension → proteinuria → mesangial proliferation + matrix accumulation → sclerosis)
- Tubulointerstitial fibrosis – proteinuria + ischemia → tubular damage + interstitial inflammation

Glomerulopathy

- Antigen-antibody deposition – general pathway of injury + local hemodynamics + structure/changes of glomerulus →

  variable morphologic/functional alterations

Glomerular injury distribution

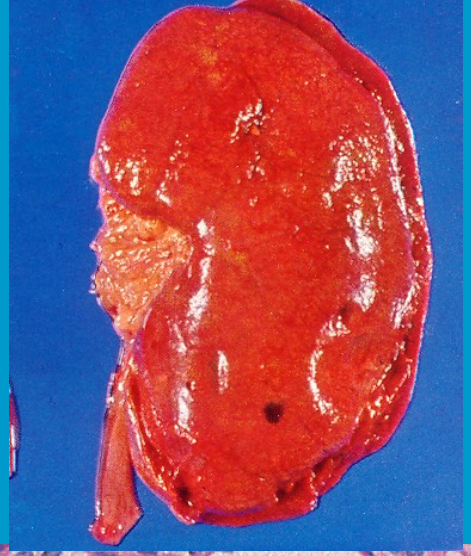
- **Diffuse** – almost all glomeruli affected (> 50-80%)
- **Focal** – only some glomeruli
- **Global** – affecting the whole glomerulus
- **Segmental** – affecting only part of the glomerulus

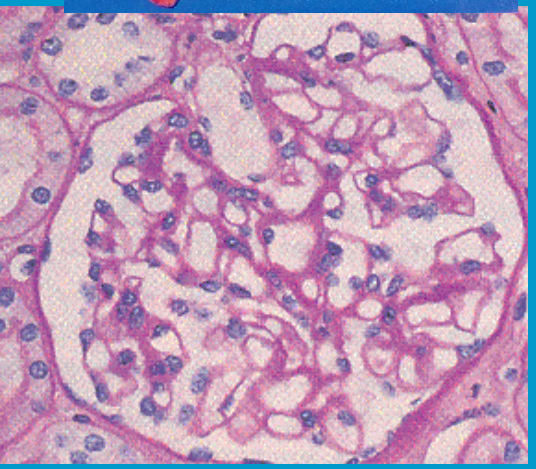
Clinical presentations

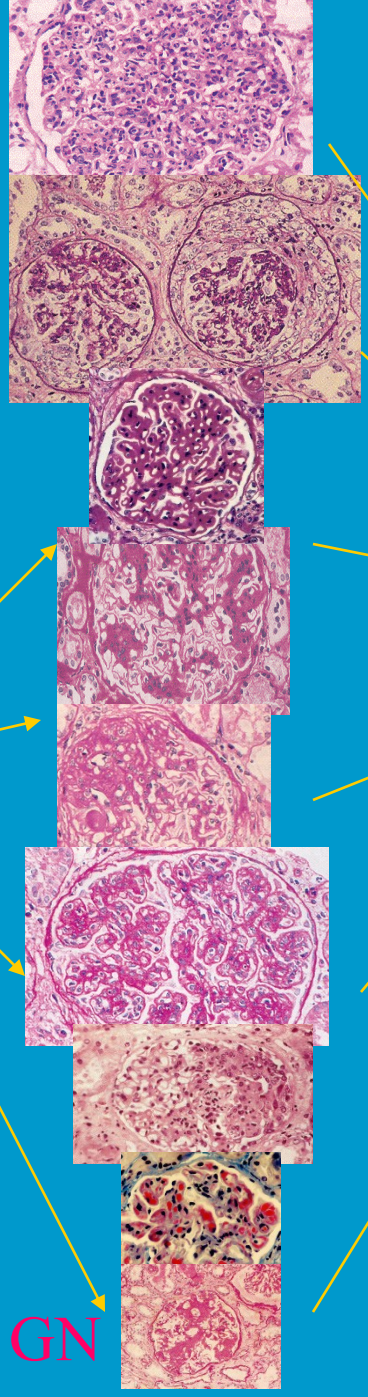
- Acute nephritic syndrome – rapid start, hematuria, hypertension; variable proteinuria, oliguria, azotemia
- Nephrotic syndrome - heavy proteinuria > 3,5 g, oedemas, hypoalbuminemia, hyperlipidemia, lipiduria
- Isolated, sometimes asymptomatic hematuria or proteinuria
- Acute renal failure – progressive oliguria to anuria, azotemia
- Chronic renal failure - prolongated symptoms of uremia, anemia, nausea

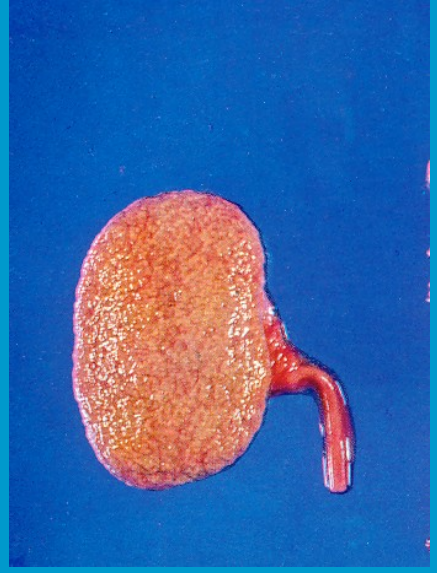
GLOMERULAR DISEASES

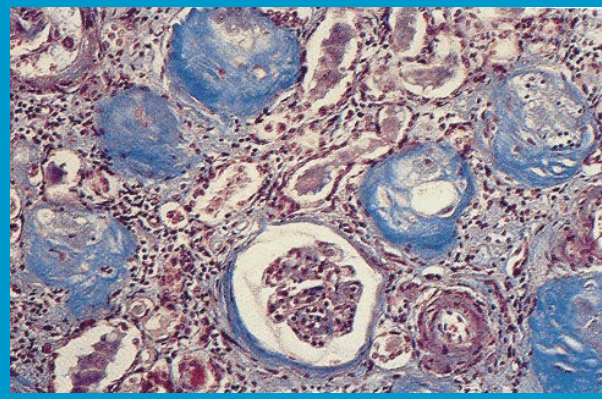
- PRIMARY GLOMERULAR DISEASE: kidney as a main affected organ, other clinical signs due to impaired renal function (i.e. minimal change disease)
- SECONDARY GLOMERULAR DISEASE: renal injury only a part of systemic disease affecting multiple organs (lung, joints, skin), i.e. SLE











Normal kidney

GN

Chronic sclerosing GN

Glomerulopathy

- One histological type may have variable clinical presentation, i.e. membranoproliferative lesion may present as glomerulonephritis with nephritic sy, glomerulopathy with nephrotic sy, or isolated hematuria

Glomerulopathy

- Acute nephritic sy:
  - acute (diffuse endocapillary) proliferative GN
  - membranoproliferative GN (C3, prim. IC),
    - mixed w. nephrotic
  - rapidly progressive GN (lupus)
- Isolated or dominant hematuria
  - IgA nephropathy
  - Purpura Henoch-Schönlein
  - Alport sy /thin BM – collagen IV

Glomerulopathy

- Proteinuria or nephrotic sy
  - Minimal change disease
  - Focal segmental glomerulosclerosis
  - Membranous glomerulopathy
  - Other immune complex GN
  - Amyloidosis
  - DM nephropathy

Glomerulopathy

- In vascular disorders
  - systemic vasculitis (ANCA+, microscopic polyangiitis, anti-GBM GN)
  - in hypertension
  - thrombotic microangiopathy (HUS, thrombotic thrompocytopenic purpura)
  - other vascular changes (infarction, renal artery stenosis)
- SLE (variable changes)
- Chronic GN

Acute nephritis

- Primary:

  diffuse proliferative (post-infectious) GN

  rapidly progressive glomerulonephritis incl. anti-GBM disease

  membrano-proliferative GN

- Secondary: mostly in vasculitis – SLE,

  polyarteritis

  granulomatosis with polyangiitis (Wegener)

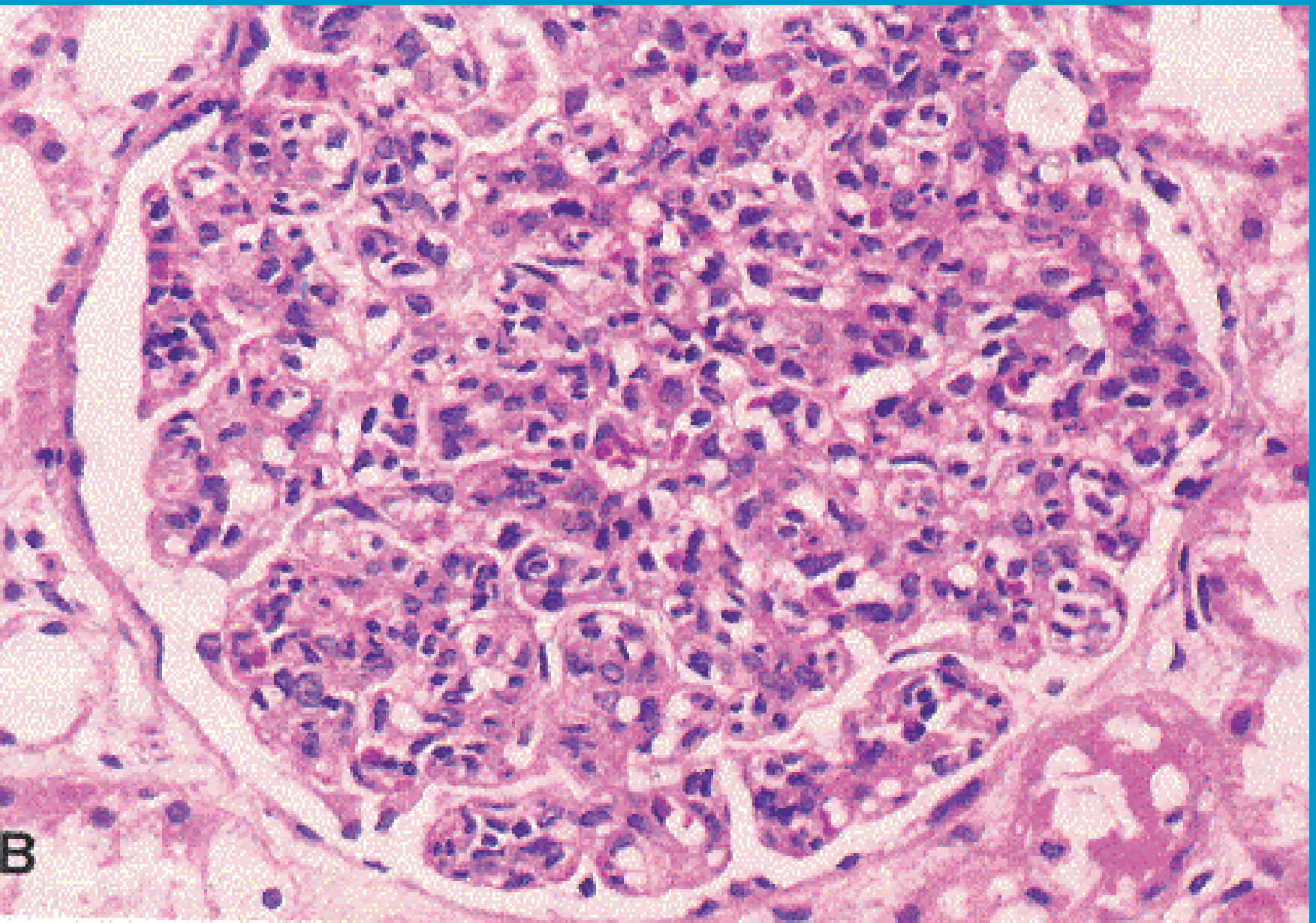
  Henoch-Schönlein purpura

  cryoglobulinemia

Diffuse proliferative GN

- postinfectious (str., staph., viruses, protozoan - malaria, toxoplasmosis; schistosomiasis)
- any age, children more commonly
- acute nephritis (+ fever, nausea)
- may be partially crescentic (→ progressive)
- prognosis – regeneration usual in children, in adults possible ↓ renal function

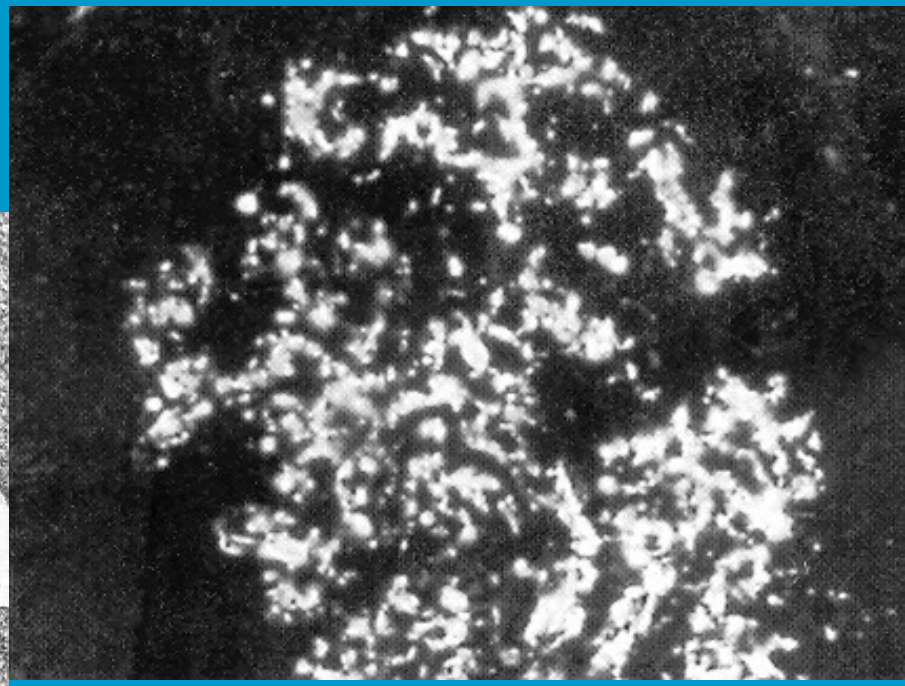
Diffuse proliferative GN



Diffuse proliferative GN

subepithelial immune complex deposition, postinfective

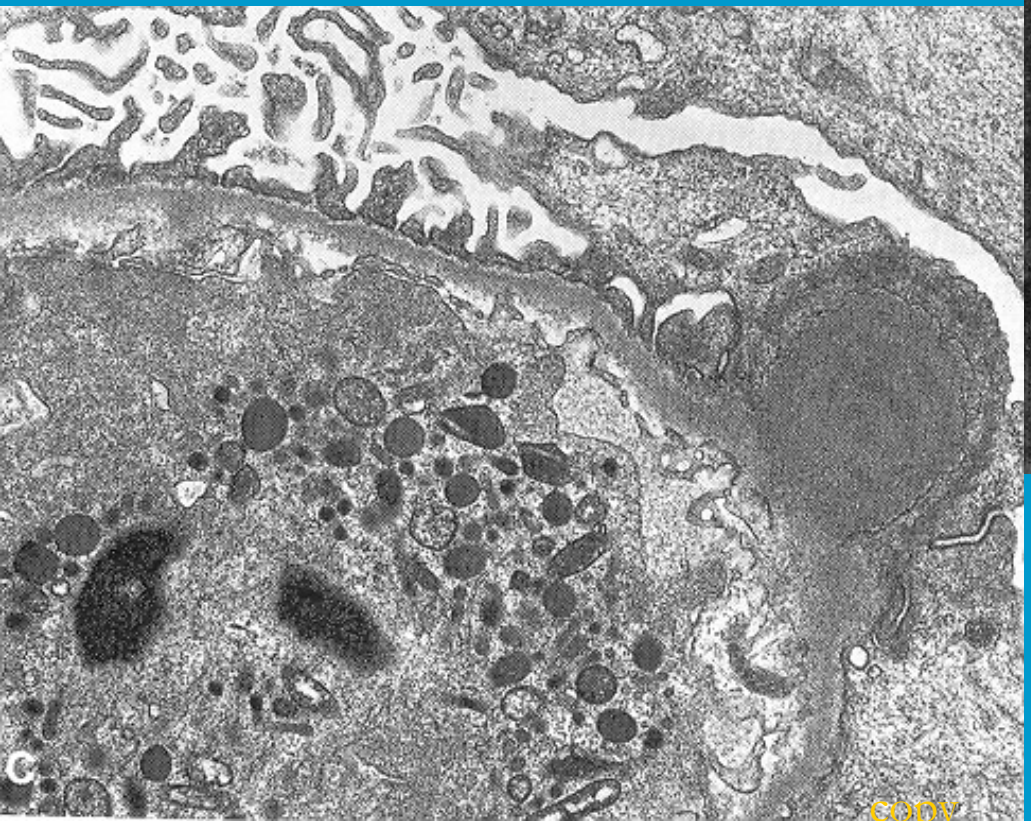
Immunofluorescence



granular deposits

Elmi

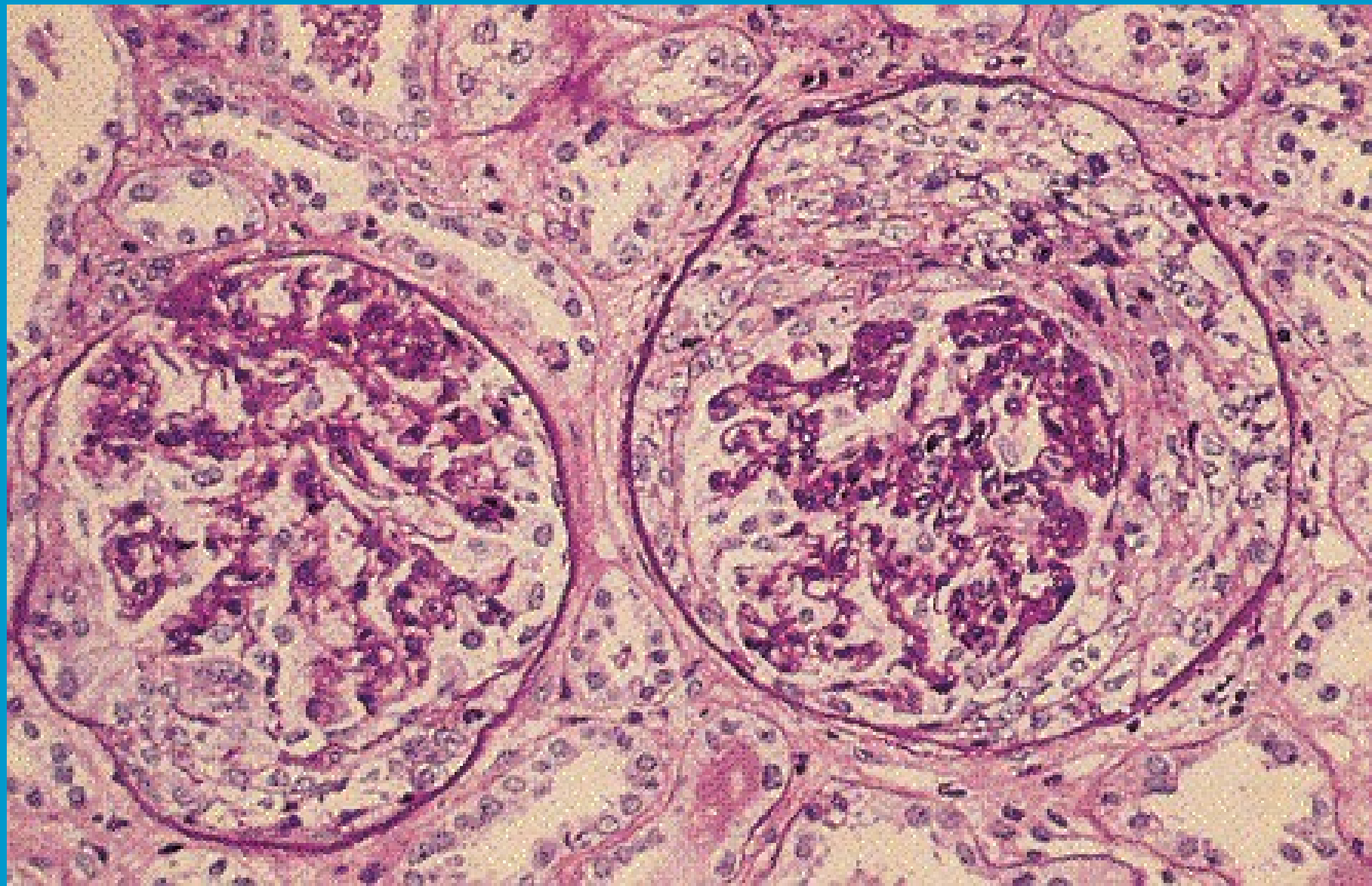
„humps“



Crescentic GN

- clinically rapidly progressive GN
- various etiology (immune-complex mediated, pauci-immune + ANCA, anti-GMB)
- primary or secondary (small vessel vasculitis, SLE,…)
- necrotising GN – capillary rupture, exudation – extracapillary proliferation - crescentic
- Immunosuppression in active lesion + plasma exchange in known circulating AB (anti-GBM)
- No direct therapy in fibrosing lesion

Rapidly progressive (crescentic) GN



Vasculitis

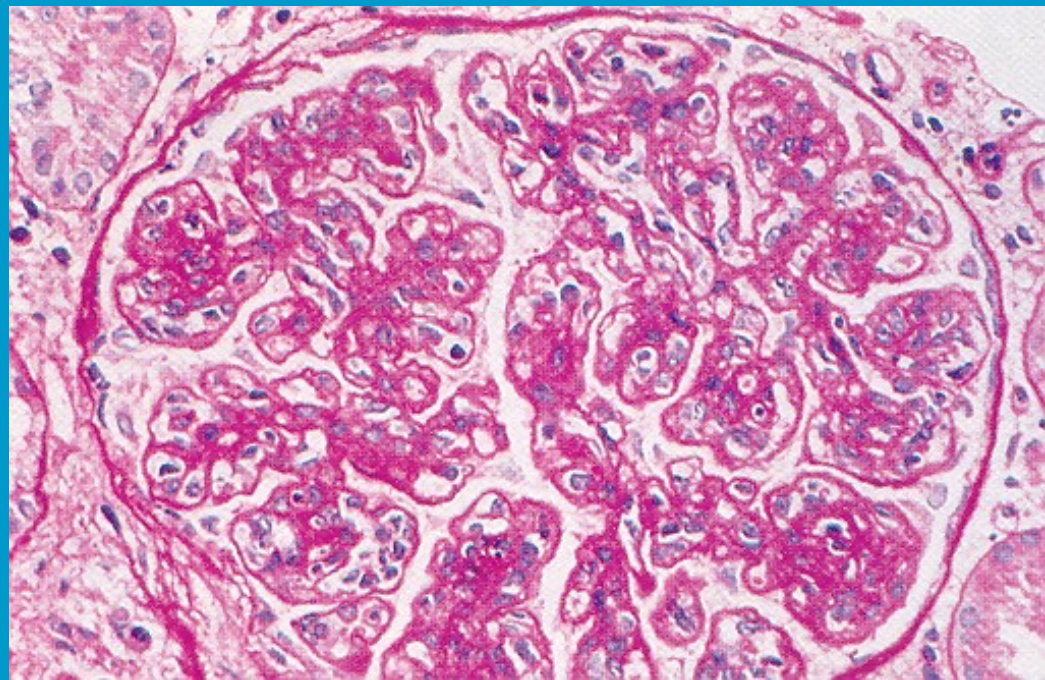
- Small vessel vasculitis (granulomatosis with polyangiitis – Wegener; ANCA+ vasculitis)
- Incidence ↑ with age
- Renal or multiorgan
- Rapidly progressive GN, hematuria, proteinuria, red cell casts

Anti-GBM disease

- uncommon
- rapidly progressive renal failure +/- hemoptysis (Goodpasture sy)
- linear deposits of IgG

Membranoproliferative GN

- pattern of variable diseases
- mesangial + endothelial cells activation and proliferation (mesangiocapillary GN), mesangial matrix expansion, BM thickening – „duplication – tram-track“
- nephrotic syndrome or acute nephritis



Membranoproliferative GN

- secondary to other diseases - IC: cryoglobulinemia (80% due to HCV); SLE, HIV; malignancy (CLL, ML), alpha1- AT deficiency),
- primary MPGN: young, poor progn., CHRI, recurrent in graft
- nephrotic sy, mixed nephrotic + nephritic
- C3 glomerulopathies – C3 activation control defect
  - morphology
    - Type I MPGN: subendothelial deposits
    - (Type II MPGN): dense deposit disease intramembranous
    - Type III MPGN EM deposits subendothelial + subepithelial

Glomerulopathy with hematuria

- Primary: IgA nephropathy (Berger's disease)

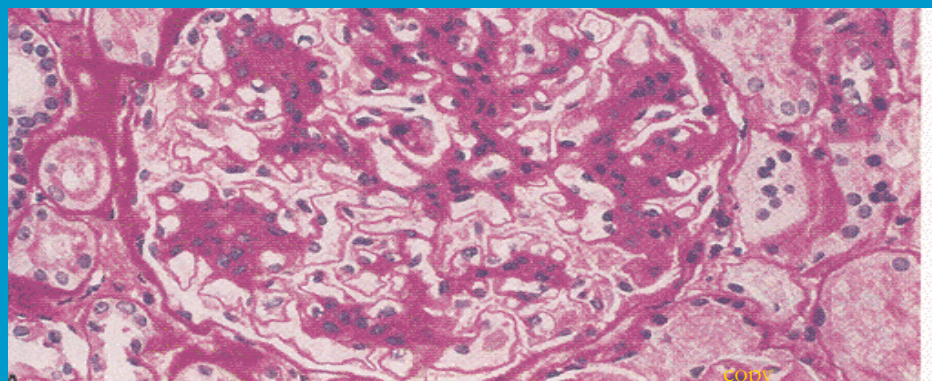
  Alport syndrome / thin basement mambranes sy
- Secondary (systemic): SLE

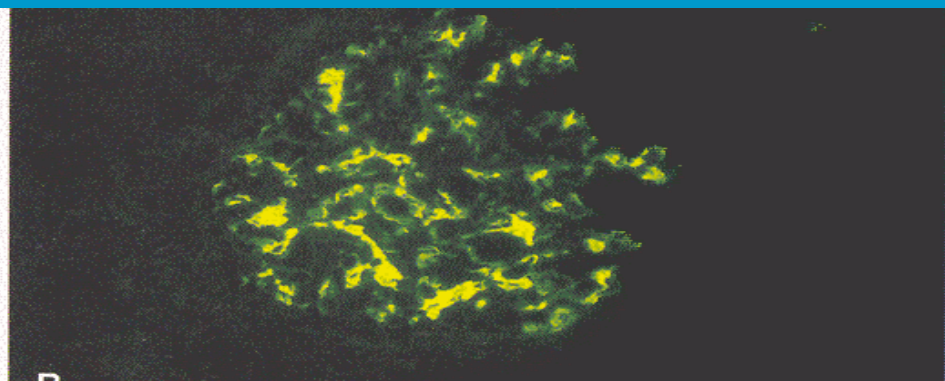
  Henoch-Schönlein purpura (+ skin rash, GIT hemorrhage, arthritis)

  polyarteritis

IgA nephropathy

- Recurrent hematuria, children and young adults (male), after GIT, respitatory tract, urinary tract infections, may → RF; most common
- IgA and C3 mesangial deposition, mesang. cells and matrix proliferation, segmental glomerulosclerosis
- Abnormal increase/pathologic form of IgA production, AAxIgA – IC;↓ clearance of IC in cirrhosis





