

Renal failure (when kidney fail to carry out normal metabolic and endocrine function)

Pre renal failure

1. Decrease renal blood flow
2. Circulatory collapse
3. Obstruction
4. Shock
5. Severe hypovolemia

Renal disease

1. Increase intra vascular creatinine, urea, ammonia nitrogenous waste products and protein catabolism is known as **Azotemia**.
2. Uremia syndrome associated with multisystem clinical signs and lesion due to renal failure.

Developmental anomalies

- ▶ **Renal aplasia/agenesis** (Failure of development of one or both kidneys)
 - ▶ Unilateral / bilateral
- ▶ **Hypoplasia** (incomplete development of kidney such as fewer nephrones, lobes and calyces (unilateral, bilateral)).
- ▶ **Dysplasia** (an abnormality of altered structural organization resulting from abnormal differentiation with presence of structure not representative of normal nephrones.
 - Persistence of primitive mesenchymal (CT)
 - Presence of metanephric ducts
 - Atypical tubular epithelium
 - Presence of cartilaginous/oseous tissue
 - Interstitial fibrosis, renal cysts
 - Enlargement hyper cellular glomeruli.
- ▶ **Ectopic and fused kidneys** (Pig, dog)

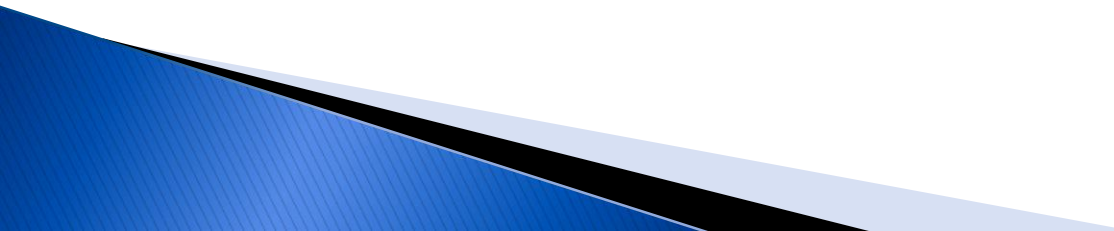
Renal cysts

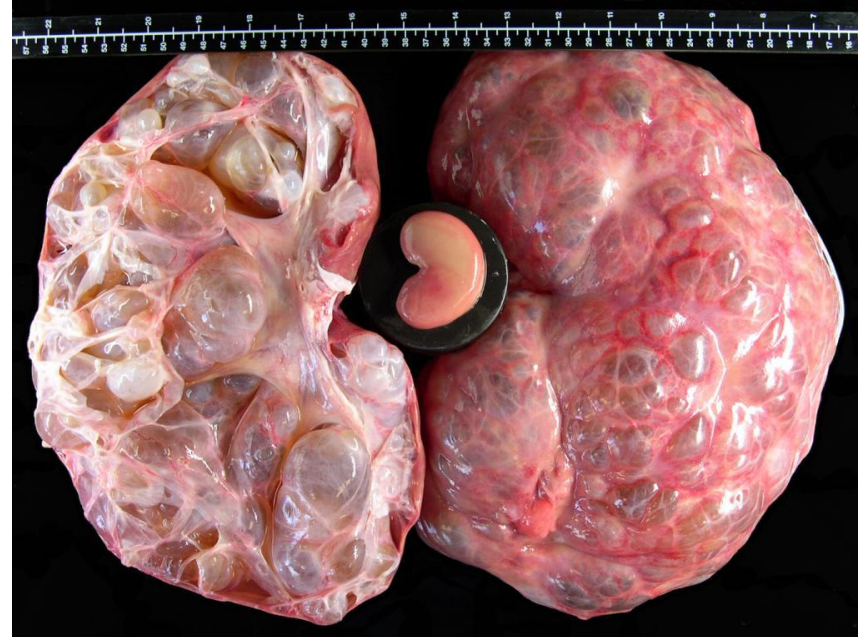
- ▶ Congenital- single or multiple
- ▶ Cortex/ medulla
- ▶ Spherical thin walled lined by flattened epithelial cells
- ▶ Filled with clear watery fluid
- ▶ Cysts wall pale grey, smooth and translucent.
- ▶ Poly cystic kidneys has Swiss cheese appearance when incised
- ▶ Failure of nephrons and collecting ducts to unite.

Four Reasons

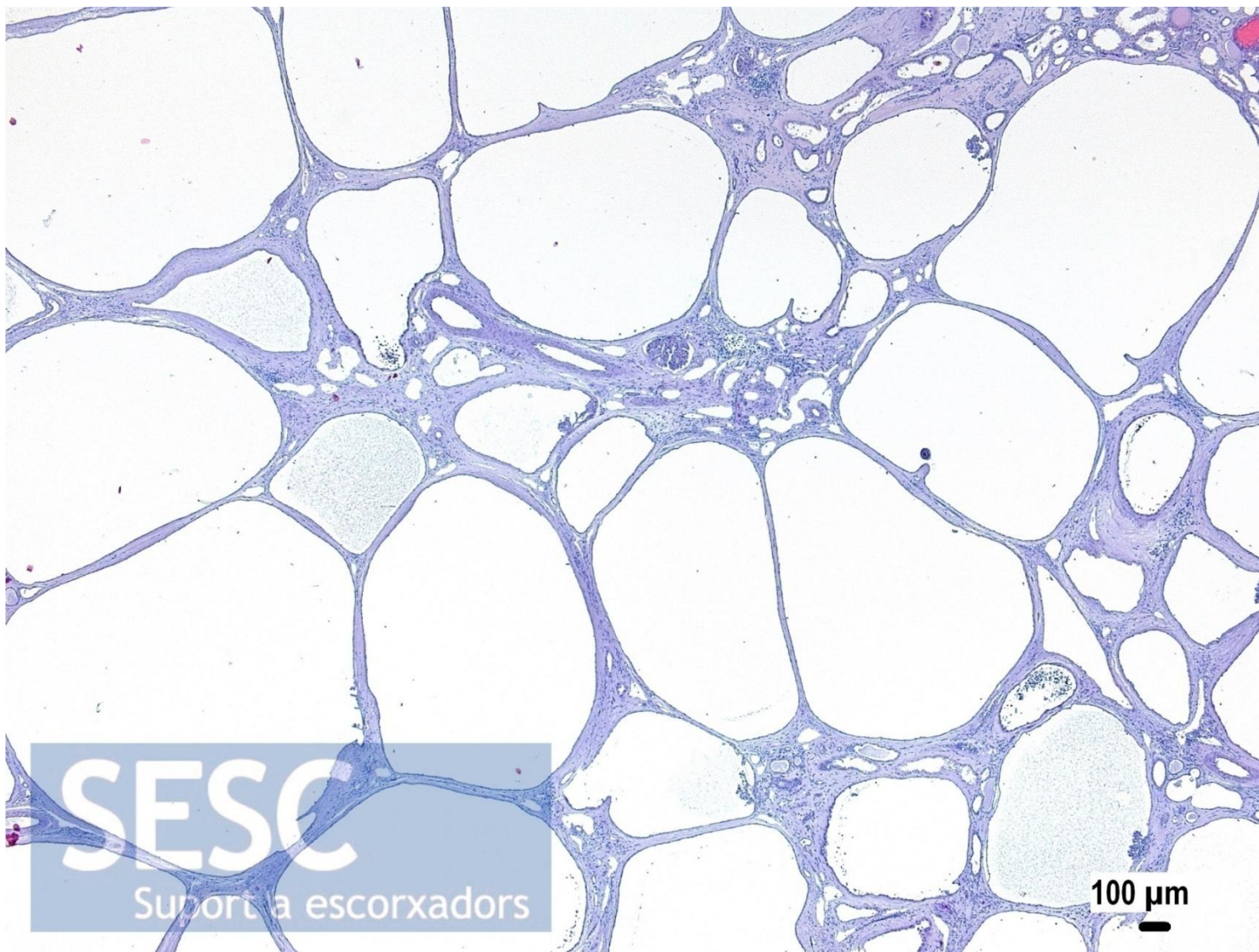
- Obstruction of nephrons
- Modification in extra cellular matrix and cell matrix that weaken tubular basement membrane allowing sacule dilation of tubules.
- Focal tubular epithelial hyperplasia with production fo new basement membrane, increased intratubular pressure and dilated tubules.
- Differentiation of tubular epithelial cells result in loss of polarity of cells with abnormal cells arrangement in tubules thus increase intratubular pressure that lead to dilation.

