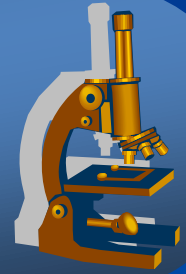


General pathology



General pathology I.

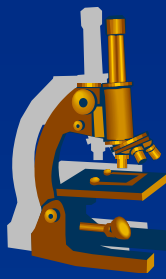
Regressive changes

(necrosis, atrophy, disorders of metabolism)

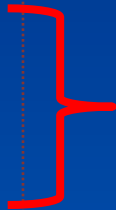
Pigments and concrements

Regressive changes (-)

Progressive changes (+)



- apoptosis
- necrosis
- gangrene



+

- metabolic change
- atrophy



morphological
and functional
alteration

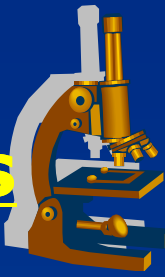
- hyperplasia
- hypertrophy
- regeneration
- repair
- metaplasia
- dysplasia
- neoplasia

APOPTOSIS



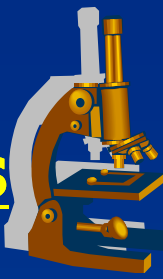
- × process of programmed death, active process
- × !! no inflammatory response (exceptions possible)

APOPTOSIS in physiological situations



- × **embryogenesis** (morphogenetic, histogenetic, phylogenetic)
- × **hormone-dependent involution**
 - ⇒ *endometrial cell breakdown during the menstrual cycle*
 - ⇒ *prostatic involution after castration*
- × **defence mechanisms during immune response**
 - ⇒ *death of neutrophils in an acute inflammatory response*
 - ⇒ *elimination of self-reactive T-lymphocytes during their maturation in the thymus, e.g.*
- × **elimination of damaged cells**
- × **during aging**

APOPTOSIS in pathological conditions



x pathological inhibition of apoptosis

⇒ tumors

- *follicular lymphoma*
- *mammary, prostatic, e.g. , carcinomas with mutation in p53 gene)*

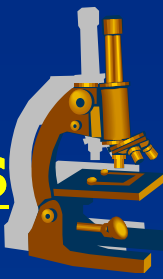
⇒ autoimmune diseases

- *SLE*

⇒ infections

- *herpes simplex virus*
- *poxviruses*
- *TBC*

APOPTOSIS in pathological conditions



× pathological induction of apoptosis

⇒ AIDS

⇒ neurodegenerative diseases

- *m. Alzheimer, m. Parkinson, ALS*

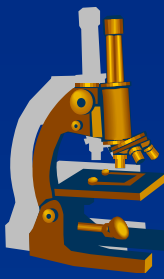
⇒ myelodysplastic syndrome

- *aplastic anemia*

⇒ ischemic injury

- *acute myocardial infarction*

NECROSIS



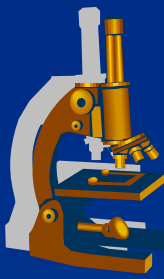
- ✘ death of tissue in a living organism (**irreversible process!!**) → always with inflammatory reaction !!

- ✘ causes:
 - ⇒ *ischemia*
 - ⇒ *radiation*
 - ⇒ *toxins, ...*

- ✘ nuclear changes:
 - ⇒ *pyknosis with increased basophilia (hyperchromasia)*
 - ⇒ *karyorrhexis*
 - ⇒ *karyolysis (fading of basophilia of the chromatin)*

- ✘ cytoplasmic changes
 - ⇒ *hypereosinophilia*
 - ⇒ *breakdown of organellar/plasma membranes*

NECROSIS - types



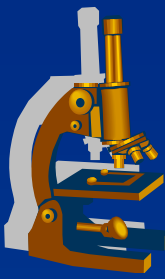
- × **Simple** (rare)

- × **Coagulative** (organs with protein predominance)
 - ⇒ *ischemic = infarction*
 - ⇒ *secondary hemorrhage = hemorrhagic infarction (lung, bowel)*
 - ⇒ *caseous (cheese-like) –TBC*

- × **Colliquative** (organs with lipid predominance)
 - ⇒ *brain*
 - ⇒ *pancreas*

- × **Fibrinoid**
 - ⇒ *the base of the ulcer*
 - ⇒ *arterial wall*

NECROSIS - healing



- **inflammatory reaction** = **inflammatory infiltrate**
(neutrophils, histiocytes..... lymphocytes) + afterwards **nonspecific granulation tissue** (fibroblasts, angiogenesis) → → maturation of the fibrous tissue →
- **scar** (within 6 weeks) + possible secondary alterations (dystrophic calcification, e.g.)
- **pseudocyst** (colliquation of a necrotic tissue)

GANGRENE



× = modified necrosis with putrefaction

× types:

⇒ dry

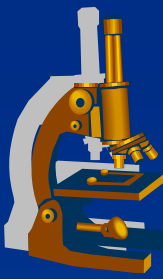
- *diabetic foot*

⇒ wet

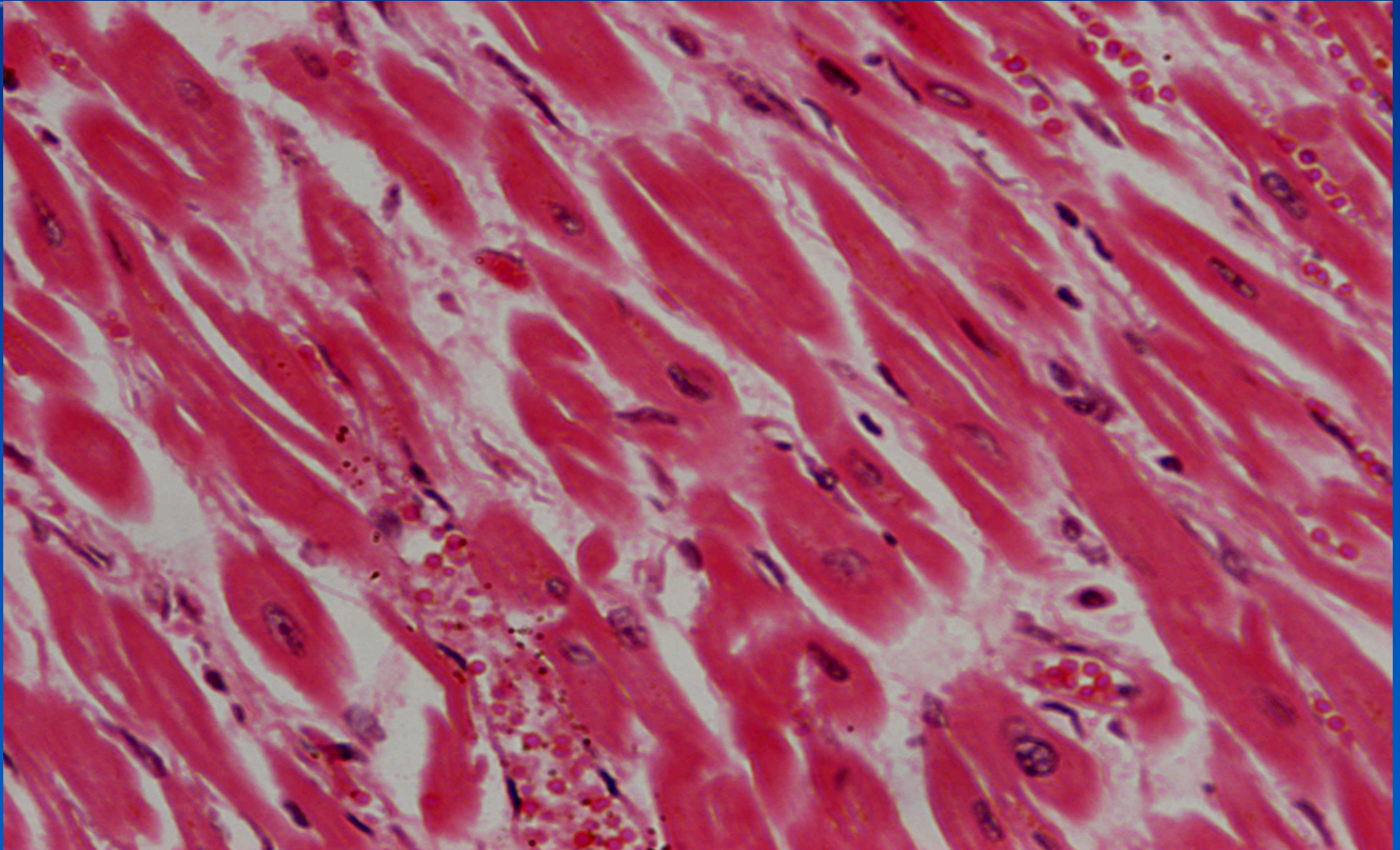
- *decubitus*

⇒ gas (*Clostridium perfringens*)

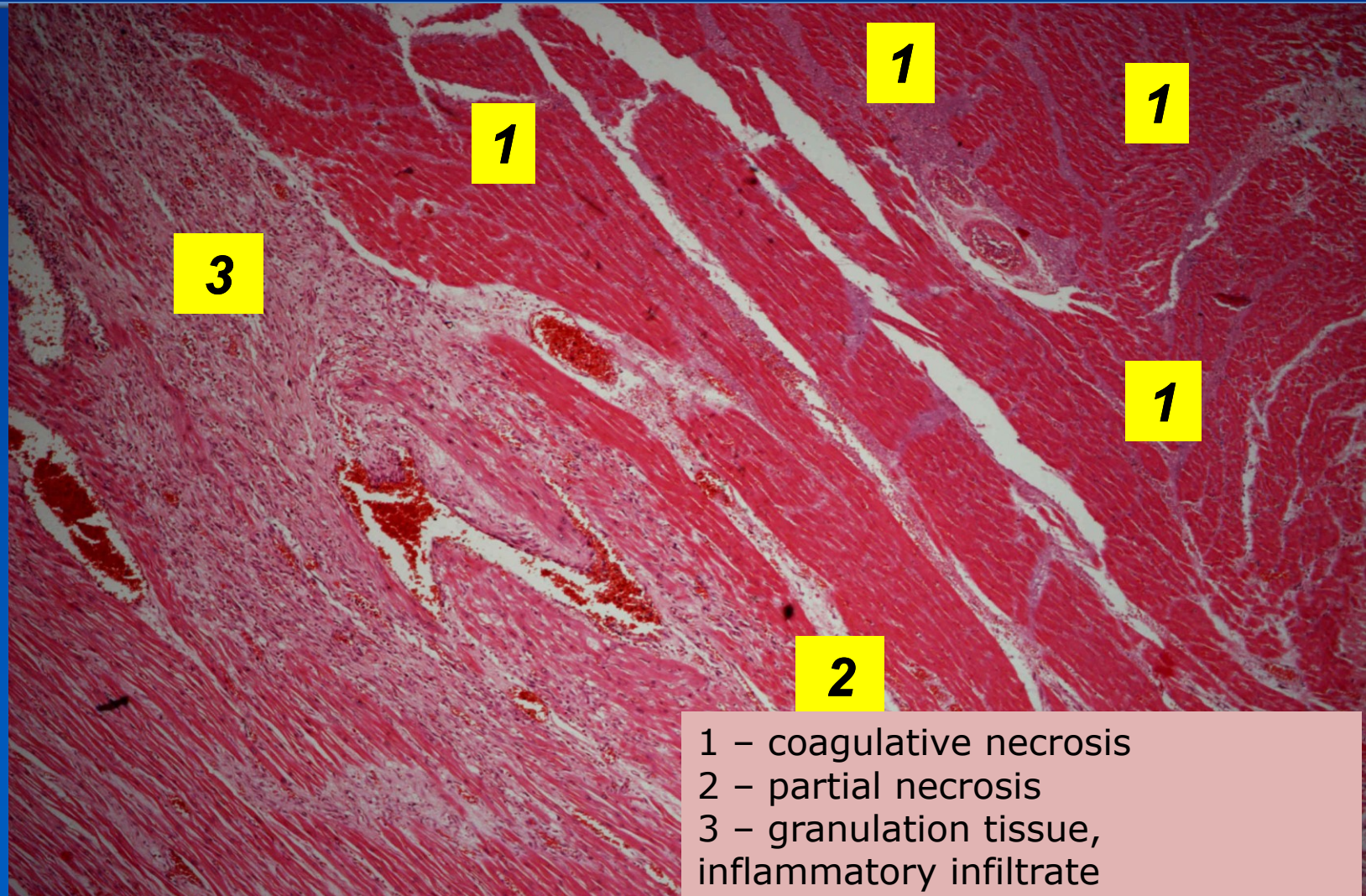
coagulative necrosis – myocardial infarction



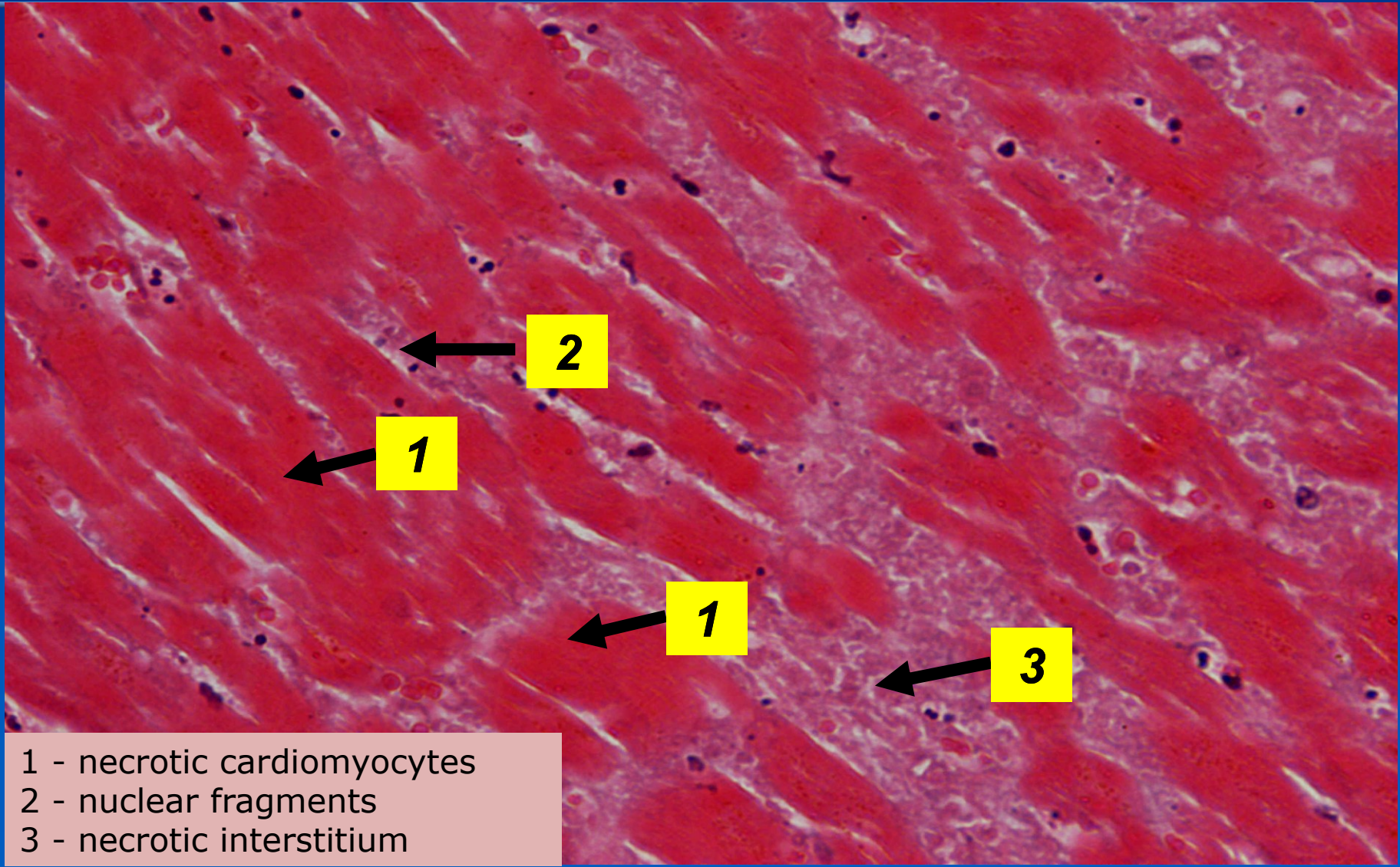
cardiomyocytes – norm



coagulative necrosis – myocardial infarction



coagulative necrosis – myocardial infarction

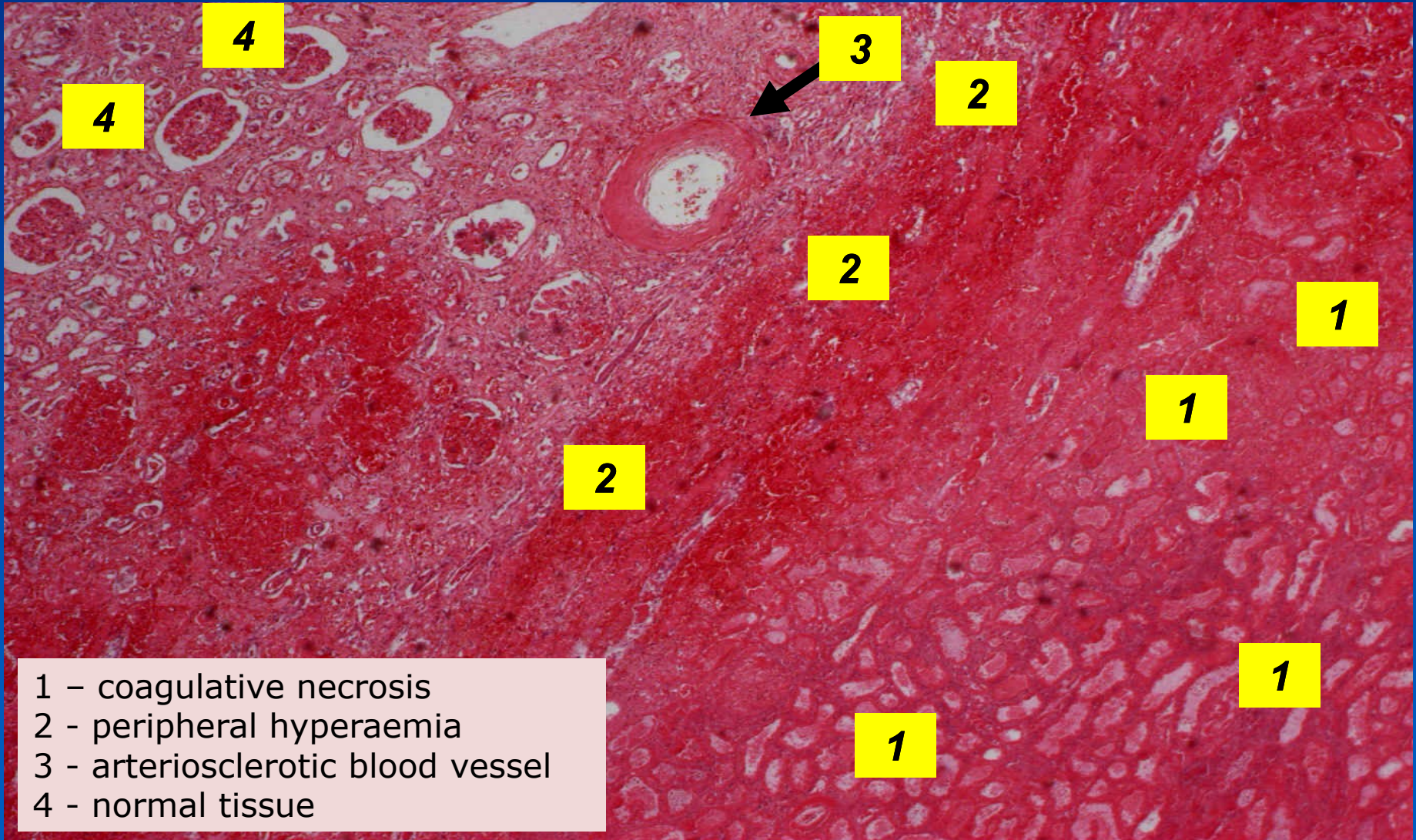


- 1 - necrotic cardiomyocytes
- 2 - nuclear fragments
- 3 - necrotic interstitium

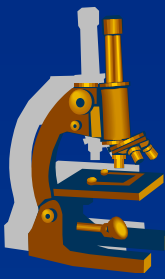
coagulative necrosis – renal infarction



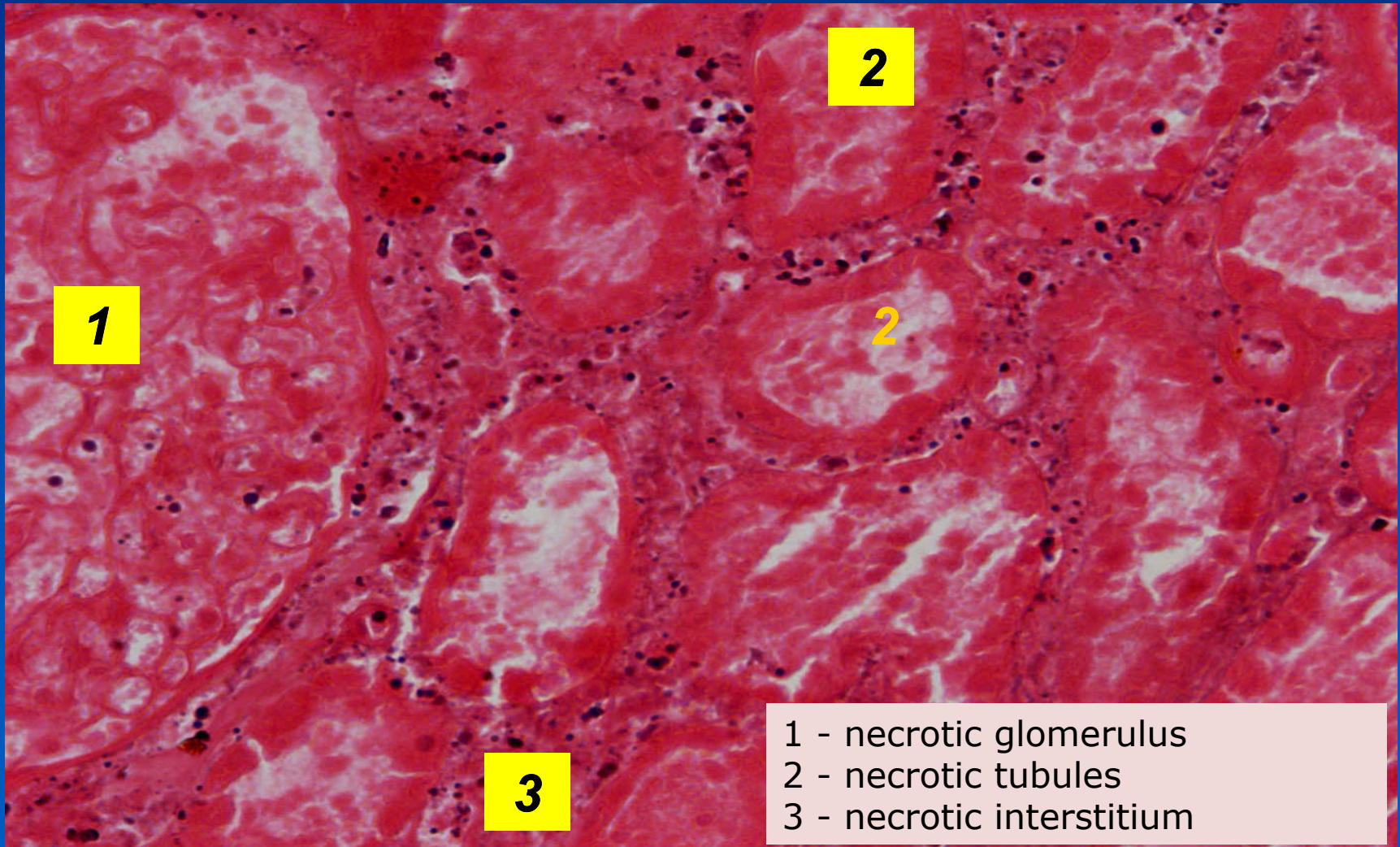
coagulative necrosis – renal infarction



- 1 - coagulative necrosis
- 2 - peripheral hyperaemia
- 3 - arteriosclerotic blood vessel
- 4 - normal tissue