Alport syndrome

- Part of collagen IV glomerulopathies
- genetic disorder, 90% X-linked
- abnormal basement membranes (lamina densa), later FSGS, tubular atrophy, interstitial fibrosis
- manifestation mostly in kidney (hematuria – nefritis, proteinuria)
- ear – deafness
- eye – lens + cornea disorders, cataract

Thin basement membrane

- benign familial hematuria
- common inherited lesion
- heterozygous carriers of collagen IV mutations
- without other problems (ocular, …)
- differential diagnosis

Glomerulopathy with proteinuria / nephrotic sy

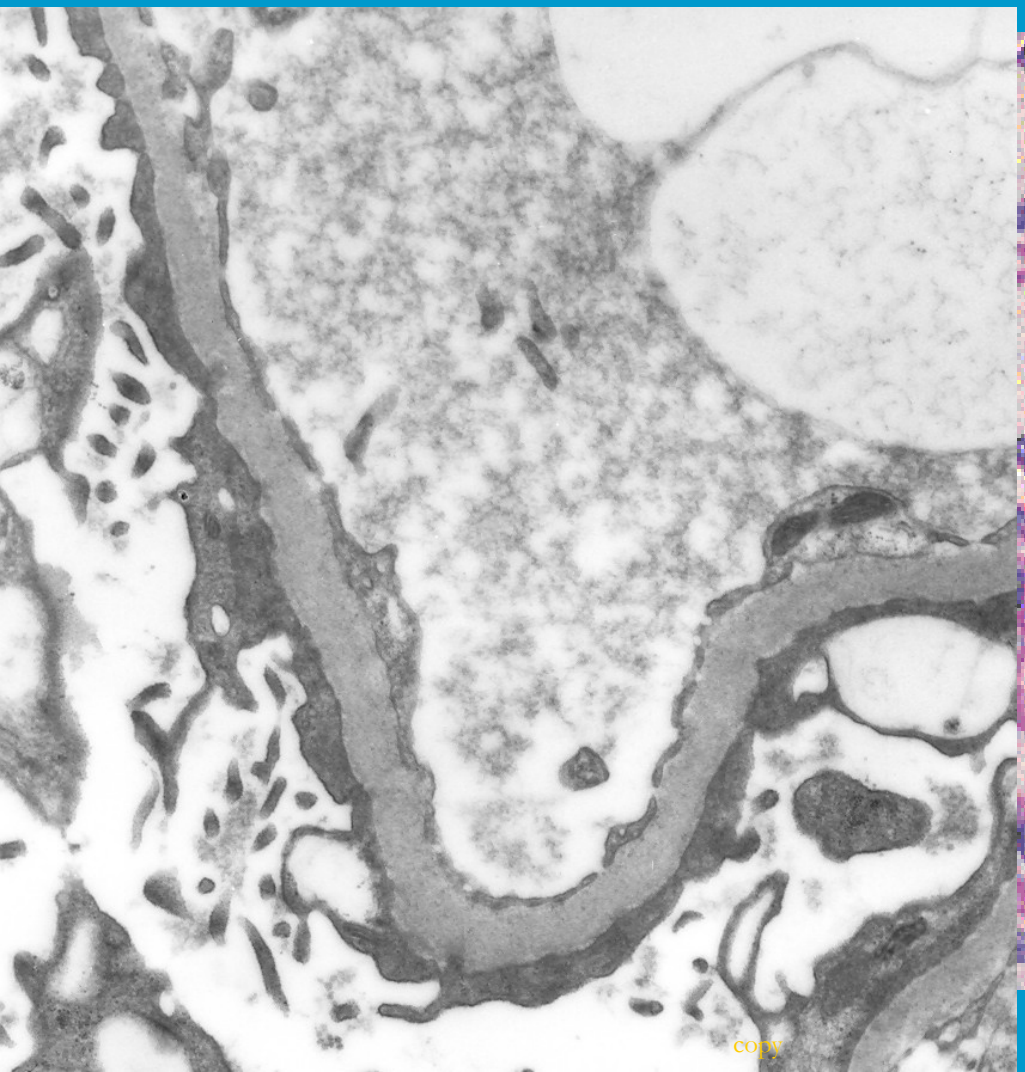
- Primary: minimal change disease
  membranous glomerulopathy
  membranoproliferative GN
  focal segmental glomerulosclerosis
- Secondary: SLE
  diabetes mellitus
  amyloidosis
  …

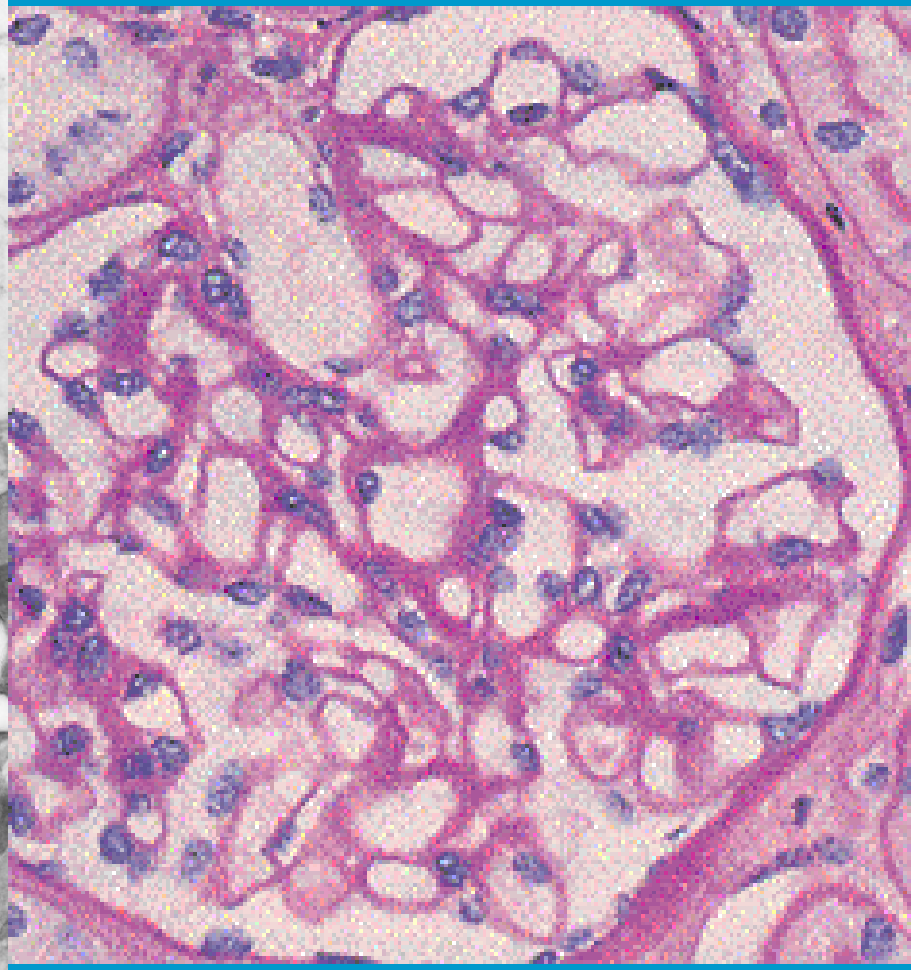
Minimal change disease

- Most common cause of nephrotic sy in children
- mostly in children ≤ 5 yrs
- Light microscopy normal
- Genetic predisposition + immunological basis (association with respiratory infection, atopy, Hodgkin lymphoma)
- Epithelial cell injury – effaced foot processes
- steroid therapy, good prognosis in children

Minimal change disease

Loss of epithelial foot processes in elmi, fat in tubular epithelia („lipoid nephrosis“)

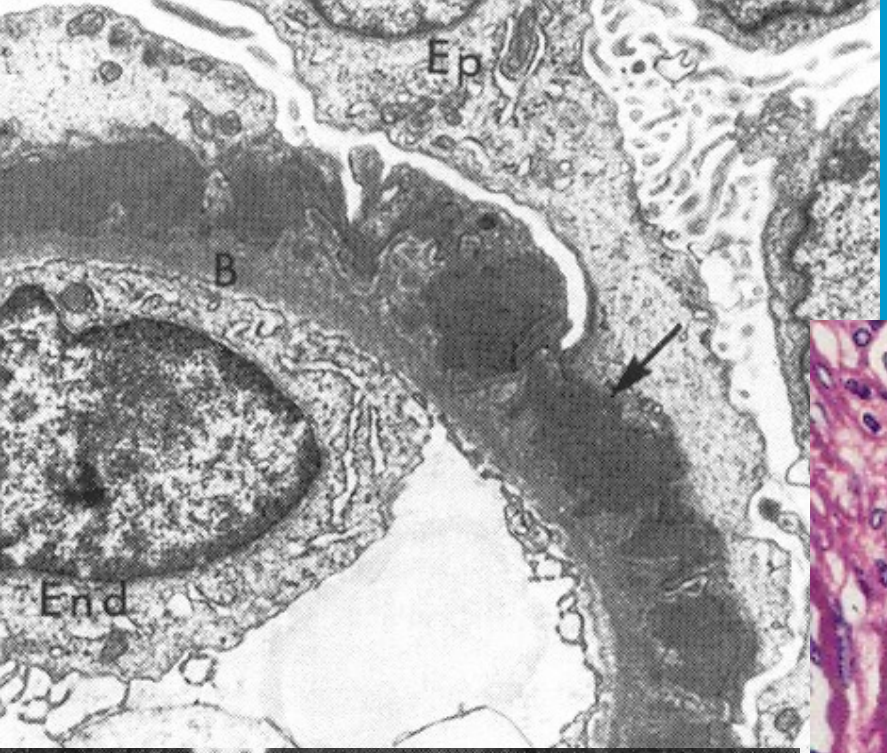


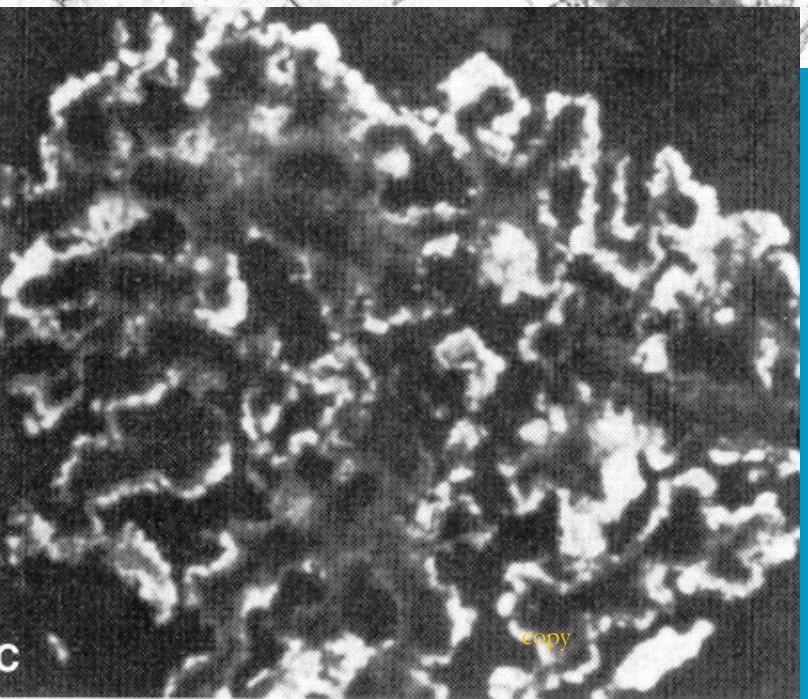


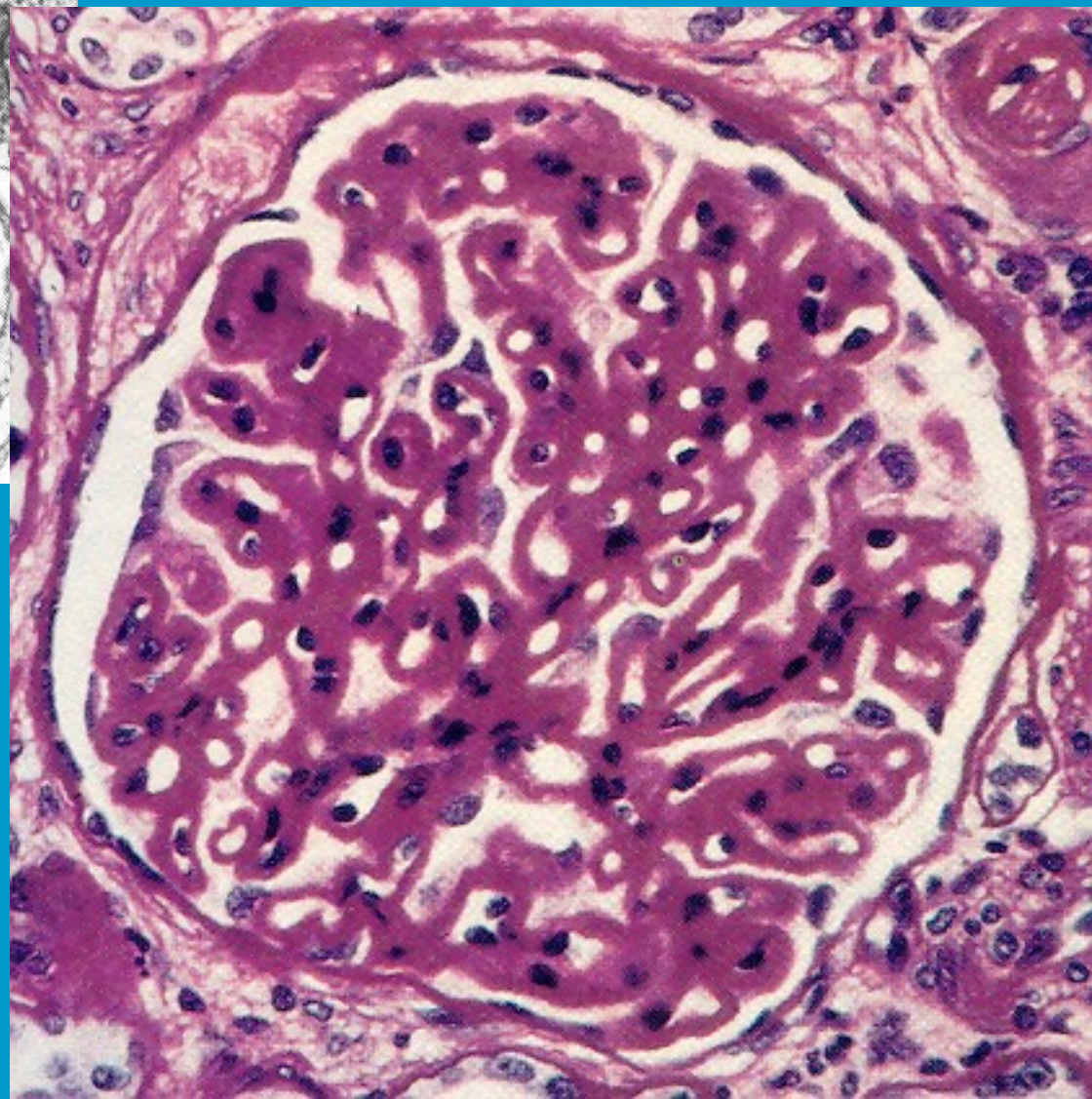
Membranous glomerulopathy

- idiopathic (85%)
- secondary – infections (HBV, HCV, syphilis, malaria) tumors (lung ca, colorectal ca, melanoma), drugs (NSAID), autoimmune diseases (SLE, thyroiditis)
- IC-mediated (incl. Ab x renal autoantigen), mostly older adults – most common nephrotic sy in this age group
- proteinuria or nephrotic sy, variable course, 1/3 RI
- diffuse thickening of capillary wall, subepithelial IC deposits, „spikes“ - BM material in impregnation

Membranous glomerulopathy







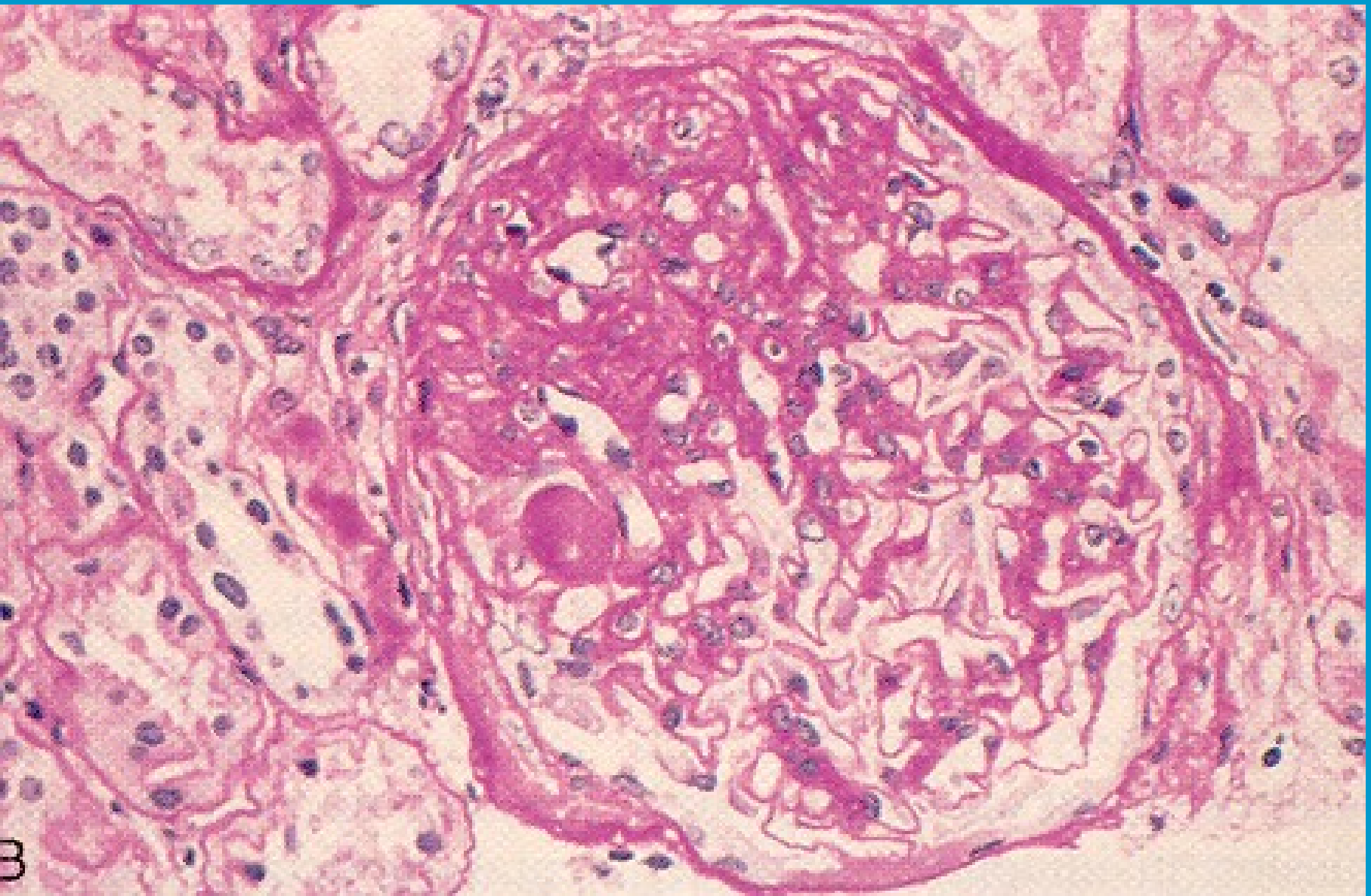
Focal segmental glomerulosclerosis

- Nephrotic sy, ↑ incidence
- Hematuria, ↓ GFR, proteinuria
- Progression usual – 50% → RF in 7 years
- Primary – idiopathic, variable podocyte protein mutations, plasma factor ↑ permeability
- Secondary: late part of adaptive response to preexisting renal disease (renal ablation - reflux nephropathy, hypertension, glomerulopathies – IgA, SLE,…)
- Association with other diseases (HIV, obesity, toxins – heroin, drugs)

FSGS

- epithelial damage
- hyalinosis (plasma protein leakage), foamy macrophages
- segmental sclerosis (mesangial matrix production, capillary loops collapse)
- No immune deposits on IF
- Podocyte injury on EM

Focal segmental glomerulosclerosis

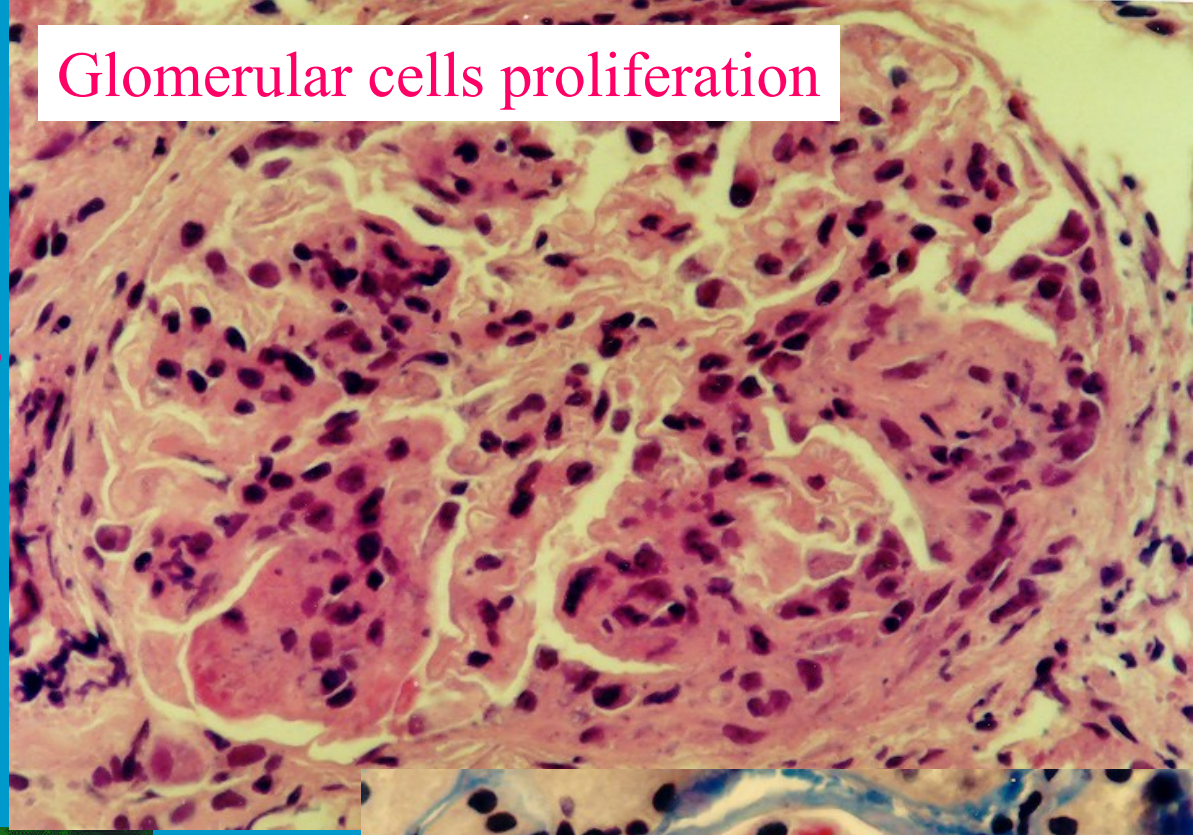


SECONDARY **glomerular diseases**

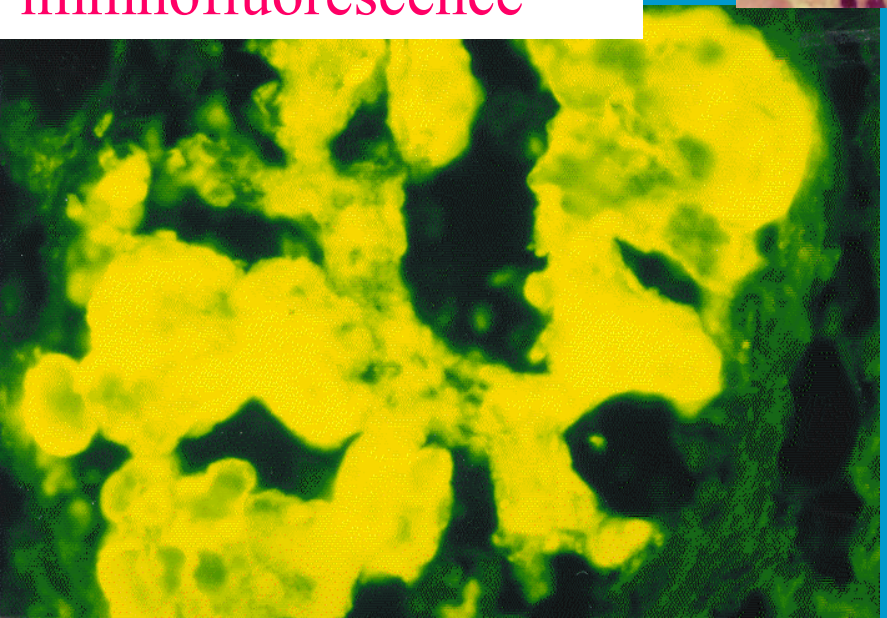
- Systemic lupus erythematosus
- Goodpasture's syndrome
- Henoch-Schönlein purpura
- Microscopic form of *polyarteritis nodosa*
- Wegener's granulomatosis
- Bacterial endocarditis
- Diabetes mellitus
- Amyloidosis