Acquired:

- ▶ Abnormality of tubular membrane in transport that increase resorption of glucose, AA ions and protein also
 - ▶ Increased excretion of large quantity of cystine (Cystinuria)
 - ▶ Glucosuria
- 



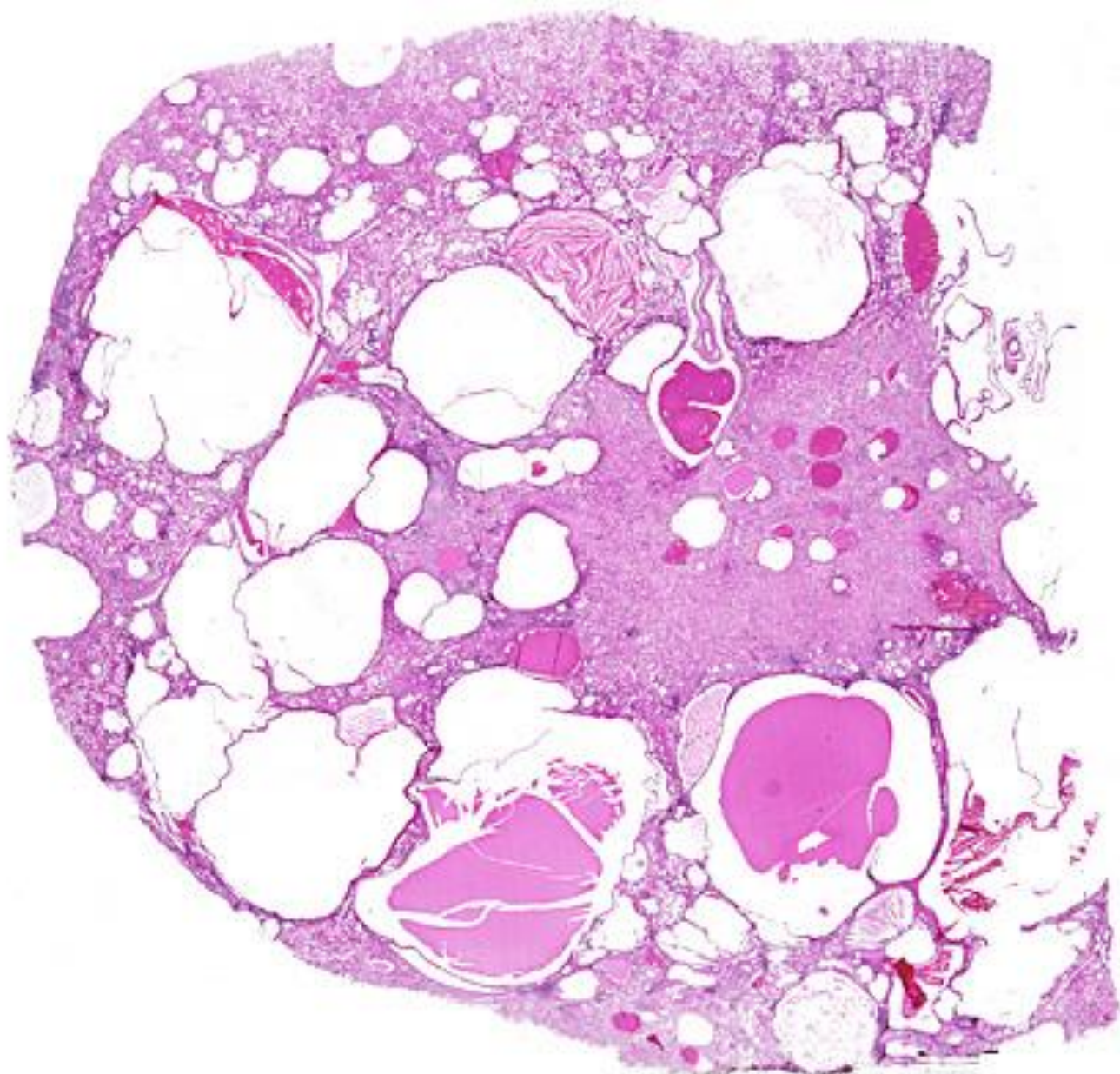




SESC

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100 μm



Circulatory Disturbance

- ▶ Renal hyperemia and congestion
- ▶ Hemorrhage (in septicemia diseases/ vasculitis, thrombo-embolism, DIC)
- ▶ Renal cortical echymotic hemorrhages (Herpes virus septicemia of neonatal puppies).
- ▶ Large intra renal or sub capsular hemorrhages as a result from (Direct trauma, bleeding disorders & DIC).

Infarction (area of coagulative necrosis due to local ischemia of vascular occlusion)

Gross Appearance

- Red, pale white (lysis of erythrocytes loss of hemoglobin)
- Cortical area of coagulative necrosis surrounded by zone of congestion and haemrhages, pale margin zone of leucocytes.
- Often wedge shape (base to ward cortical surface and apex toward medulla).

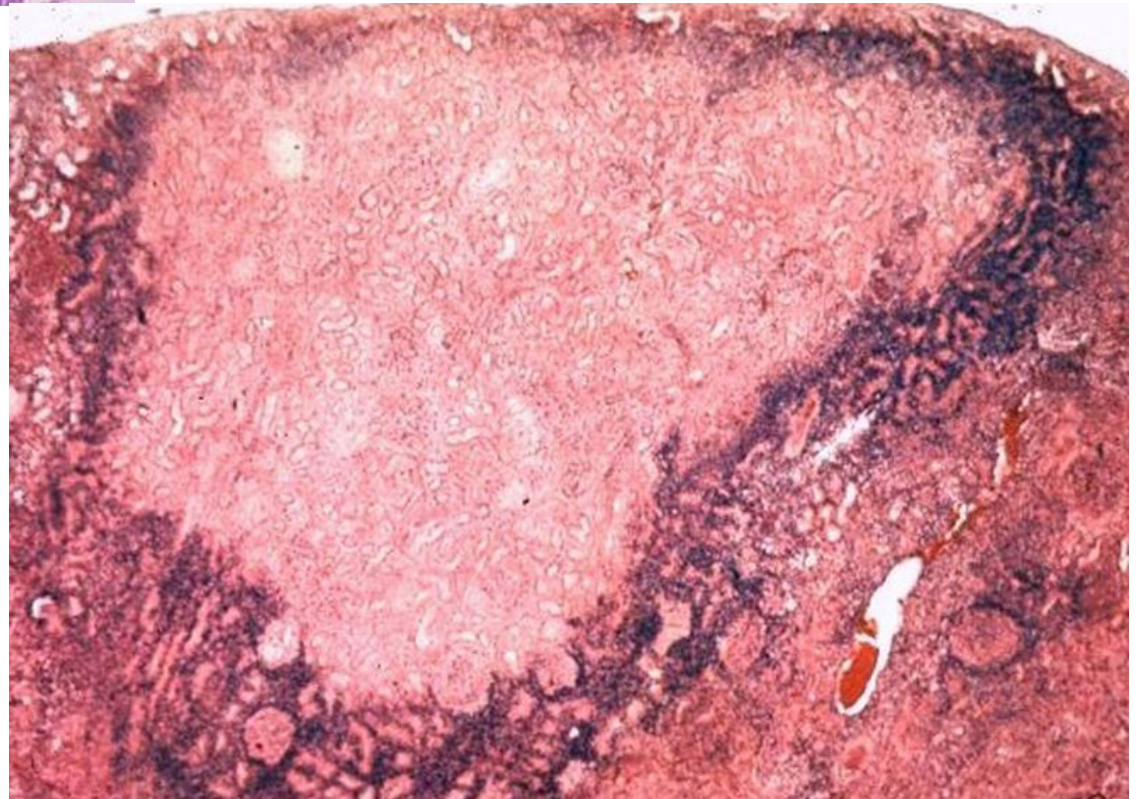
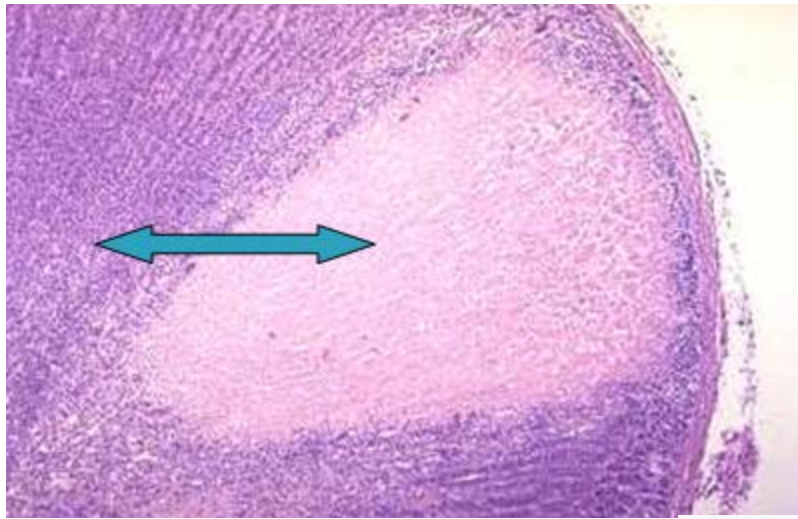
Microscopically

- Nephrones in central zone necrotic, glomeruli tend to be sparsed, margin infiltrated with neutrophils with few macrophages, lymphocytes.
- Capillary near necrotic area markedly engorged with blood
- Healing through phagocytosis and replacement with fibrous CT leaving fibrotic scar.