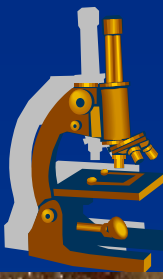


coagulative necrosis – renal infarction



1 - necrotic glomerulus
2 - necrotic tubules
3 - necrotic interstitium

hemorrhagic necrosis – pulmonary infarction

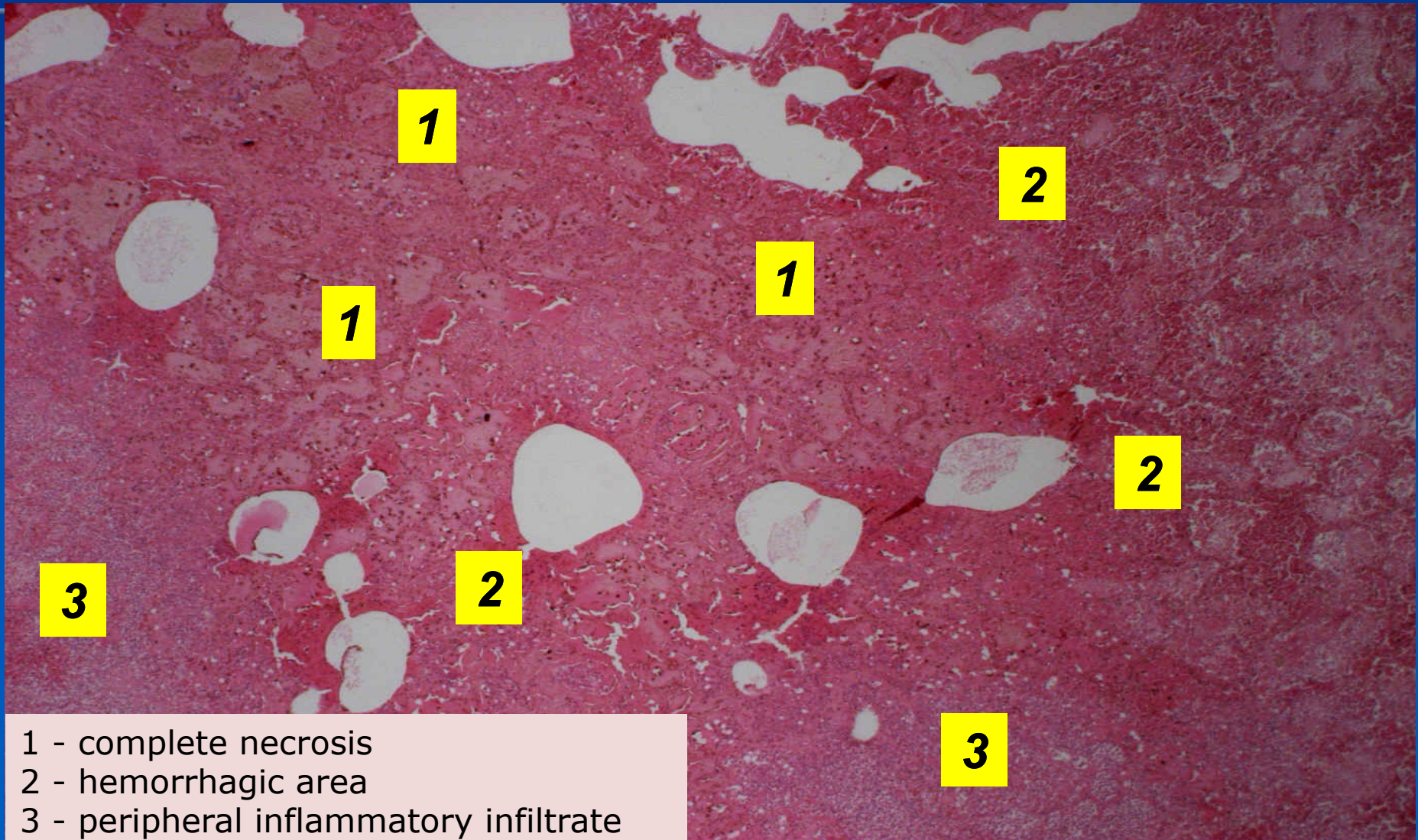


Wedge-shaped subpleural infarction



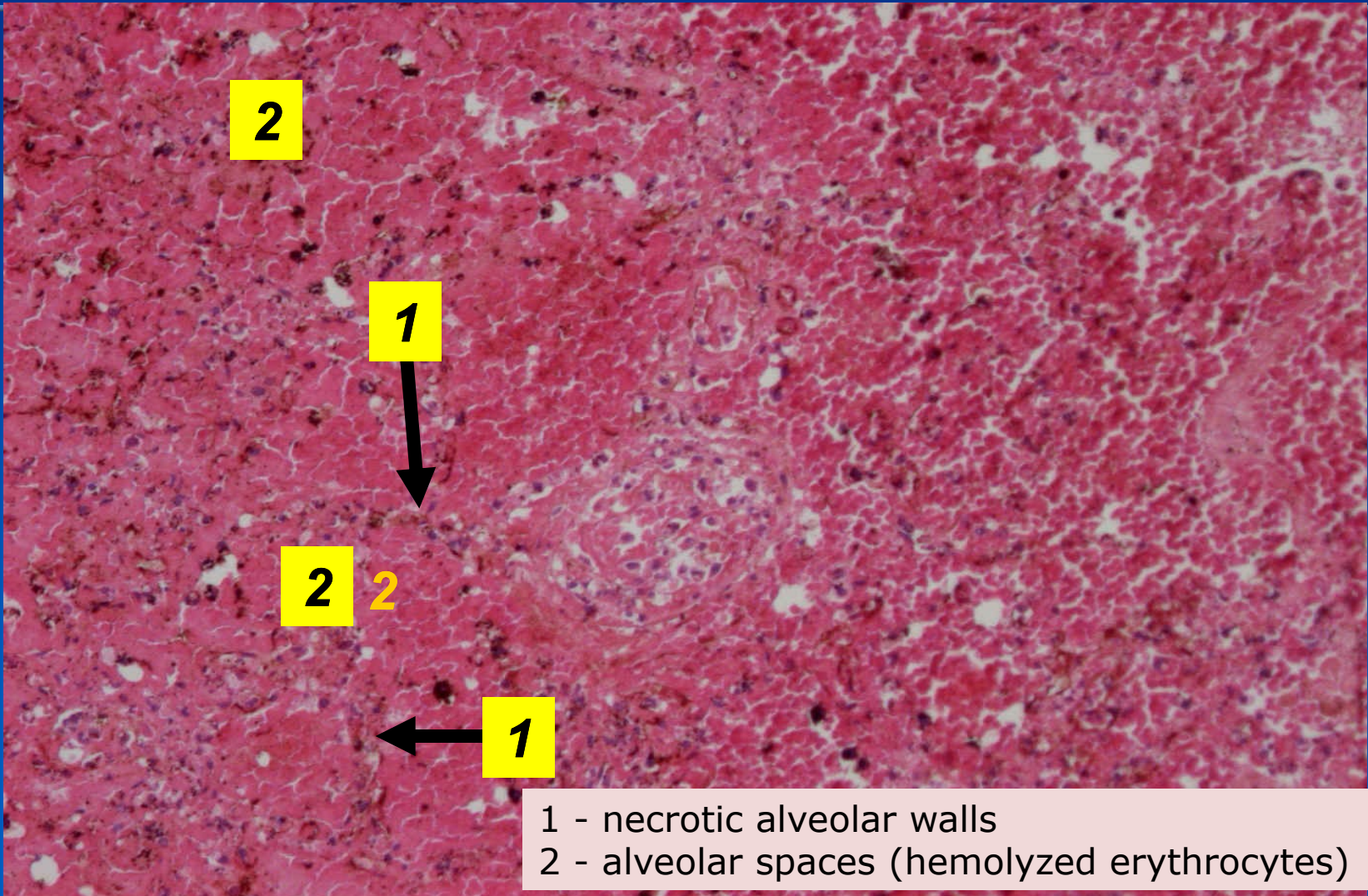
Pulmonary artery with embolus

hemorrhagic necrosis – pulmonary infarction (review)



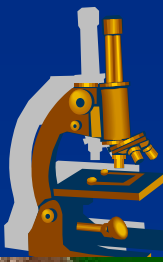
- 1 - complete necrosis
- 2 - hemorrhagic area
- 3 - peripheral inflammatory infiltrate

hemorrhagic necrosis – pulmonary infarction, destruction, nuclear detritus, erythrocyte hemolysis



1 - necrotic alveolar walls
2 - alveolar spaces (hemolyzed erythrocytes)

caseous necrosis - TBC bronchopneumonia / miliary TBC



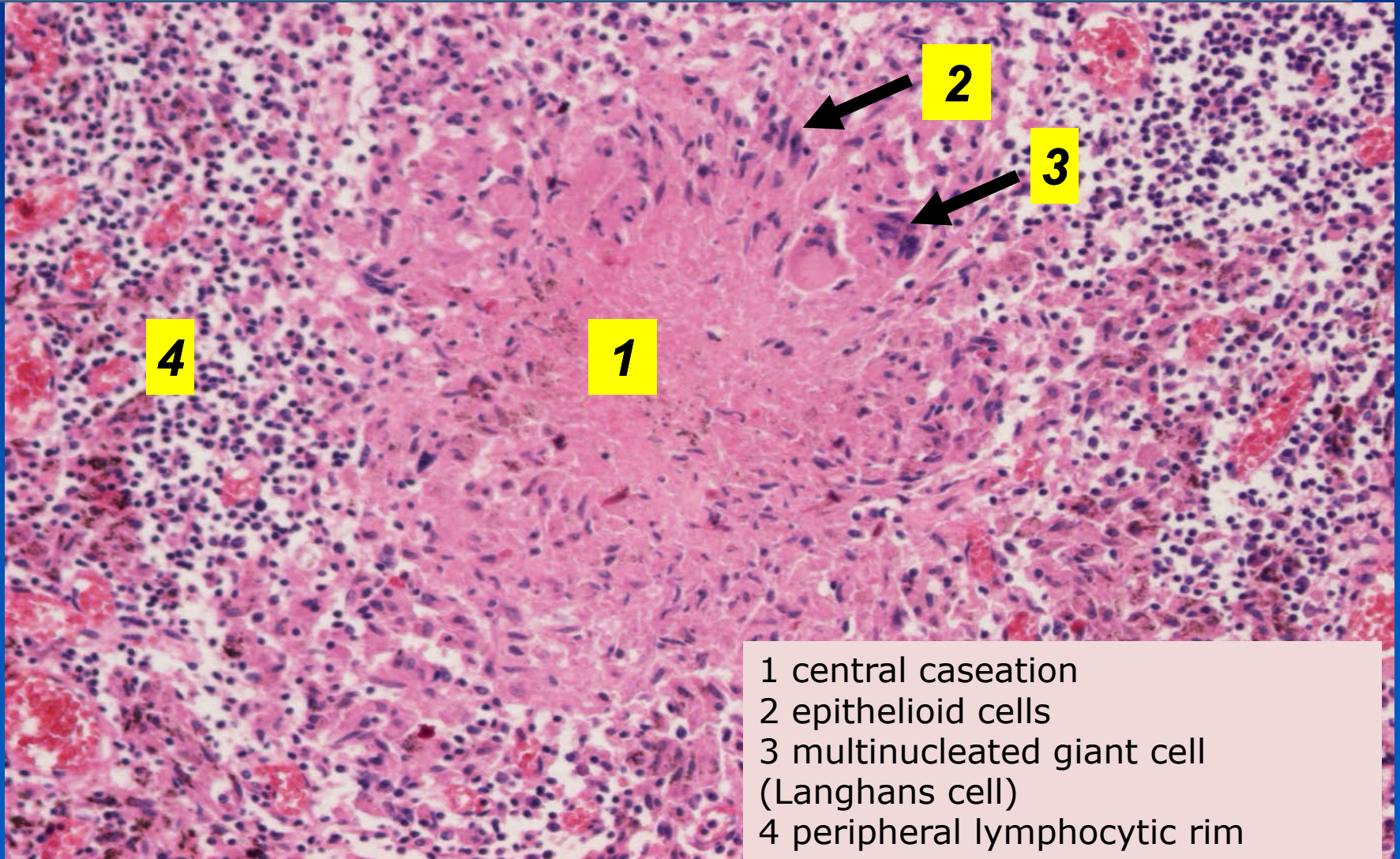
1



2

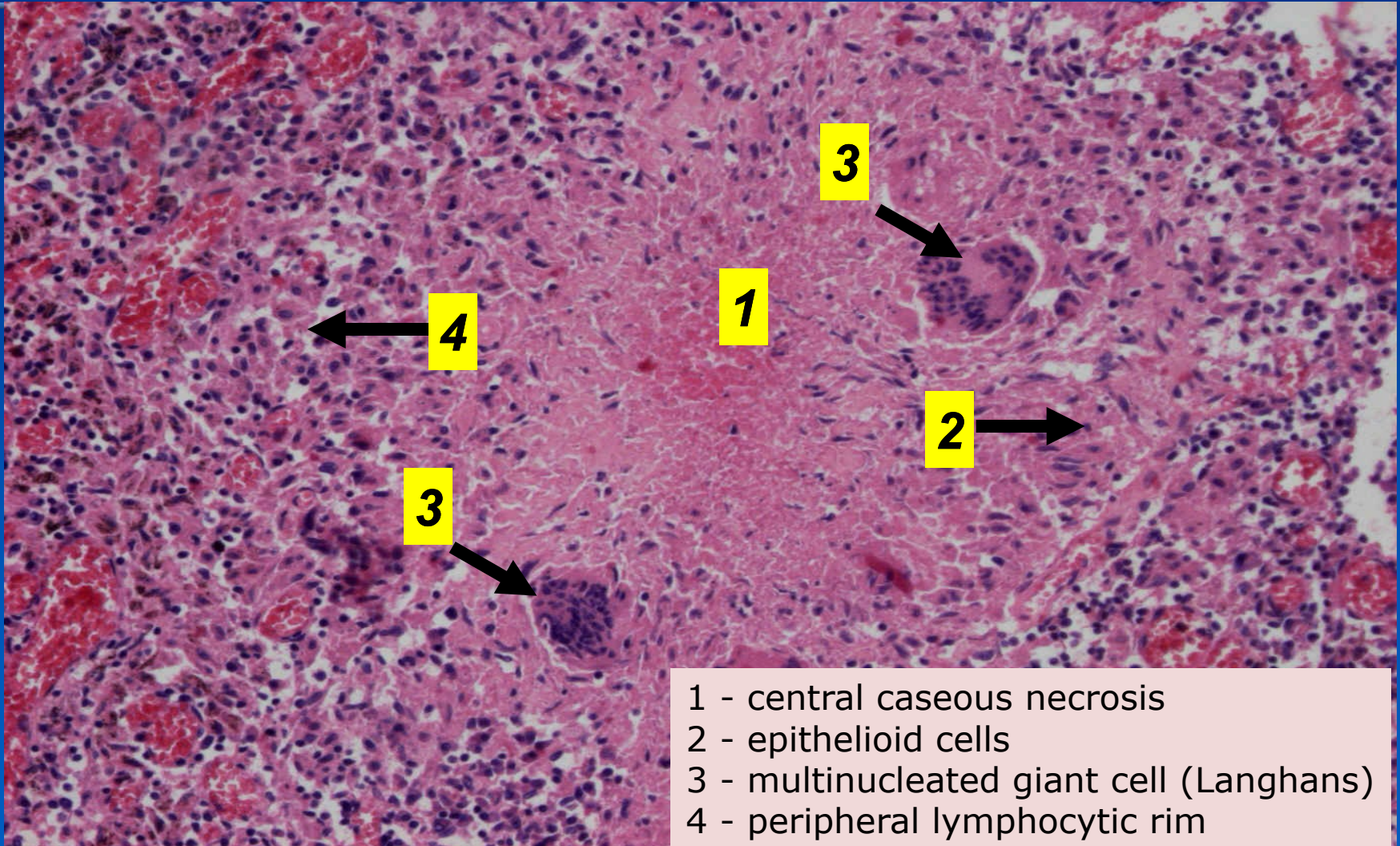


caseous necrosis-lymph node-TBC granuloma



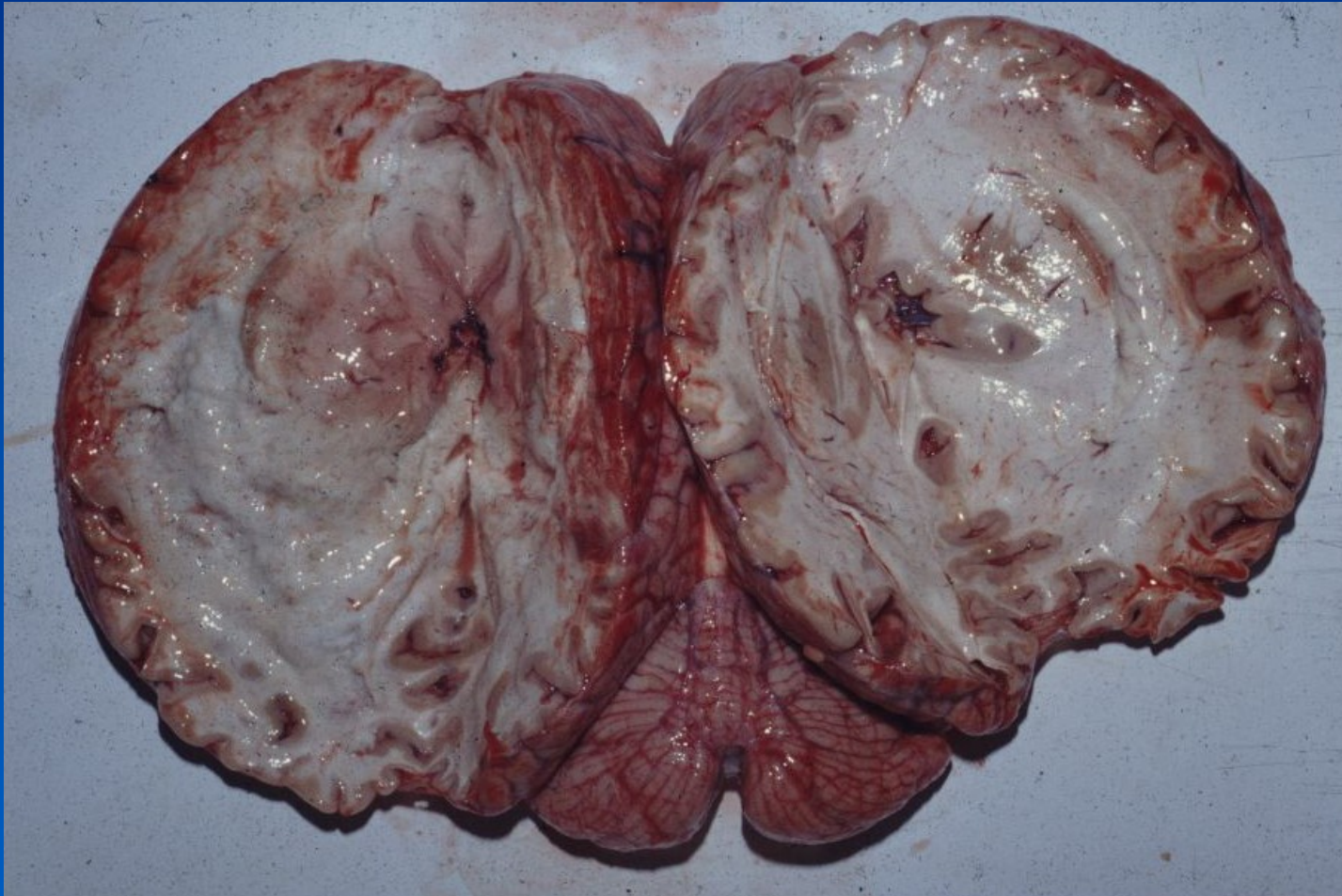
- 1 central caseation
- 2 epithelioid cells
- 3 multinucleated giant cell (Langhans cell)
- 4 peripheral lymphocytic rim

caseous necrosis - lymph node - TBC granuloma, Langhans multinucleated giant cells