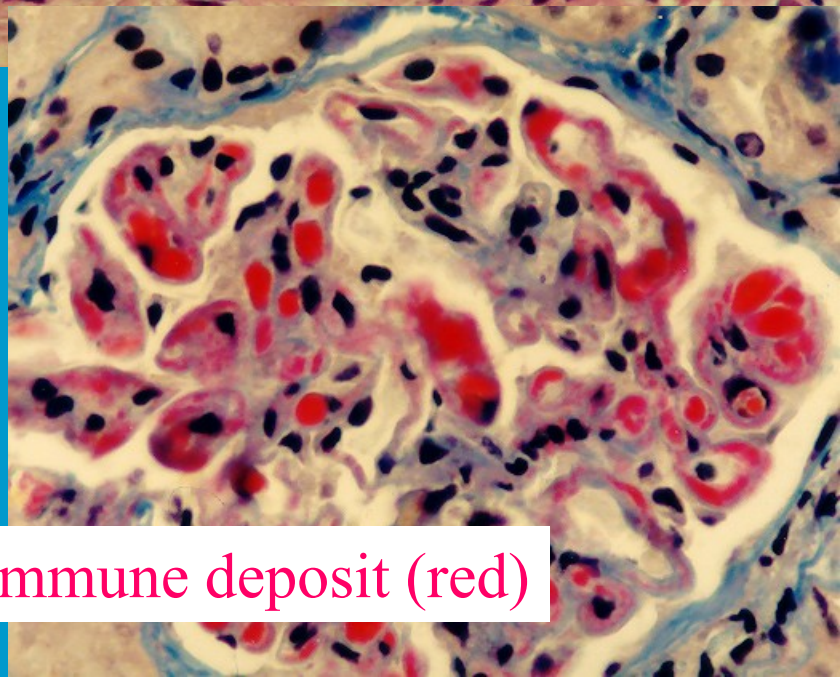
Lupus nephritis

Glomerular cells proliferation



Deposits in direct immnofluorescence





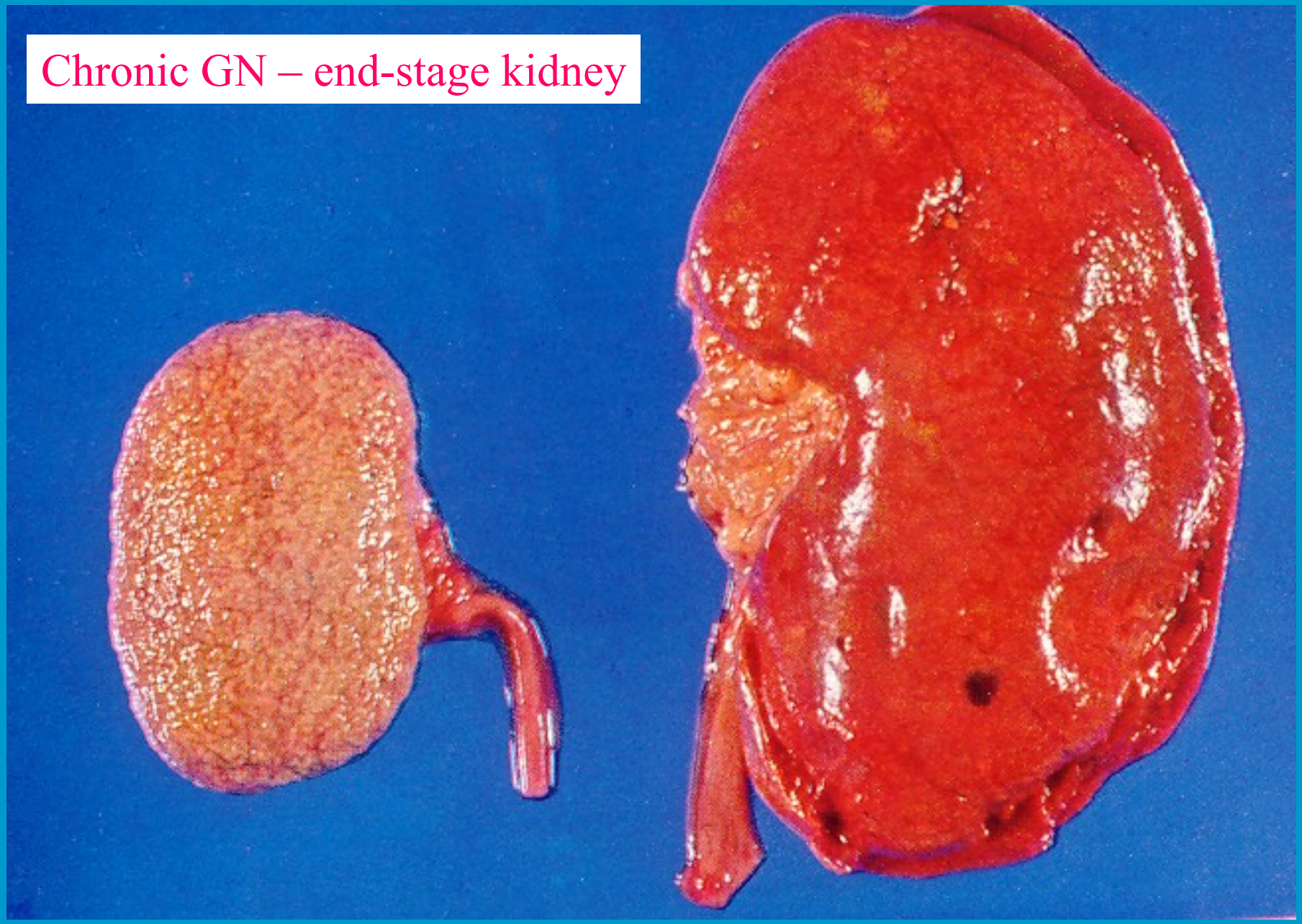
Immune deposit (red)

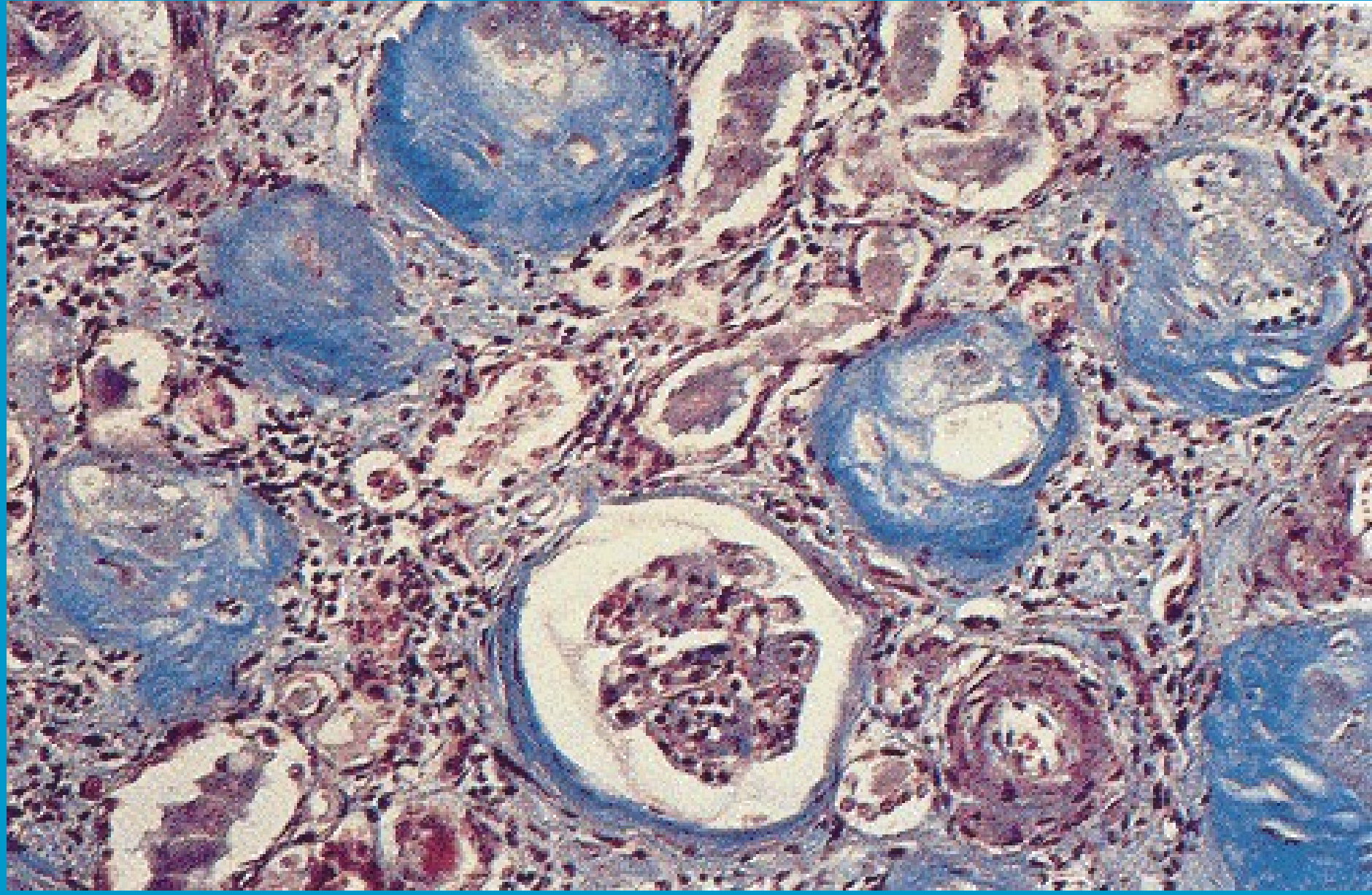
Chronic glomerulonephritis

- end stage of variable glomerular disease
- different rate of progression in different diseases
- FSGS 50-80%
- RPGN, membranous, membranoproliferative ~ 50%
- poststreptococcal 1-2%

Chronic glomerulonephritis

- granular surface (!x chronic interstitial nephritis, nephrosclerosis, diabetic nephropathy,…)
- thin cortex
- obliterated glomeruli, arterio- and arteriolosclerosis (hypertension), tubular atrophy


Chronic GN – end-stage kidney



Diabetic nephropathy

- **Diabetic microvascular disease**
- **Clinically:** non-nephrotic proteinuria, nephrotic syndrome, chronic renal failure
- **Morphology:** glomerulosclerosis (diffuse mesangial, nodular), hyalinizing arteriolar sclerosis, tubulointerstitial lesions (pyelonephritis, papillary necrosis)

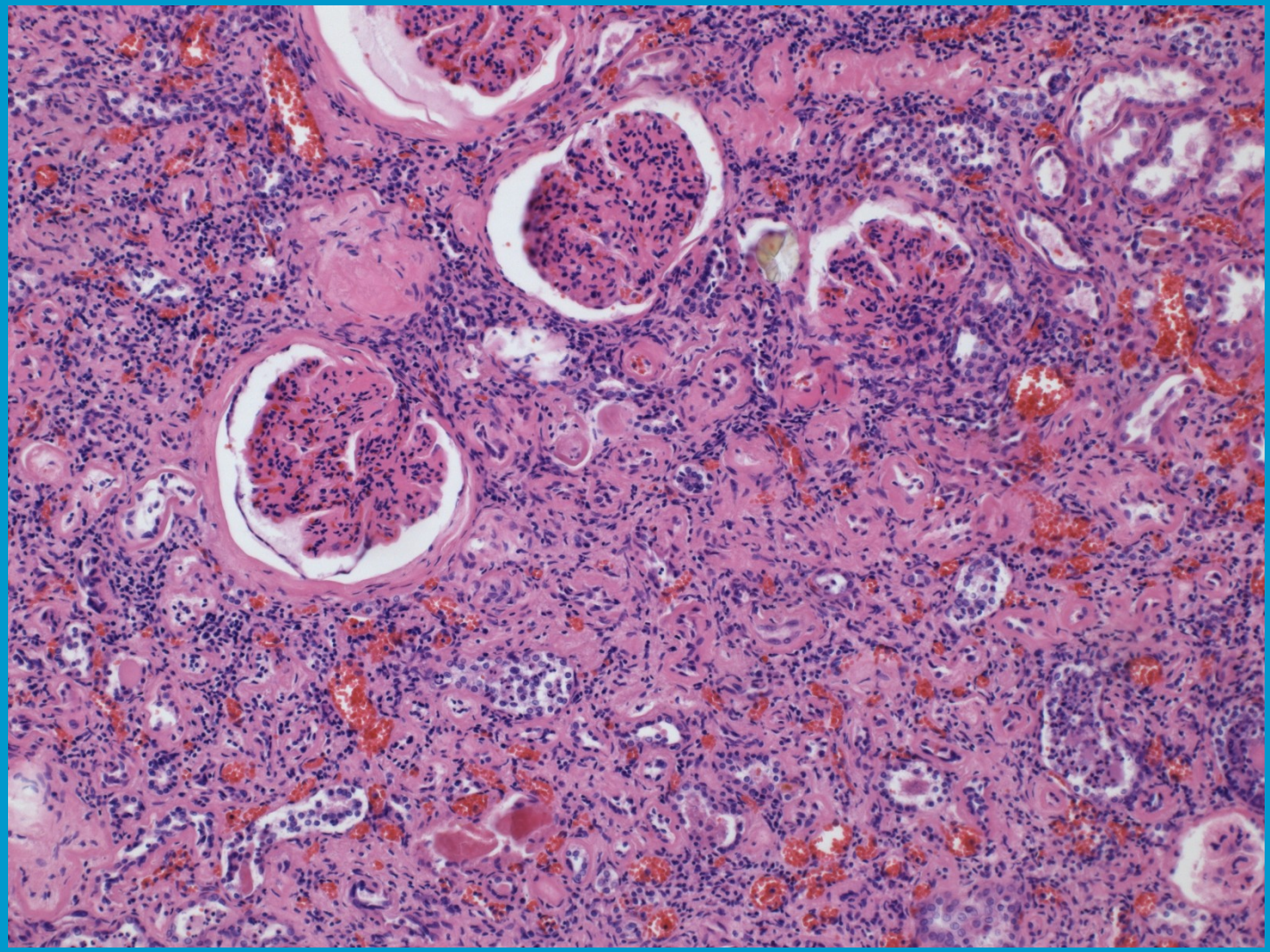
Diabetes mellitus and kidneys

- **Nonenzymatic glycosylation** of proteins – accumulation of irreversible glycosylation products in BM of vessel walls, **metabolic defect** – increased collagen synthesis, **hemodynamic changes**
- **Diabetic microangiopathy** in kidney (glomerulosclerosis) and retina (diabetic retinopathy). Diffuse thickening of capillary BM leads to ischemic changes, simultaneously increased plasmatic proteins permeability

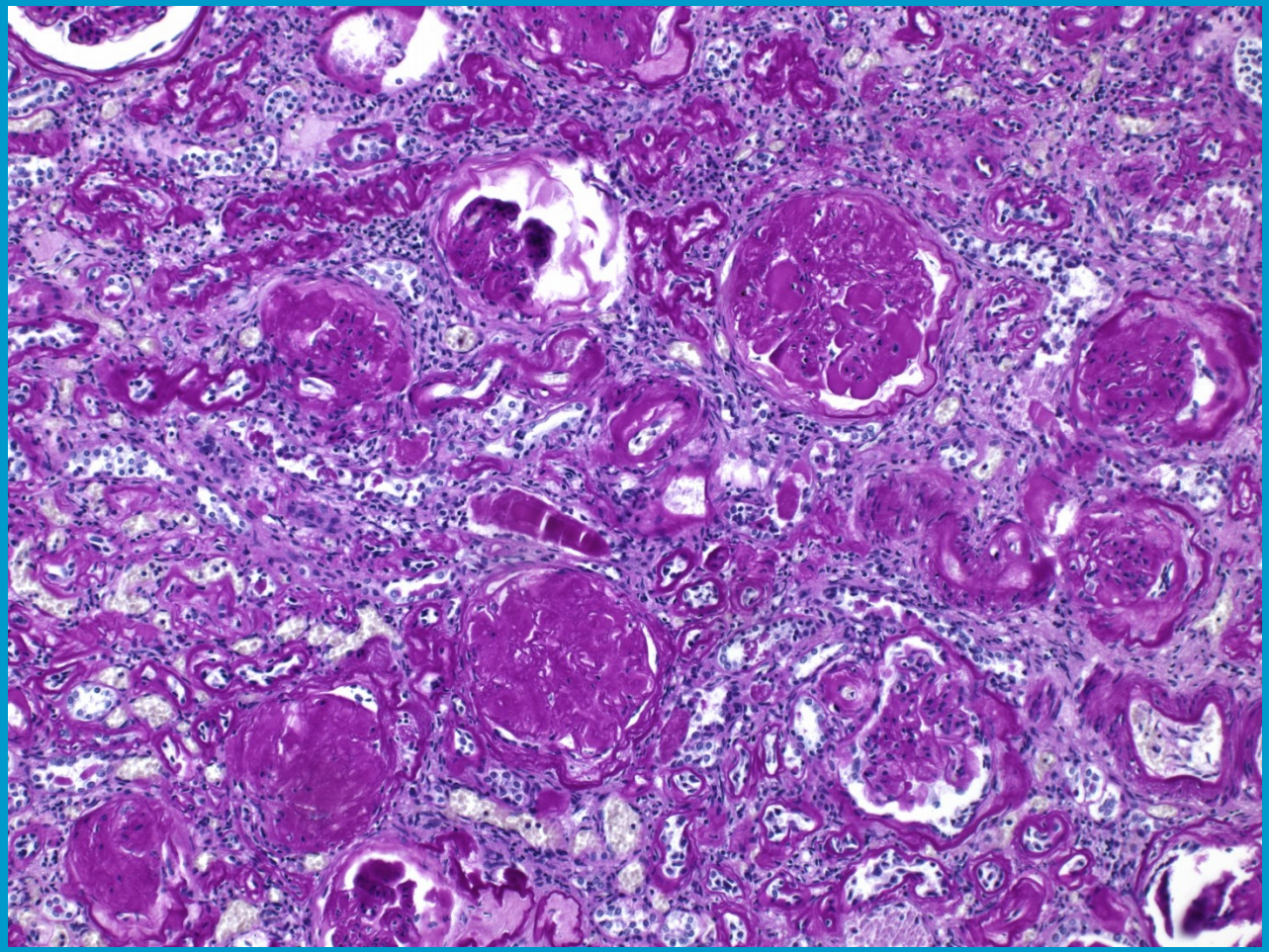
Diabetic glomerulosclerosis

- **Diffuse glomerulosclerosis** – GBM thickening, increase in mesangial matrix
- **Nodular glomerulosclerosis** - (Kimmelstiel-Wilson) after 10-15 yrs; PAS+ nodular acellular material deposits at the tips of capillary loops; leads to chronic renal insufficiency

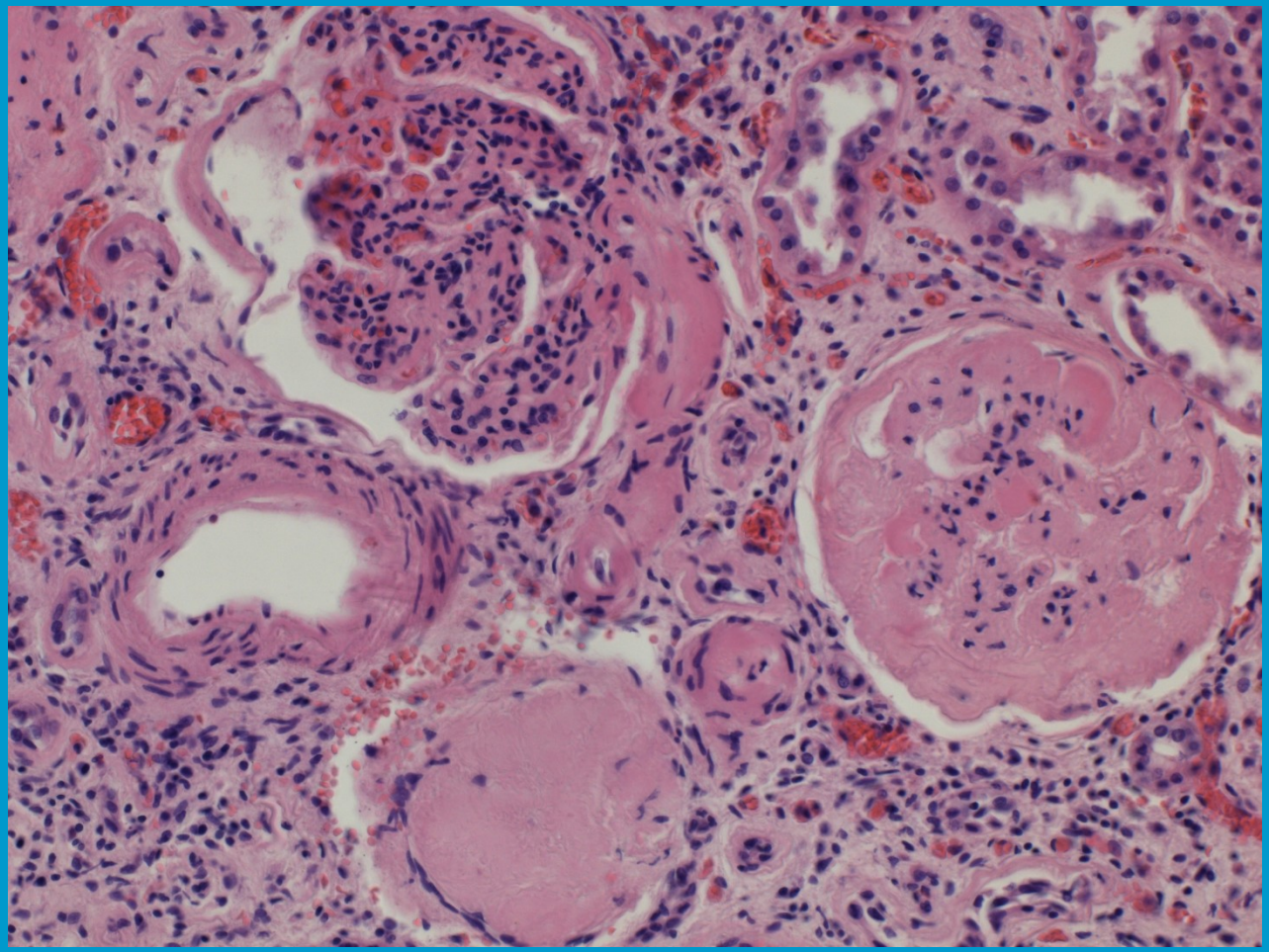
Diabetic glomerulosclerosis

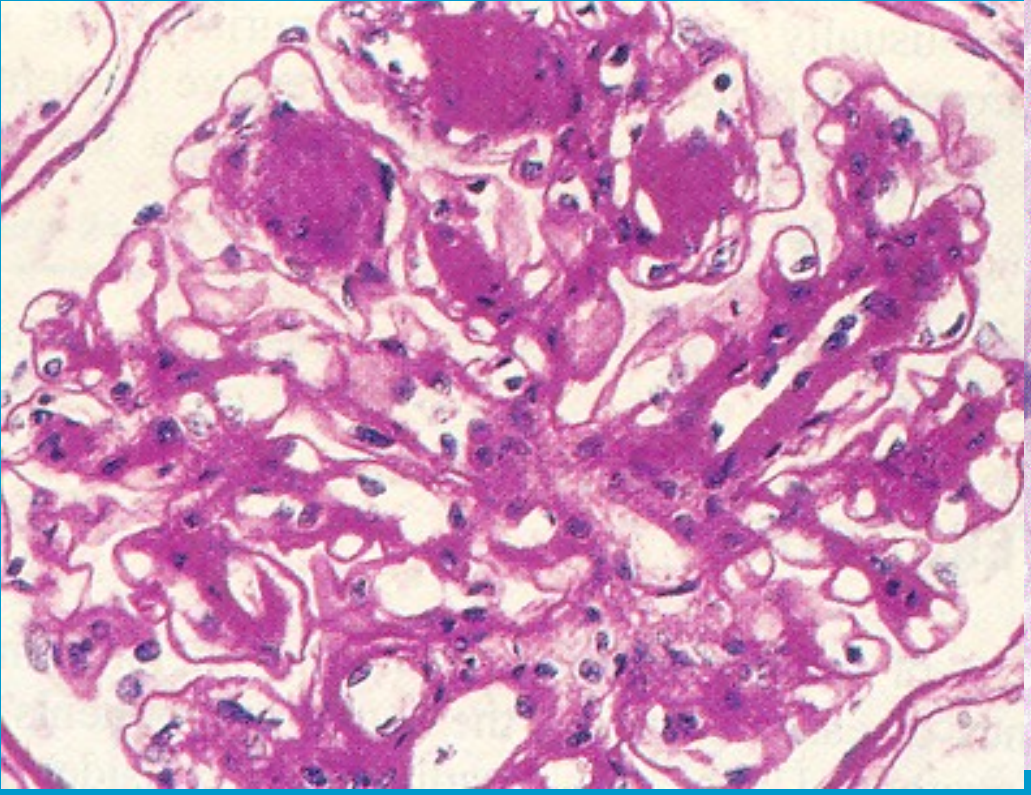


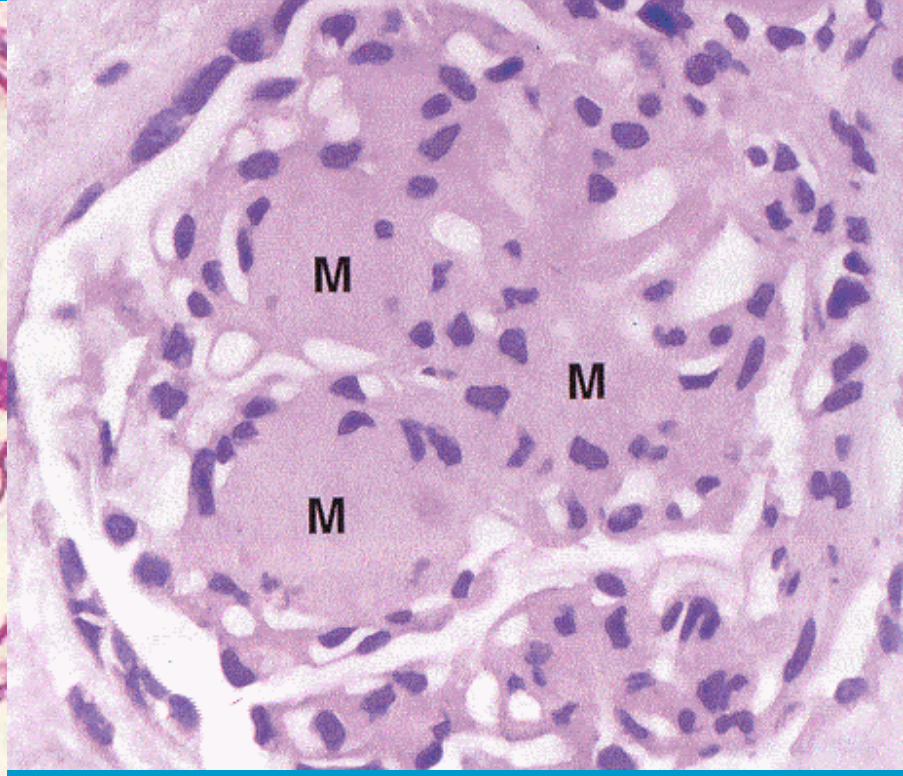
Diabetic glomerulosclerosis



Diabetic glomerulosclerosis







Diabetic glomerulosclerosis

Further renal complications in diabetics

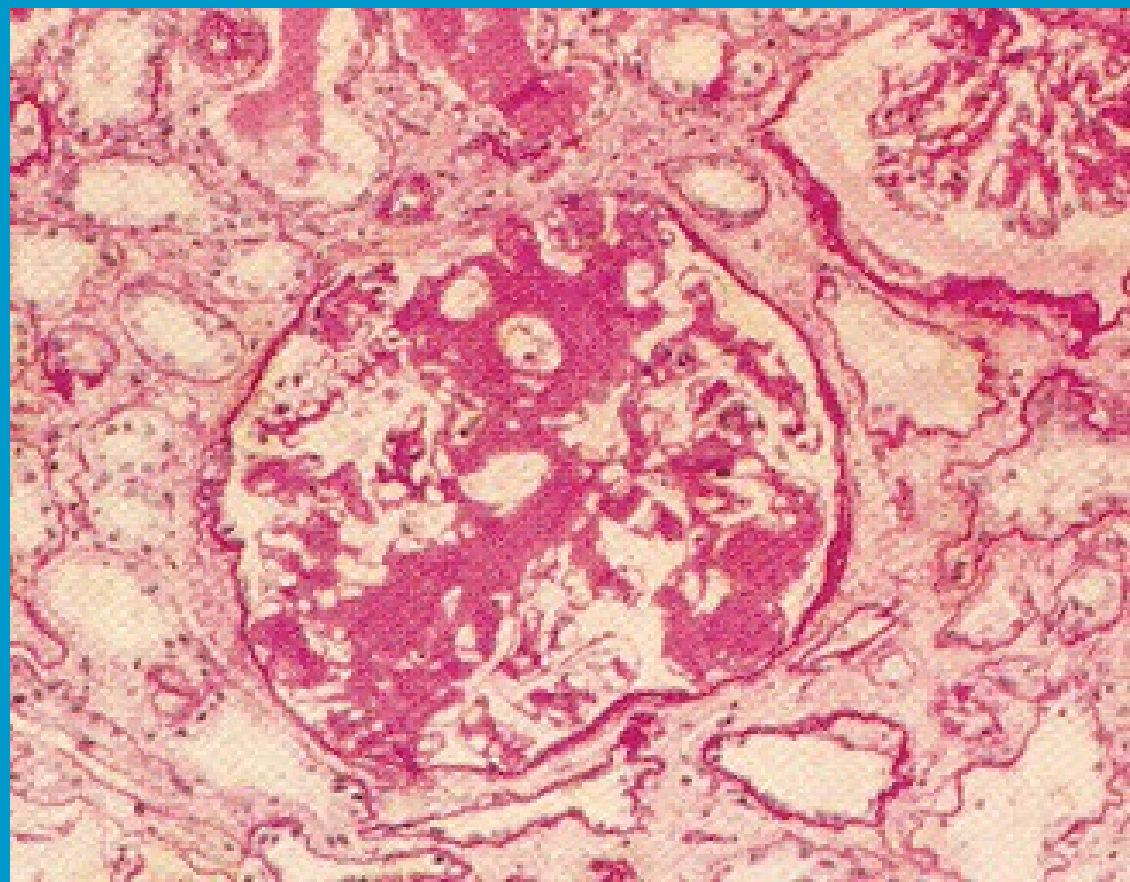
- accelerated **arteriolosclerosis and arteriosclerosis, hypertension**
- **Pyelonephritis**
- **Renal papillary necrosis** in acute PN

Renal amyloidosis

- Amyloidosis – pathologic deposits of abnormal microfibrillary (8-10nm) proteinaceous acellular material
- Eosinophilic in HE, Kongo red +, green dichroism in polarised light
- Tough pale enlarged kidney in macroscopy

Renal amyloidosis

- Amyloid deposits in glomerular mesangial matrix and capillary walls; glomerular obliteration
- Peritubular and blood vessel walls
- Proteinuria
- Nephrotic syndrome
- CHRI



Tubulo-interstitial disorders

- Concurrent damage to the tubular epithelium and interstitium
- Usually no glomerular damage, or only secondary (e.g. glomerulosclerosis)

Tubulo-interstitial disorders - groups

TUBULOINTERSTITIAL NEPHRITIS (TIN)

- Acute pyelonephritis
- Chronic pyelonephritis, reflux nephropathy
- Abacterial interstitial nephritis (drugs, etc.)