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Tubular Necrosis (acute tubular degeneration and necrosis often referred to nephrosis) characterized by Ischemic, toxic damage to renal tubular epithelial cells, Necrosis, desquamation of cells into tubular lumen, signs of uremia, decreased in urine production (oliguria), anuria (absence of urine)

Causes

- ✓ Ischemia,
- ✓ nephrotoxicity,
- ✓ hemoglobinnemia (intravascular hemolysis),
- ✓ Myoglobinuria (Cu toxicity, leptospirosis, babesiasis in cattle , red maple toxicity in horses, autoimmune injury, hemolytic anemia in dog)
- ✓ Myoglobin (Acute rhabdomyolysis occur in (azoturia/monday morning diseases of horses)
- ✓ Capture myopathy of exotic or wild animals

- ✓ severe trauma, serum conc. of Hb and myoglobin increased
- ✓ renal cortices diffusely stained red brown to blue black
- ✓ intratubular heme casts, casts appear as red black stippling of external surface and continue in to cortex as radially oriented dark red (red streaks)
- ✓ Cu poisoning in sheep (diffusely and strikingly blue black (Gun metal blue)
- ✓ tubular epithelium degeneration, necrosis
- ✓ lumen filled with abundant orange red granular refractive material the characteristic appearance of heme compound.

Gross

- kidney swollen, capsular surface smooth, pale mahogany, cut surface of cortex bulges , radially oriented, opaque white streaks

Micro

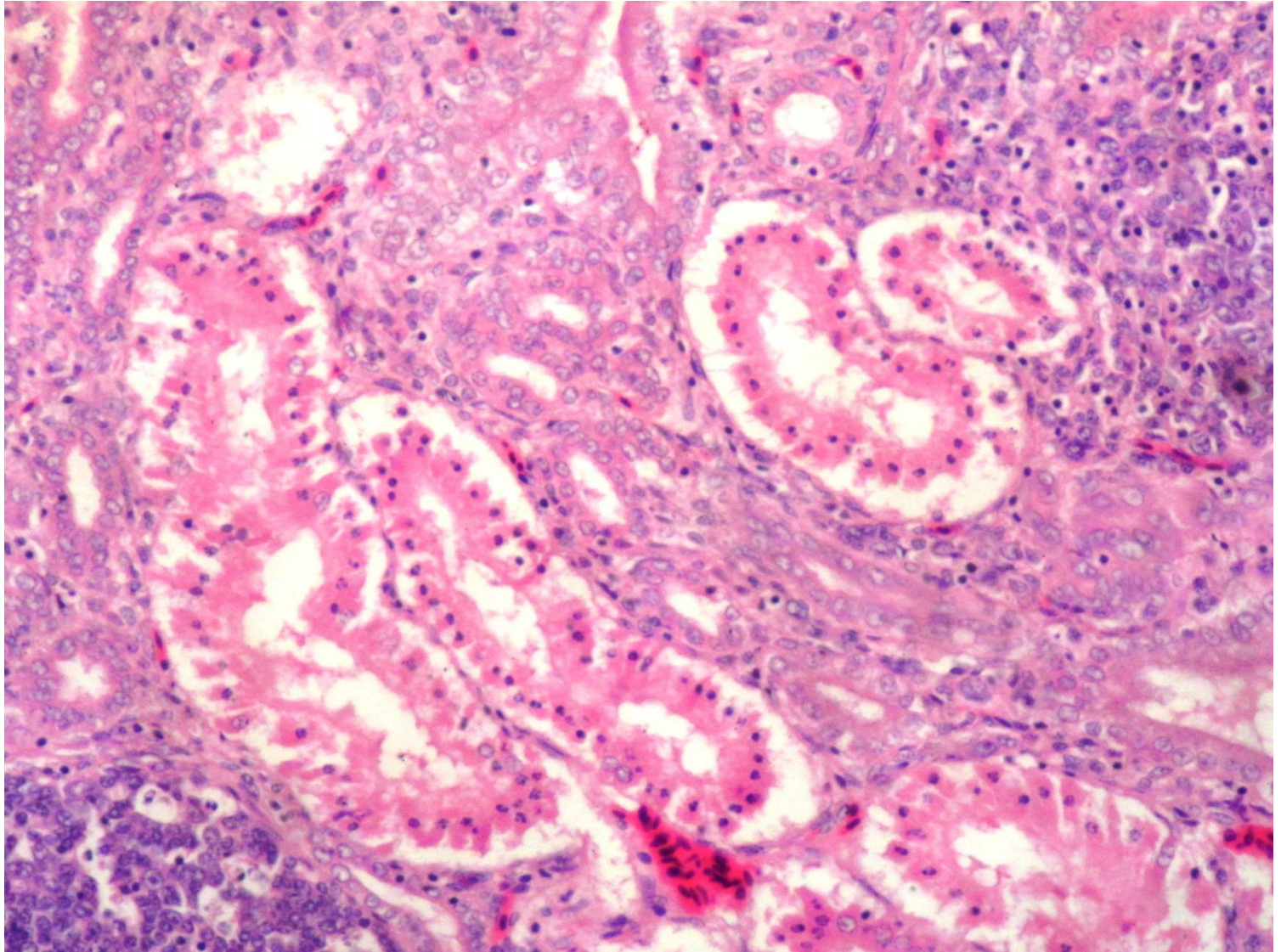
- Tubular epithelium swollen, microvilli absent , cytoplasm vacuolar or granular and intensely eosinophilic (coagulation),
- markedly hypercellular tubules and contain necrotic cellular debris and hyalinized or granular casts.