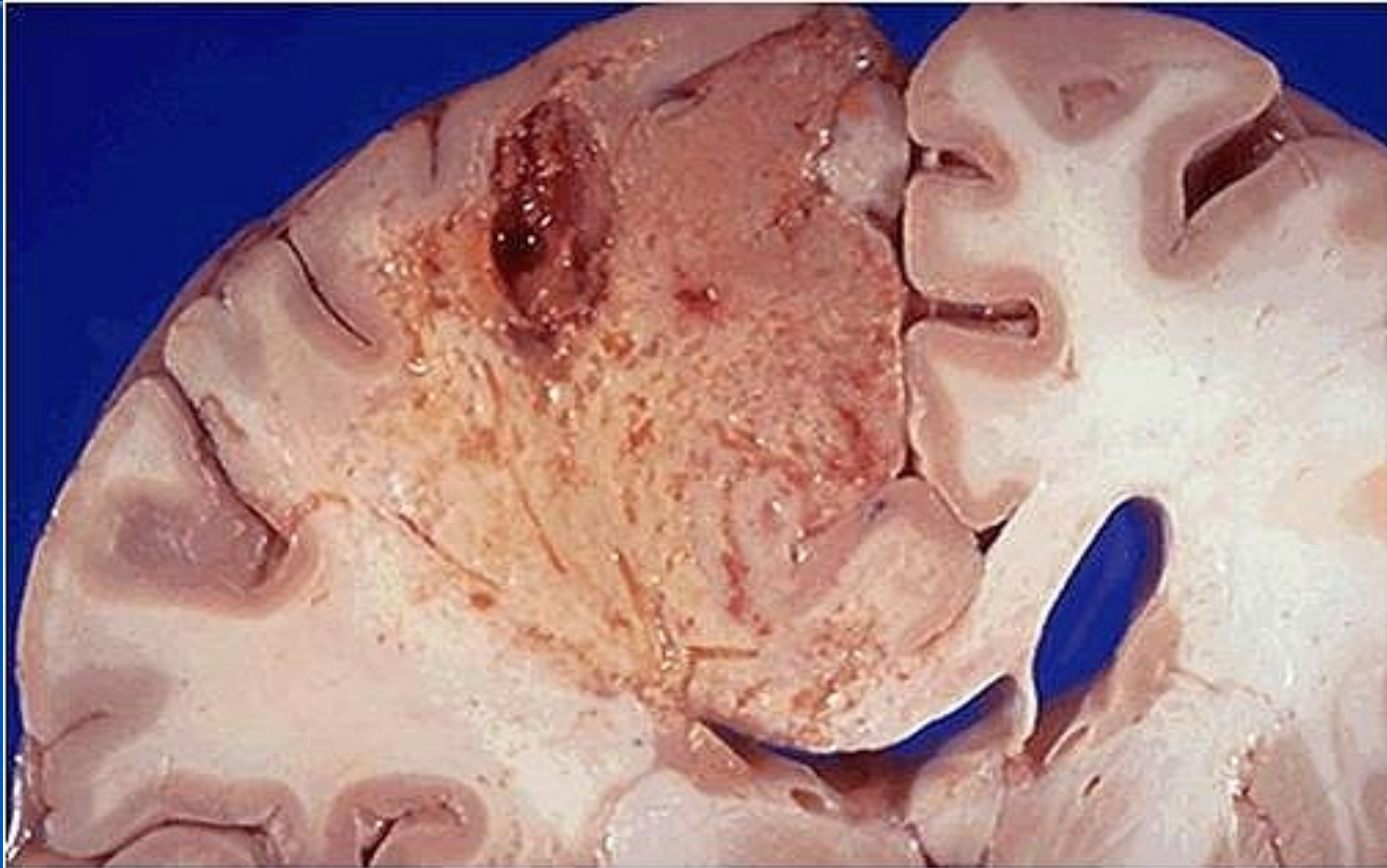


- 1 - central caseous necrosis
- 2 - epithelioid cells
- 3 - multinucleated giant cell (Langhans)
- 4 - peripheral lymphocytic rim

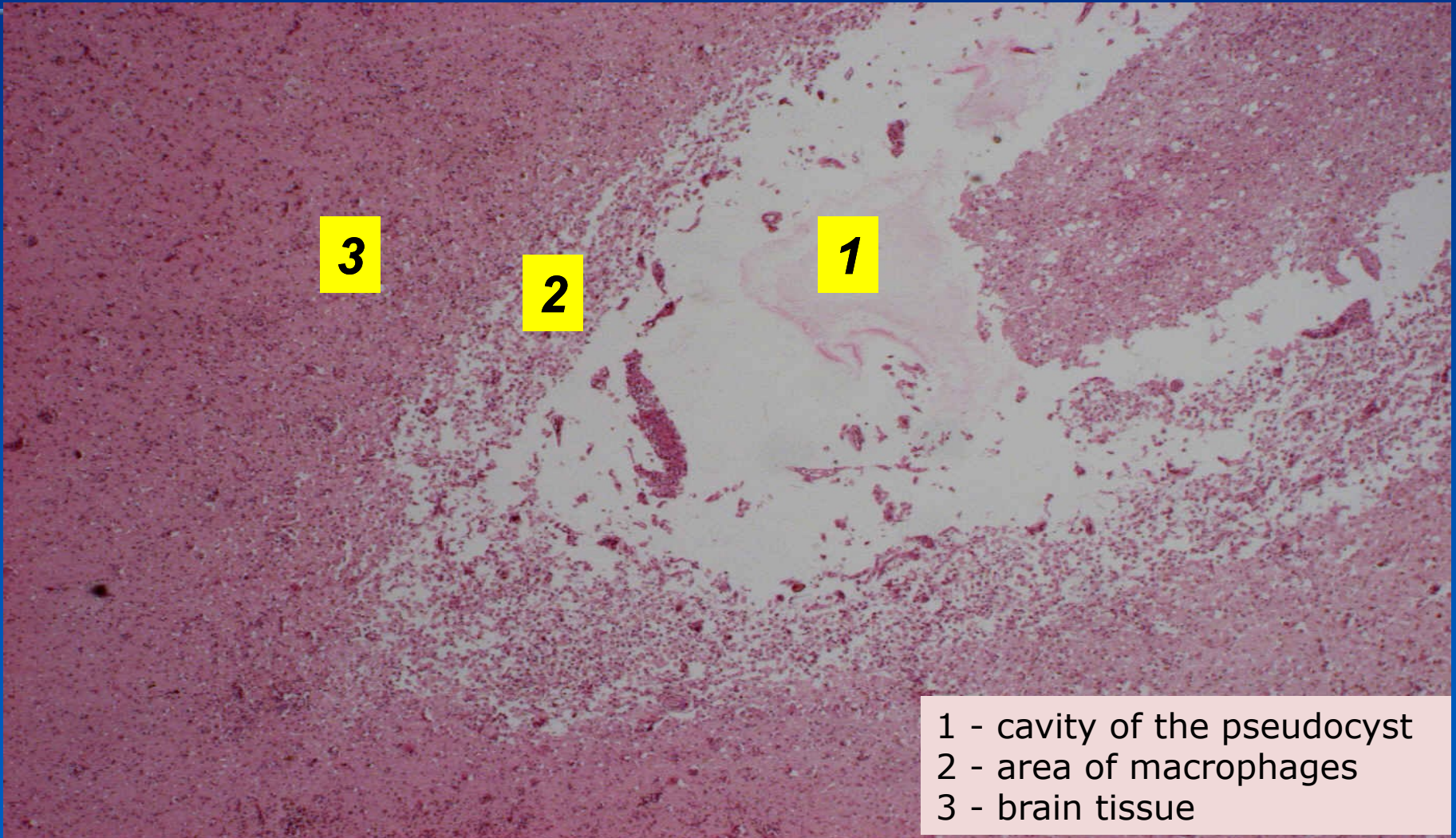
colliquative necrosis - encephalomalacia



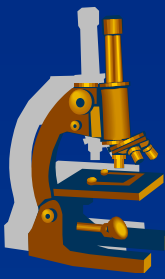
**colliquative necrosis (subacute) -
encephalomalacia + pseudocyst formation**



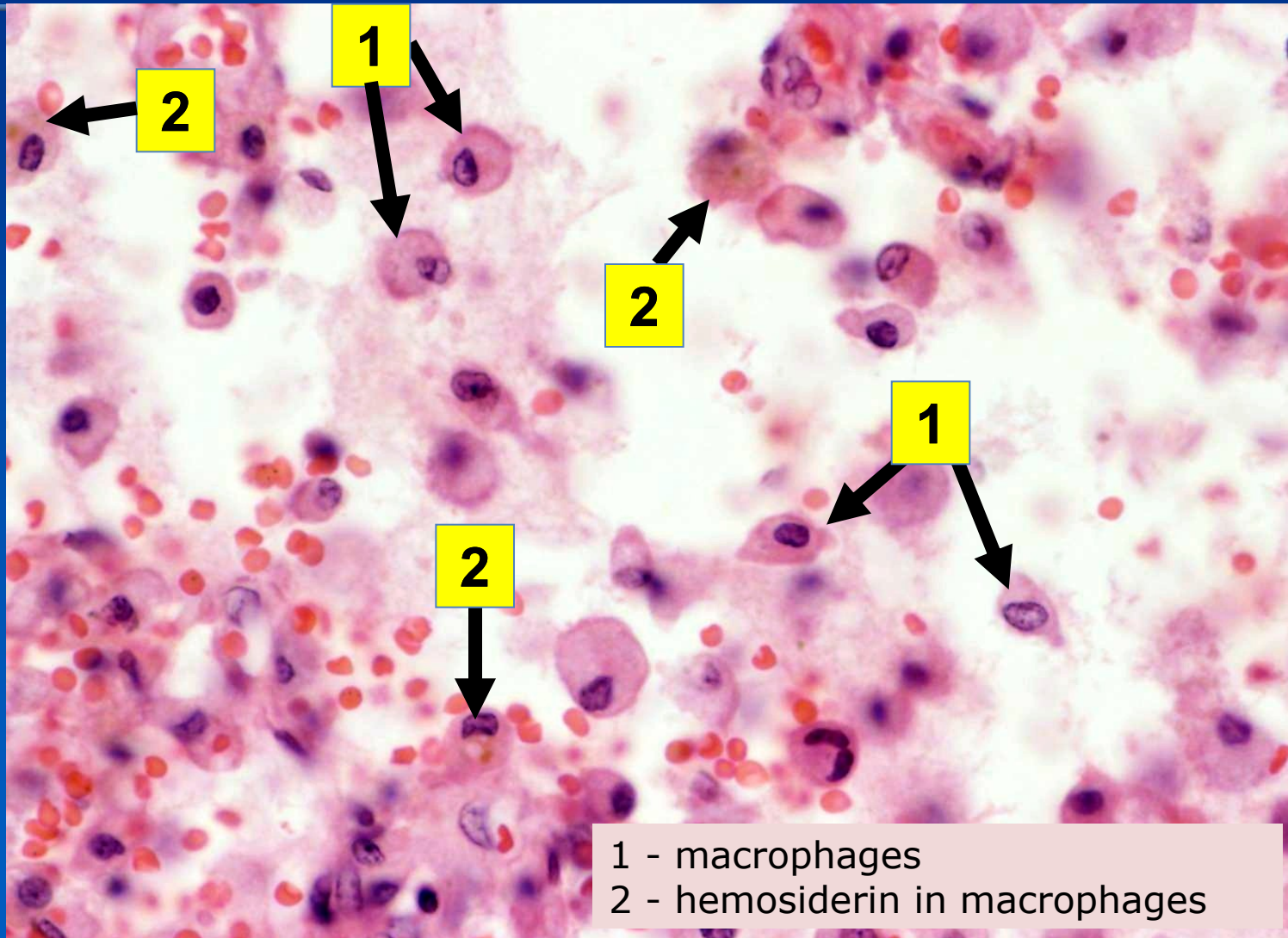
Colliquative necrosis – pseudocyst formation – white matter, subcortical area



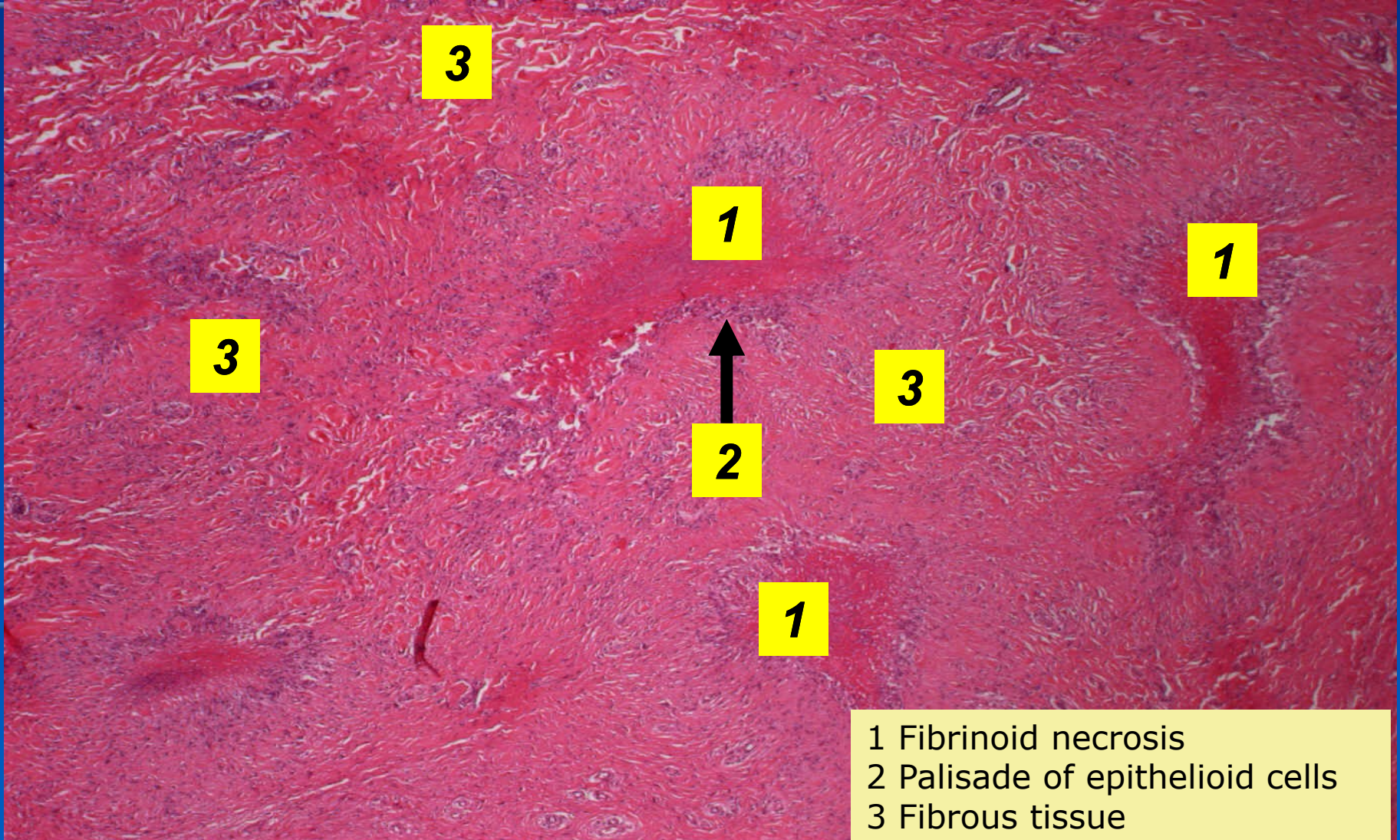
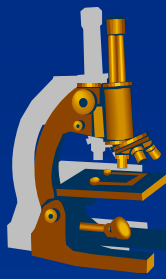
- 1 - cavity of the pseudocyst
- 2 - area of macrophages
- 3 - brain tissue



colliquative necrosis - cerebral infarction, macrophages

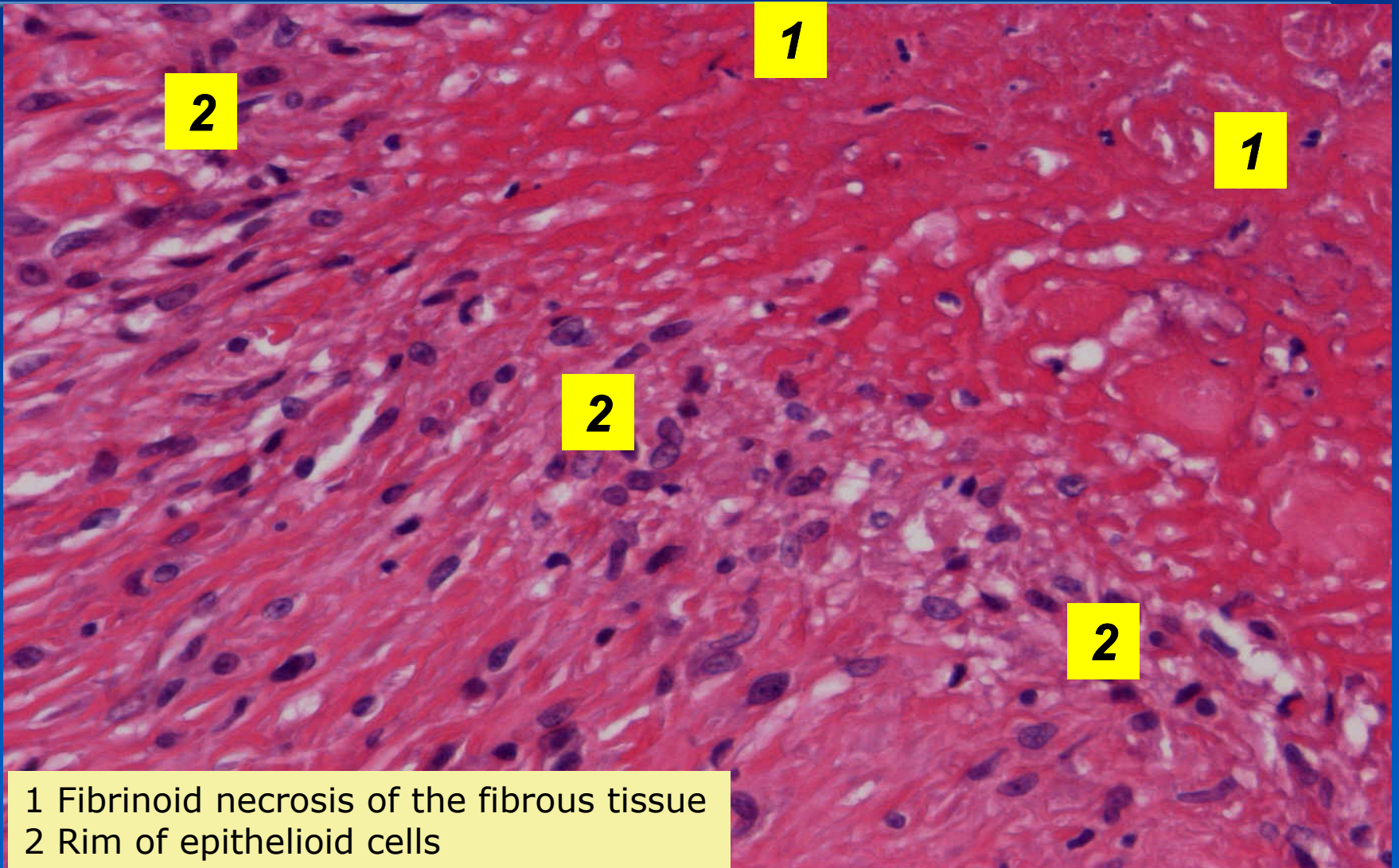


fibrinoid necrosis - rheumatoid nodule



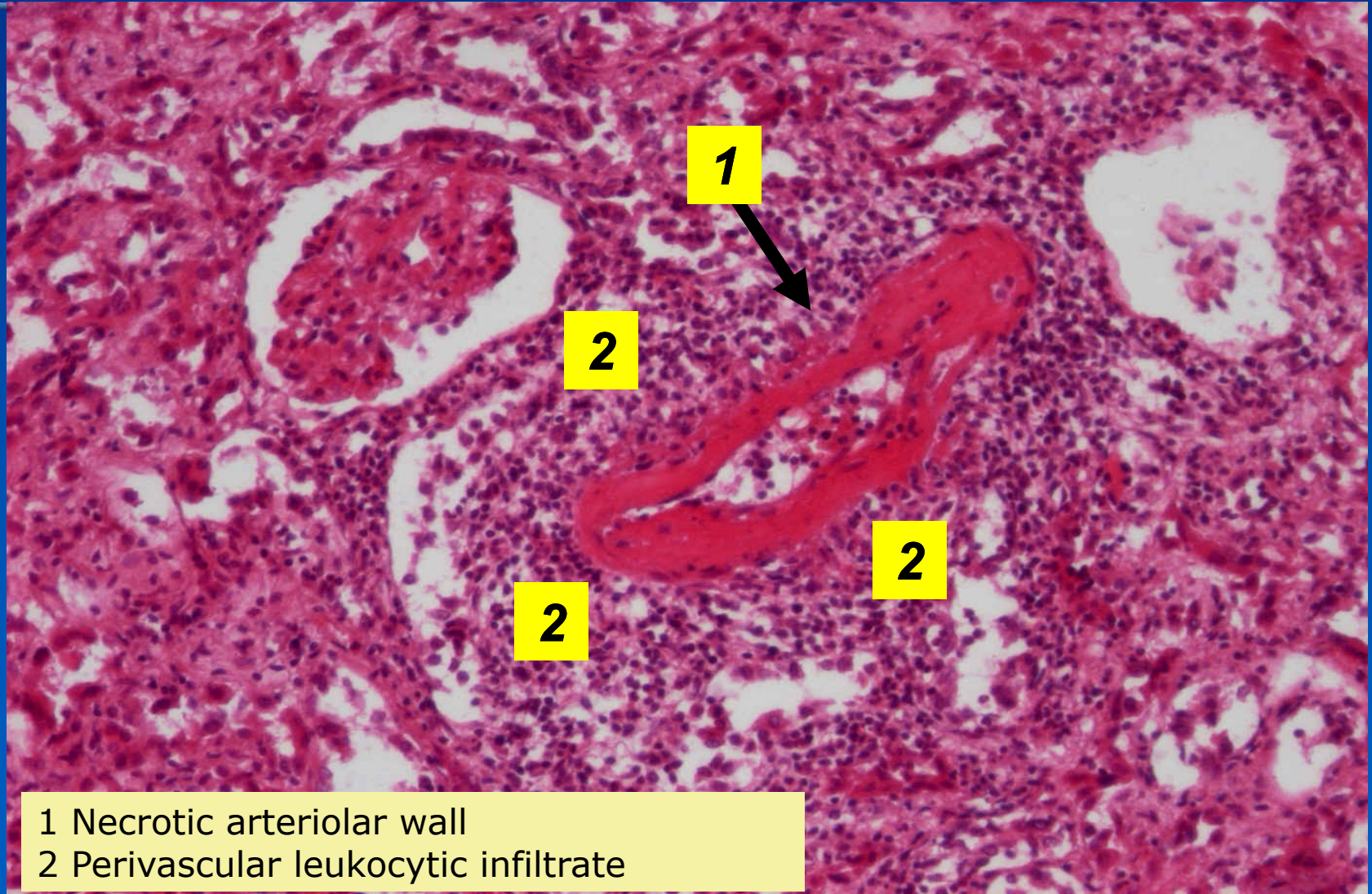
- 1 Fibrinoid necrosis
- 2 Palisade of epithelioid cells
- 3 Fibrous tissue