ISCHAEMIC AND TOXIC INJURY

- Acute tubular necrosis

OTHERS (e.g. obstructive uropathy, tbc, myeloma, urate nephropathy)

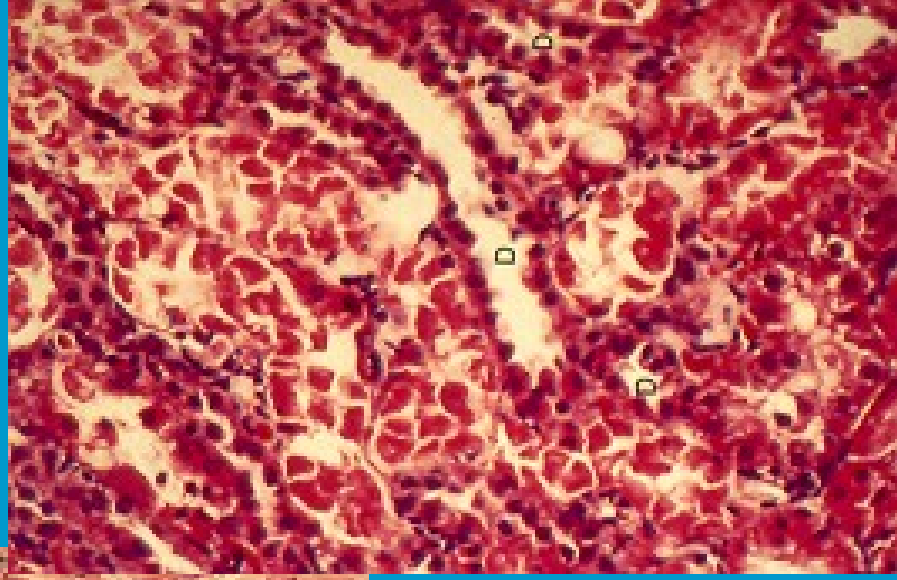
Acute tubular necrosis (ATN)

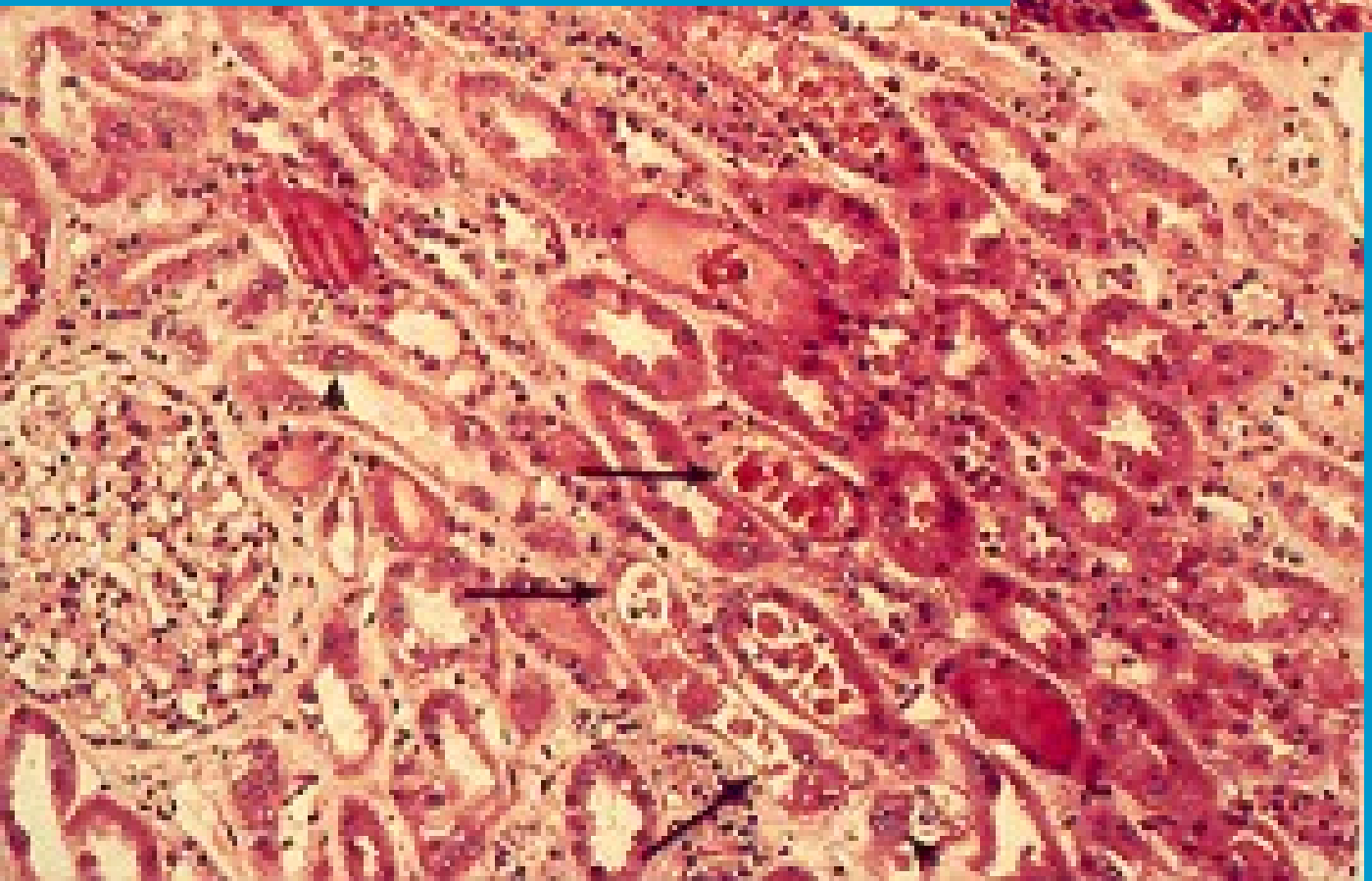
- Destruction/injury of tubular epithelium, leading to acute diminution or loss of renal function
- **Ischemic ATN** – due to decreased or interrupted blood flow, e.g. in shock, trauma, acute pancreatitis, polyarteritis nodosa, haemoglobinuria (haemolysis), myoglobinuria (crush), etc.
- **Nephrotoxic ATN** – direct toxic injury to the tubules by drugs, heavy metals (mercury), organic solvents (carbon tetrachloride), ethylene glycol

Acute tubular necrosis (ATN)

- Morphology: **ischemic ATN** with loss of proximal epithelial brush border, cell flattening, focal tubular epithelial necrosis along the whole nephron, BM rupture, occlusion by casts; interstitial oedema, inflammatory infiltrate
- Later epithelial regeneration starting from uninjured parts
- **Toxic ATN:** extensive tubular necrosis/cytotoxic changes along the proximal tubules

Acute tubular necrosis (ATN)





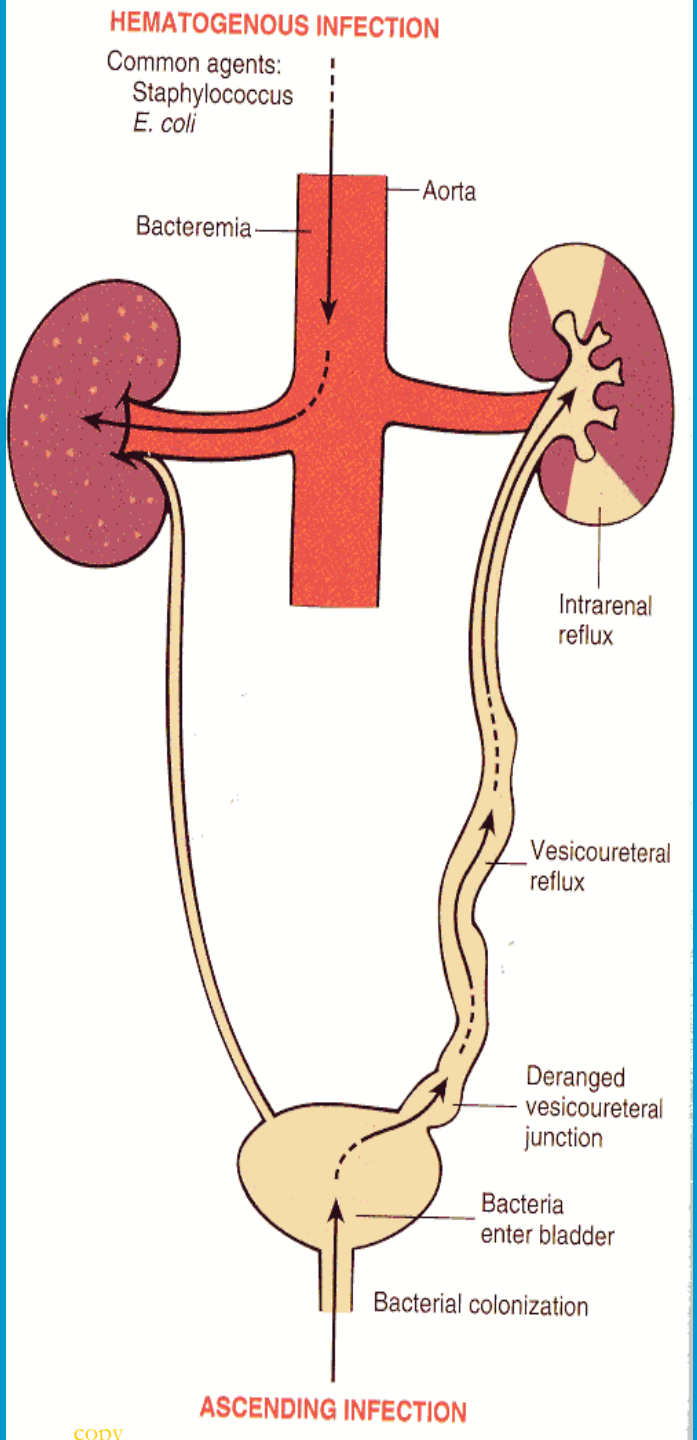
Acute pyelonephritis

- Common purulent renal inflammation, bacterial infection by *Escherichia coli, Proteus, Klebsiella, Enterobakter*
- **Ascending** infection by urine reflux in urinary tract inflammation
- **Descending (haematogenous)** infection in septicaemia, rare

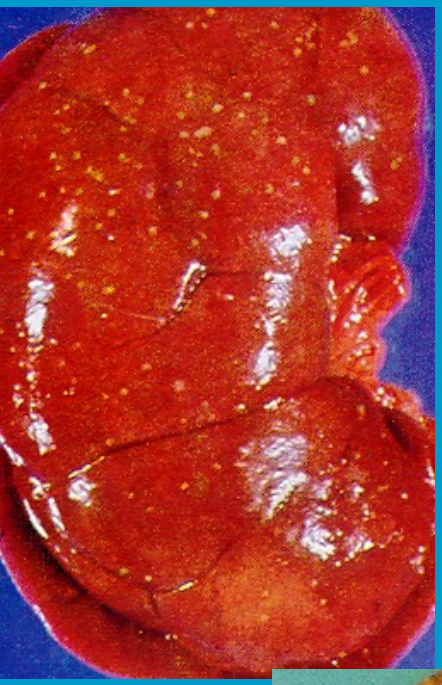
Acute pyelonephritis

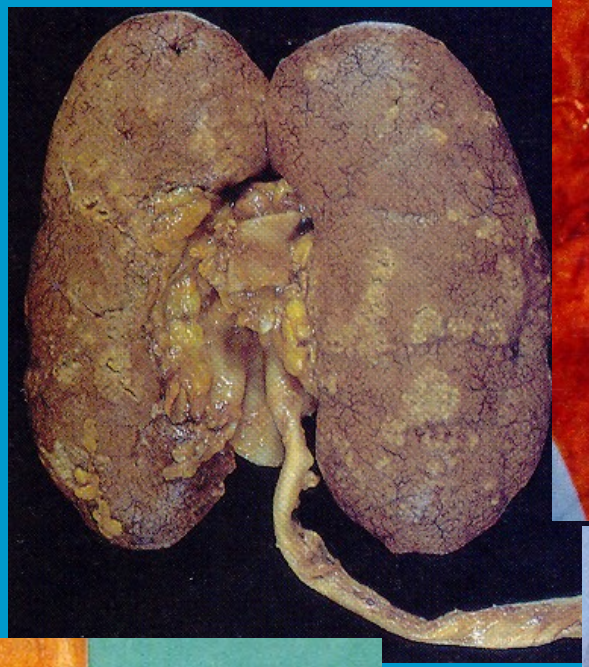
- Facilitated by DM, gout, all causes of obstructive uropathy (e.g. nephrolithiasis, tumors, urinary tract anomalies incl. vesicoureteric and intrarenal reflux)
- Instrumental interventions (cathetrization, cystoscopy)
- MACRO: enlarged kidney, cortical and medullary abscessses
- MICRO: purulent neutrophilic exudate in tubules and interstitium, oedema

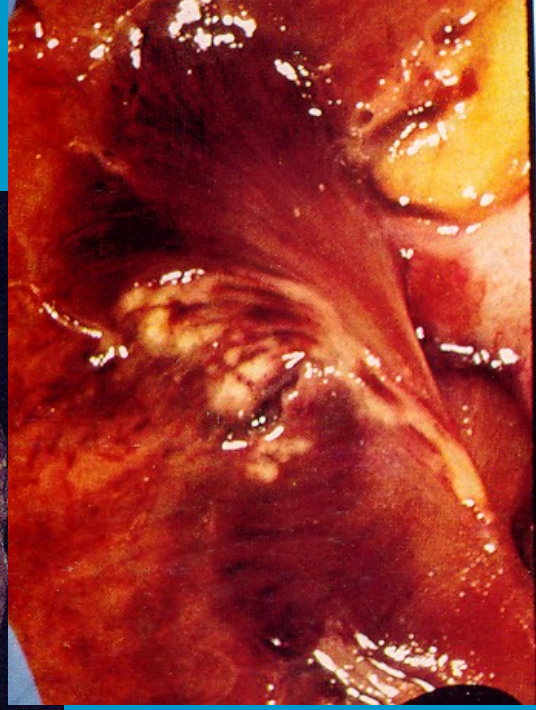
Acute pyelonephritis

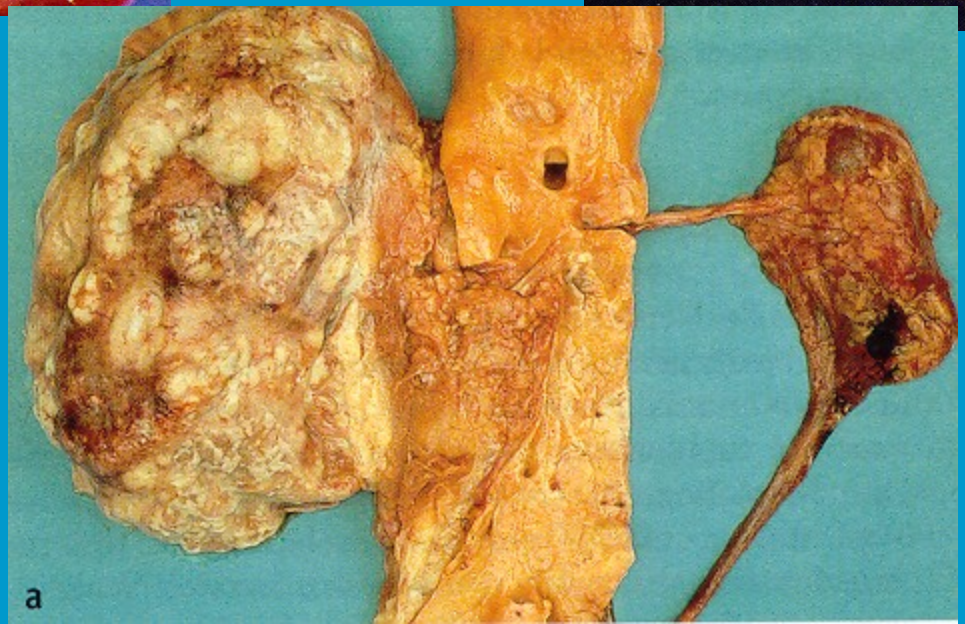


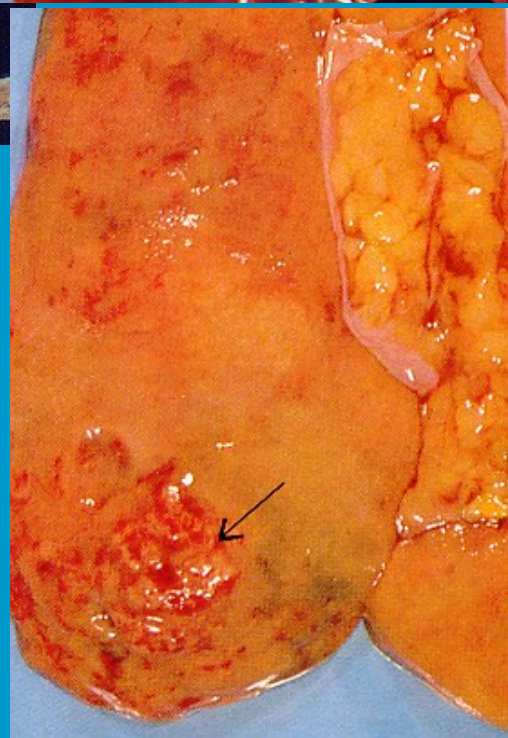
Acute pyelonephritis





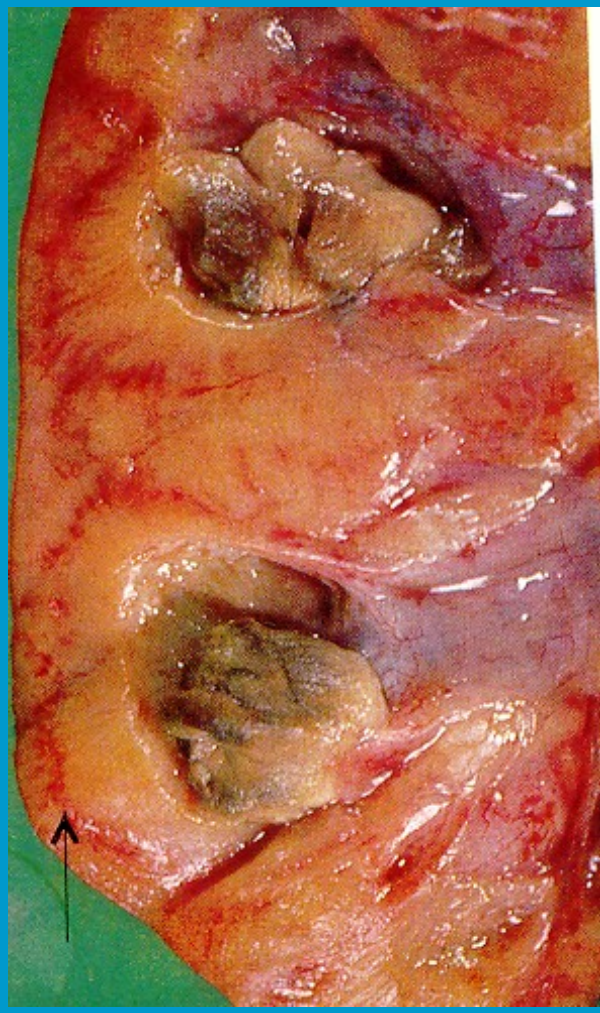






Acute pyelonephritis

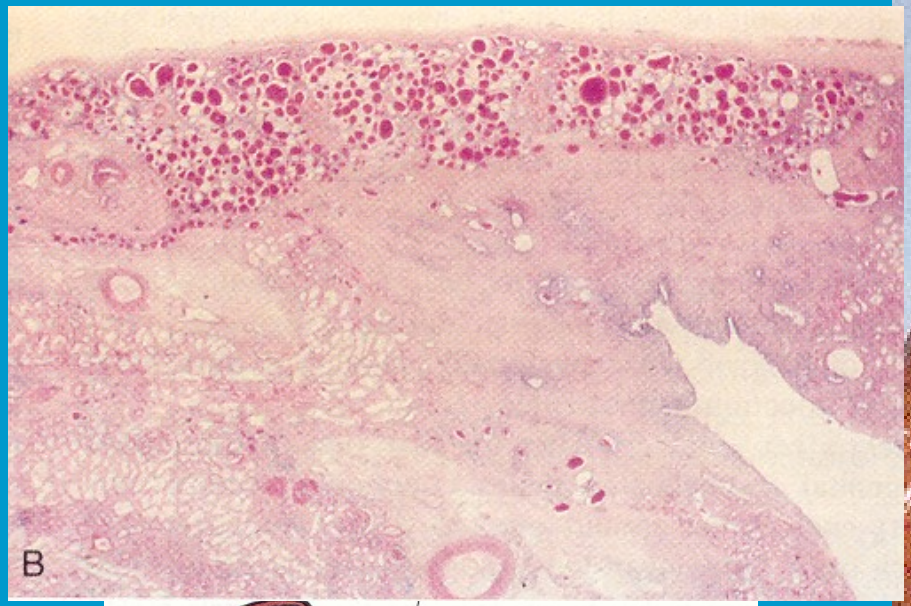
- **Pyonephrosis**
- **Papillary necrosis** in diabetics
- **Peri- and paranephritic abscess**

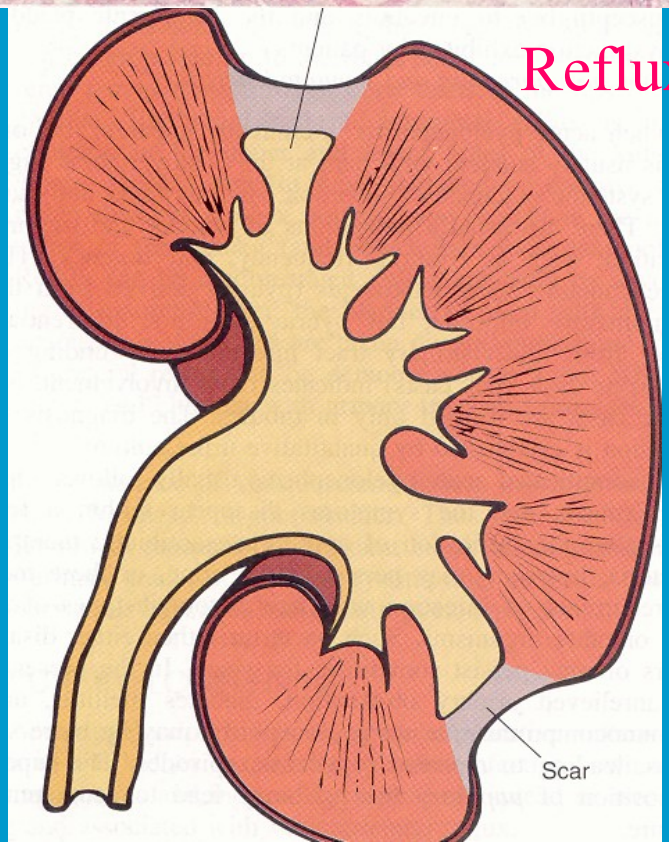


Papillary necrosis

Chronic pyelonephritis

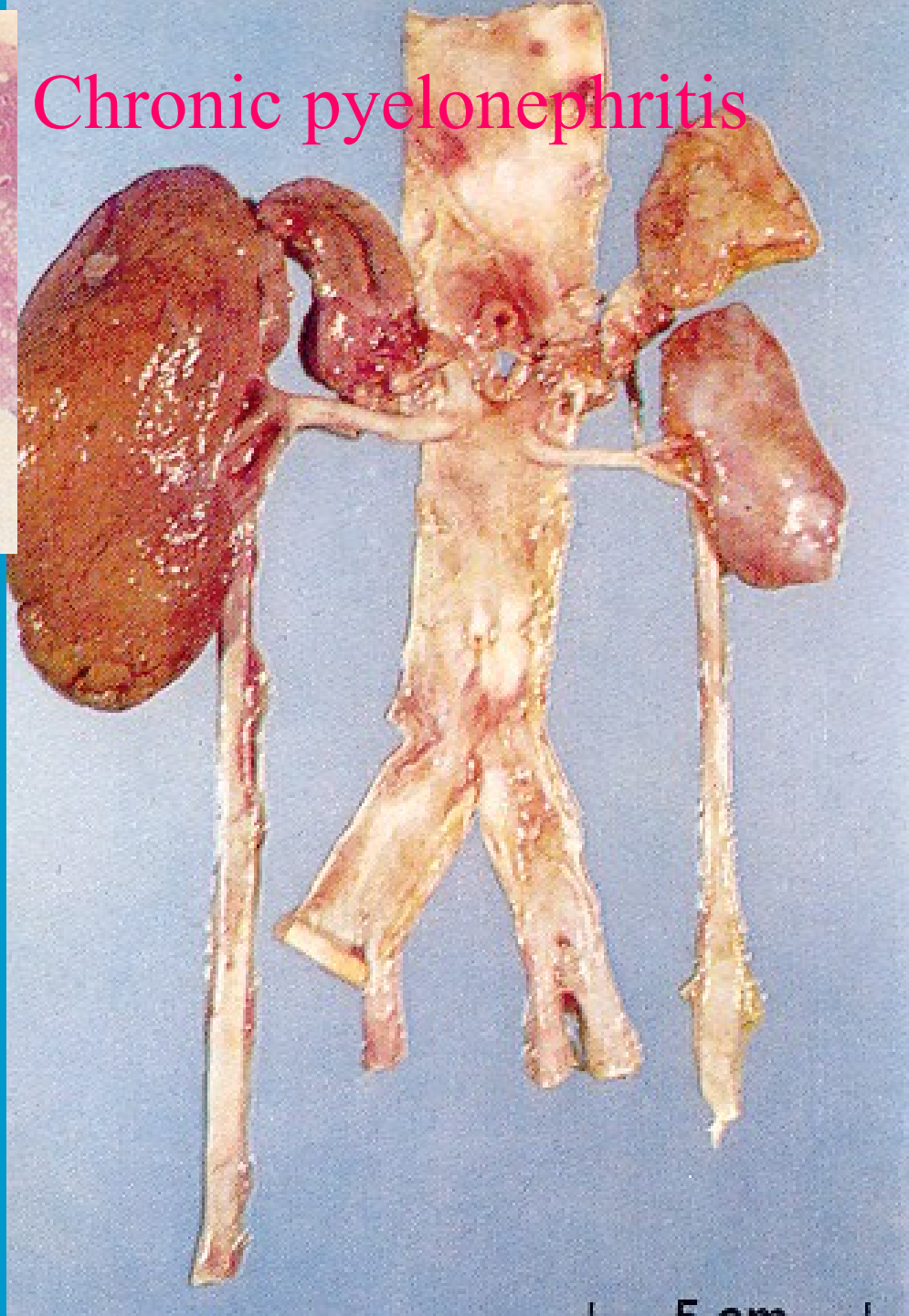
- Uni- or bilateral chron. tubulo-interstitial renal inflammation with scarring
- 10-20% end-stage kidney
- **Obstructive PN -** repeated infections
- **Reflux nephropathy –vesicoureteric** and/or **pelveorenal reflux** (from lower and upper pole calyces into renal parenchyme)