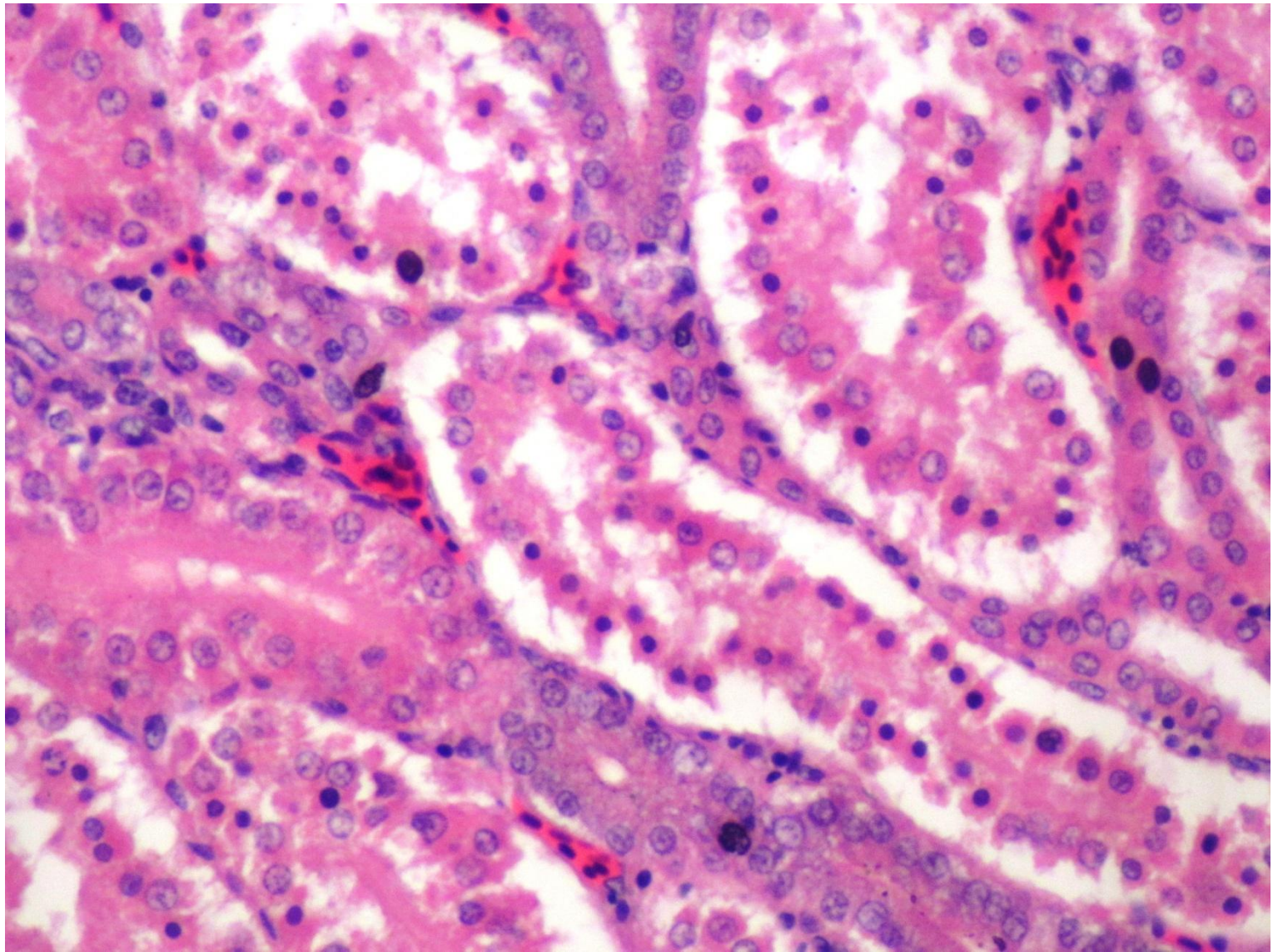
Nephrotoxic tubular necrosis

- ❖ **Mercury ions** (become concentrated in the rough endoplasmic reticulum and caused early tubular changes that include loss of brush border, dispersion of ribosome, mitochondrial swelling and cellular death.
- ❖ **Cadmium** (cause cell death in proximal convoluted tubules by apoptosis
- ❖ **Lead** protein complexes
- ❖ **Cisplatin** (platin containing cancer chemotherapeutic cause direct tubular damage and decrease renal blood flow via vasoconstriction
- ❖ **Aminoglycosides** (become concentrated in lysosomes and then toxic effects occur after release of large conc of the drugs from these organelles,

Comon nephrotoxins of domestic animals

Heavy Metals	NSAID
Mercurury	Aspirin
Lead	Phenylbutazone
Arsenic	Ibuprofen
Cadmium	Mycotoxins
Antibacterial and Antifungal	Ochratoxin A
Amynoglycosides	Oxalates
Gentamycin	Ethylene glycol
Neomycin	Halogeton
kenamycin	Vitamin D
septomycin	Antineoplastic compounds
Plants	Cisplatin
Pigweed	
Oaks	



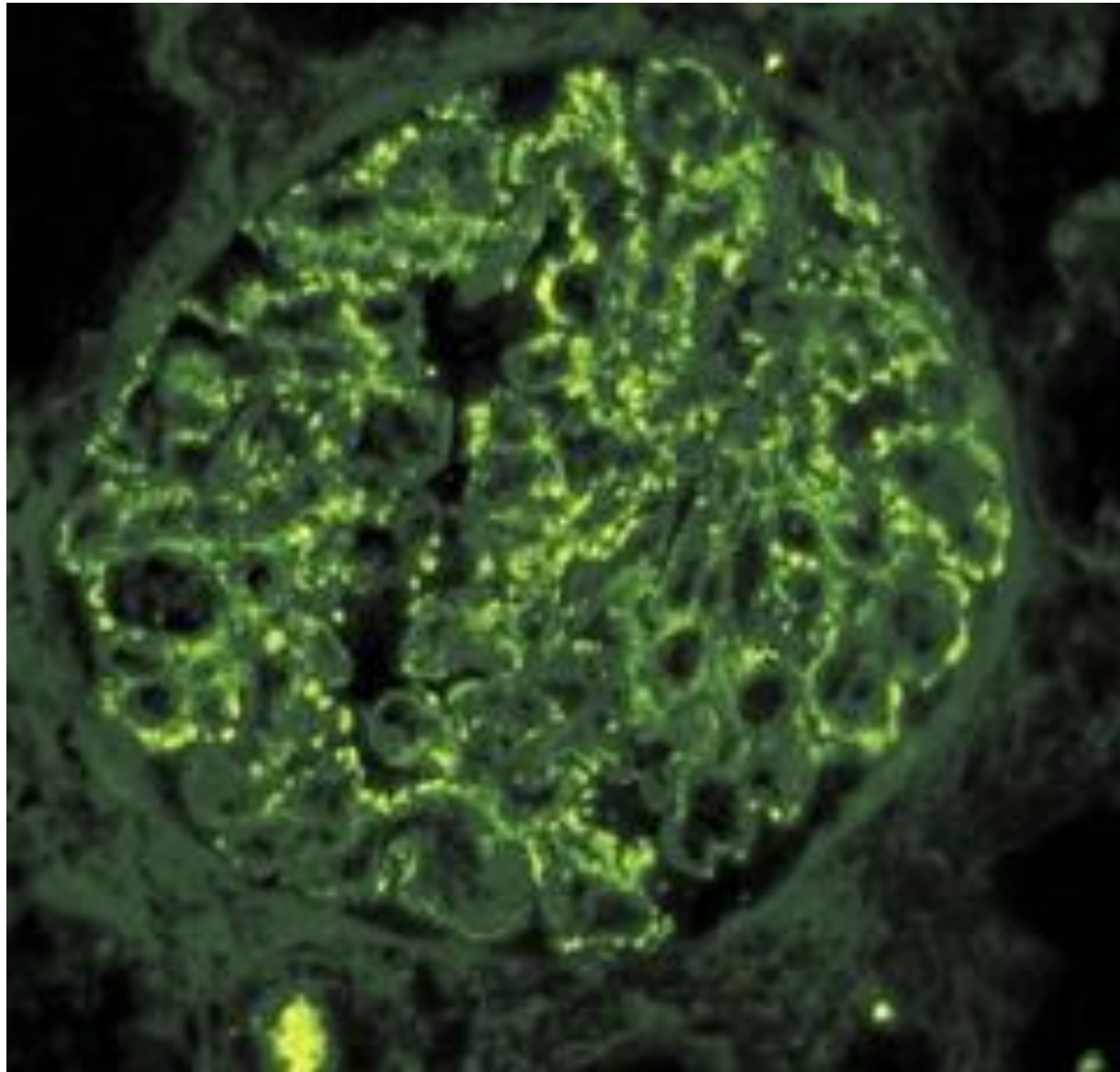


Viral glomerulitis

- Acute infectious canine hepatitis,
- Septicemic cytomegalovirus (pig)
- Equine viral arteritis
- Hog cholera
- Newcastle disease (birds)

Lesions

- ▶ Mild and transient due to replication in capillary endothelium, proteinuria
- ▶ Intracellular inclusions in glomerular capillary endothelium, large basophilic to magenta, endothelial hypertrophy,
- ▶ Thickened and edematous mesangium,
- ▶ Hemorrhages, and necrosis of endothelium



Embolic nephritis/Suppurative glomerulitis

- ▶ As a result of bacteriemia , bacteria lodges in glomeruli, multiple foci of inflammation through out renal cortex, glomerular capillaries have numerous bacterial colonies , necrosis and extension infiltration with neutrophils often obliterate glomeruli,
- ▶ Hemorrhages/ glomeruli or interstitial, increased number of lymphocytes, plasma cell and macrophages

Specific examples

- ▶ Actinobacillosis of foals caused by actinobacillus equuli,
- ▶ Pigs- erysipelothrix specis/streptococcus and corynae bacterium