fibrinoid necrosis - rheumatoid nodule



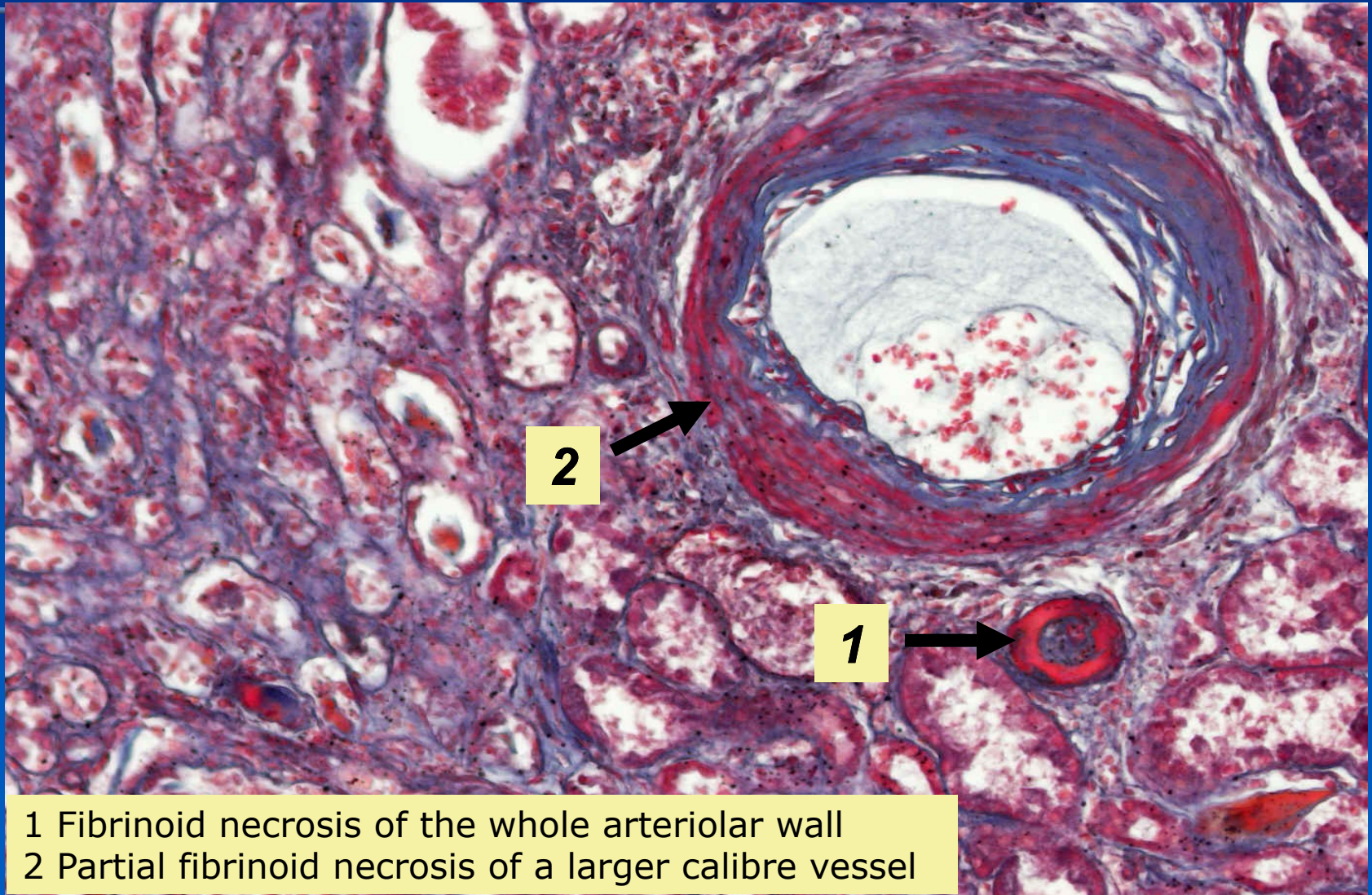
1 Fibrinoid necrosis of the fibrous tissue
2 Rim of epithelioid cells

fibrinoid necrosis of renal arteriole



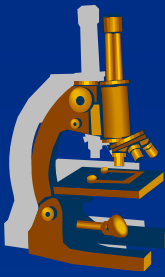
- 1 Necrotic arteriolar wall
- 2 Perivascular leukocytic infiltrate

**fibrinoid necrosis - arteritis, Mallory trichrom (stains
normal fibrous tissue blue)**



- 1 Fibrinoid necrosis of the whole arteriolar wall
- 2 Partial fibrinoid necrosis of a larger calibre vessel

ATROPHY



= **pathologic shrinkage in the size of normally** evolved organ
(X hypoplasia, aplasia)

✖ types:

- ⇒ **simple** (*reduction in cell size*)
- ⇒ **numeric** (*reduction in cell numbers*)

ATROPHY



etiology:

- ✗ physiologic involution (thymus)
- ✗ lack of nutrition ->> cachexia
- ✗ pressure atrophy (compressed tissue)
- ✗ loss of function (immobilisation of a limb)
- ✗ loss of blood supply
- ✗ loss of innervation
- ✗ loss of endocrine stimulation
- ✗ hormone-induced atrophy (in the skin after topically applied corticosteroids)
- ✗ idiopathic

Disorders of metabolism (dystrophy)



= regressive change due to abnormal metabolism of the cell

✗ disorders of metabolism of:

1. Proteins

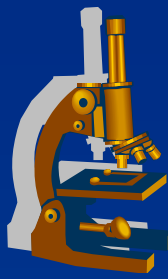
2. Lipids

3. Carbohydrates (glycogen, ...)

4. Mineral elements

5. Water

Water+minerals distribution disturbances



✘ type/localisation associated with the distribution of ions:

⇒ *EC: Na⁺, Cl⁻, HCO₃⁻, Mg²⁺, sulphates*

⇒ *IC: K⁺, phosphates*

A. extracellular changes:

- → dehydration

+ → hyperhydration, **oedema**

✓ venous

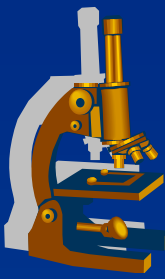
✓ lymphatic

✓ hypoalbuminaemic

✓ inflammatory

• **anasarca** = extreme generalised oedema of connective tissues

Water+minerals distribution disturbances



B. intracellular changes:

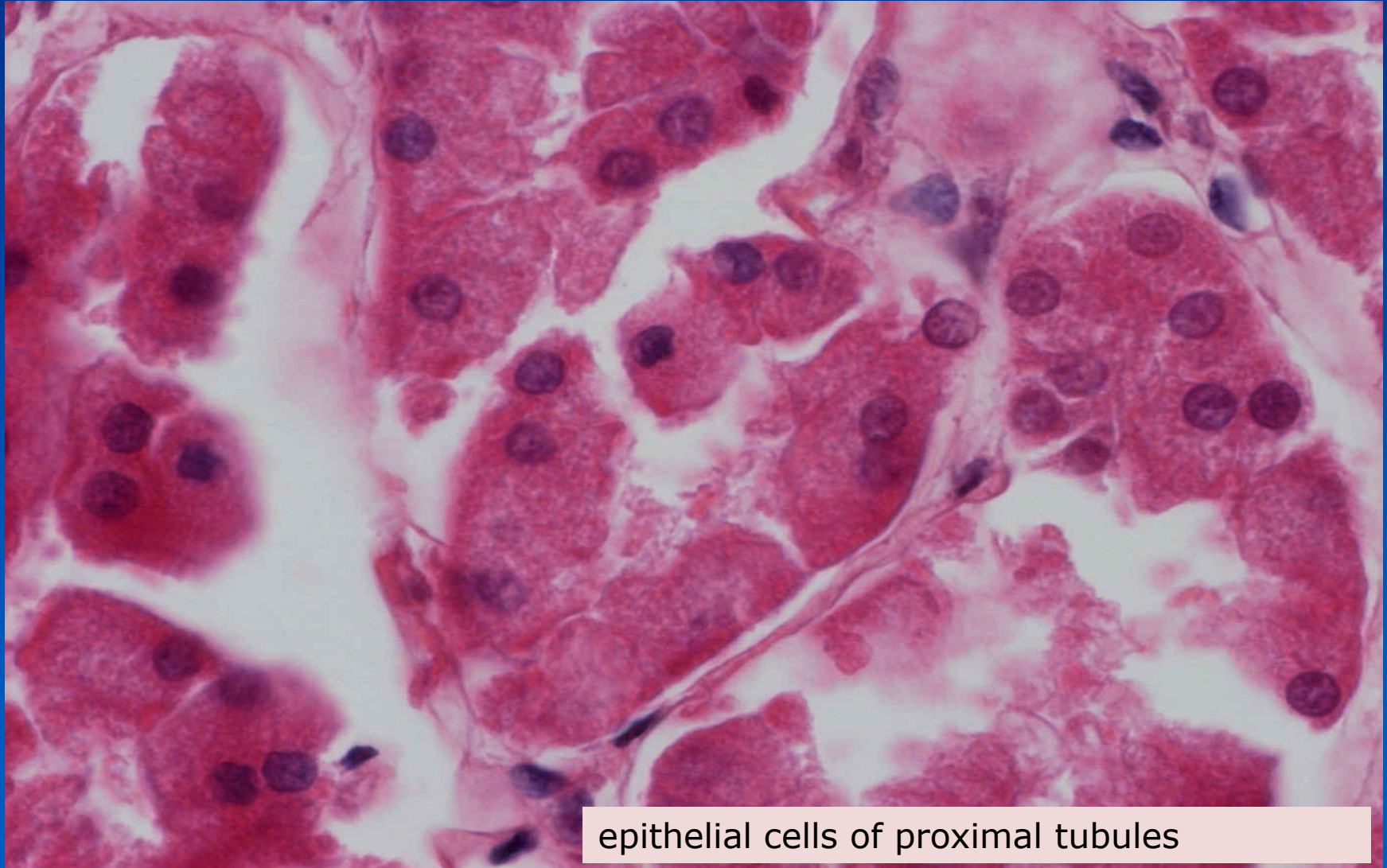
(caused by ischemia, hyperaldosteronism, viral infections, toxic insults)

⇒ **Swelling** - „intracellular oedema“, granulated cytoplasm

⇒ **Vacuolisation**

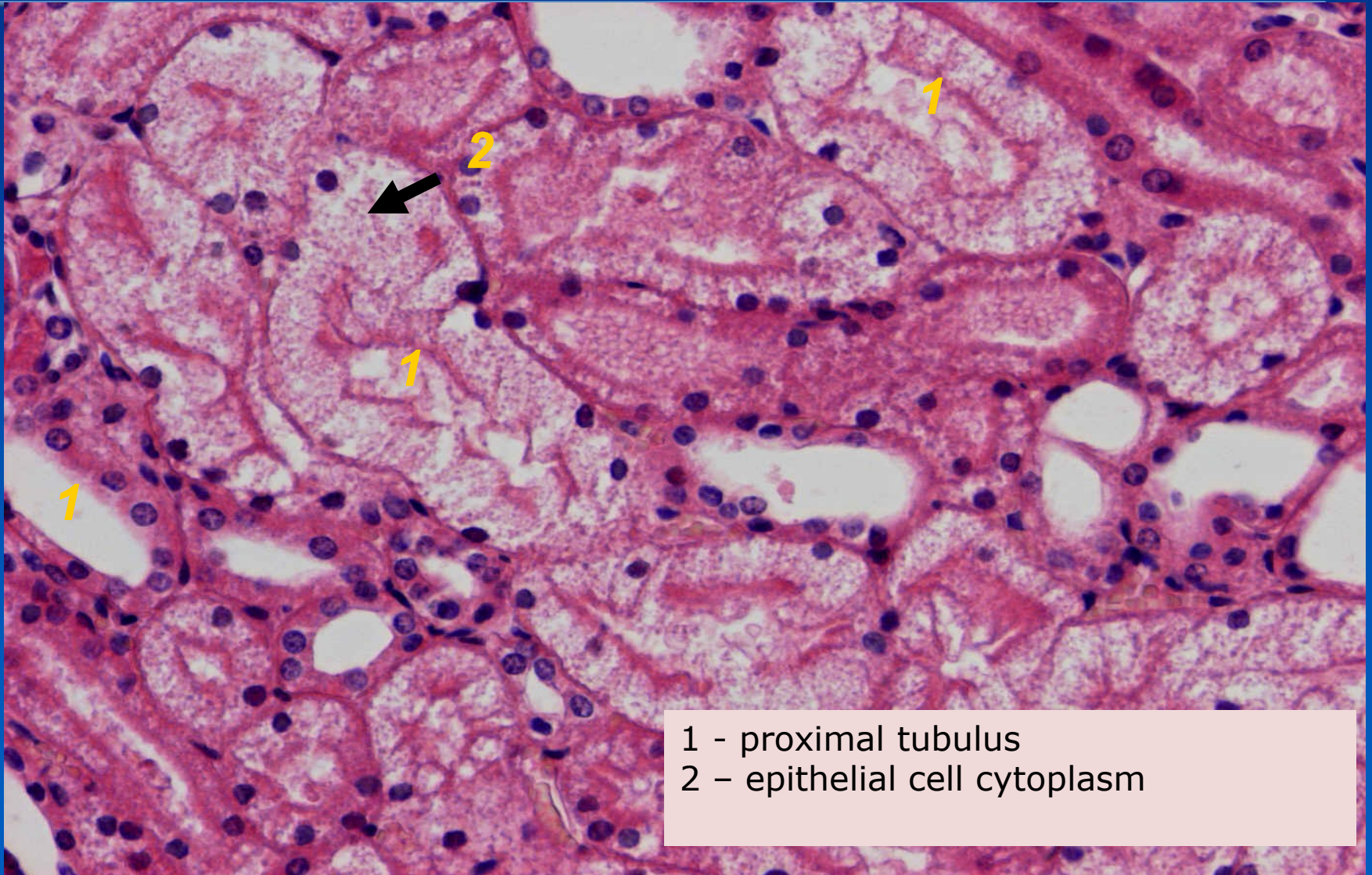
- cytoplasmatic vacuoles containing water → foam appearance
- specific subtypes – i.e. ballooning degeneration in hepatocytes (ischaemia, toxic, etc.)

Swelling of tubular cells in kidney



epithelial cells of proximal tubules

Swelling of tubular cells in kidney

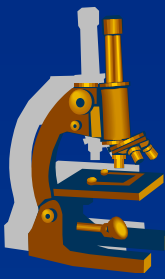


1 - proximal tubulus
2 - epithelial cell cytoplasm

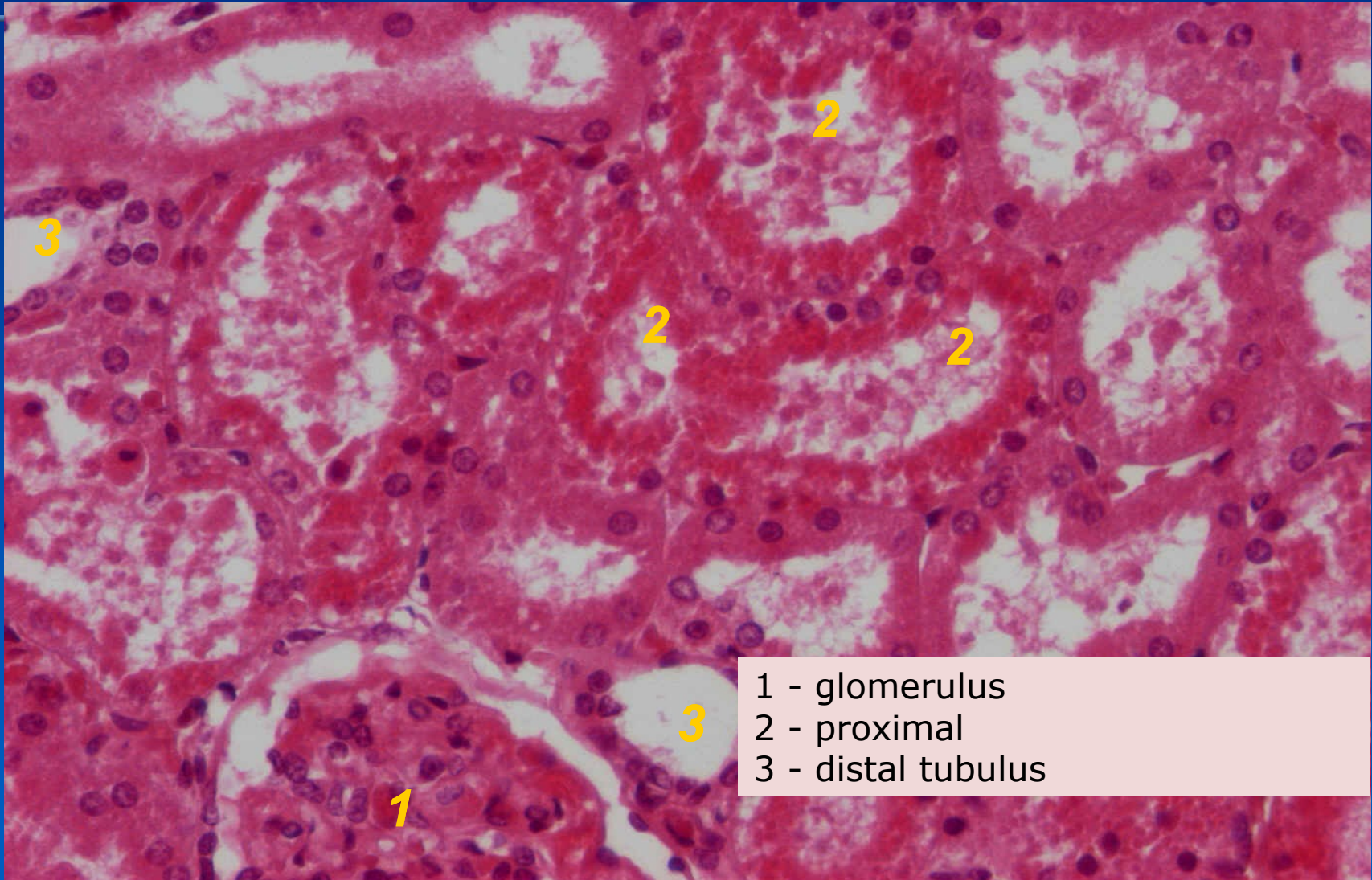
Disorders of protein metabolism



- 1) IC and EC hyaline material deposition
(transformed proteins – collagen, keratin, usually in form of pink globules)
- 2) Inclusion bodies
- 3) Mucinous dystrophy
- 4) Amyloidosis
- 5) Gout



Hyaline deposition in kidney tubules 200x



Hyaline change - intracellular



✘ Mallory bodies

- ⇒ *inclusions found in the cytoplasm of hepatocytes*
- ⇒ *associated with alcoholic liver disease*

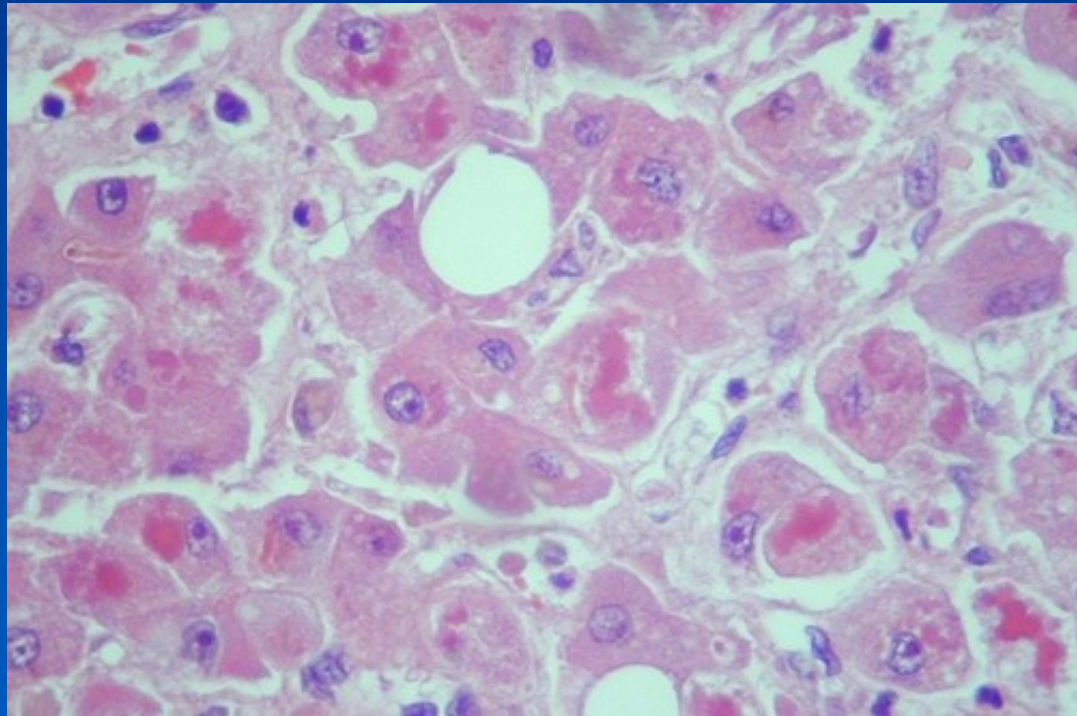
✘ Russell bodies

- ⇒ *eosinophilic, immunoglobulin-containing inclusions*
- ⇒ *usually found in a plasma cells undergoing excessive synthesis of immunoglobulin*

✘ **hyalin** = intra- and extracellular homogenous eosinophilic substance, pink in HE staining

Mallory bodies

(twisted-rope pink appearance)