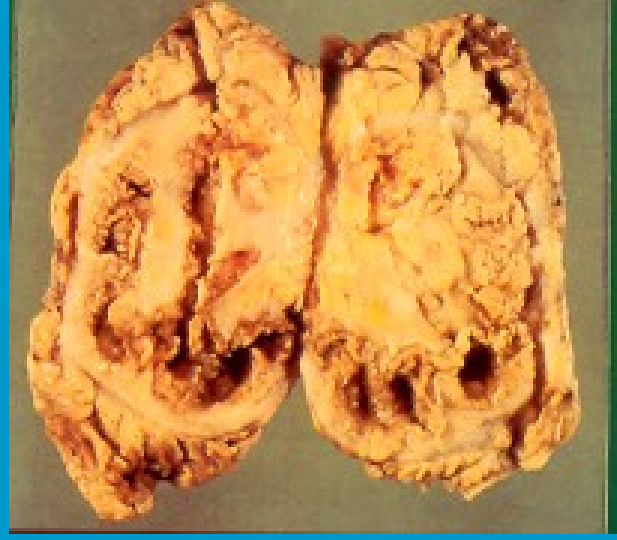


Reflux

Chronic pyelonephritis



Xanthogranulomatous pyelonephritis



- Uncommon form of chronic pyelonephritis with accumulation of foamy macrophages in interstitium
- Yellowish focal lesions in macroscopy, diff. dg. x renal carcinoma

Tubulointerstitial nephritis induced by drugs and toxins (hypersensitivity nephritis)

- Sulfonamids, synthetic penicilins, some diuretics, NSAIDs
- 7-15 days after exposure fever, eosinophilia, rash, hematuria, proteinuria, leukocyturia, cca 50% acute renal failure with oliguria
- Late-phase reaction of an IgE-mediated hypersensitivity (type I)
- Oedema and mononuclear **interstitial infiltration,** commonly with **eosinophils**, giant cell **granulomas** may be present. Tubulitis and tubular regressive changes.

Analgesic nephropathy

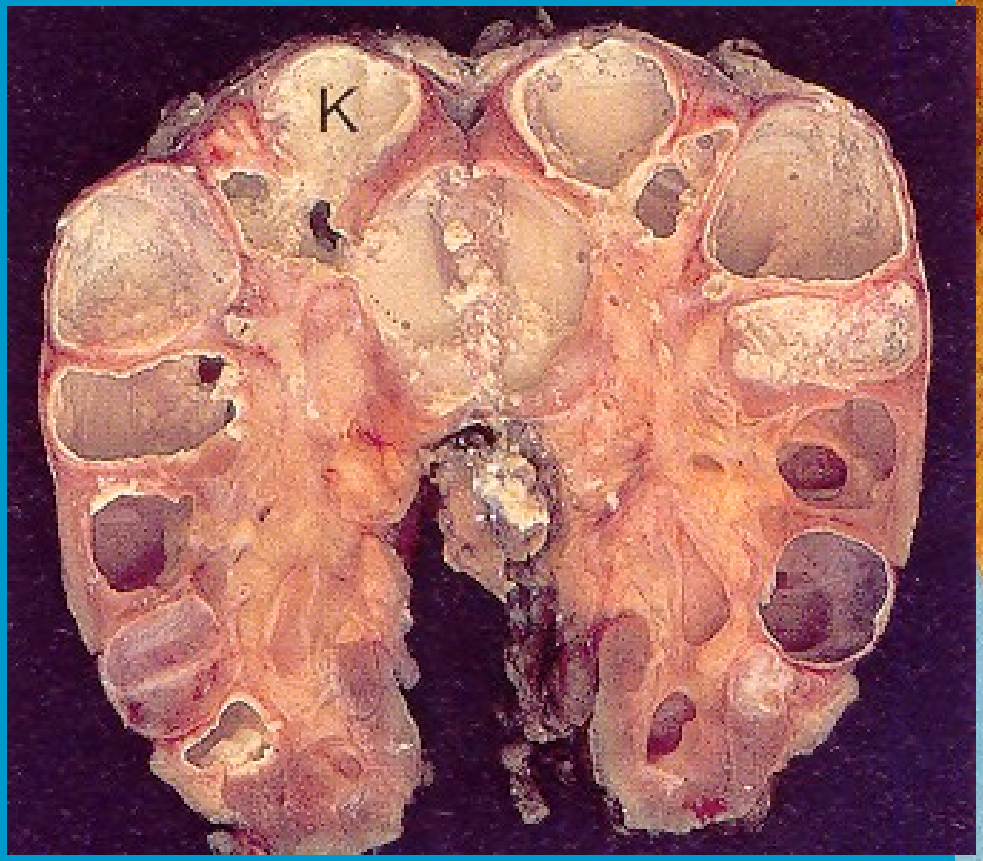
- Chronic renal disease due to excessive use of analgesic mixtures
- Form of chronic tubulointerstitial nephritis with renal papillary necrosis
- Combination effects of aspirin (papillary ischaemia), phenacetin (toxic metabolites)

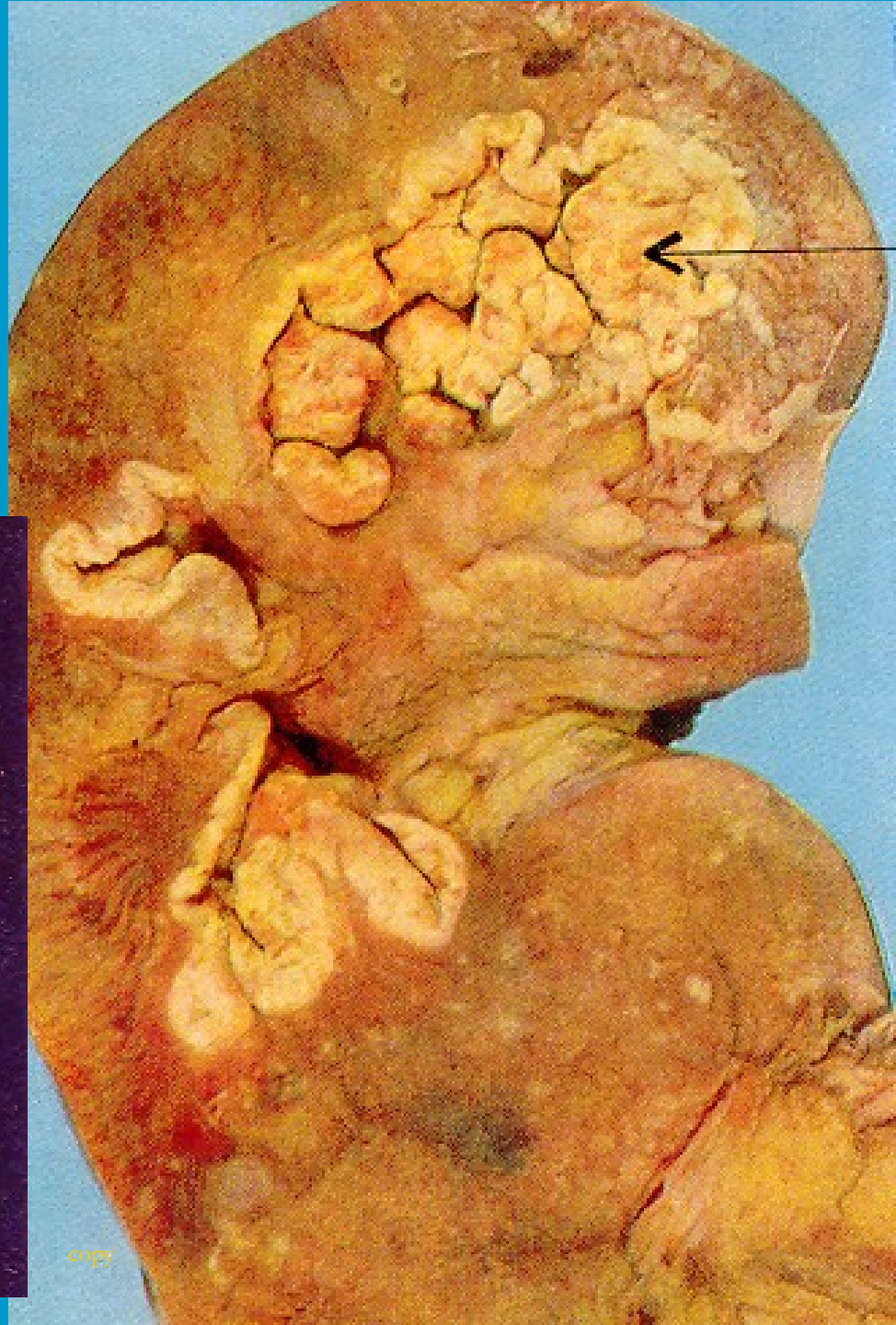
Renal TBC

- Part of miliary spread
- Solitary postprimary tbc lesion
- Gross: caseous-cavernous mass with fibrous capsule (closed tbc) or rupture and drain into pelvis (open tbc), possible infection of urinary tract.

Renal TBC

Caseation

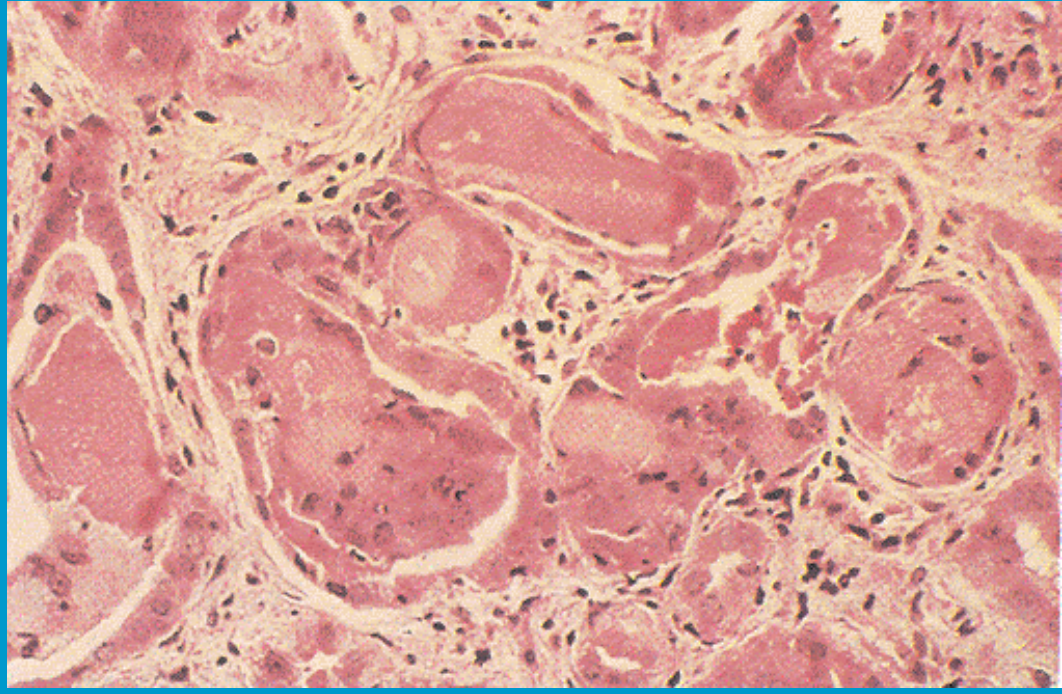




Urate nephropathy

- Hyperuricemic disorders (urate crystals formation) may lead to 3 forms of injury:
- **Acute urate nephropathy** in patients with haematologic malignancies, commonly during chemotherapy (extensive cell breakdown – release of nucleic acids – urate crystals in tubules – acute renal failure
- **Chronic urate nephropathy** – in gout. Urate crystals surrounded by foreign body giant cells, tubulo-interstitial nephritis
- **Urate stones**

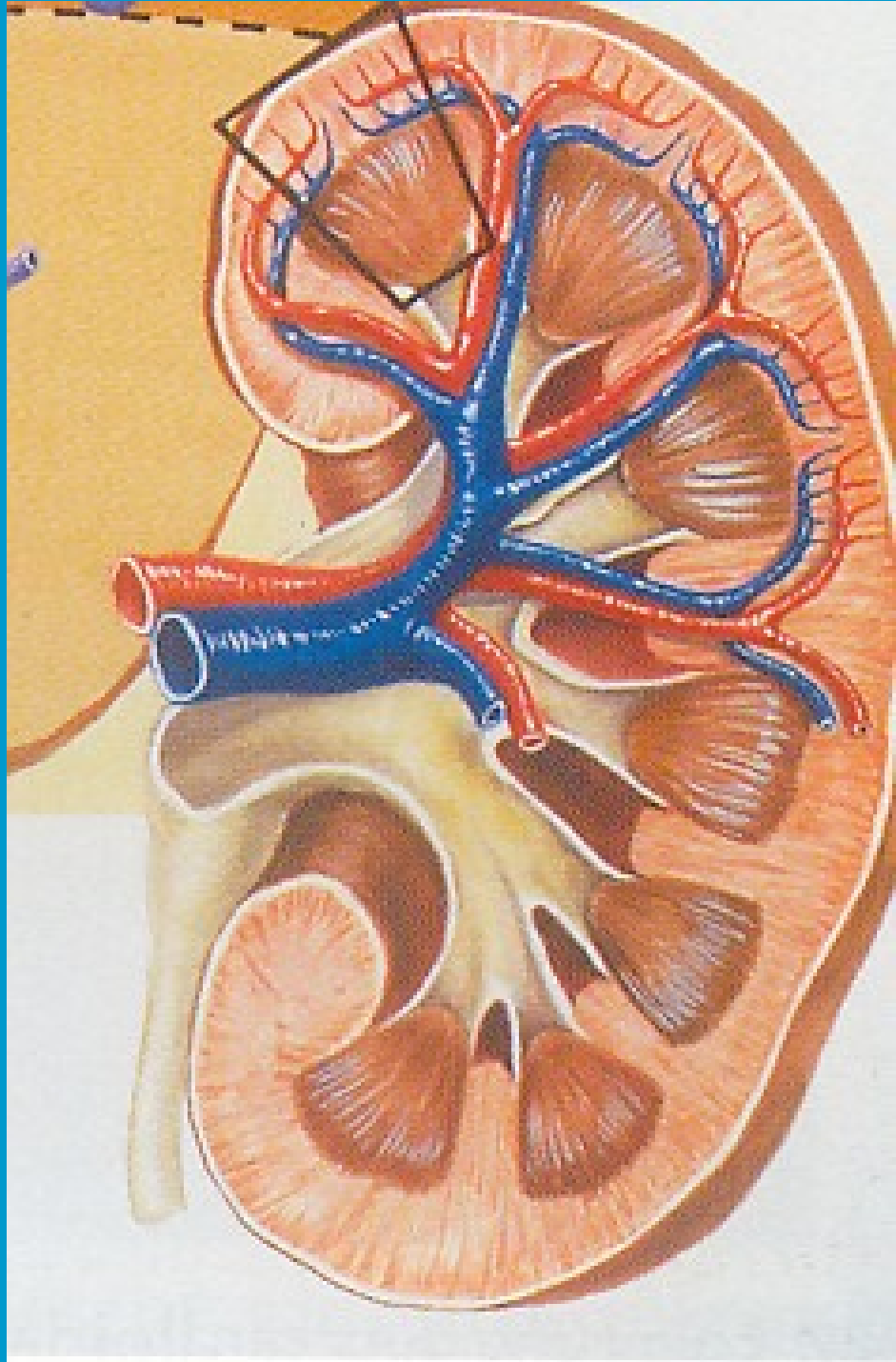
Multiple myeloma



- Amyloidosis
- Myeloma nephrosis: tubular casts formed by precipitated
  Bence-Jones protein, giant cell reaction

Blood vessels

- a. renalis
- a. segmentalis
- a. interlobaris
- a.arcuata
- a. interlobularis
- afferent arteriole



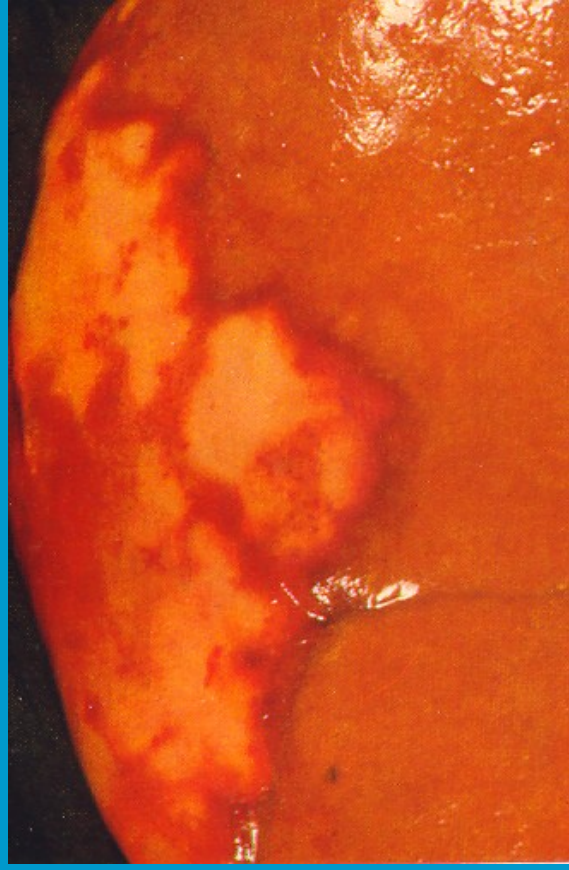
Renal infarction

- Causes: thrombosis due to AS;

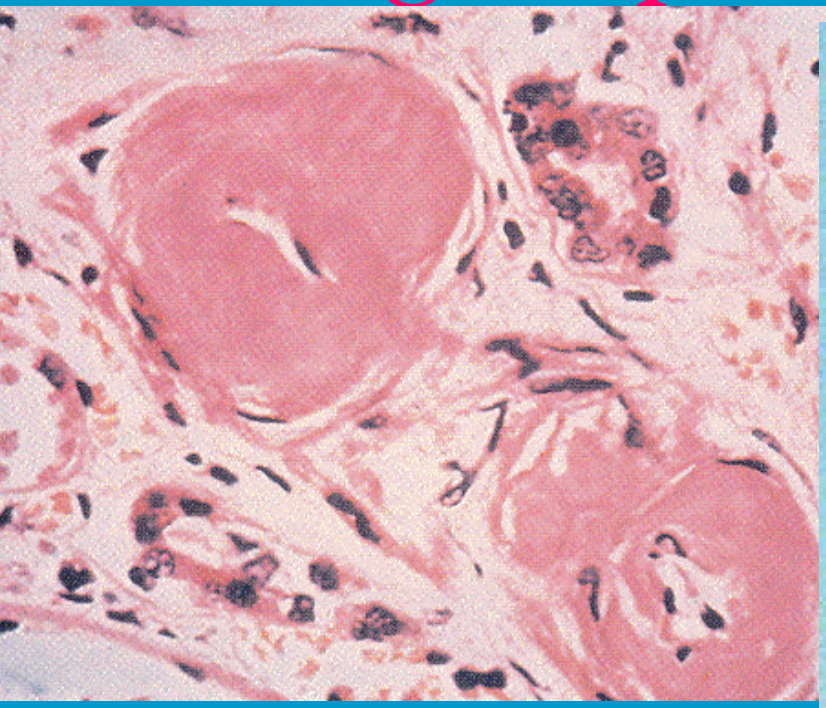
  polyarteritis nodosa;

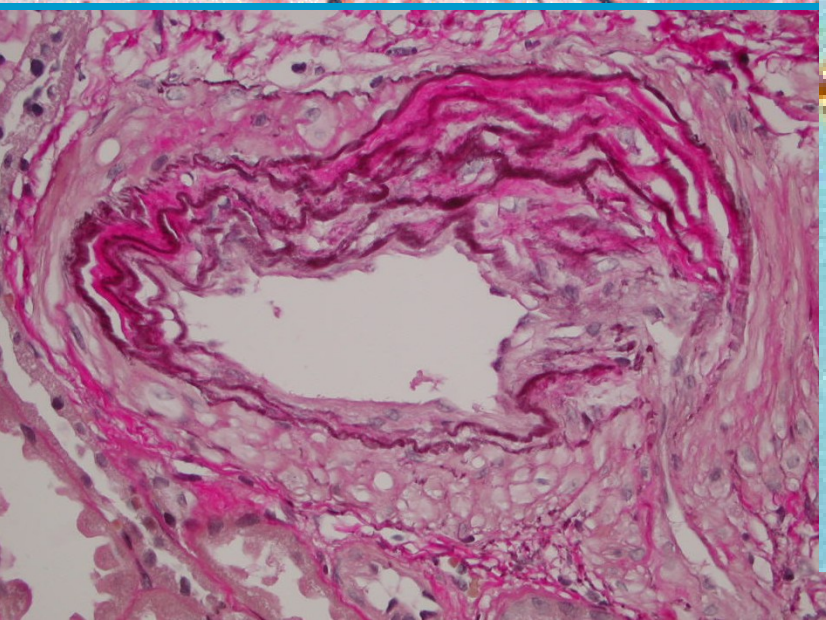
  thrombembolia;

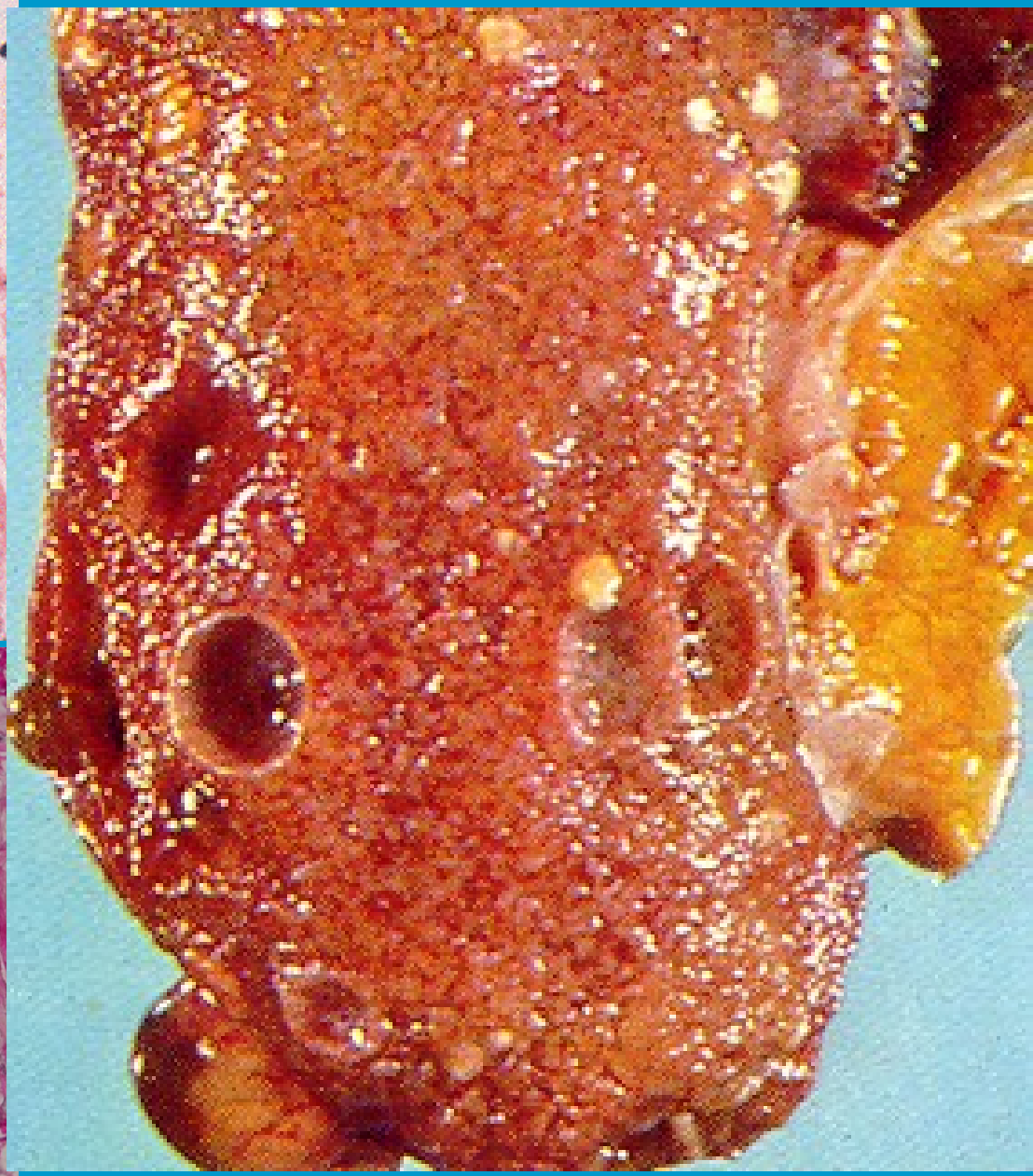
  aneurysm of abdominal aorta;