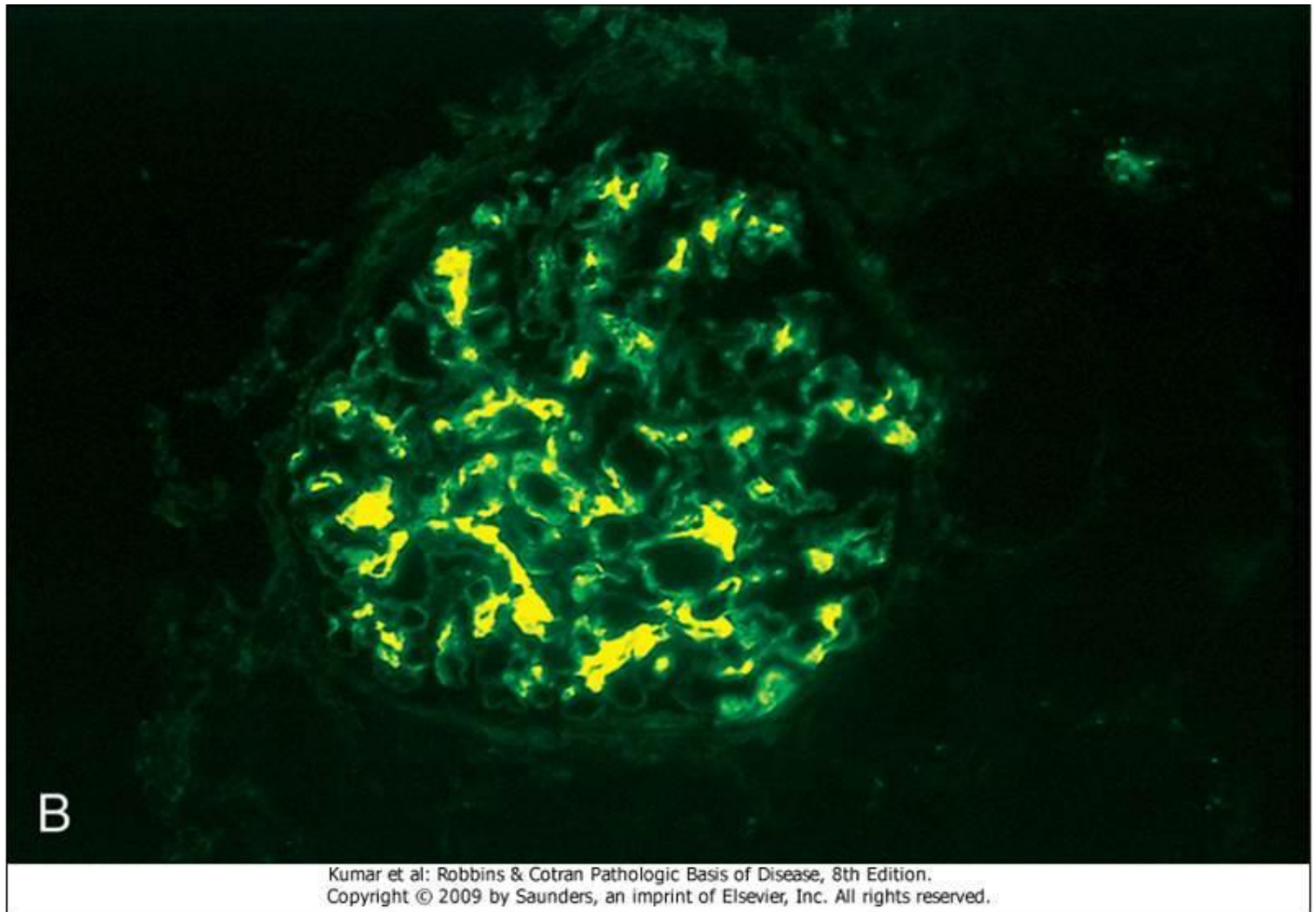
Immune mediated glomeruonephirtis

- Ab to glomerular basement membrane or deposition of soluble immune complexes within the glomeurli
- Diagnosis by demonstration of Ig, complements(C3) in glomeruli
- Damage to glomeruli result in leuckocytic infiltration (damage basement membrane releasing proteinases, AA metabolite thromboxane, H₂O₂).
- Often observed in dogs, cats in particularly Viral infections (feline leukemia virus, canine systemic lupus erytheromatosis, parasitism dirofilariasis

Diseases in which immune complex glomerulonephritis can occur

Dogs	Infectious canine hepatitis
	Chronic hepatitis
	Dirofilariasis
	Borreliosis (Lyme disease)
	Systemic lupus erythromatosis
	Immune mediated polyarthrititis
Cattle	Bovine viral diarrrohea
	Trypanosomiasis
Pig	Hog cholera
	African swine fever

Deposition of IgA



Bovine kidney chronic multifocal interstitial nephritis (White Spotted Kidney)



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Interstitial nephritis

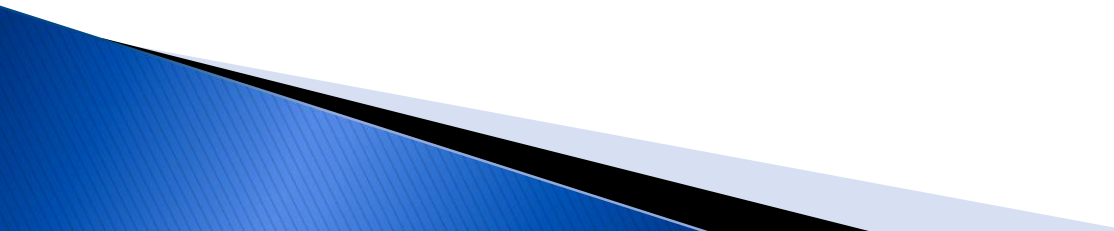
Aggregates of inflammatory cells can be present in renal interstitium in various infectious diseases of domestic animals

1. Bacterial and viral septicemia
2. Canine leptospirosis
3. Serovars canicola
4. Serovars icterohemorrhagiae
5. Serovar pomona (Pig and cattle)
6. Serovar grippotyphosa
7. Equine viral arteritis
8. Seep pox

Gross

- ▶ multifocal areas as in white spotted kidneys of calves
- ▶ swollen pale tan gray mottling of capsular surface

Pyelonephritis

- ▶ **Pyelitis** (Inflammation of the renal pelvis)
 - ▶ **Pyelonephritis** (Inflammation of both renal pelvis and renal parenchyma)
 - ▶ Ascending bacterial infection
 - ▶ Occur more frequently in female than males
 - ▶ E coli
 - ▶ Proteus , klebsilla, staphyloccous, pseudomonas aeragnosa
 - ▶ Corynebacterium renale, eubacterium
 - ▶ Unilateral but often bilateral
 - ▶ Mucous membrane acutely inflamed, thickened, red
- 

- ▶ Roughened, or granular and coated with thin exudates.
- ▶ Medullary crest (Papilla) is often ulcerated and necrotic
- ▶ Renal involvement is marked with irregular radially oriented red or gray streaks involving medulla
- ▶ Inflammation is often severe at renal pelvis
- ▶ Extensive necrosis and fibrosis with scarring
- ▶ Transitional epithelium is usually necrotic
- ▶ Desquamated debris, fibrin, neutrophils and bacterial colonies can be adherent to the denuded surface.
- ▶ Medullary tubules are markedly dilated and their lumen contain neutrophils and bacterial colonies
- ▶ Marked interstitial hemorrhages edema
- ▶ Chronic cases severe fibrosis.

Parasites

- ▶ Nematodes
- ▶ *Diactophyma renal* (Giant kidney worm of dogs)
- ▶ *Stephanurus dentatus* (Pig)
- ▶ *Capillaria plica*
- ▶ *Capillaria feliscati* (Dog, cat).

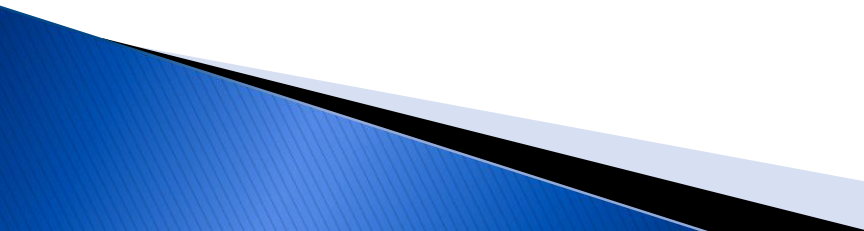
Urolithiasis/ Renal calculi

Are concretion formed in to urinary tract and are usually composed of salts of inorganic or organic acids or other material such as

- Cystine, xanthine
- Struvite
- oxalate

- ▶ Apatite, carbonate, silica, urate, xanthine
- ▶ Variable size shape
- ▶ Smooth or rough surfaces
- ▶ Solid, soft and friable
- ▶ Variable in color
- ▶ White to gray (Struvite and oxalate)
- ▶ Yellow (Urate, cystine ,benzocoumerine)
- ▶ Brown (Silica, urate, xanthine)
- ▶ Calculi more in male cause urinary obstruction come in male because of narrow urethral diameter