Hyaline change - extracellular



= EC hyaline accumulation

× tendency to calcification

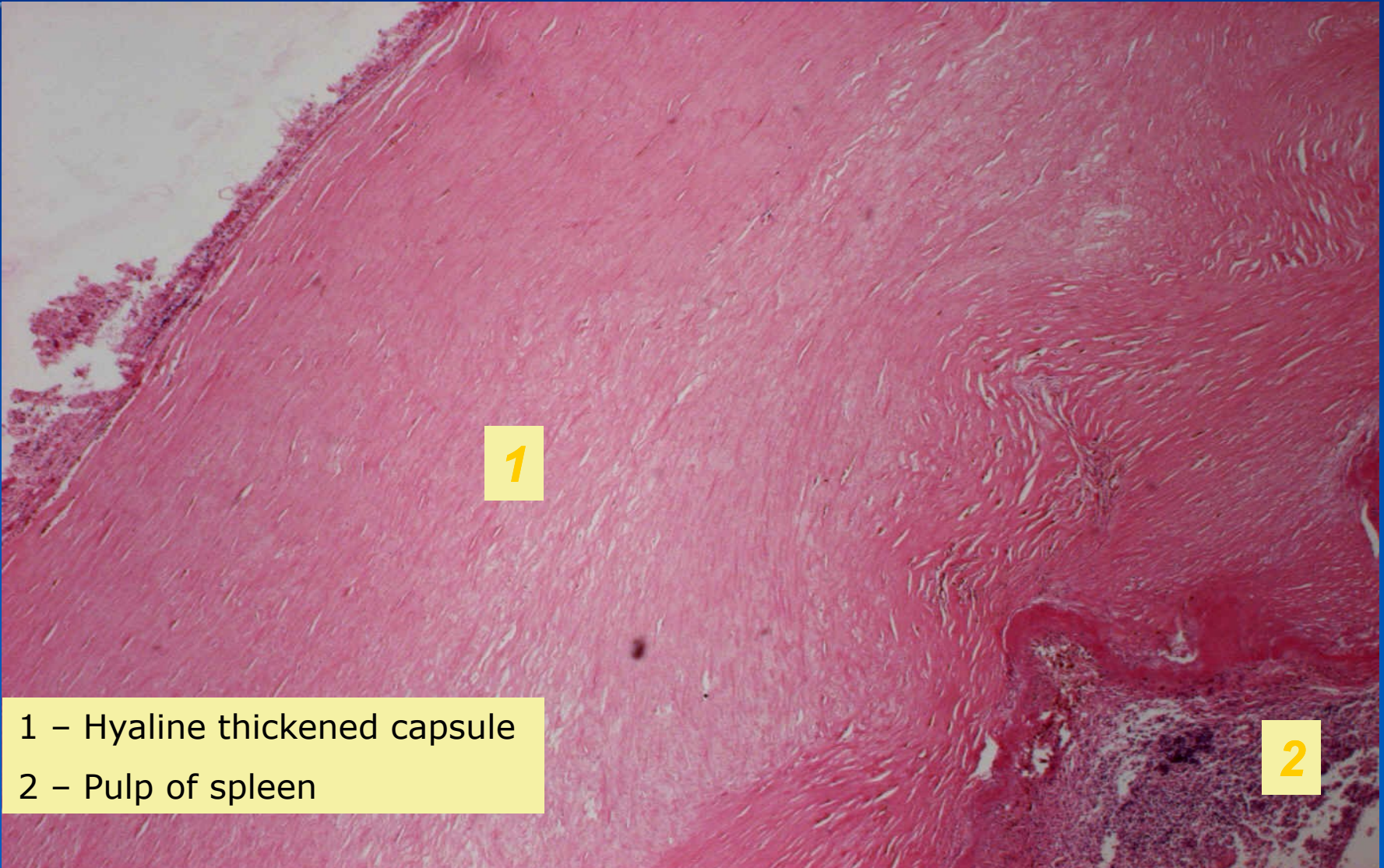
× diff.dg.: amyloid

× Hyaline change of the scars

× Hyaline change of the serous membranes

⇒ coating of the organ with a fibrous hyaline -> sugar-coated spleen

Hyaline change – EC (sugar coated spleen)



- 1 – Hyaline thickened capsule
- 2 – Pulp of spleen

Inclusion bodies

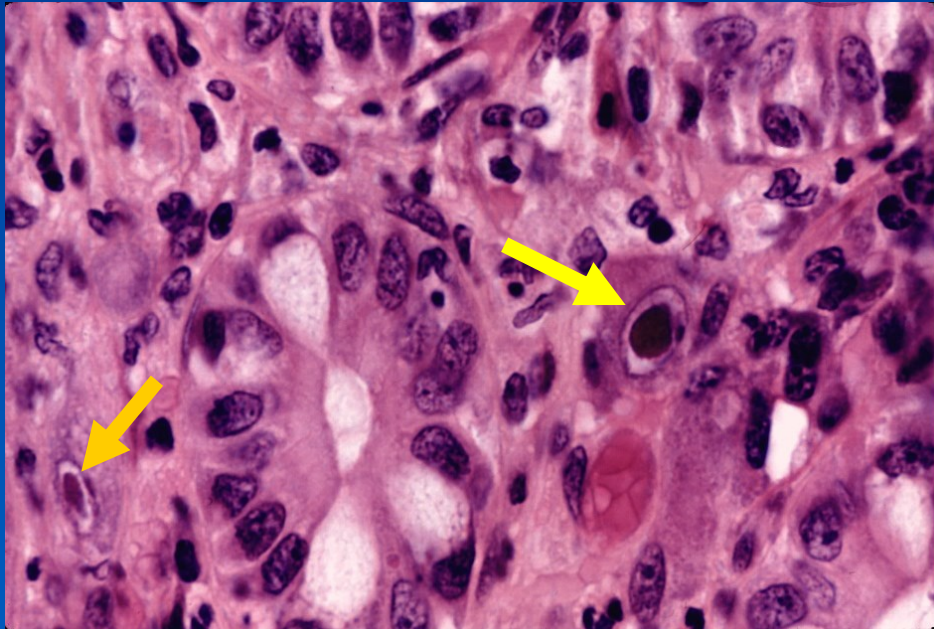


= pathologic intracellular particles

- ✗ cytoplasmatic / nuclear
- ✗ variable size
- ✗ eosinophilic or basophilic
- ✗ typically represent sites of viral multiplication
 - ⇒ *viral inclusion bodies: herpes simplex virus, CMV – owl eyes, rabbies - Negri bodies*)

Diagnostic methods: special staining, IHC, in situ hybridisation, ELM

CMV colitis (owl-eyes)



Mucinous change/accumulation



1) epithelial

2) mesenchymal

- × **PAS** (Periodic acid-Schiff) - neutral mucosubstances
- × **Alcian blue** (acid mucosubstances)

A) Mucinous change/accumulation – epithelial



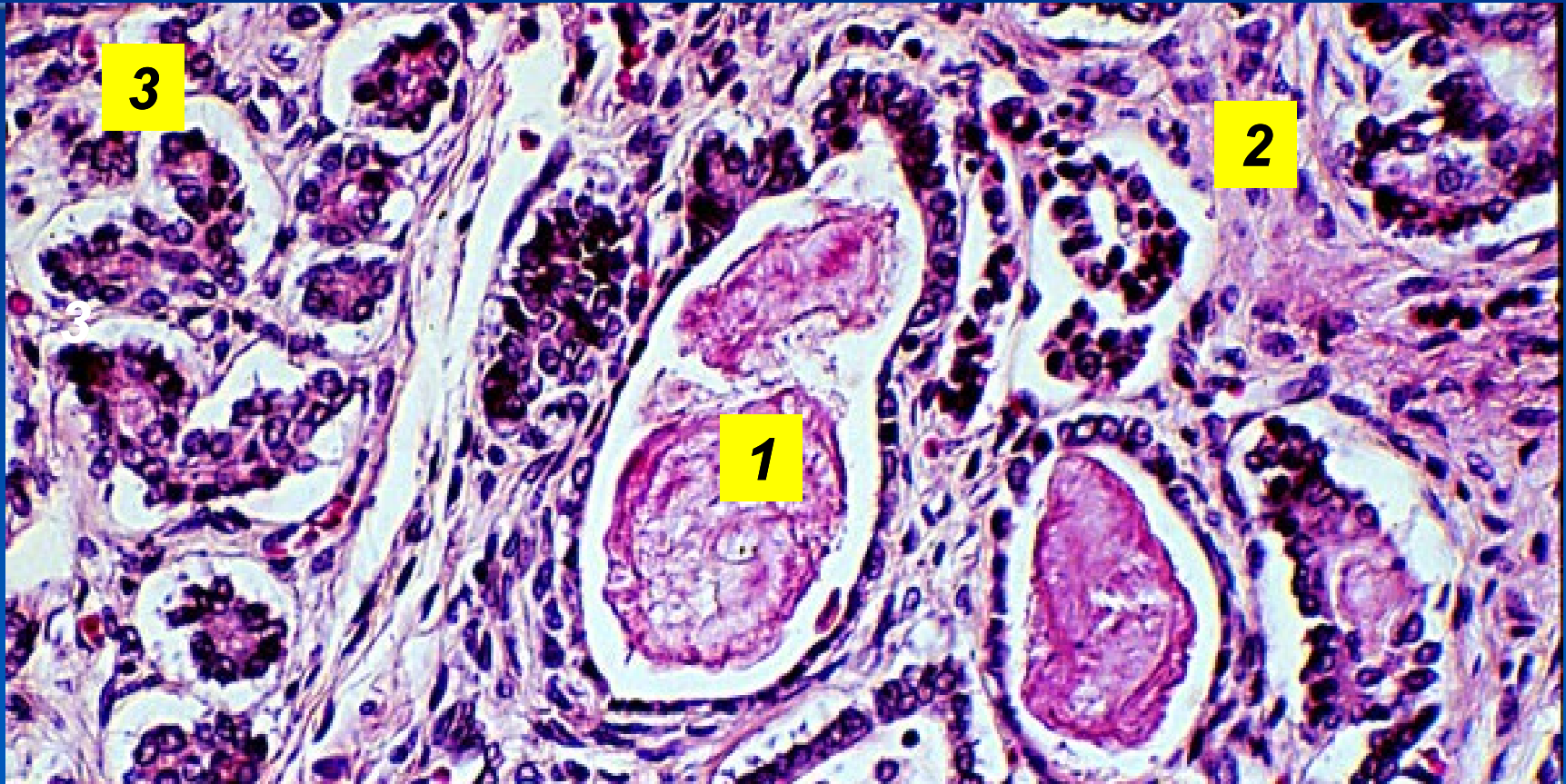
× cystic fibrosis

- ⇒ *inherited metabolic disorder (AR - CFTR gen)*
- ⇒ *abnormal mucous secretion – mucus plugs exocrine ducts -> parenchymal damage to the affected organs.*
- ⇒ *clinically:*
 - *bronchiectasis*
 - *recurrent bronchopulmonary infections*
 - *pancreatic fibrosis – chronic pancreatitis*
 - *malabsorption due to defective pancreatic secretions*

× alopecia mucinosa (follicular mucinosis)

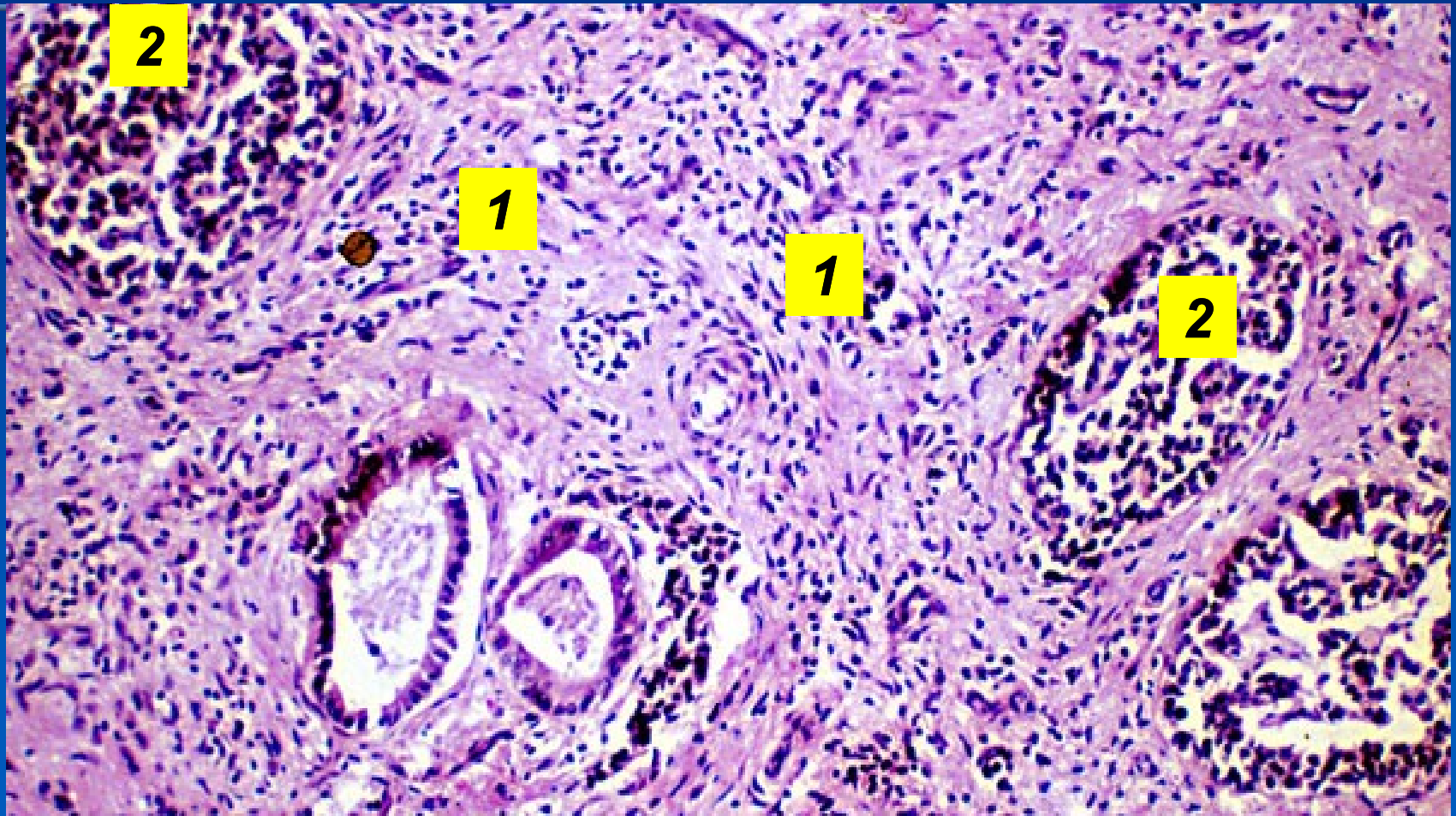
- ⇒ *male pattern baldness due to irreversible loss of follicles*
- ⇒ *accumulation of mucinous material in the damaged hair follicles and sebaceous glands creates an inflammatory condition and subsequent degenerative process*

Cystic fibrosis



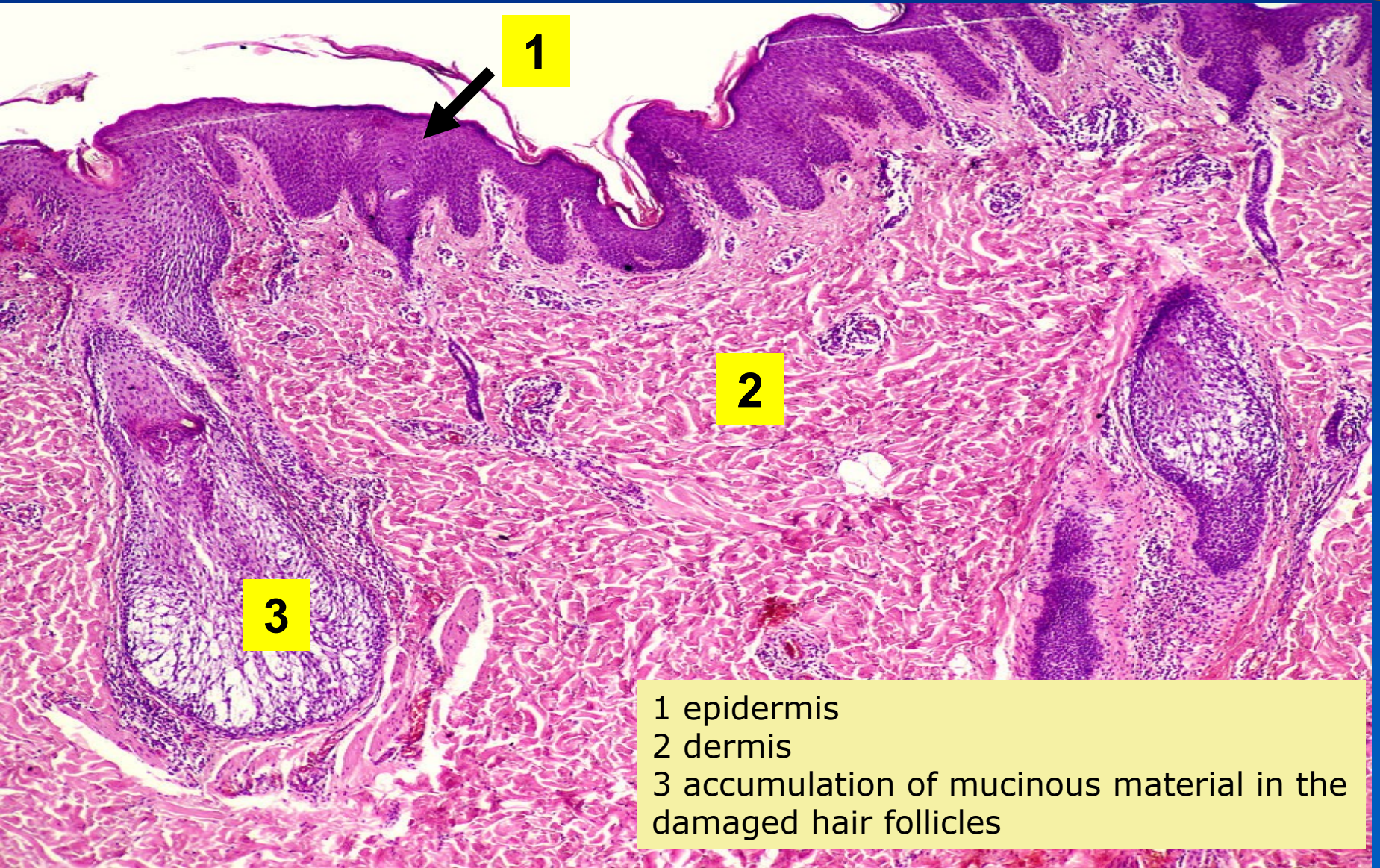
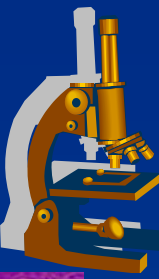
- 1 accumulation of mucous material in pancreatic ducts and in acini.
- 2 thickened fibrous connective tissue septa
- 3 pancreatic acini

cystic fibrosis (atrophy of pancreatic parenchyma)



1 - overgrowth of connective tissue
with chronic inflammatory infiltration
2 - persisting islets of Langerhans

alopecia mucinosa (follicular mucinosis)



- 1 epidermis
- 2 dermis
- 3 accumulation of mucinous material in the damaged hair follicles

B) Mucinous change/accumulation - mesenchymal



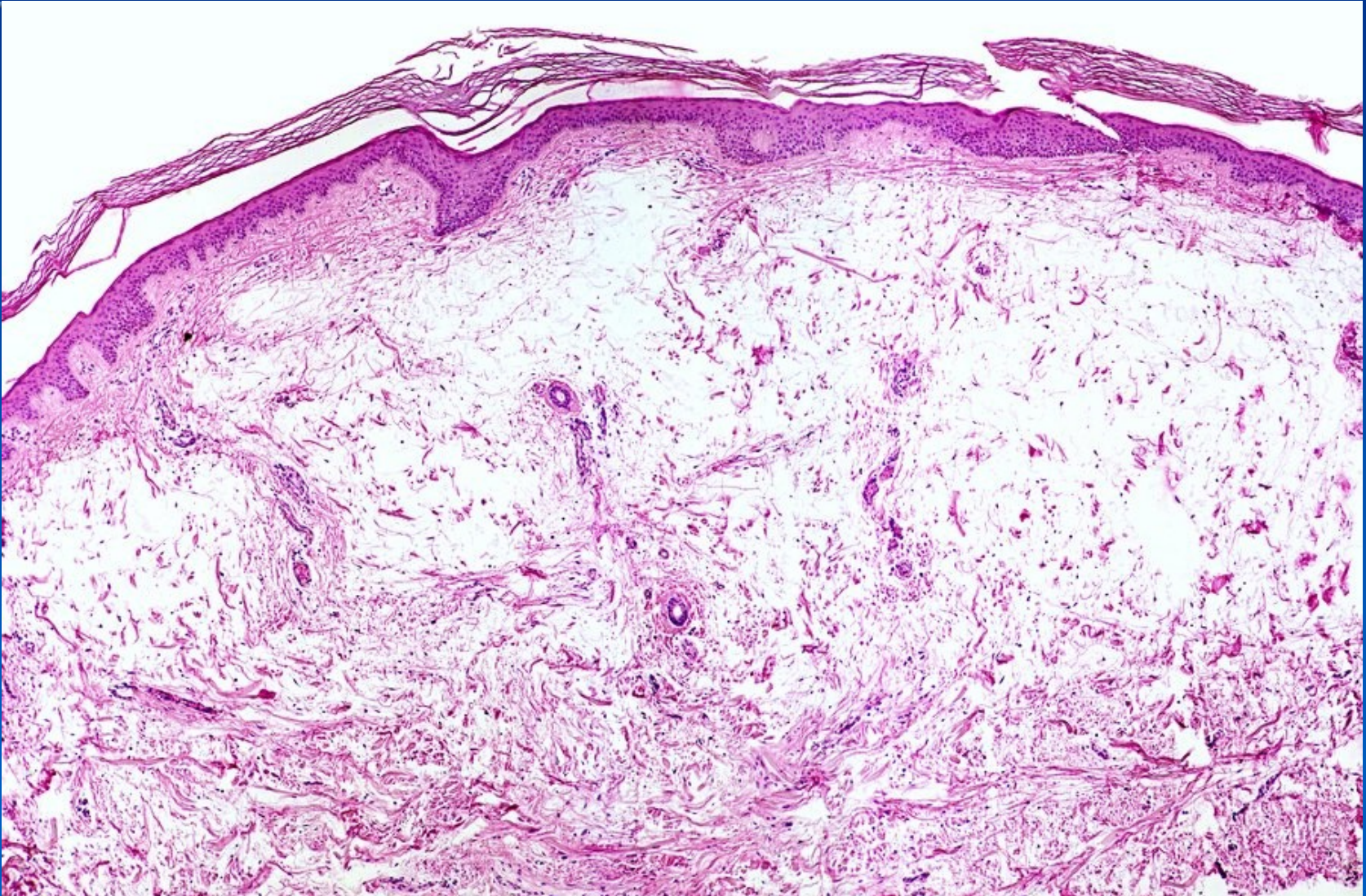
× ganglion

- ⇒ *pseudocyst formed by fibrous tissue, contains amorphous, often myxoid material*
- ⇒ *localization near a joints or a tendon*
- ⇒ *postraumatic*