Benign nephrosclerosis arteriolosclerotic



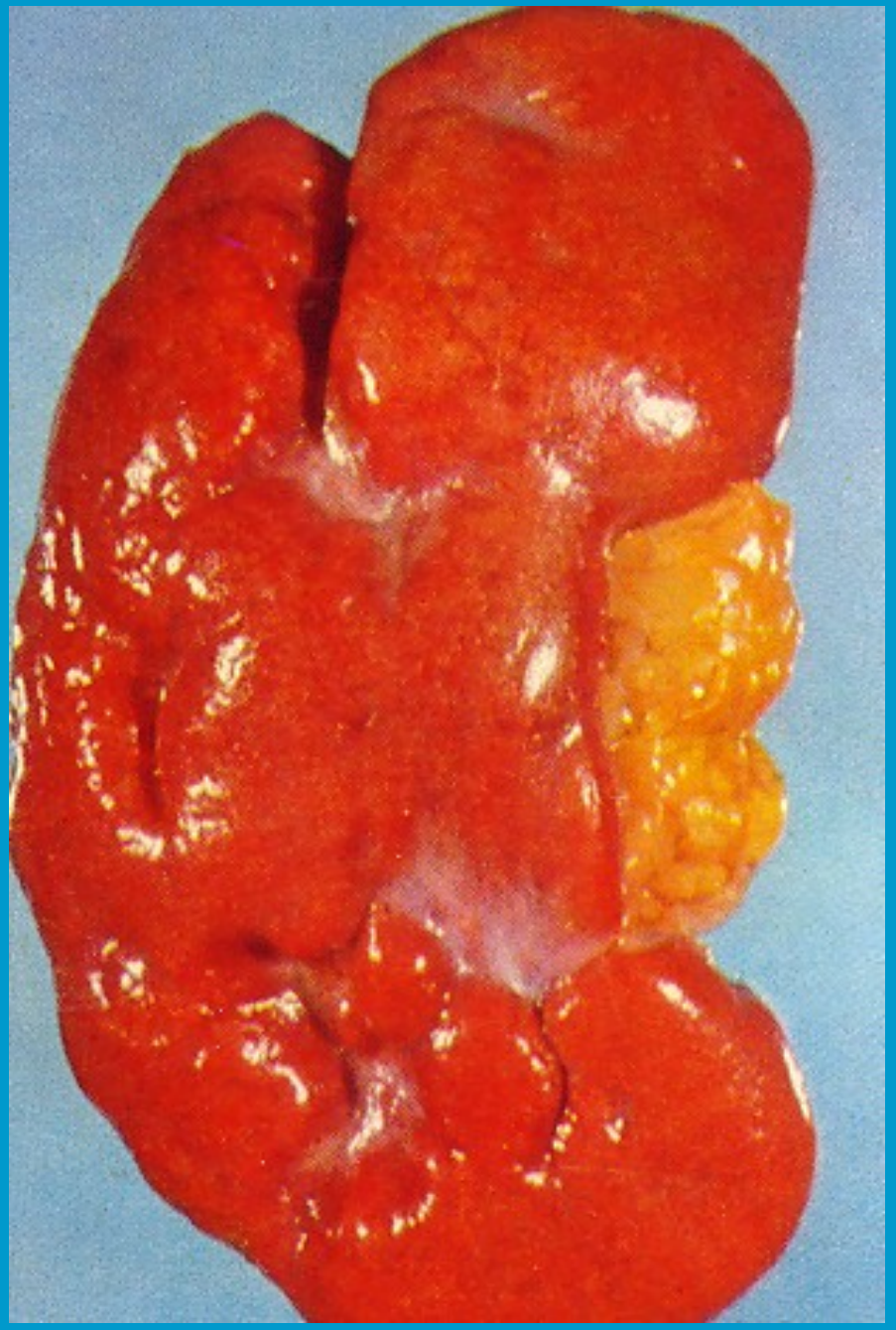




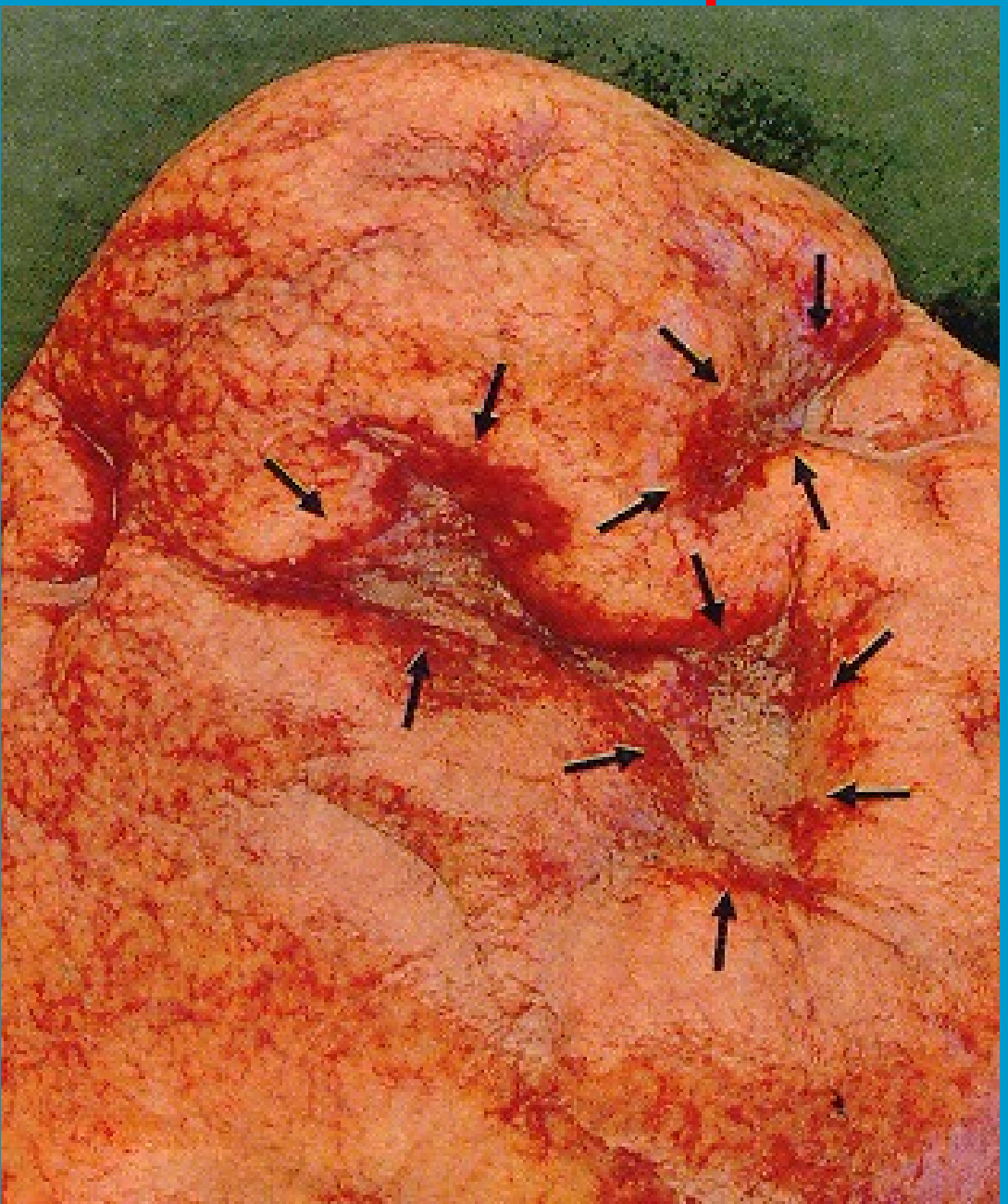
Benign nephrosclerosis – hypertensive nephropathy

- **a. renalis** stenosis, renal atrophy and hypertension (Goldblatt)

Benign nephrosclerosis

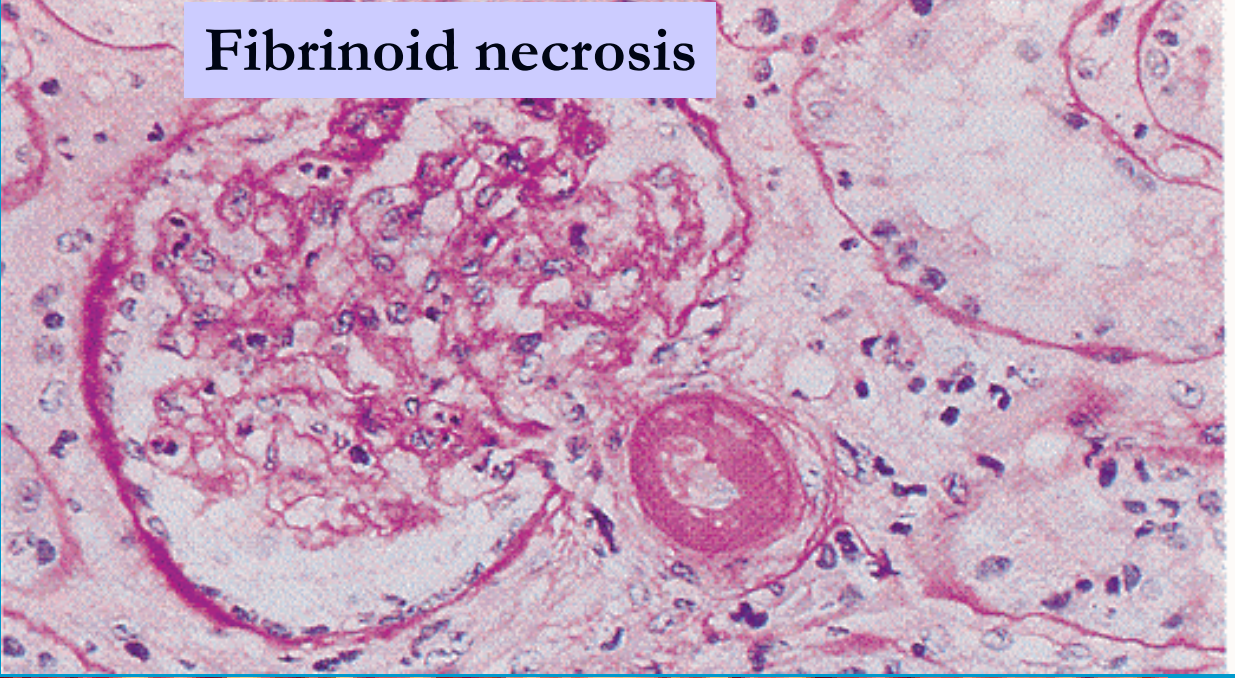


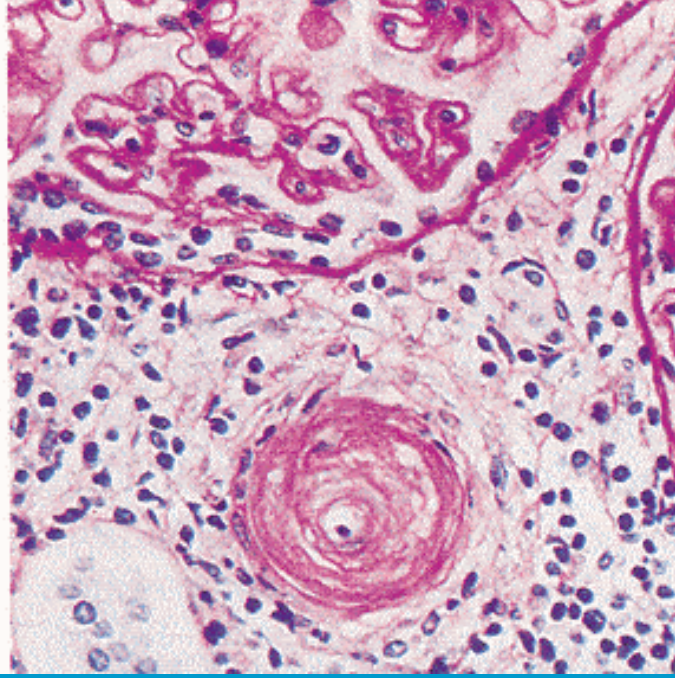
Nephrosclerosis

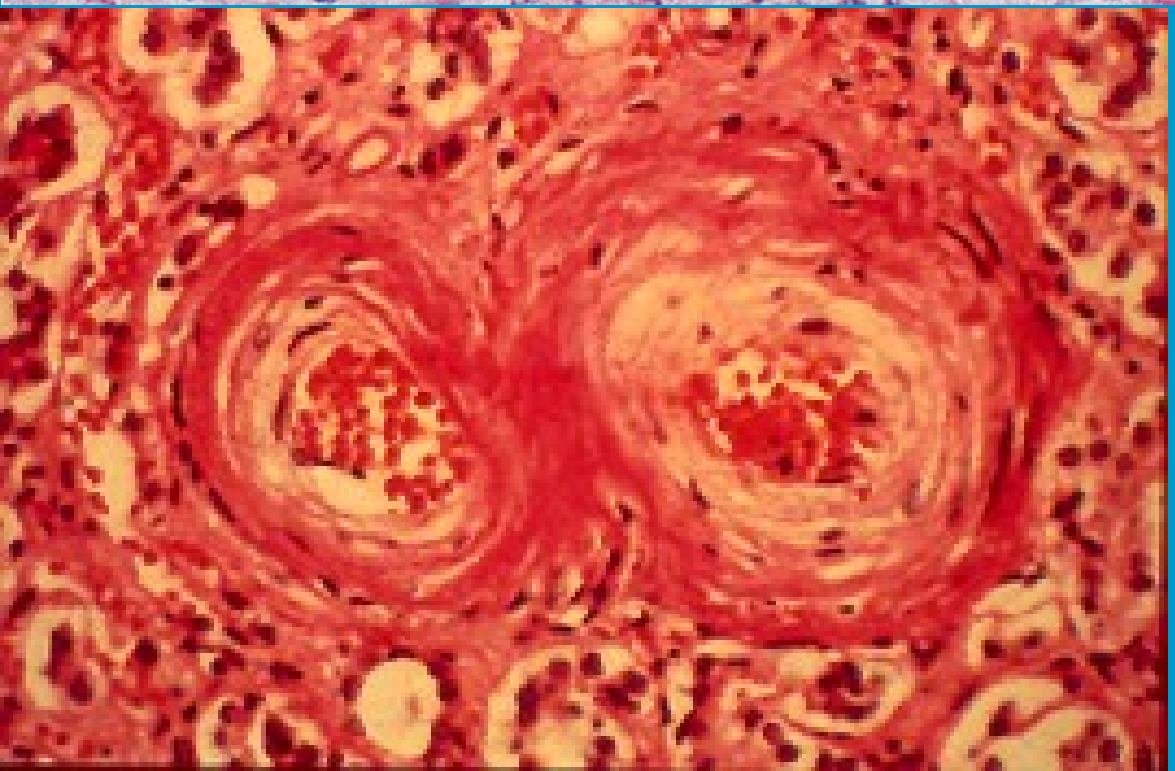


granulations
and post-infarct
scars

Fibrinoid necrosis







Onion-skin

formations – hyperplastic arteriolosclerosis +/- arteriolonecrosis; hyaline arteriolosclerosis hypertension

Thrombotic microangiopathy

- Endothelial damage → microthrombi → damage of erythocytes + platelets → hemolytic anaemia
- Hemolytic-uremic sy (typical – epidemic – Shiga toxin; atypical – antiphospholipid antibodies, malignant hypertension, pregnancy, drugs, irradiation, …)
- Thrombotic thrombocytopenic purpura (deficiency in von Willebrand-cleaving factor)

Hemolytic-uremic syndrome

1)Ischemic cortical changes with tubular dilatation

2)Disperse focal hemoragies, necroses

3)Diffuse cortical necrosis

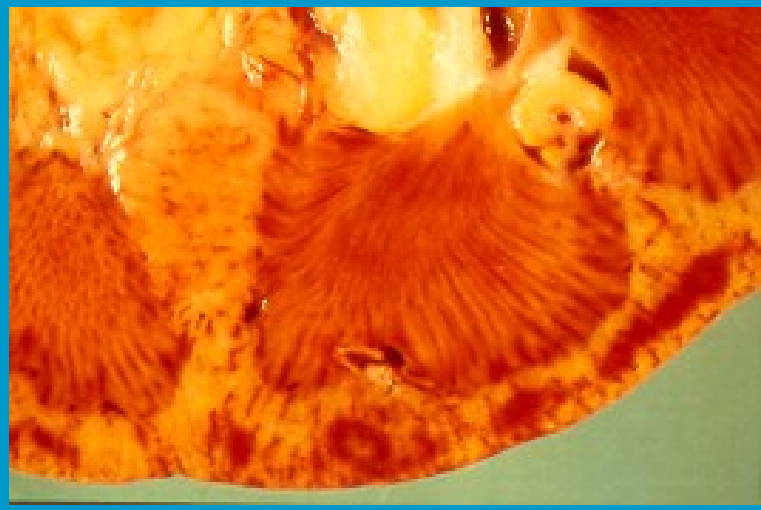
Acute nephropathy

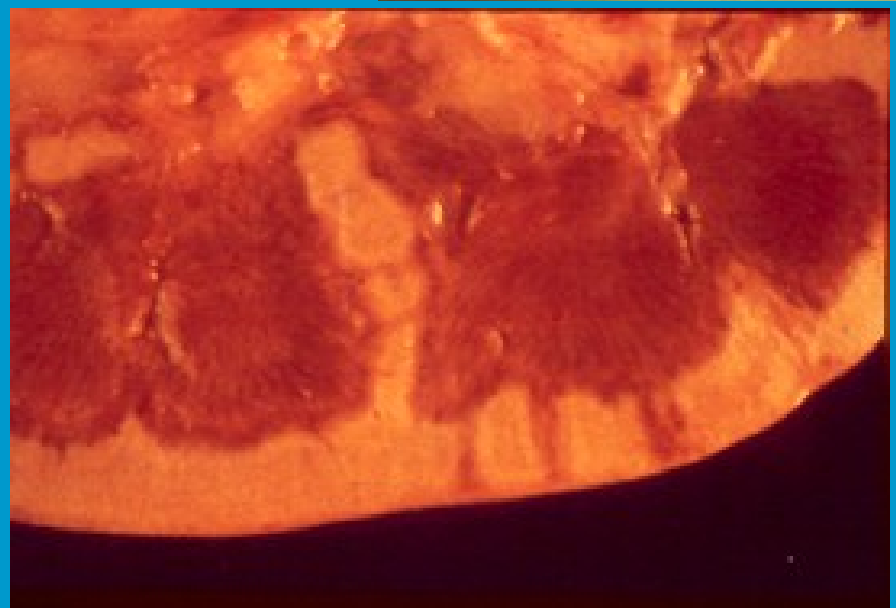
+ haemolysis

thrombocytopenia

diarrhea

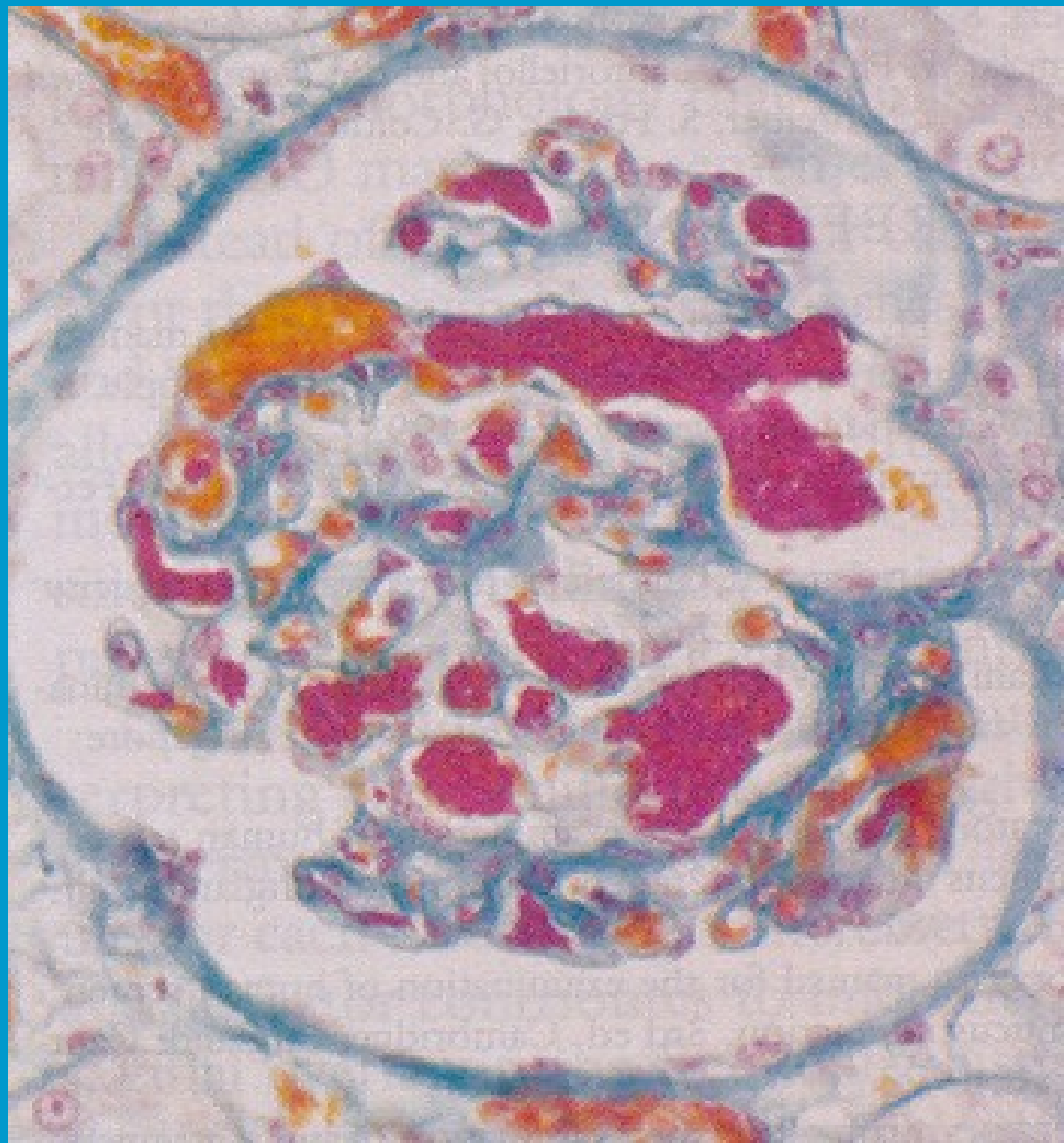
E.coli verotoxin, other toxins, AI





Hemolytic-uremic syndrome

- Microtrombi in glomerular capillaries (endothelial injury + platelet activation)
- Thickening of capillary walls
- Necrosis and intimal hyperplasia of small arteries