Cystitis


- ▶ Active metabolites of cyclophosphmides
 - ▶ Immune mediated disease of dog
 - ▶ Cantharid intoxicosis (Horses)
 - ▶ Chronic ingestion of broken fern (Cattle)
 - ▶ Cell associated herpes virus (Cat)
 - ▶ Ecoli, Corynae bacterium renale (Cattle)
 - ▶ Eubacterium (Pig)
 - ▶ Klebsiella (Horse)
 - ▶ Epithelial denudation, lamina properia intensely edematous, neutrophil infiltration
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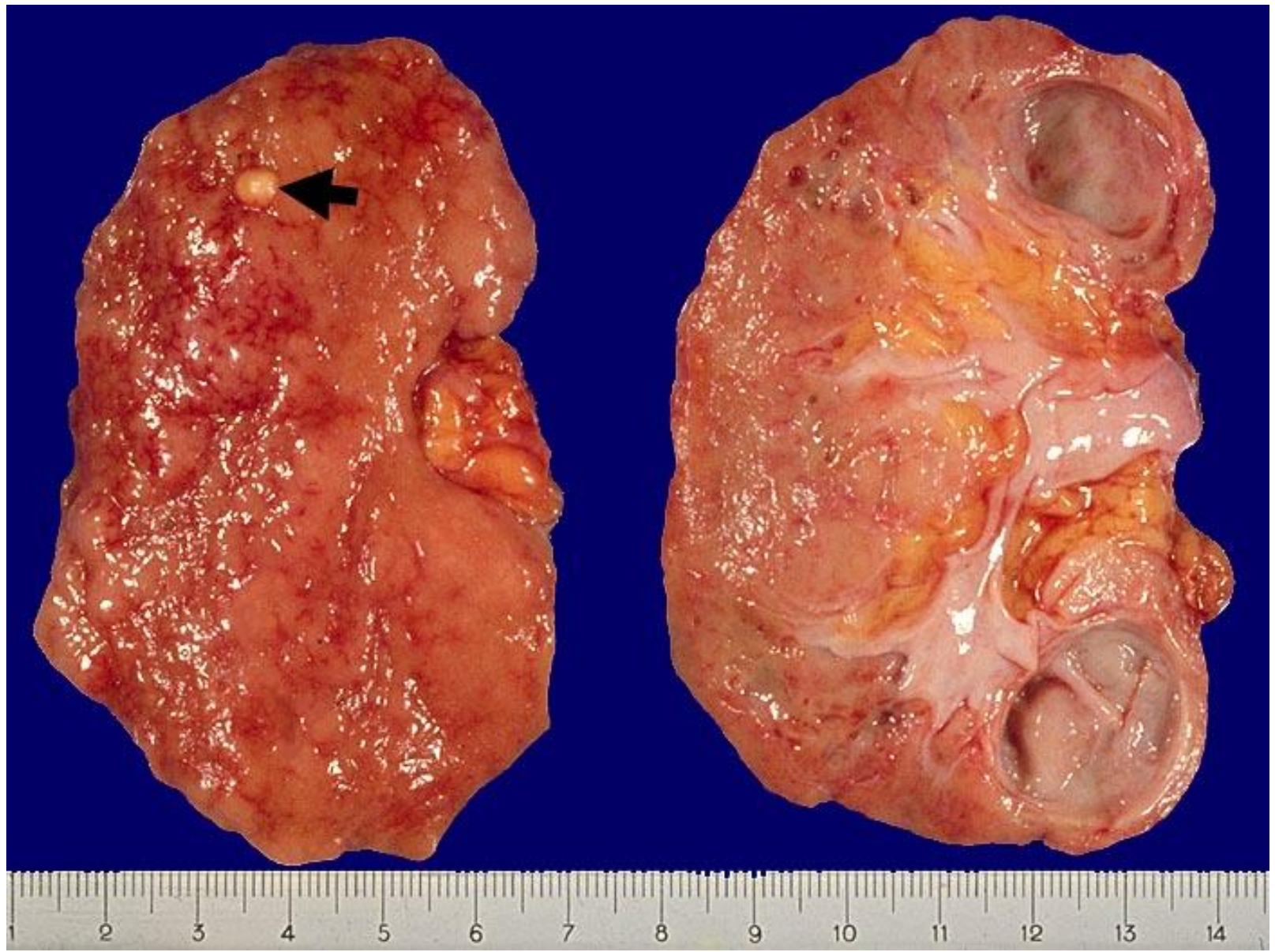
Tumors of Kidney

Renal adenoma

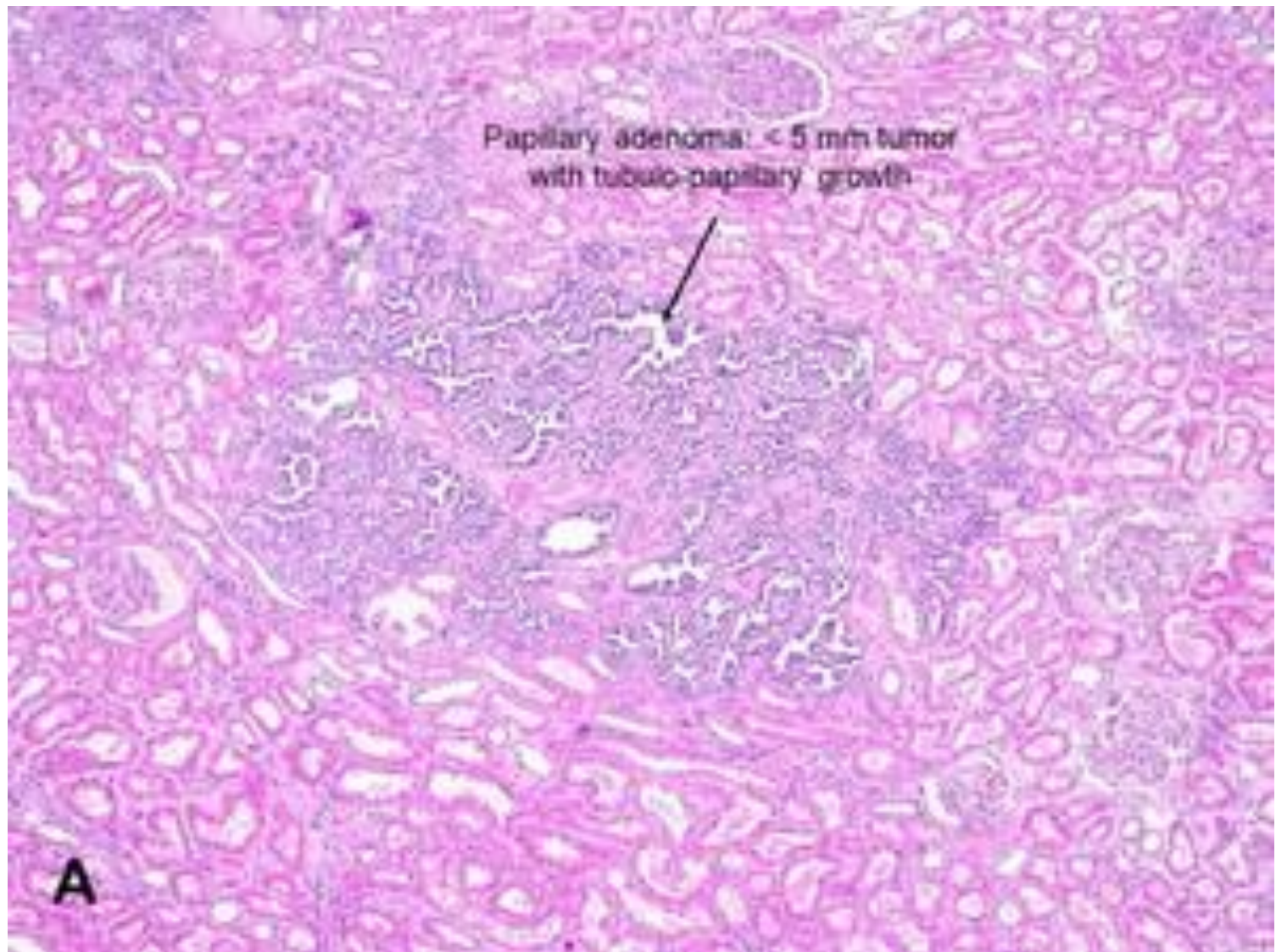
- ▶ rare
- ▶ Small white to yellow, solitary, well circumscribed mass in cortex
- ▶ Solid sheets,
- ▶ tubules, papillary proliferation of cuboidal epithelial cells that are uniform in size granular eosinophilic cytoplasm
- ▶ Small round to oval nuclei
- ▶ Mitotic figures, necrosis and fibrosis scars.