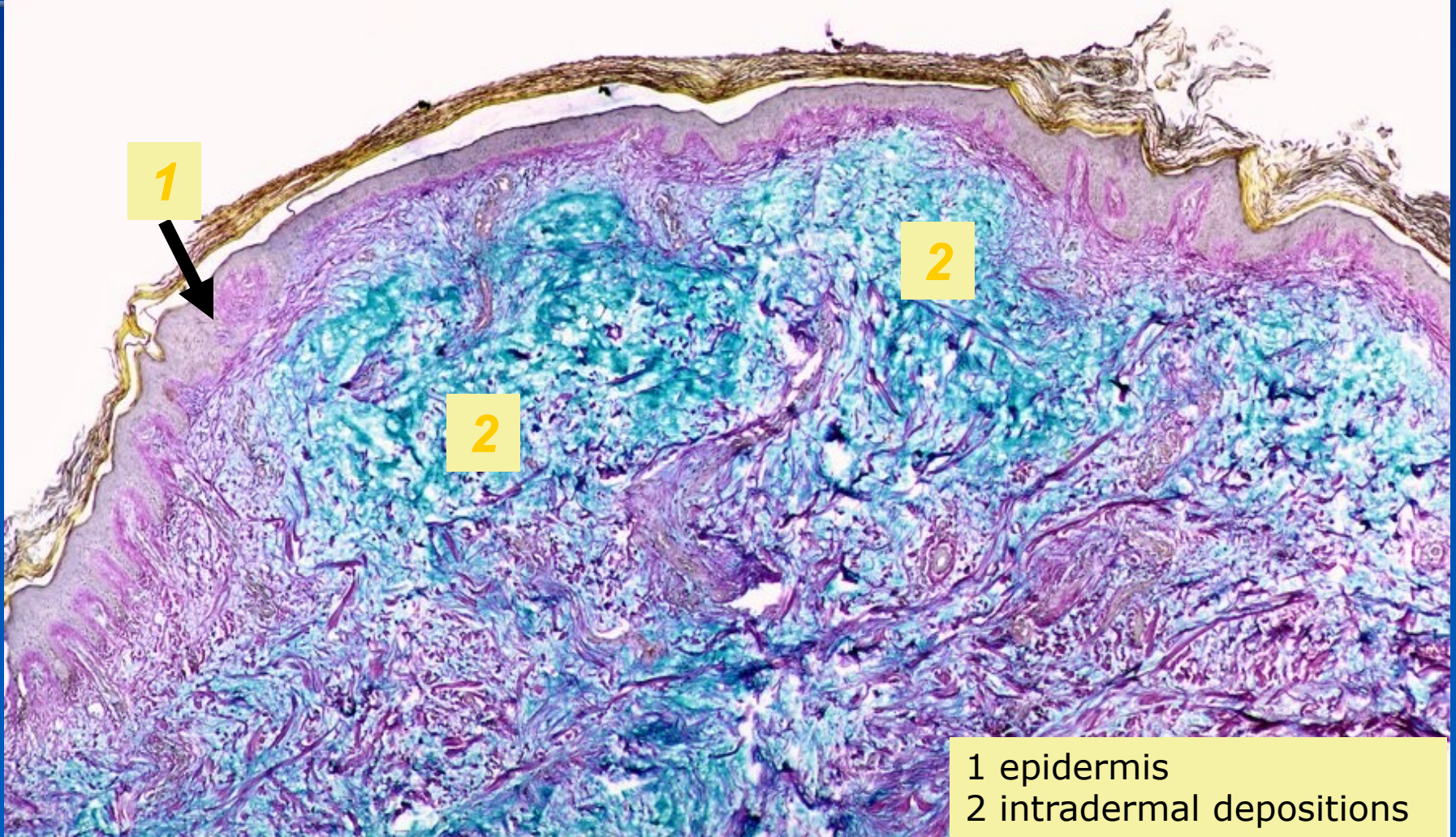
× myxoedema

- ⇒ *intradermal depositions of mucous substances*
- ⇒ *associated with hypothyreoidism*

Mucinous change/accumulation – depositions of mucinous substances in dermis

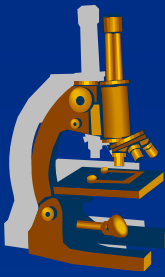


Mucinous accumulation – depositions of mucinous substances in dermis (Alcian blue staining)



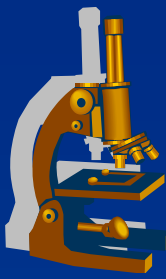
1 epidermis
2 intradermal depositions

Amyloidosis



- × amyloidosis refers to a variety of conditions wherein amyloid proteins are extracellularly abnormally deposited in tissues or organs
- × amyloid = group of pathological glycoproteins, fibrillary ultrastructure, β -pleated sheet microstructure, non-digestible.

Amyloidosis



can be classified according to:

✘ issue distribution

- ⇒ *systemic – material is deposited in a wide variety of organs*
- ⇒ *localised*

✘ aetiology:

- ⇒ *hereditary*
- ⇒ *acquired: AL, AA, etc*

✘ chemical composition

Amyloidosis



× gross:

⇒ *in major deposition affected organs with waxy appearance, greyish-white, slightly hardened.*

× micro:

⇒ *extracellular (often in BM) deposits of homogenous eosinophilic material (similar to hyalin, fibrin, etc.) -> „pressure“ atrophy -> parenchymal destruction -> organ dysfunction*

× histochemical identification:

⇒ *congo red*

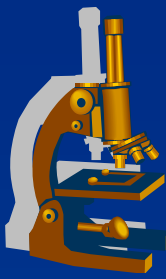
⇒ *methylviolet*

⇒ *yellow-green dichroism in polarising light*

× electron microscopy:

⇒ *fibrillar appearance*

Amyloidosis - systemic



1) AL (primary) amyloidosis

- ⇒ *associated with B-cell tumorous proliferations*
 - myeloma
- ⇒ *light chains Ig*
- ⇒ *deposits: cardiovascular system, kidney, GIT, skin, tongue, peripheral nerve*

2) AA (reactive, secondary) amyloidosis

- ⇒ *associated with with chronic inflammation*
 - rheumatoid arthritis
 - osteomyelitis
 - bronchiectasis
- ⇒ *AA amyloid derived from SAA (serum associated amyloid) plasmatic acute phase reactant protein*
- ⇒ *deposits: kidney, liver, spleen, lymph nodes, adrenal glands, intestine*

Amyloidosis - systemic

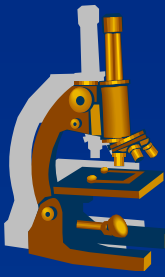


3) AH amyloidosis

- ⇒ *long-term haemodialysis*
- ⇒ *β 2-microglobulin*

4) hereditary amyloidosis

Amyloidosis - localised

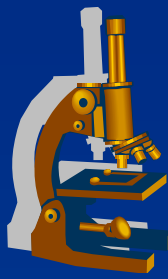


1) senile amyloid

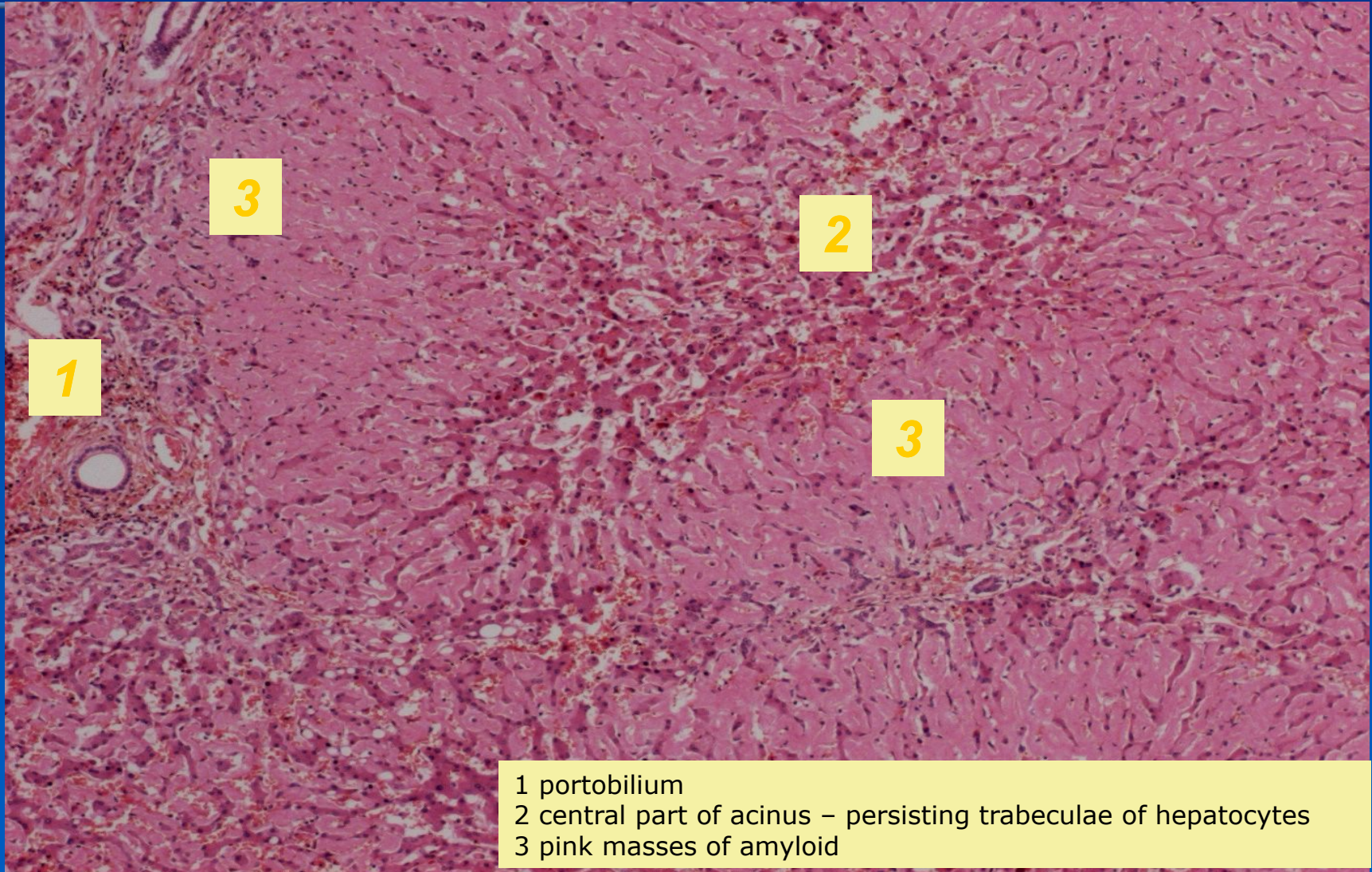
- ⇒ *aorta, myocardium*
- ⇒ *cerebral (Alzheimer's disease, old people)*

2) tumor-associated amyloid

- ⇒ *in peptide hormones producing tumors (medullary thyroid carcinoma)*

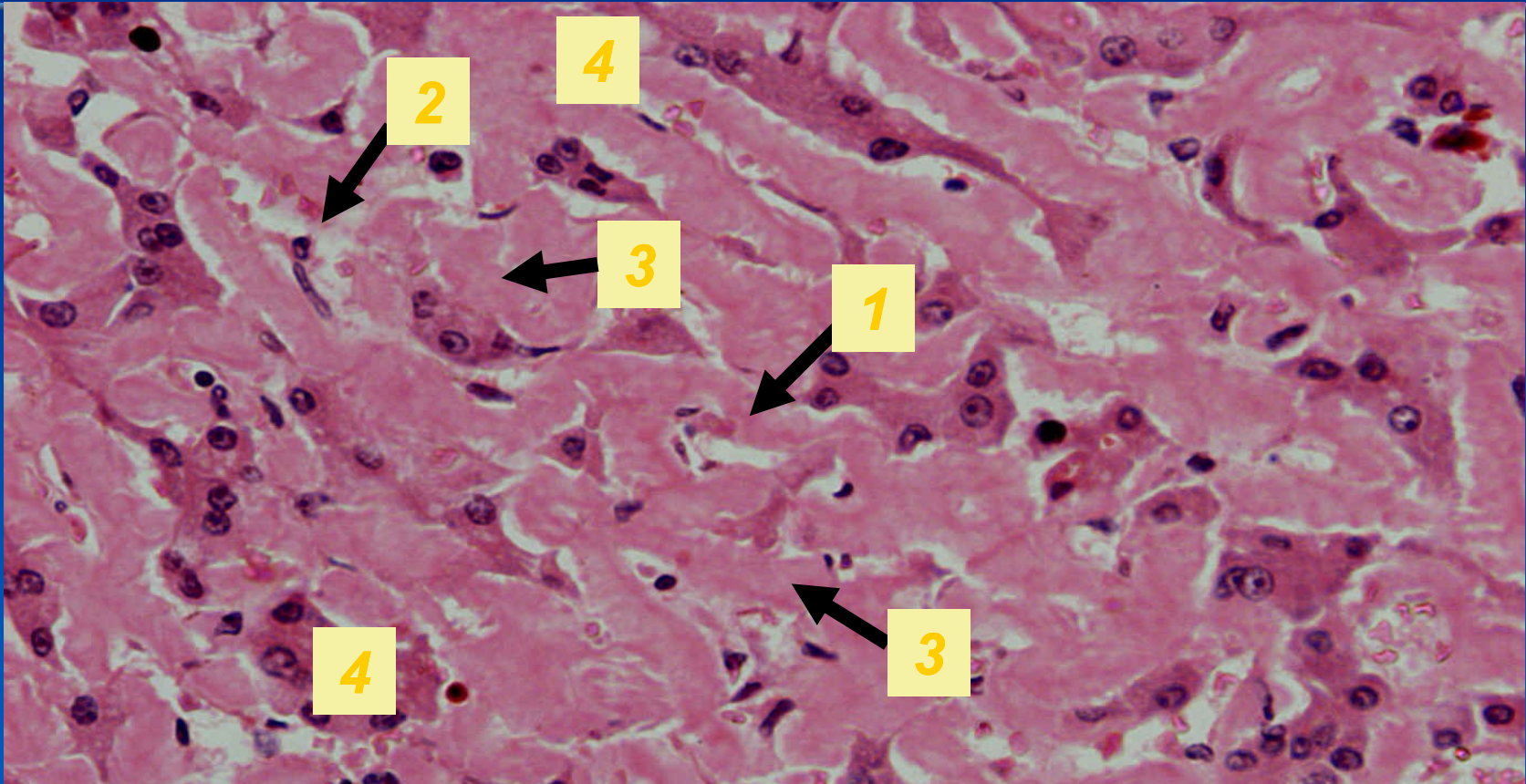
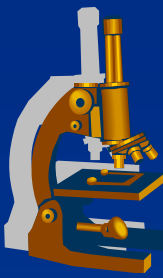


(secondary) amyloidosis - liver



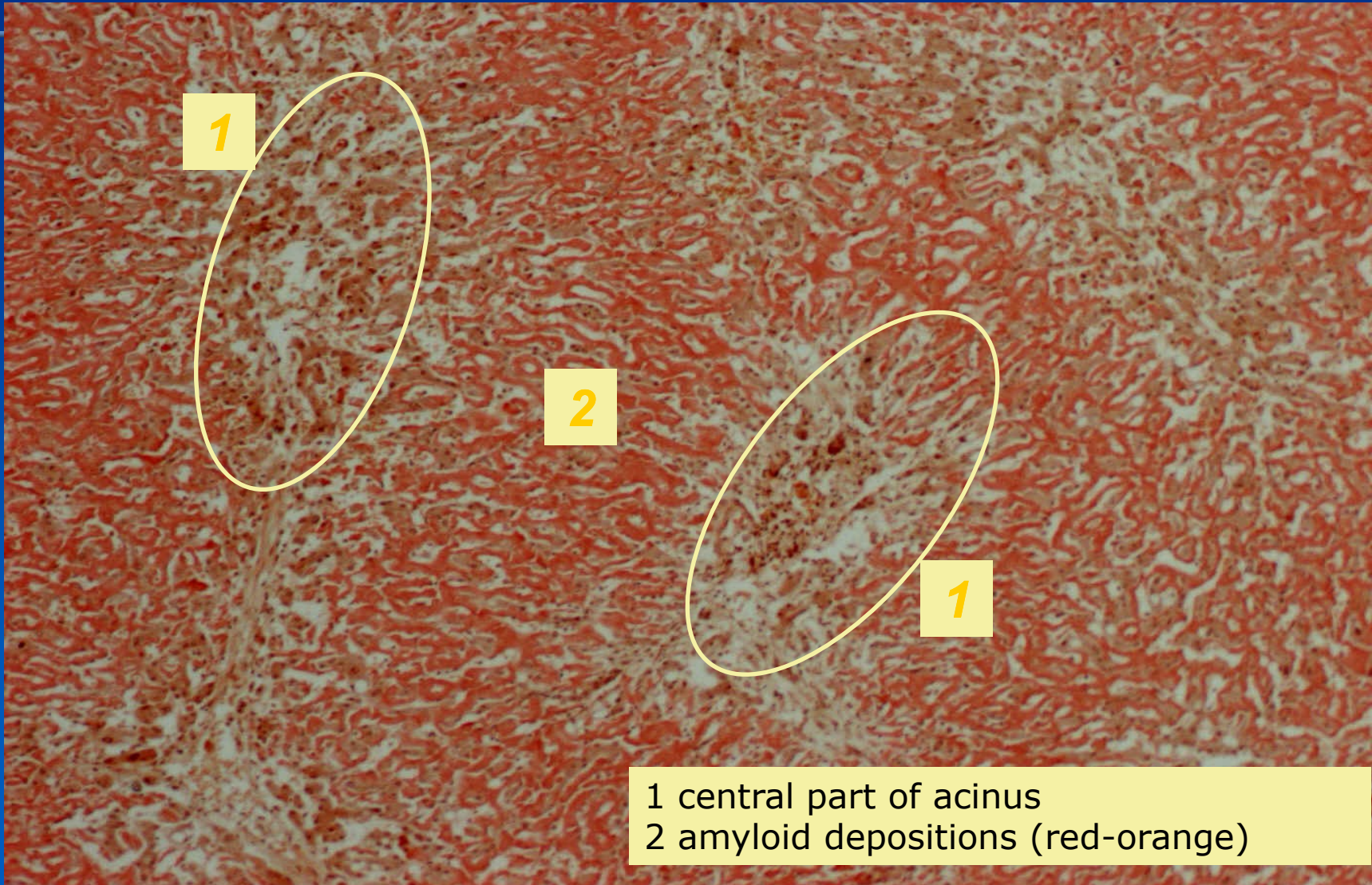
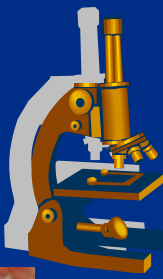
- 1 portobilium
- 2 central part of acinus – persisting trabeculae of hepatocytes
- 3 pink masses of amyloid

(secondary) amyloidosis - liver

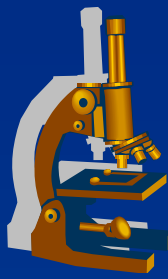


- 1 - sinusoidal lining cells
- 2 - Kupffer cells
- 3 - amyloid masses in perisinusoidal spaces
- 4 - atrophic trabeculae of hepatocytes

(secondary) amyloidosis – liver congo red staining



1 central part of acinus
2 amyloid depositions (red-orange)



Gout (arthritis uratica)

- ✗ excessive amounts of **uric acid** accumulated in tissues
 - ⇒ **primary**
 - *90%, enzyme defects*
 - ⇒ **secondary**
 - *overproduction of uric acid*
 - *increased cell lysis due to lymphoma or leukemia*
 - *decreased excretion of uric acid due to chronic renal diseases*

- ✗ urate crystals are stored in tissues:
 - ⇒ acute arthritis
 - ⇒ chronic arthritis
 - ⇒ gouty nephropathy

Gout (arthritis uratica)