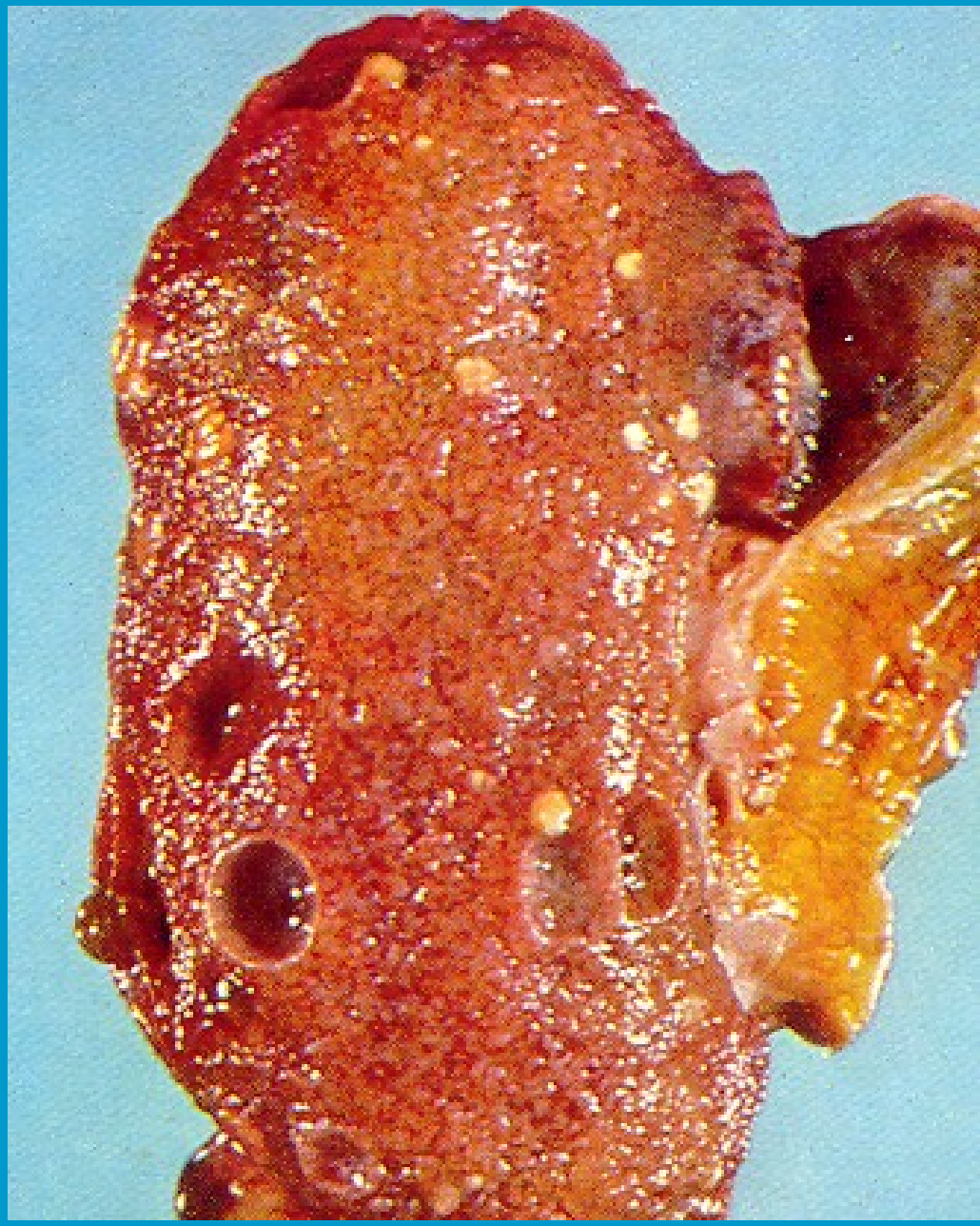


Renal tumors

Benign renal tumors

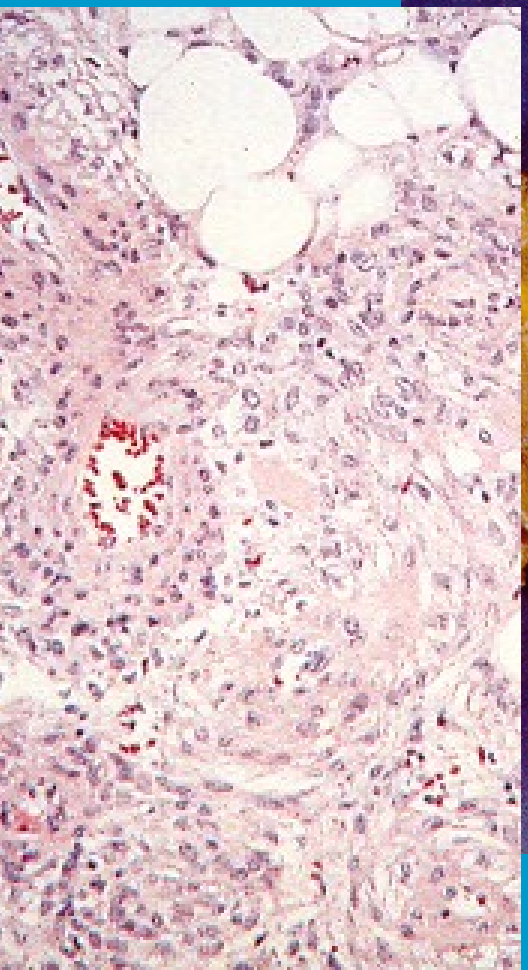
Cortical papillary adenoma

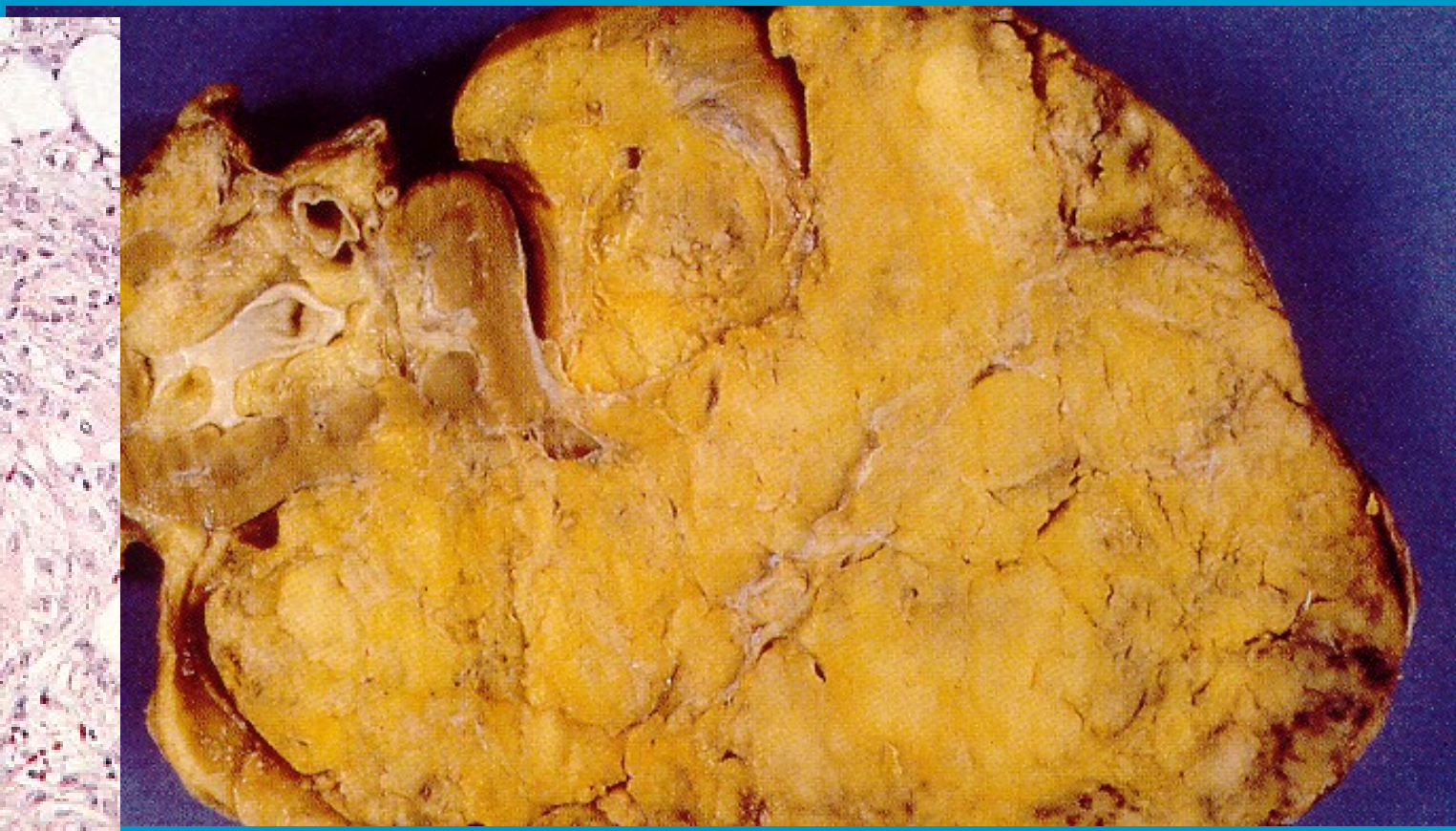
- Small tumors (1-5 mm),
- May be multiple
- Papillary structure



Benign renal tumors

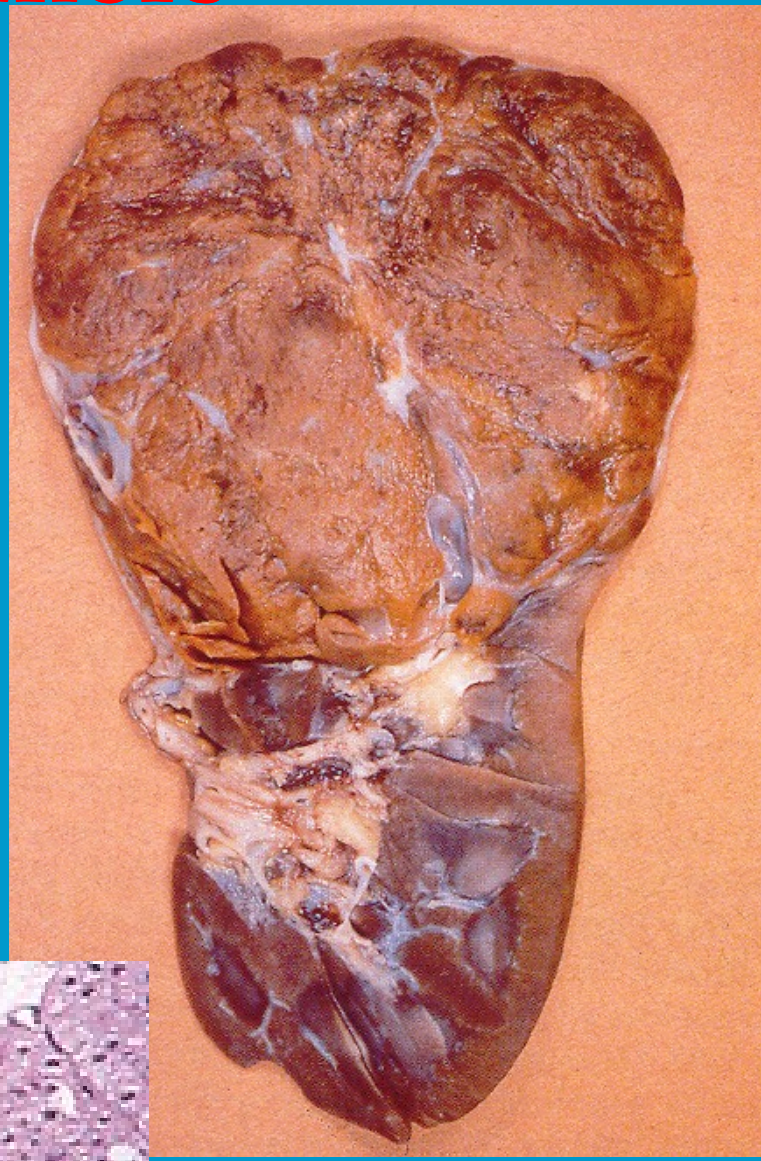
- **Angiomyolipoma** (PEComa)

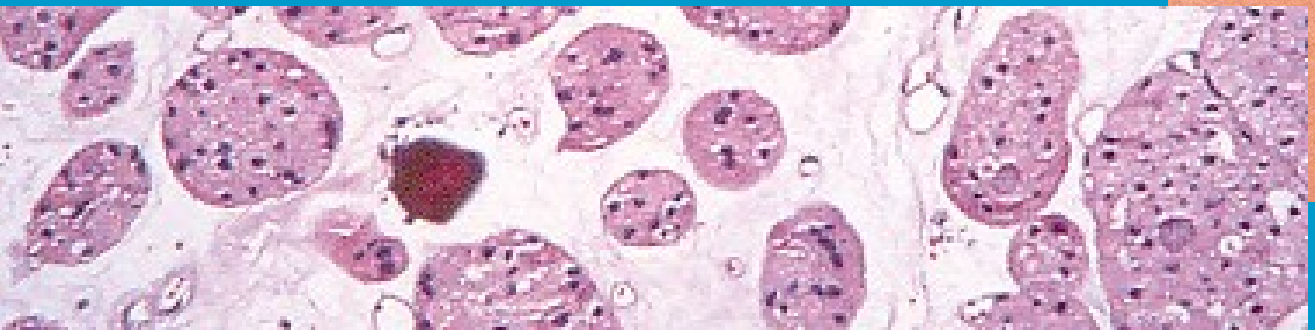




Benign renal tumors

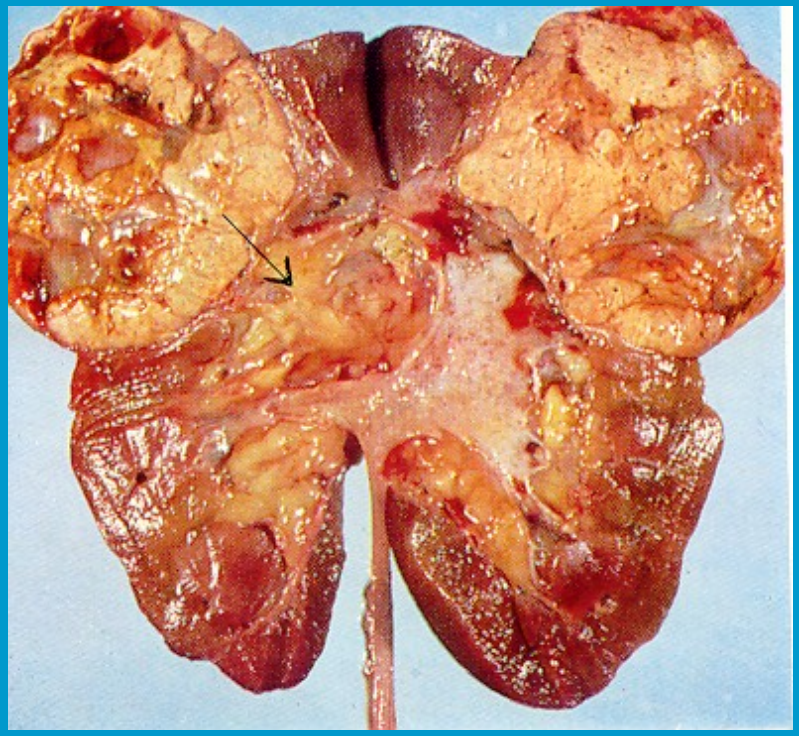
- Oncocytoma





Renal cell carcinoma

- Adenocarcinoma from tubular epithelium (clear cell - Grawitz)
- 85% of renal malignancies

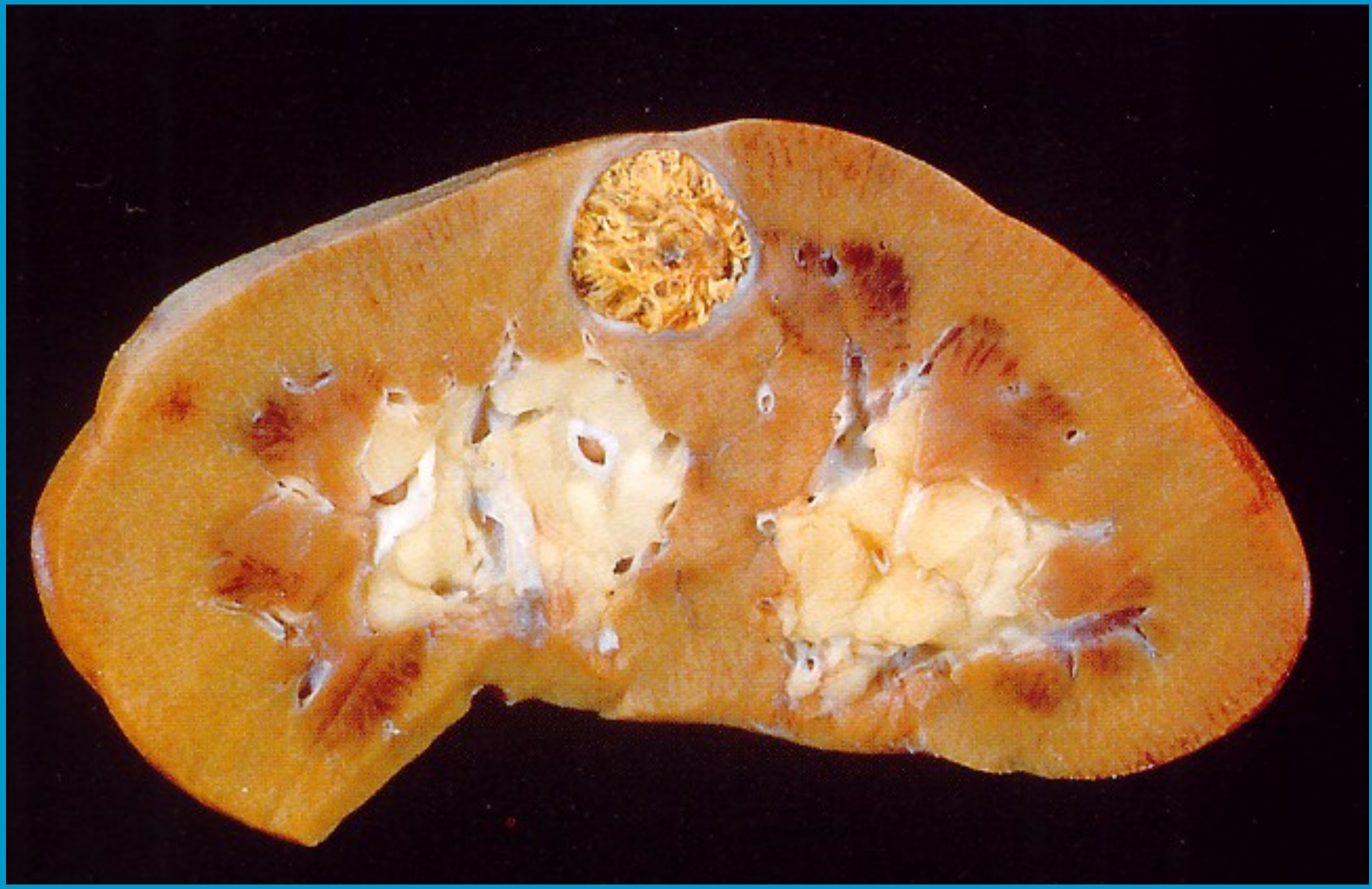


RCC

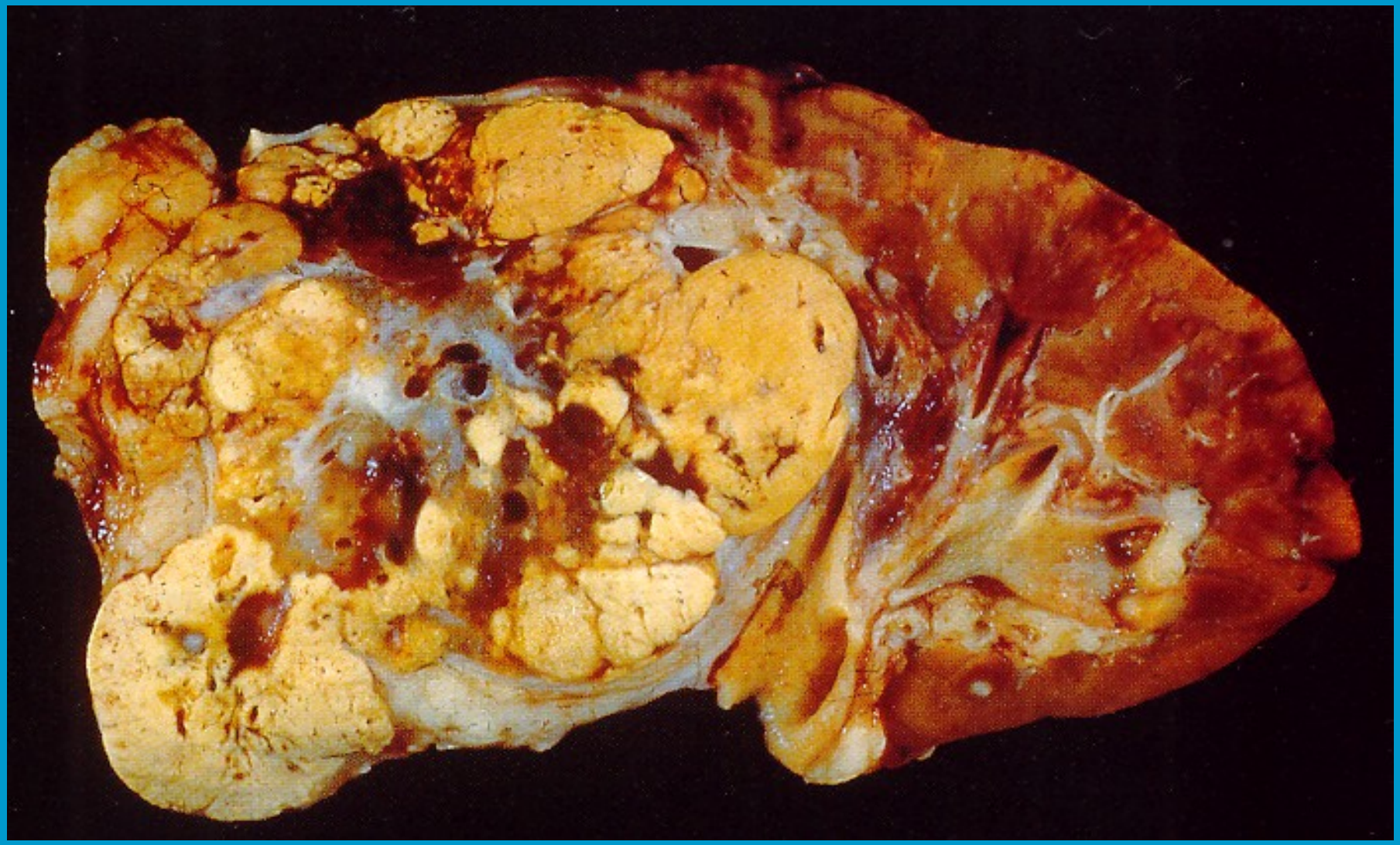
- Clear cell (conventional) RCC (80%)
- Chromophobe RCC
- Papillary RCC

- Risk f.: smoking, obesity, familiar factors, industrial pollution
- Incidental finding, hematuria, metastasis