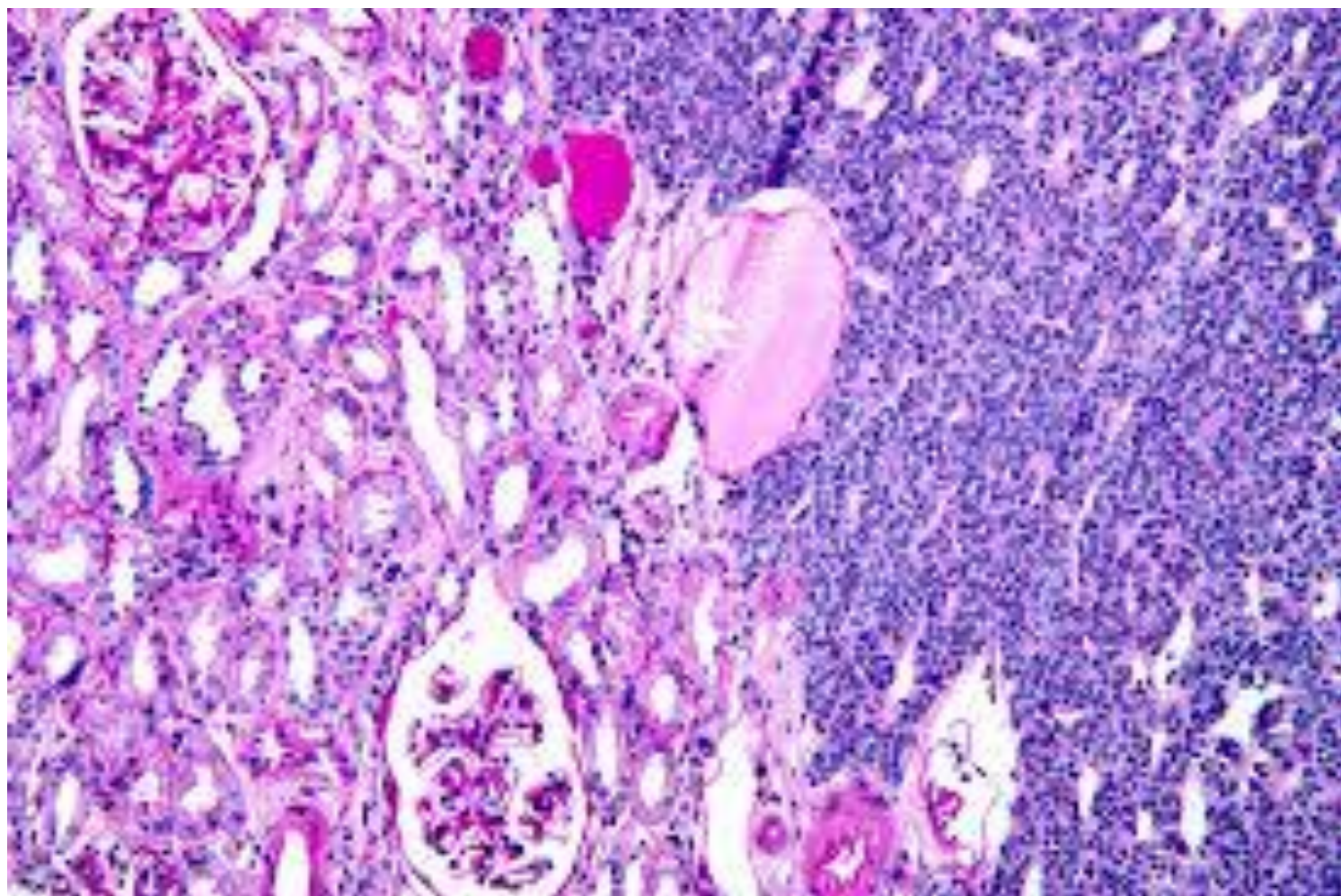
Renal carcinoma

- ▶ Older dogs
 - ▶ Large spherical to oval and firm
 - ▶ Pale yellow contain dark area of hemorrhage and necrosis and foci of cystic degeneration.
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adrenocortical adenoma