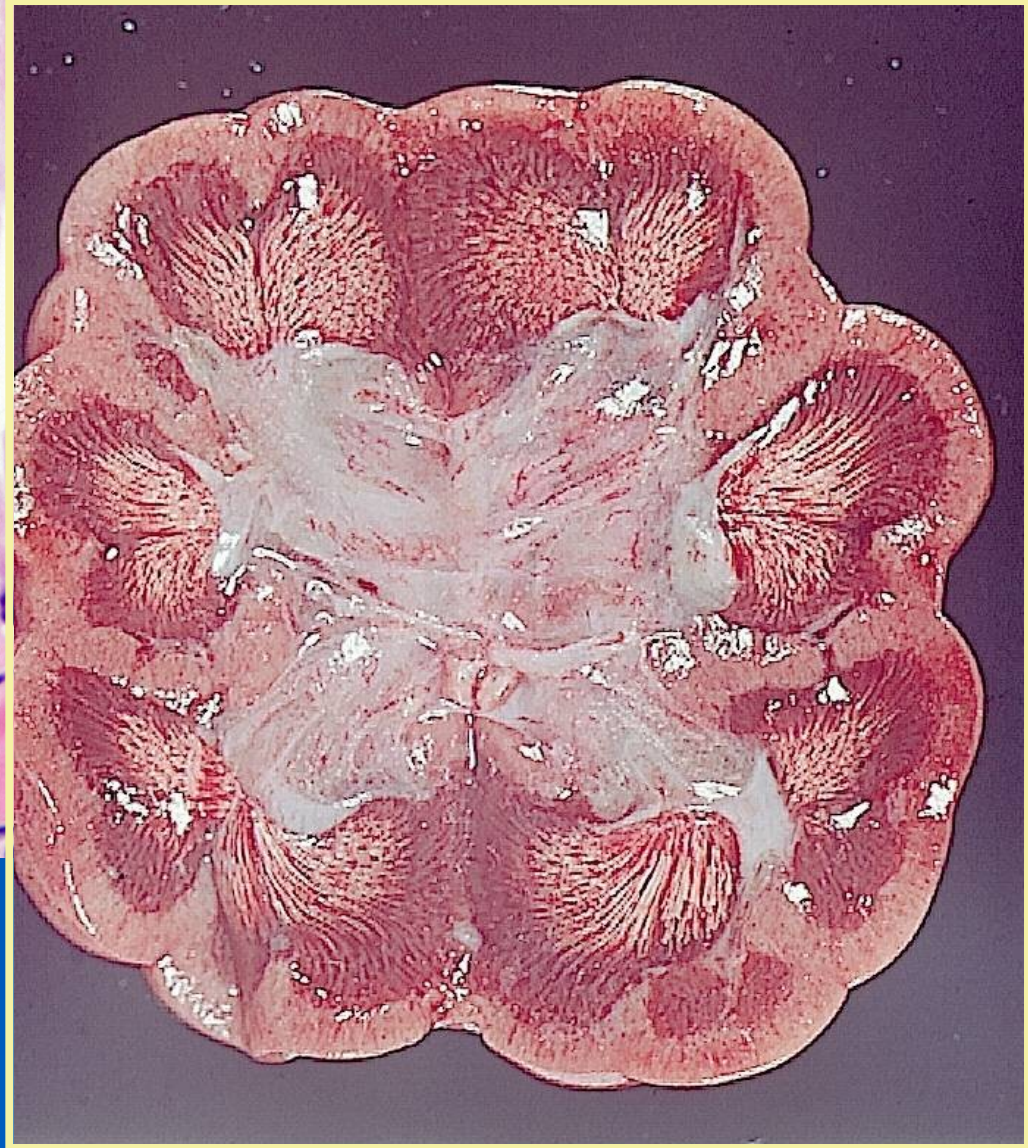
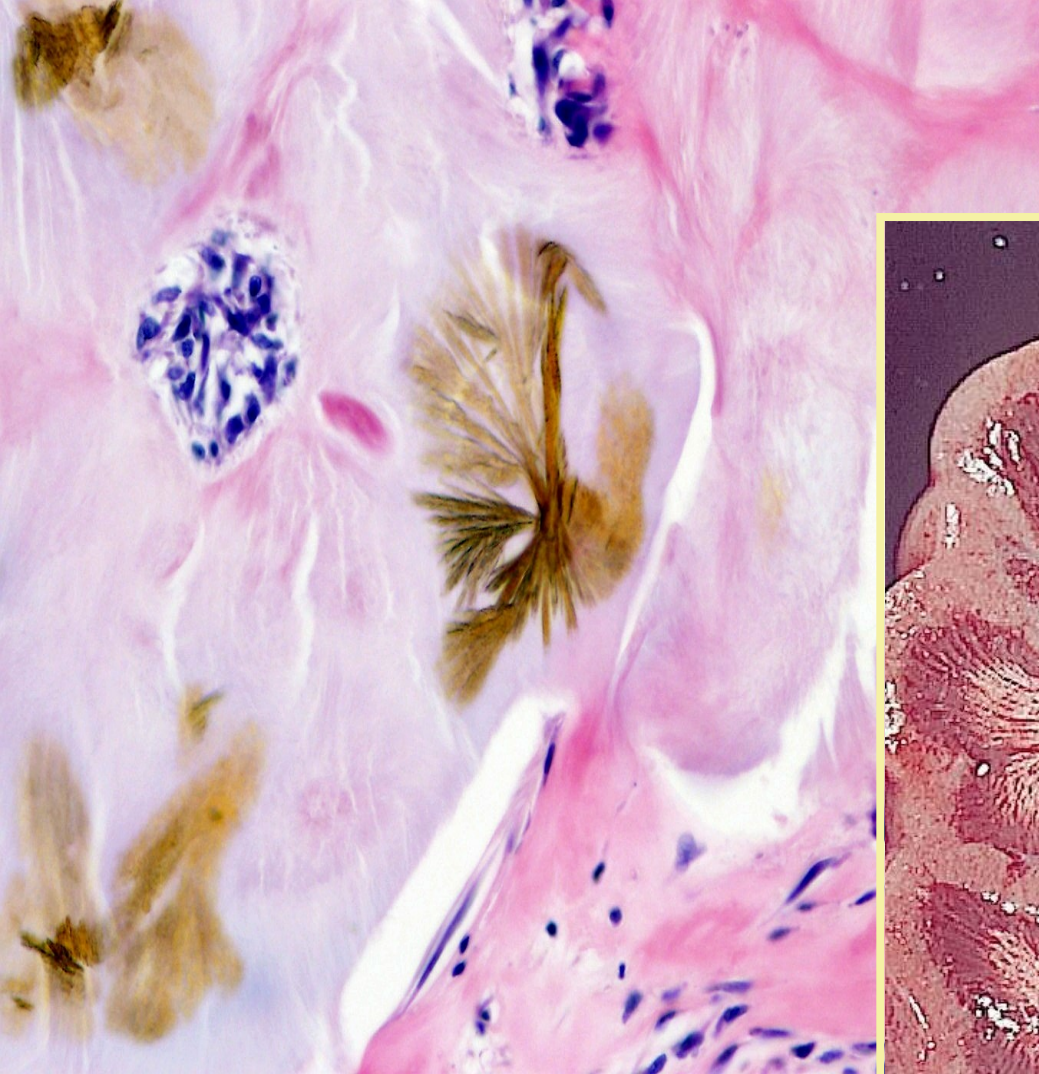
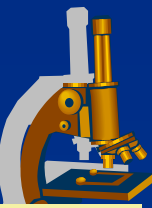


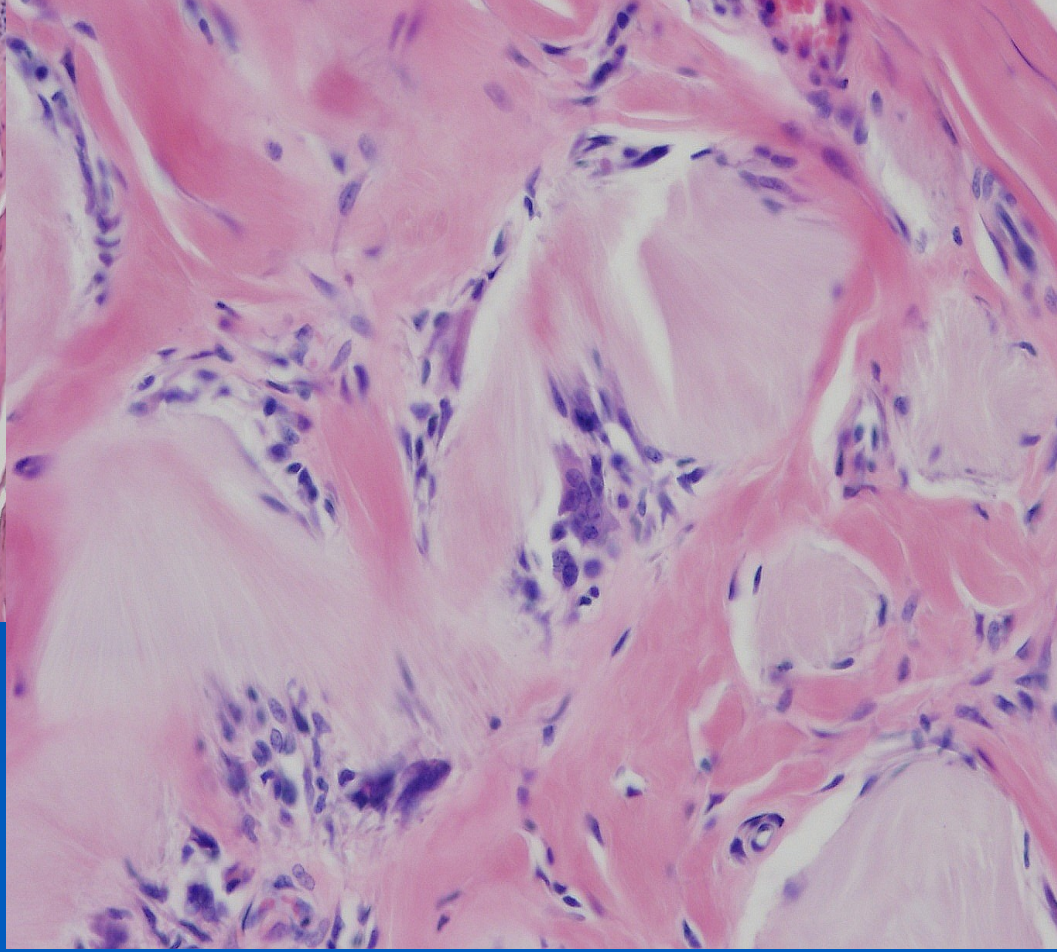
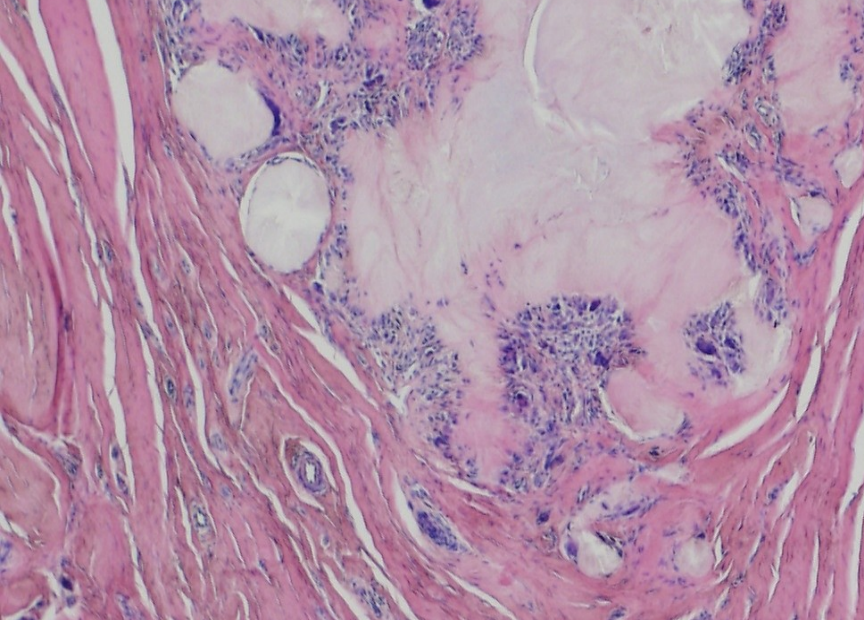
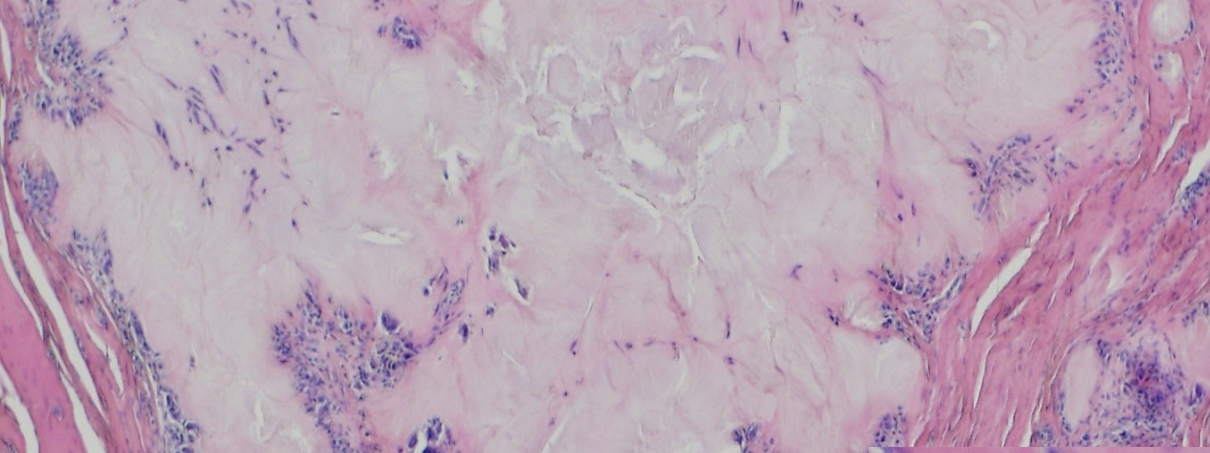
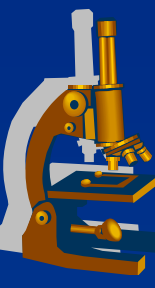
× Acute form:

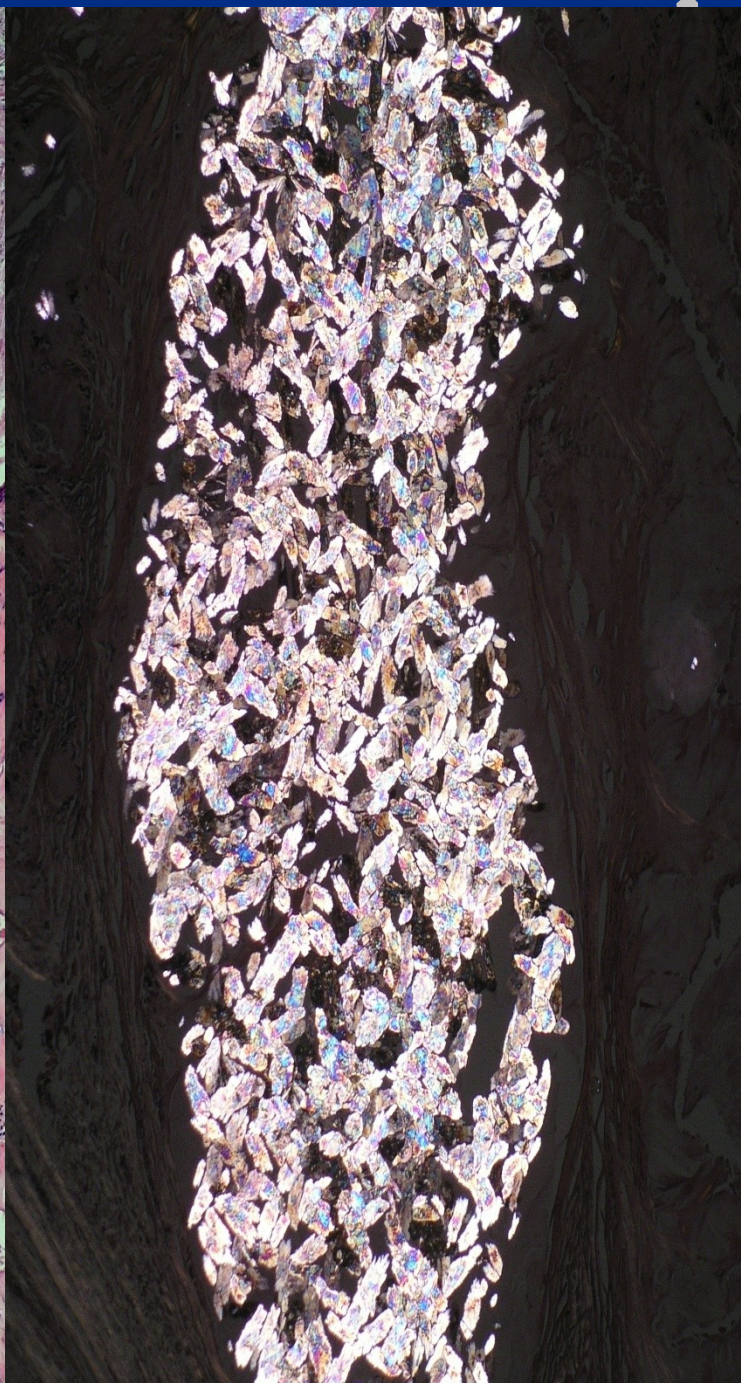
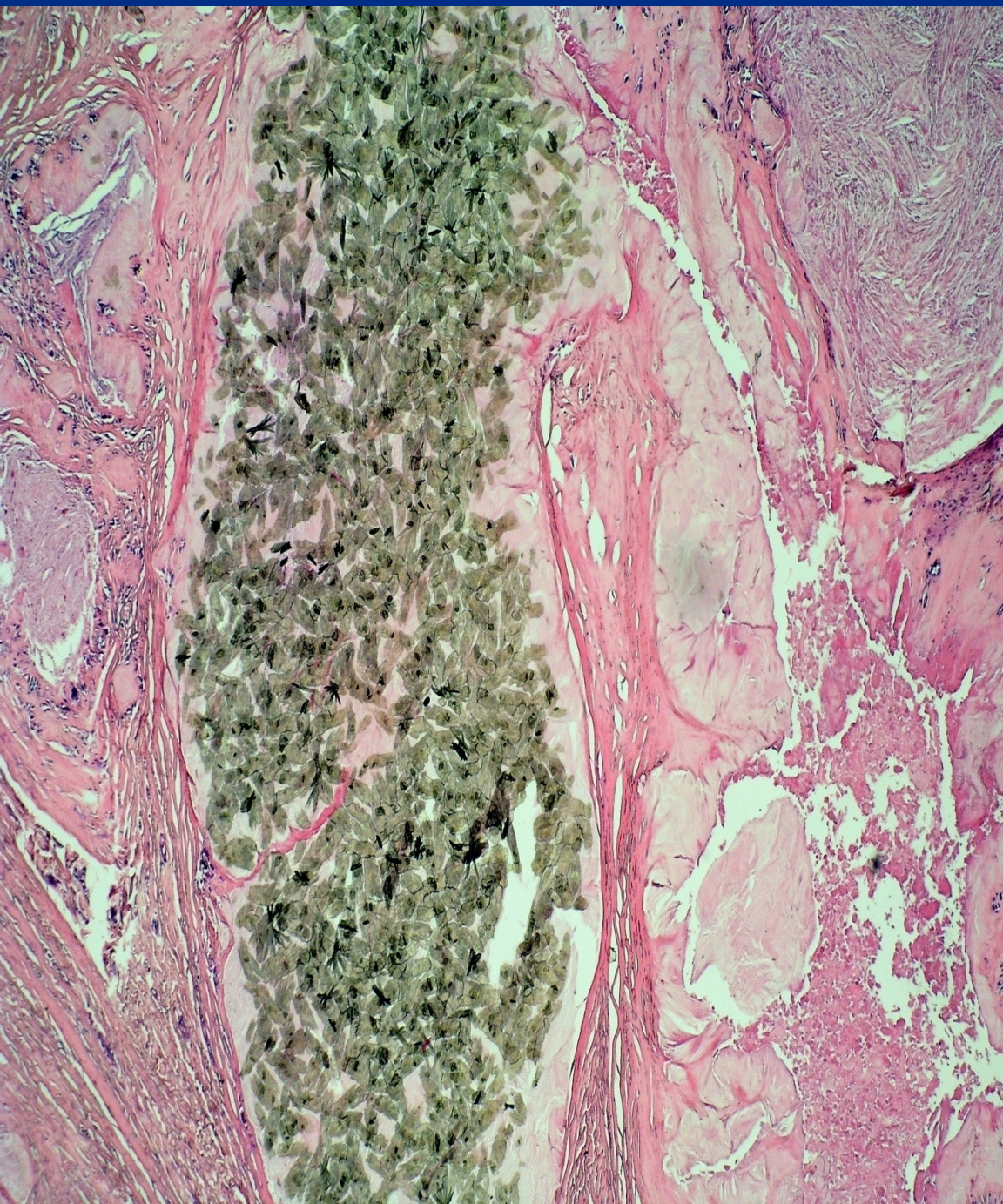
- ⇒ gouty arthritis
- ⇒ tophi formation (gouty pain in the big toe)

× Chronic form:

- ⇒ chronic tophaceous arthritis
 - *(recurrent episodes of inflammation)*
- ⇒ gouty nephropathy
 - *urate deposition in the medullar interstitium, with surrounding granulomatous reaction, intratubular urate precipitations, renal calculi*







Disorders of lipid metabolism



✗ lipomatosis

⇒ *excess amount of fat tissue*

⇒ *usually replacing atrophic functional tissue (pancreas, lymph node, kidney hilus, etc.)*

✗ lipidoses – storage disease

⇒ *inborn hereditary diseases*

⇒ *usually single-gene enzymatic defect, blockage of metabolic chains*

⇒ *accumulation of semi-products (sphingolipids) in macrophages (liver, spleen), nervous tissue*

✗ steatosis

Disorders of lipid metabolism



- ✗ **steatosis (fatty change)**

- ⇒ *abnormal cytoplasmic accumulation of normal lipids (triglycerides, cholesterol) in form of droplets*
- ⇒ *Liver, myocardium, skeletal muscle, neutrophils, etc.*

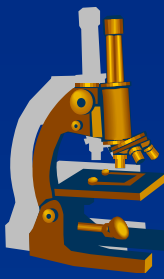
- ✗ **gross:**

- ⇒ *yellowish, greasy*

- ✗ **micro:**

- ⇒ *wash-out during embedding in paraffine (empty vacuoles)*
- ⇒ *frozen sections – oil red, Sudan*

Disorders of lipid metabolism



✘ intracellular steatosis:

⇒ *excessive fat intake*

- insufficient metabolism in normal cell

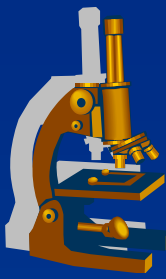
⇒ *pathological cell metabolism*

- hypoxia
- toxins,
- infections
- starvation, etc.