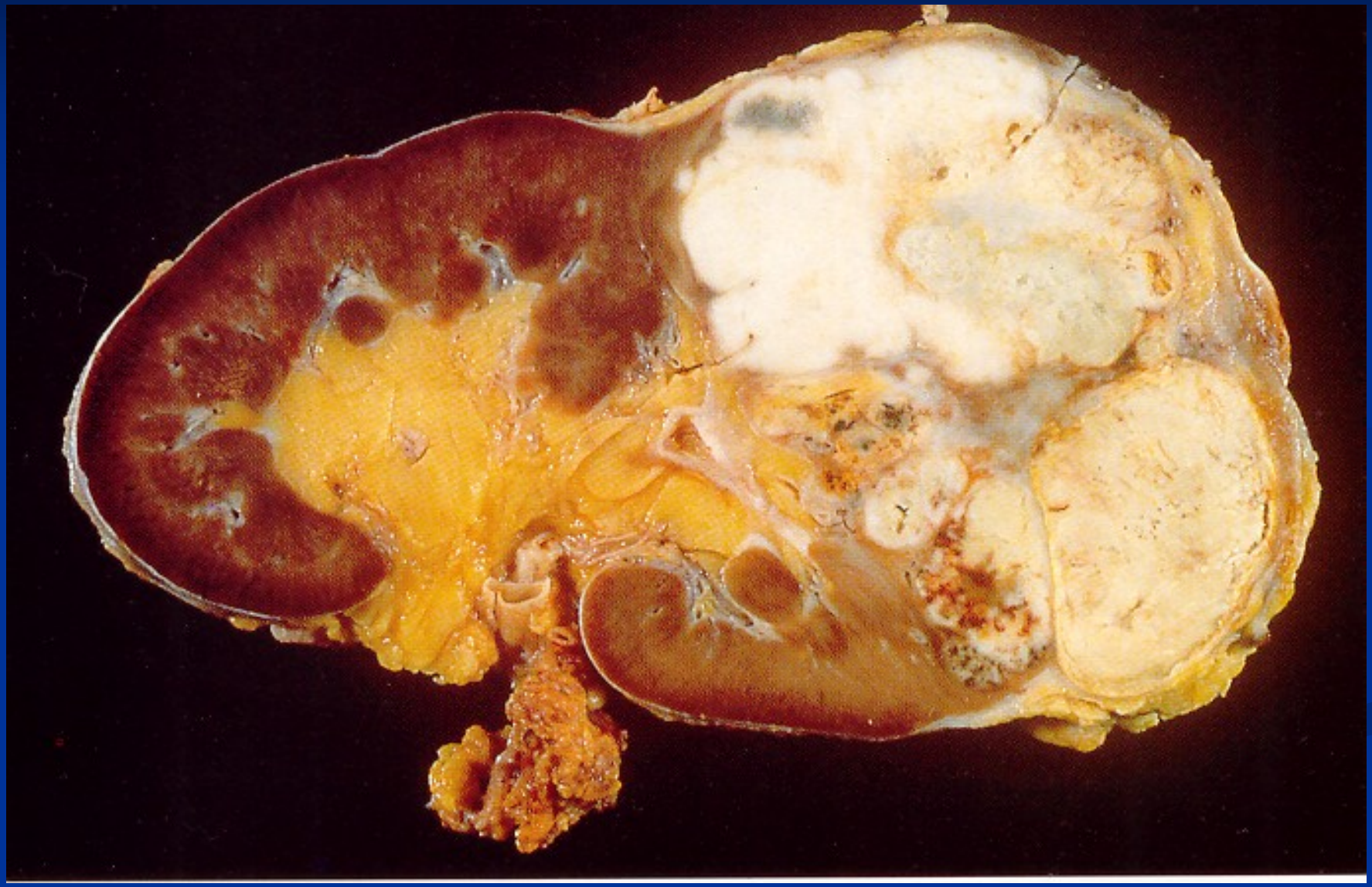
Renal cell carcinoma



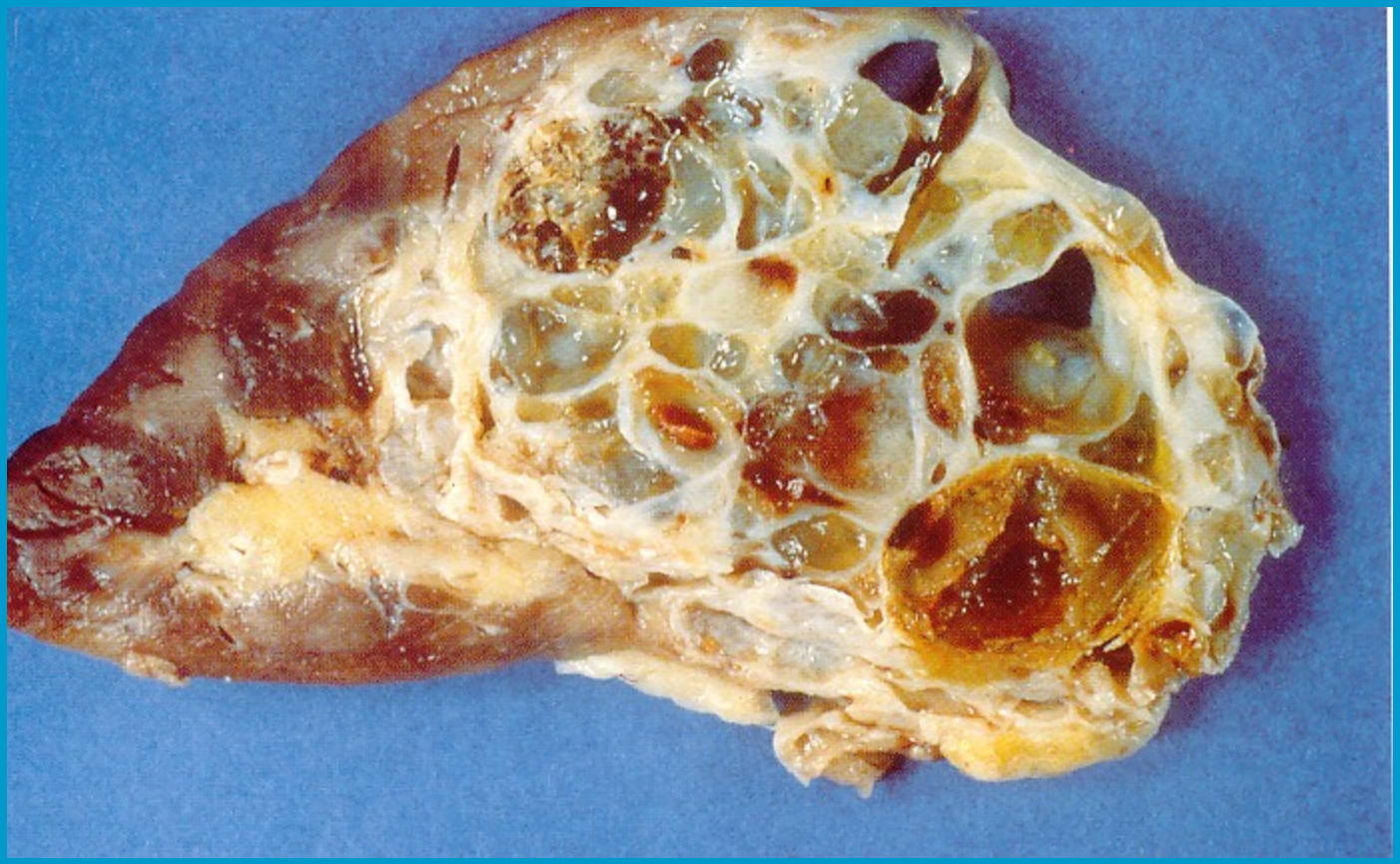
Renal cell carcinoma



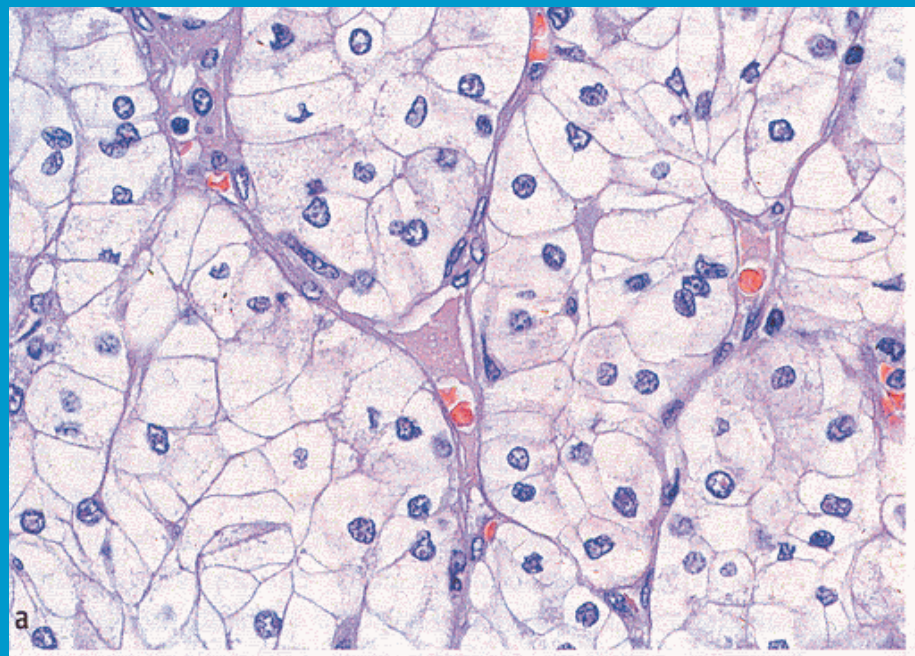
Renal cell carcinoma

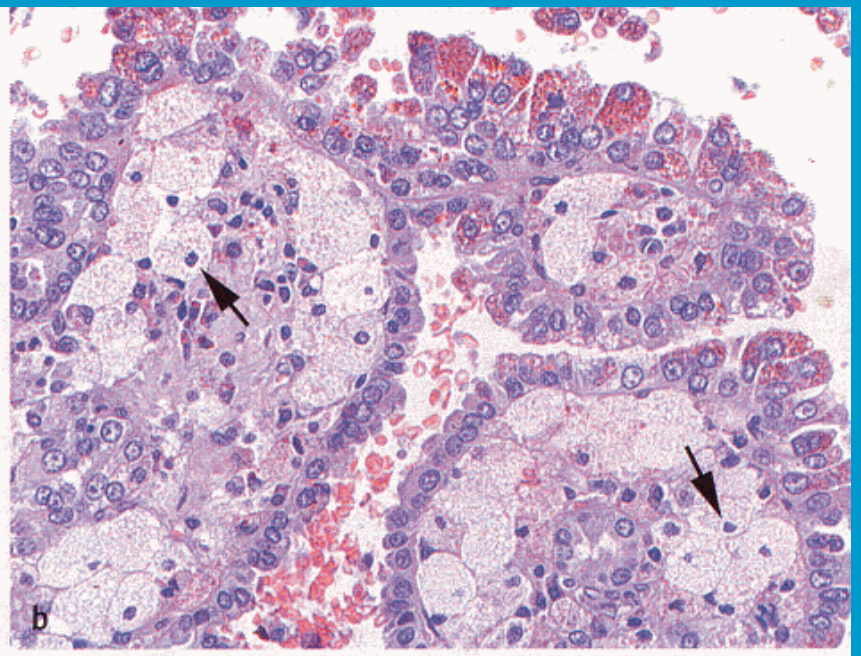


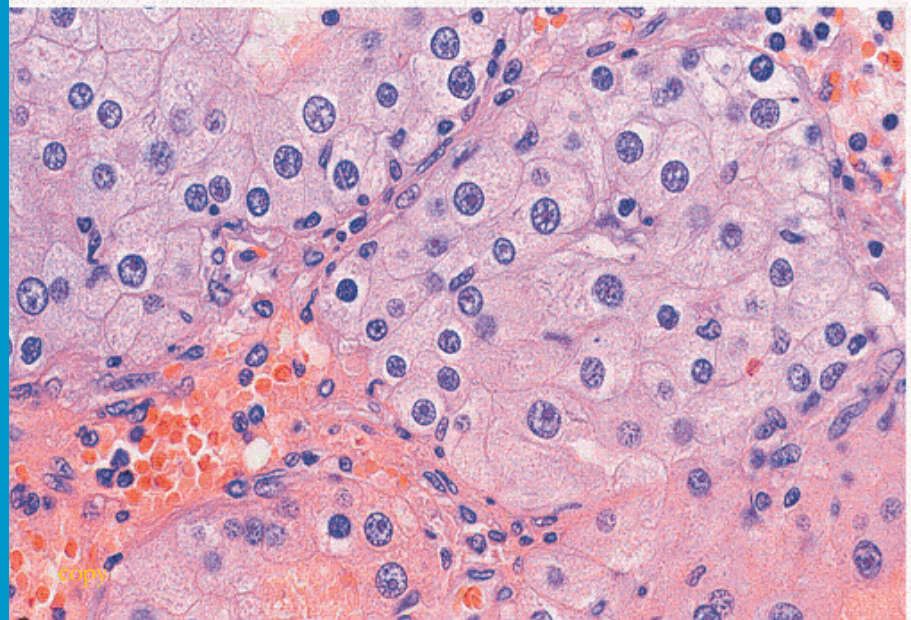
Renal cell carcinoma

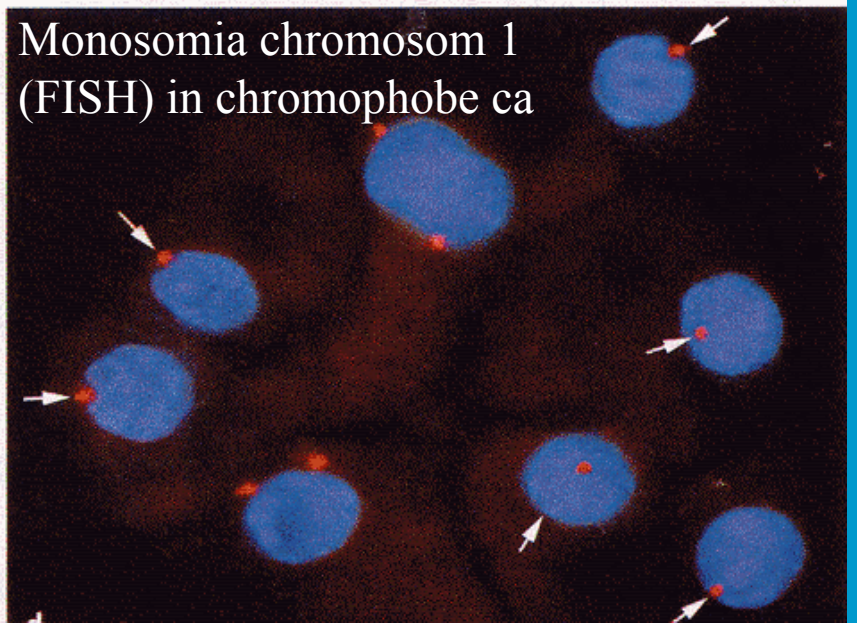


Renal cell carcinoma

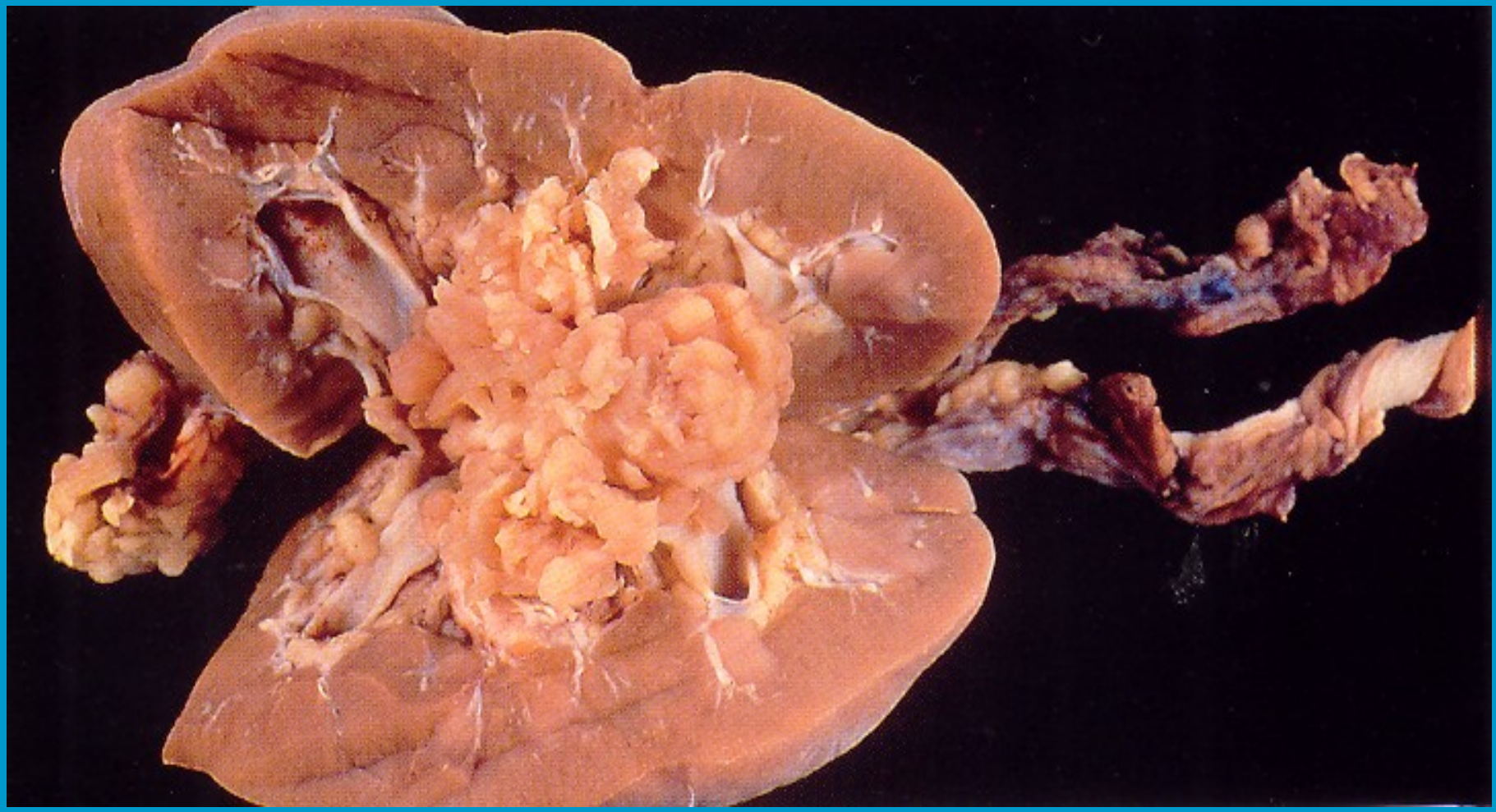




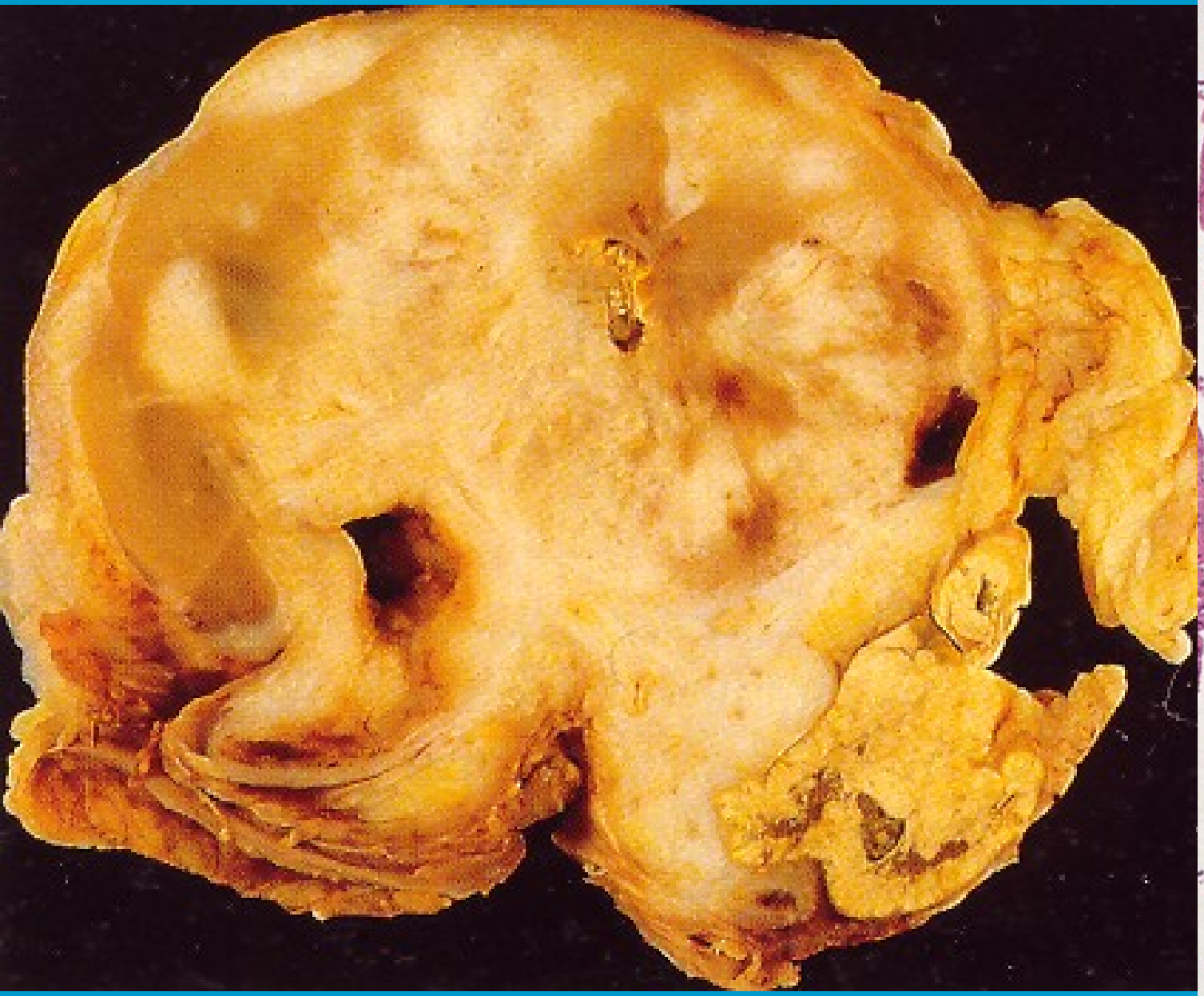


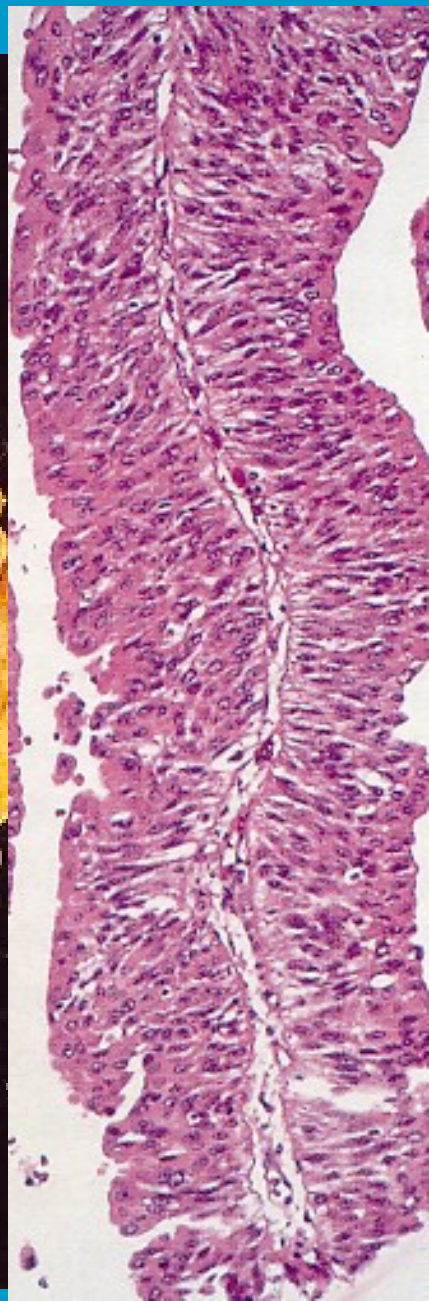


Transitional cell ca of the renal pelvis



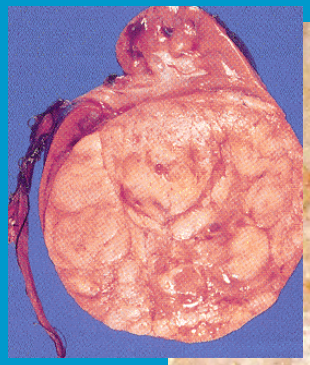
Transitional cell ca of the renal pelvis

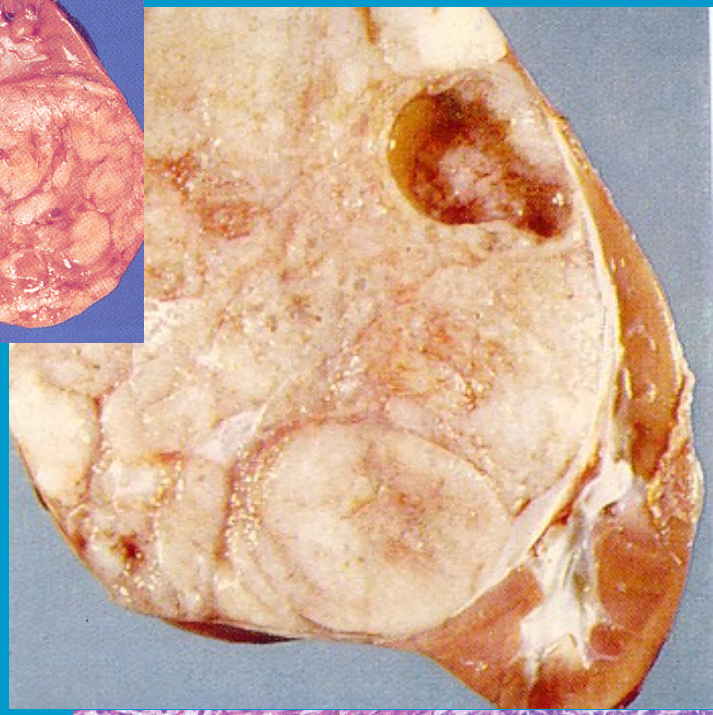


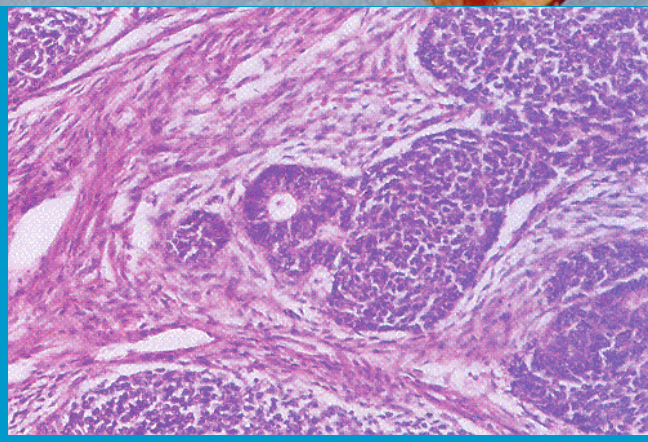


Wilms' tumor - nephroblastoma

- Malignant embryonal tu metanefrogennous blastema
- Peak incidence 1-4 yrs
- Supresoric gen WT1 (11p13), WT2 (11p15)
- MACRO: large, soft
- MICRO blastic cells, immature **epithelial, mesenchymal** differentiation



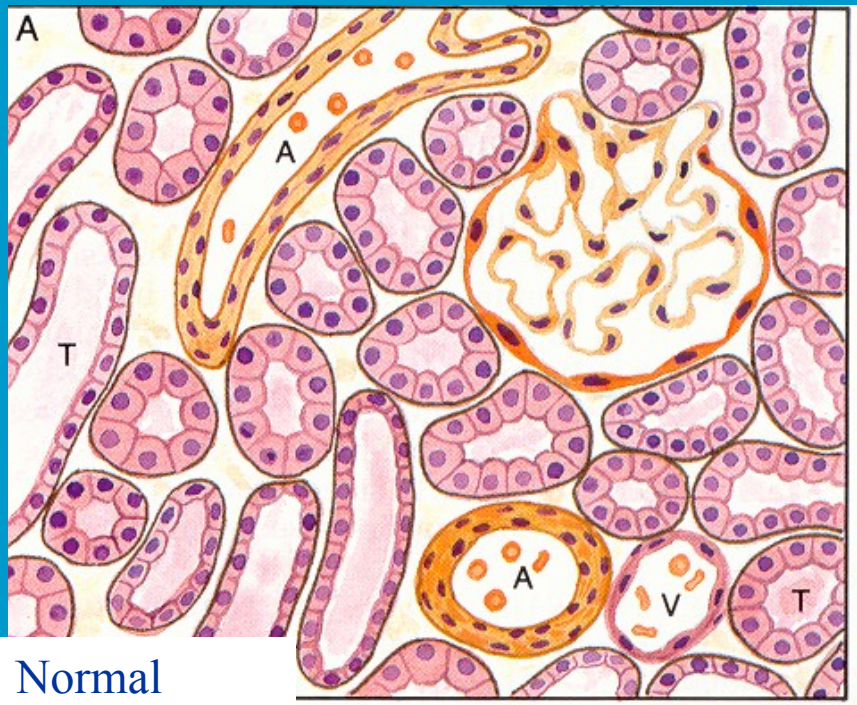




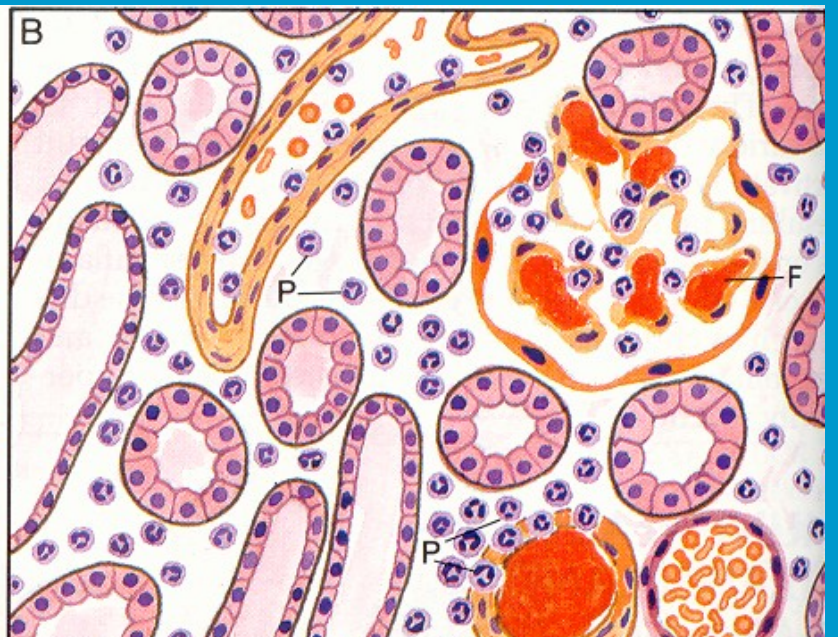
Secondary tumors

- Local spread (adrenals, pancreas, liver)
- Lung carcinoma
- Malignant lymphoma
- Others

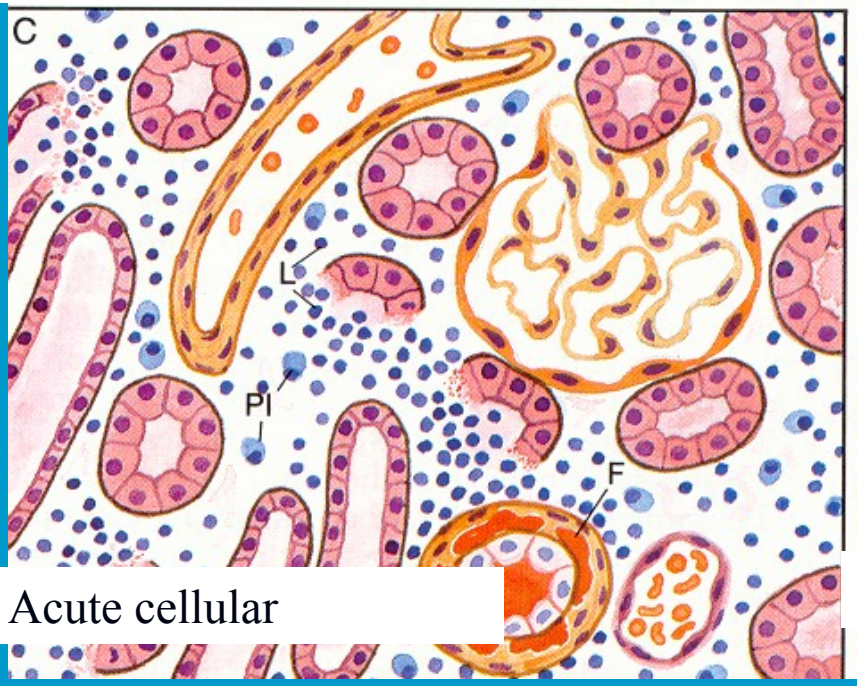
Type of graft rejec-tion



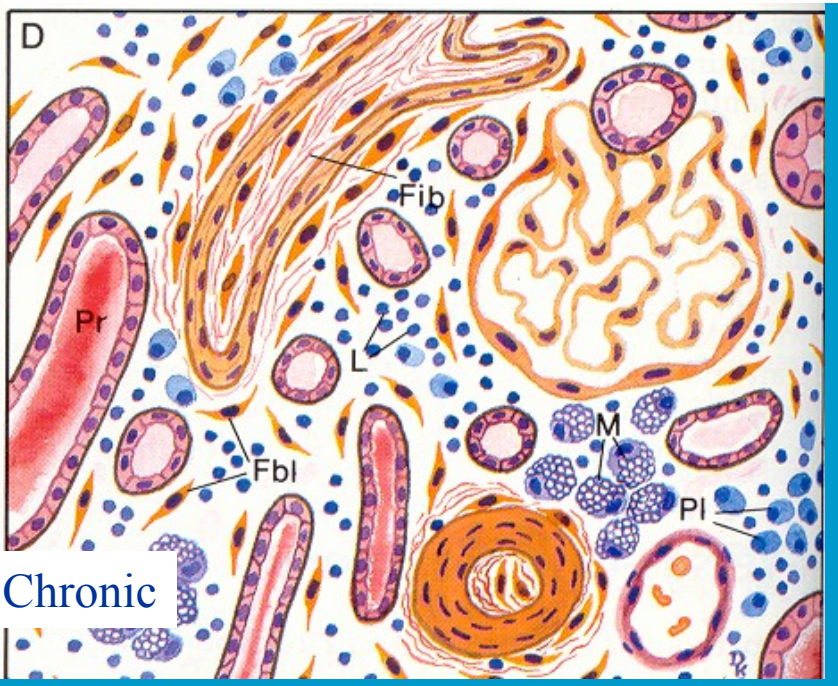
Normal



Hyperacute - preformed antibodies



Acute cellular



Chronic