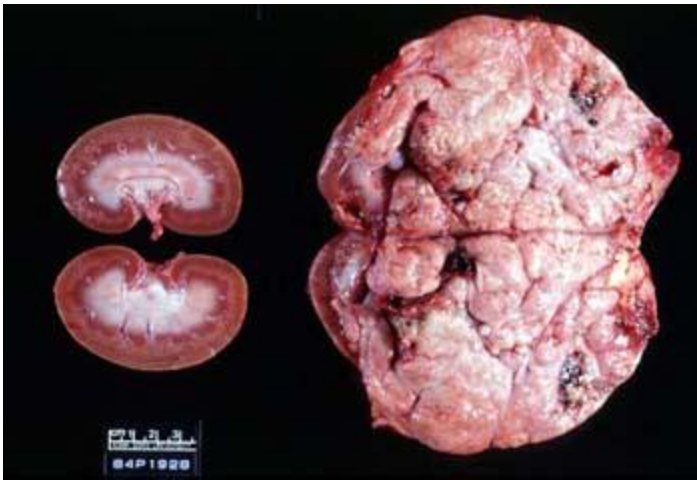


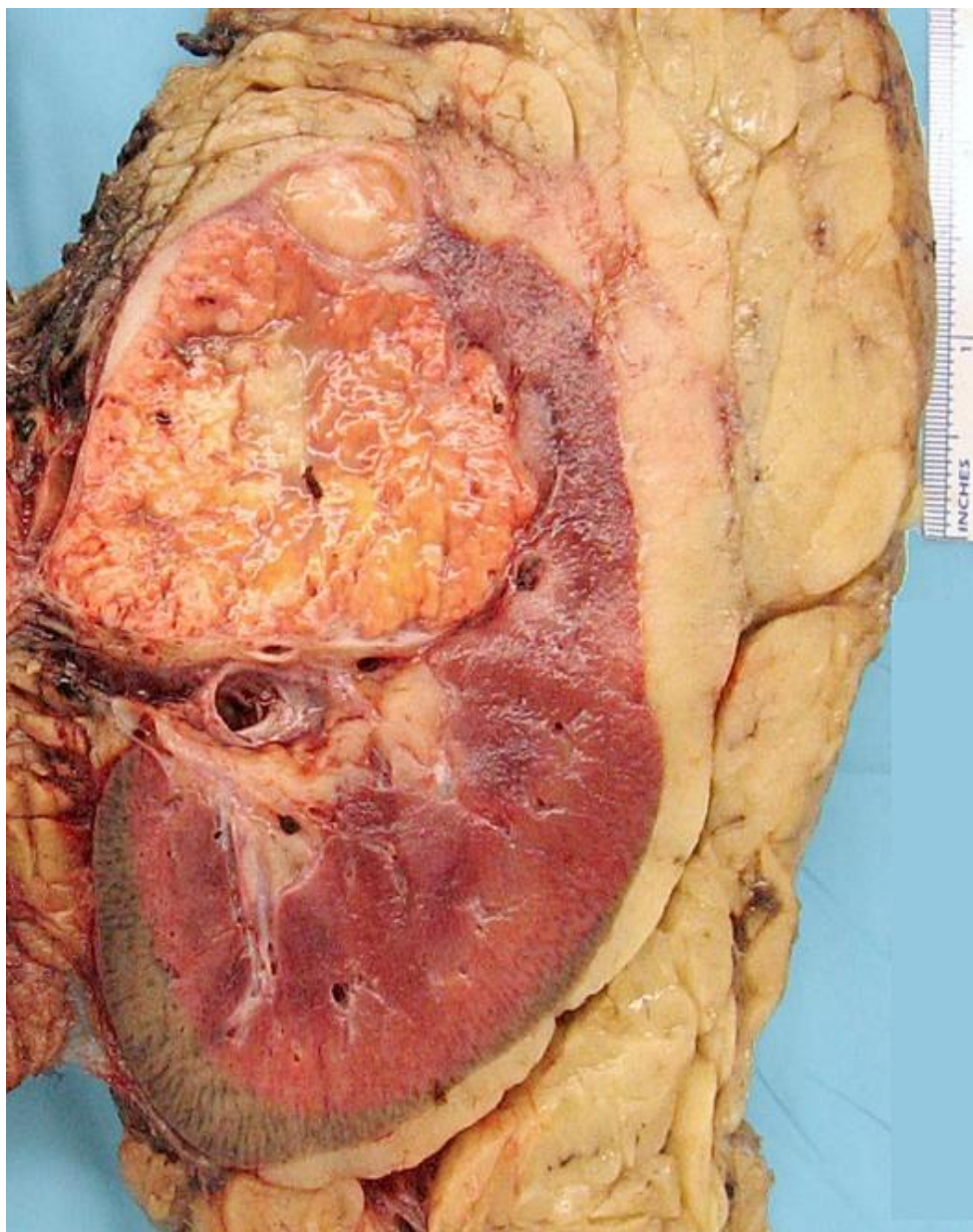


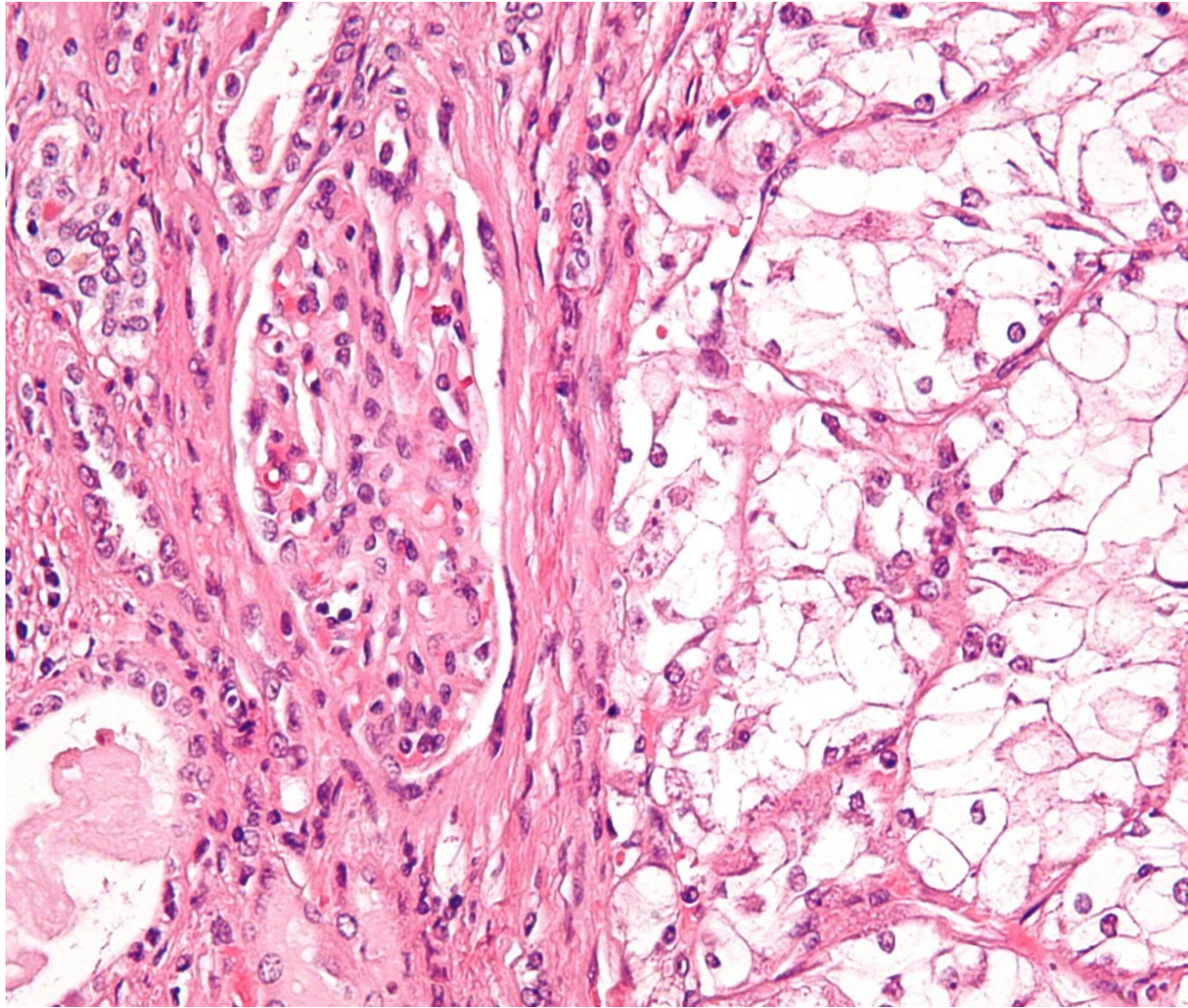
- ▶ Metastasis to lungs occur frequently
- ▶ Cells form solid sheets tubules, papillary growth pattern
- ▶ cells are more atypical and anaplastic
- ▶ Cells vary in size and have clear or granular, eosinophilic cytoplasm
- ▶ Nuclei range from small, round granular and uniform to large oval vesicular and pleomorphic.
- ▶ Mitotic figures are numerous, these neoplasm have moderate fibroelastic stroma

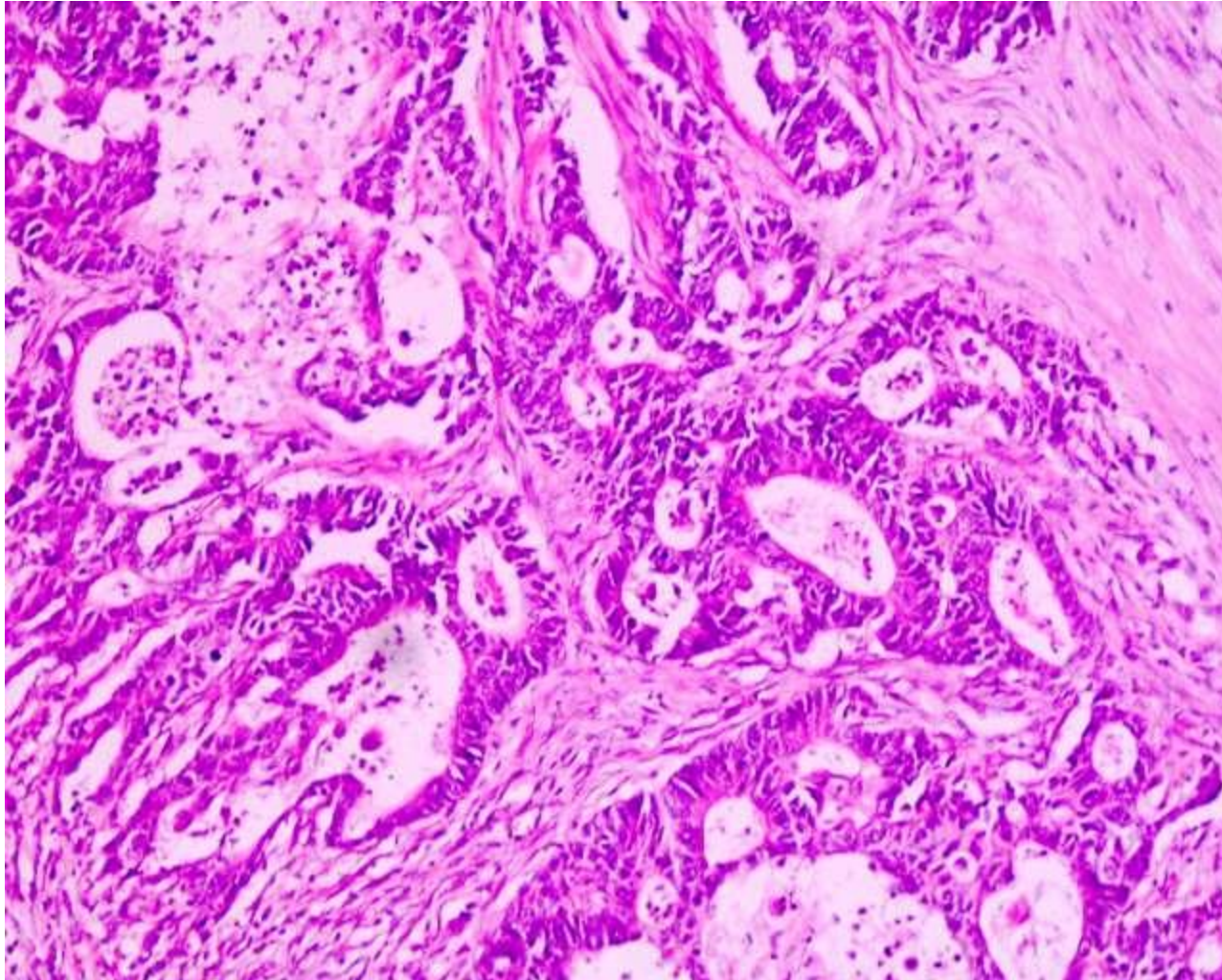
Metastatic and mesenchymal tumors

(fibroma, fibrosarcoma, hemangioma, lymphosarcoma)









Tumor of embryonal origin

Nephroblastoma

- ▶ Common neoplasm of pig, chicken, cattle and dog.
- ▶ Arises from metamesonephric blastema
- ▶ Solitary multiple masses soft to rubbery, gray with foci of hemorrhages
- ▶ On cut surfaces they are often lobulated

Histologically

- ▶ Characteristically, primitive loose myxomatous mesenchymal tissue predominant
- ▶ Interspersed in this tissue are primitive tubules lined by elongated deeply staining cells and structure that resemble primitive glomeruli
- ▶ Nests of cells resembling the metamesonephric blastema, cartilage, bone, skeletal muscles, adipose tissue.