✘ extracellular steatosis:

⇒ *deposition in intercellular substance, commonly via macrophages (atherosclerosis)*

Fatty liver disease - steatosis



✗ gross:

⇒ *enlarged, paler, in extreme cases yellow, softer consistency*

✗ micro:

⇒ *small or confluent droplets in cytoplasm*

✗ causes:

⇒ *alcohol*

⇒ *other toxins (drugs, organic substances)*

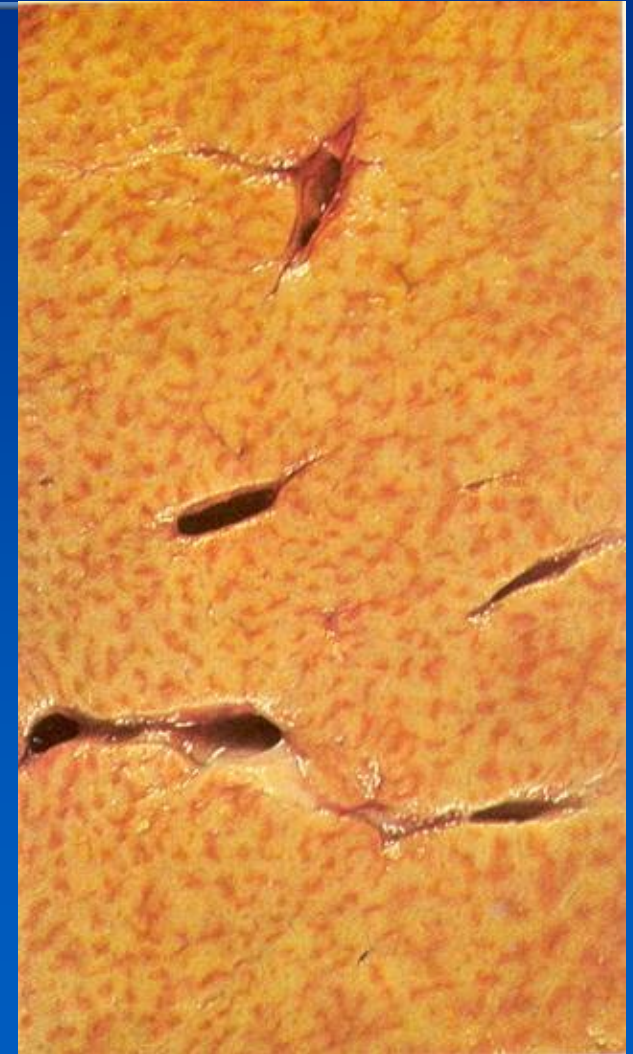
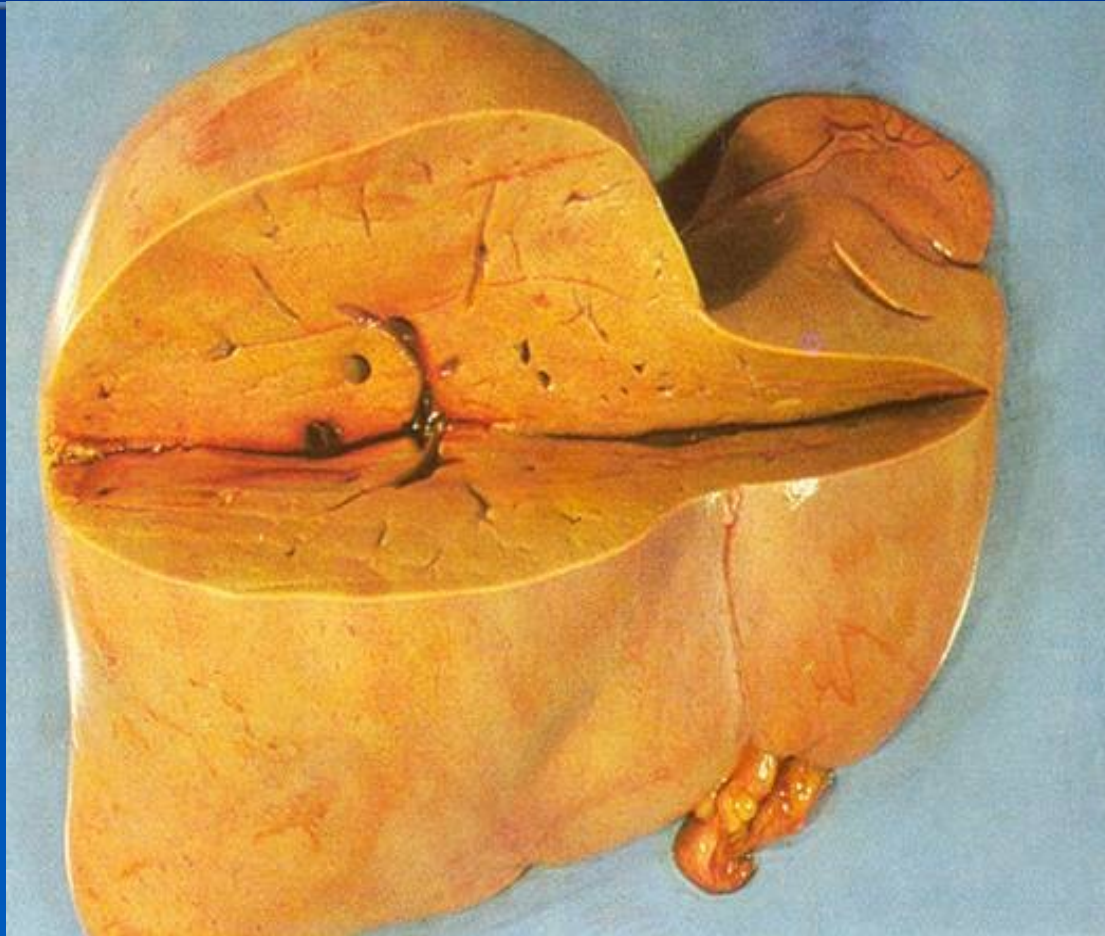
⇒ *diabetes mellitus + metabolic syndrom*

⇒ *excessive fat intake*

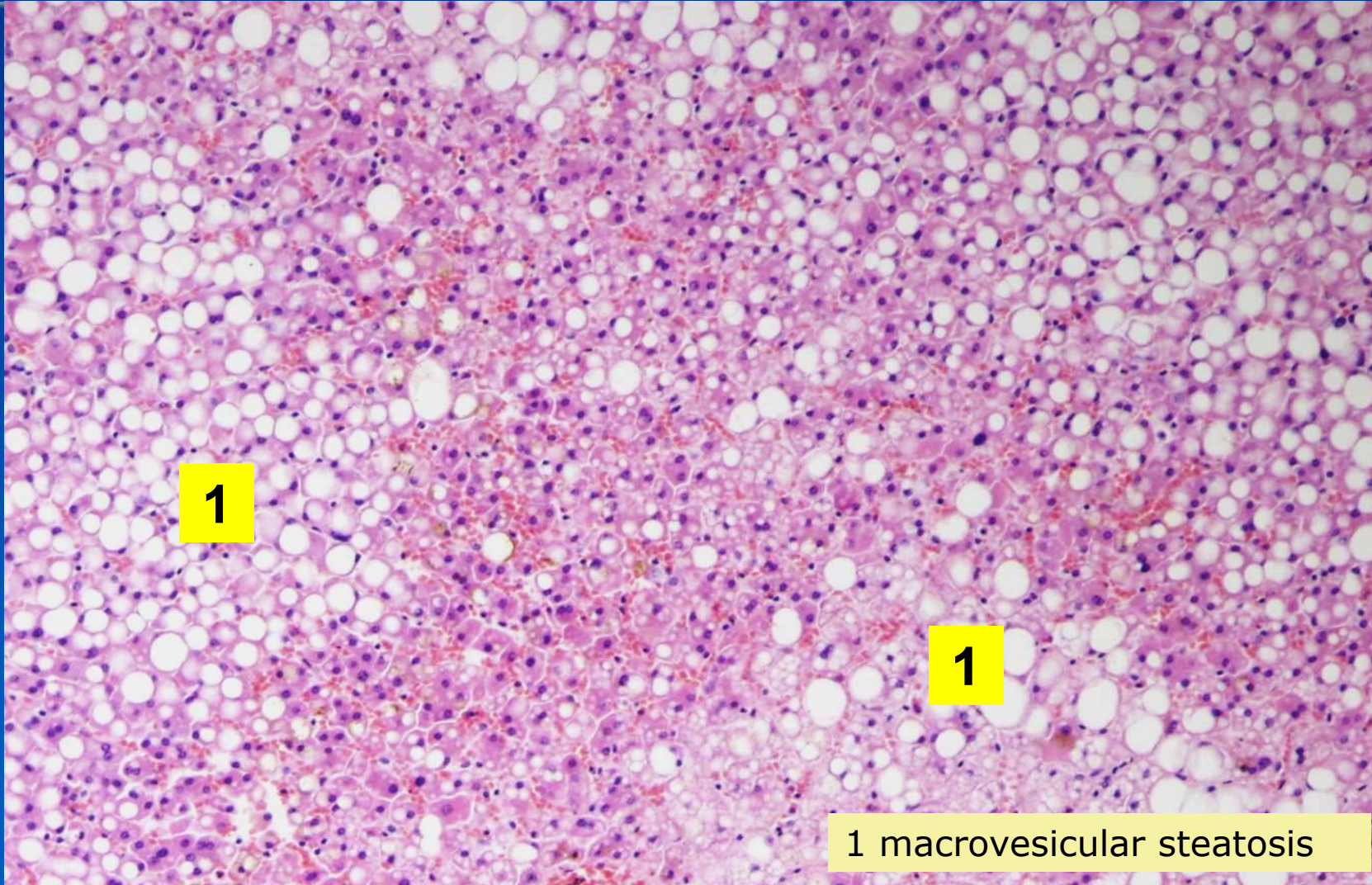
⇒ *infection (hepatitis C, ...)*

⇒ *hypoxia*

Fatty liver disease - steatosis



Fatty liver disease - steatosis

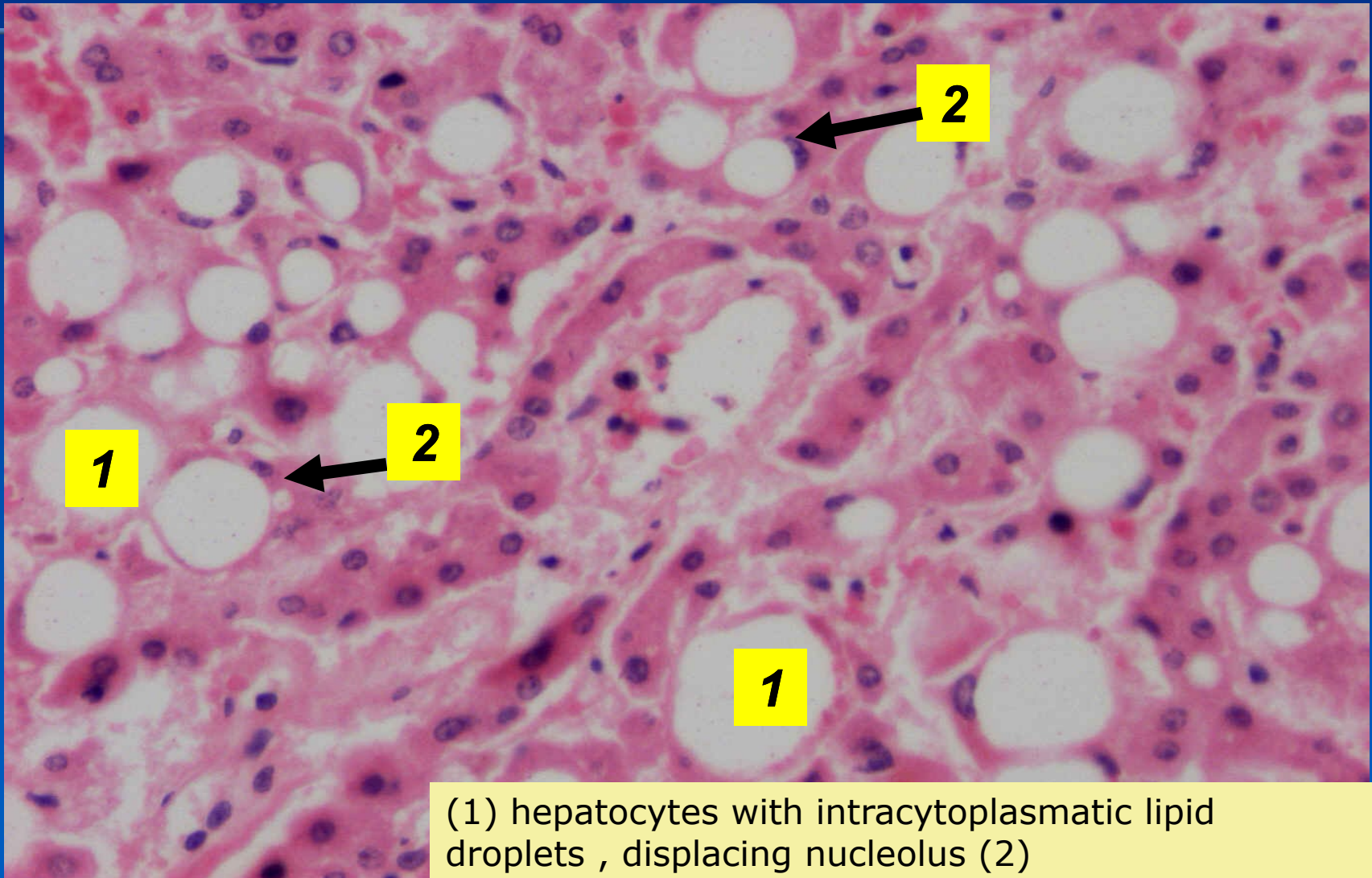
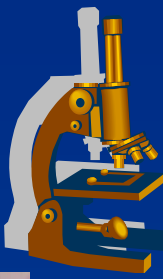


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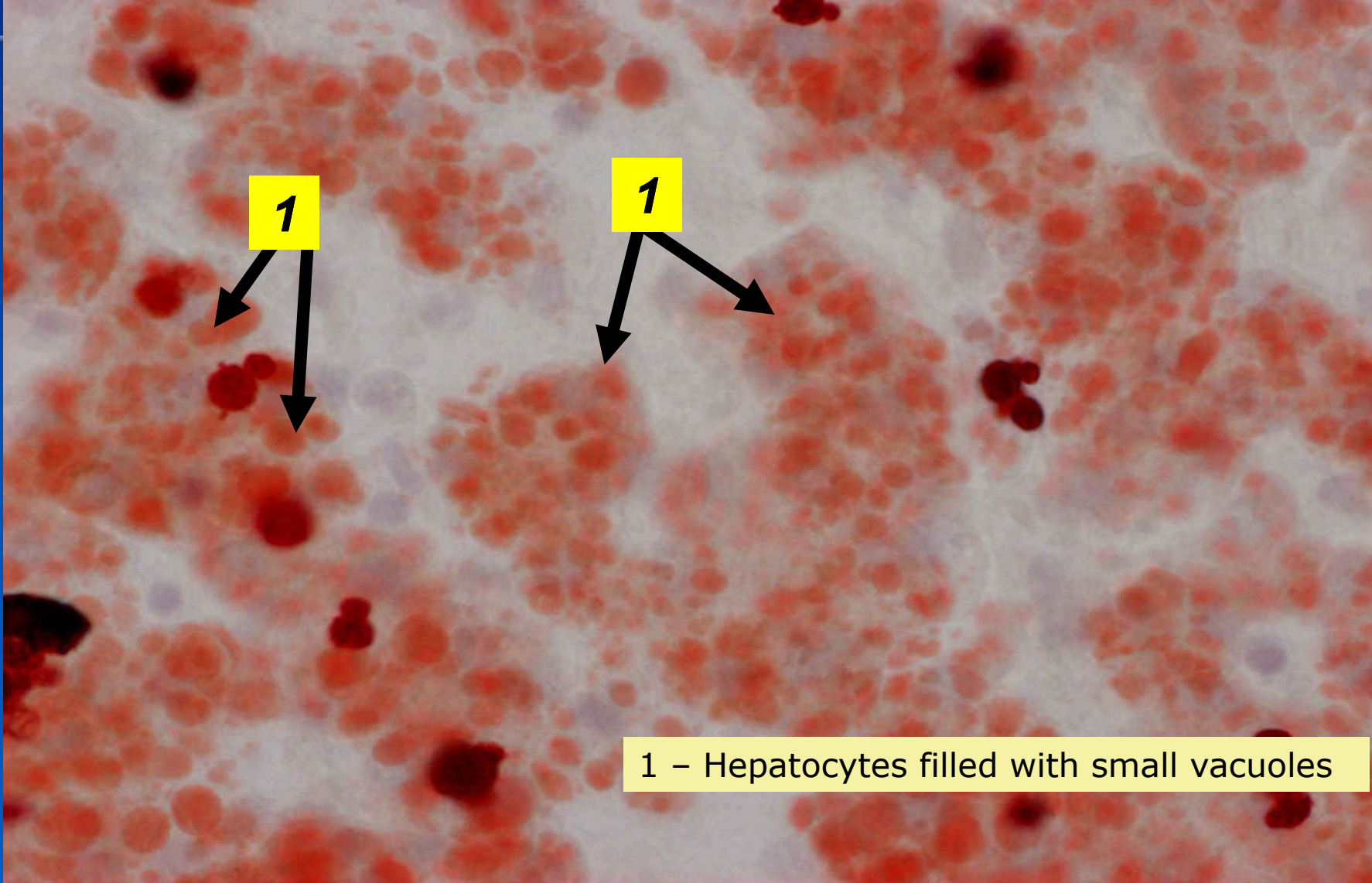
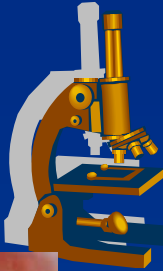
1 macrovesicular steatosis

Fatty liver disease - macrovesicular steatosis



(1) hepatocytes with intracytoplasmic lipid droplets , displacing nucleolus (2)

Fatty liver disease- microvesicular steatosis, oil red (frozen section)



1 - Hepatocytes filled with small vacuoles

Disorders of sacharid metabolism



- ✗ glycogenosis (hereditary, AR)

- ✗ intracellular glycogen deposits
 - ⇒ *in tumors (renal cell carcinoma)*

- ✗ diabetes mellitus
 - ⇒ *primary impaired glucose metabolism – glucose intolerance, secondary. lipids + proteins, water and electrolytes homeostasis*
 - ⇒ *heterogenous group of diseases, multifactorial*
 - ⇒ *relative or absolute insufficiency of insulin, causing hyperglycaemia*

Diabetes mellitus



- ✘ **insulin dependent (IDDM – type I):**
 - ⇒ *juvenile - onset diabetes (usually manifests before age of 20 years)*
 - ⇒ *insulin dependent*
 - ⇒ *insufficient insulin production*
 - ⇒ *genetic predisposition, viral and autoimmune factors*

- ✘ **non-insulin-dependent (NIDDM – type II):**
 - ⇒ *mature age*
 - ⇒ *connected with metabolic syndrom*
 - ⇒ *relative insulin insufficiency (↓ receptors)*

- ✘ **secondary diabetes mellitus**
 - ⇒ *chronic pancreatitis*
 - ⇒ *haemochromatosis*
 - ⇒ *hyperglycaemic hormones*

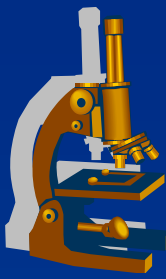
Diabetes mellitus



✘ complications:

- ⇒ *microangiopathy,*
- ⇒ *neuropathy*
- ⇒ *retinopathy*
- ⇒ *accelerated AS*
- ⇒ *hypertension*
- ⇒ *immunodeficiency (susceptibility to pyogenic bacteria, fungi)*
- ⇒ *diabetic nephropathy*

Diabetic nephropathy



× clinically:

- ⇒ *proteinuria*
- ⇒ *nephrotic syndrome*
- ⇒ *chronic renal failure*

× morphology:

- ⇒ *glomerulosclerosis*
- ⇒ *hyalinizing arteriolar sclerosis*
- ⇒ *tubulointerstitial lesions*

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)*

⇒ *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*

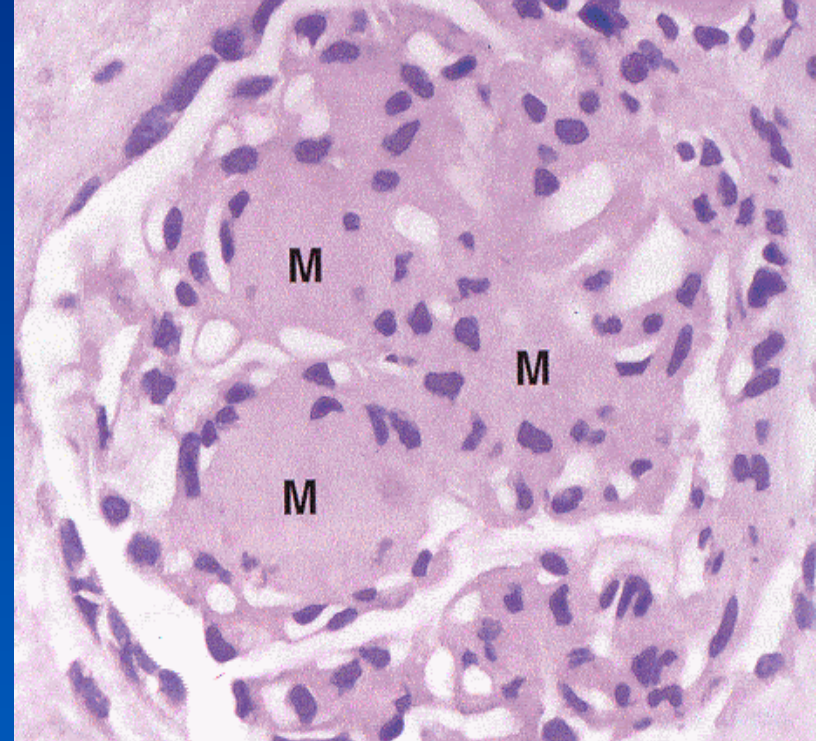
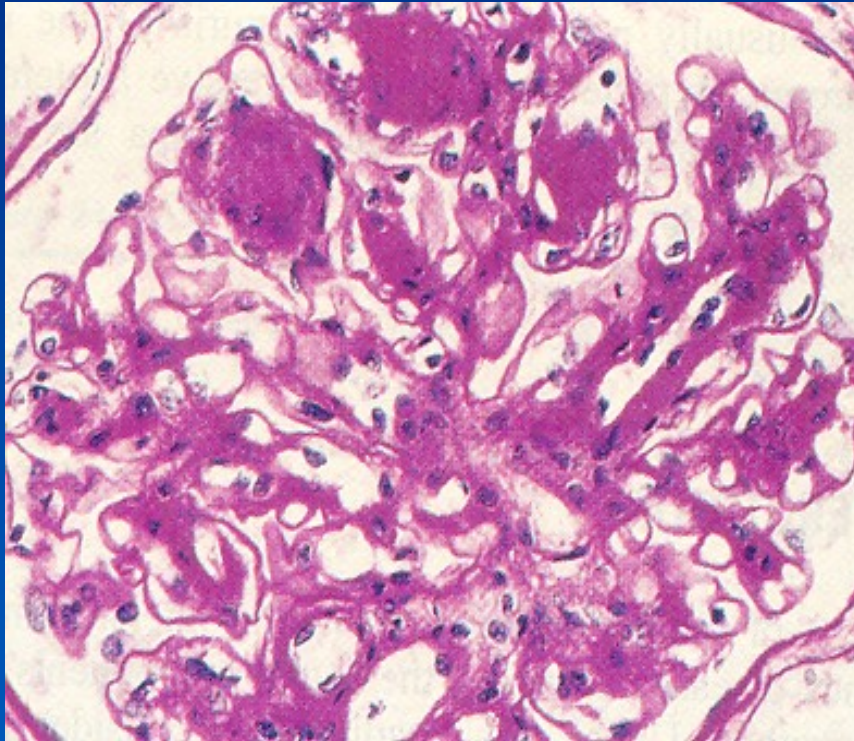
- ✗ nodular glomerulosclerosis (Kimmelstiel-Wilson)

 - ⇒ *after 10-15 yrs*

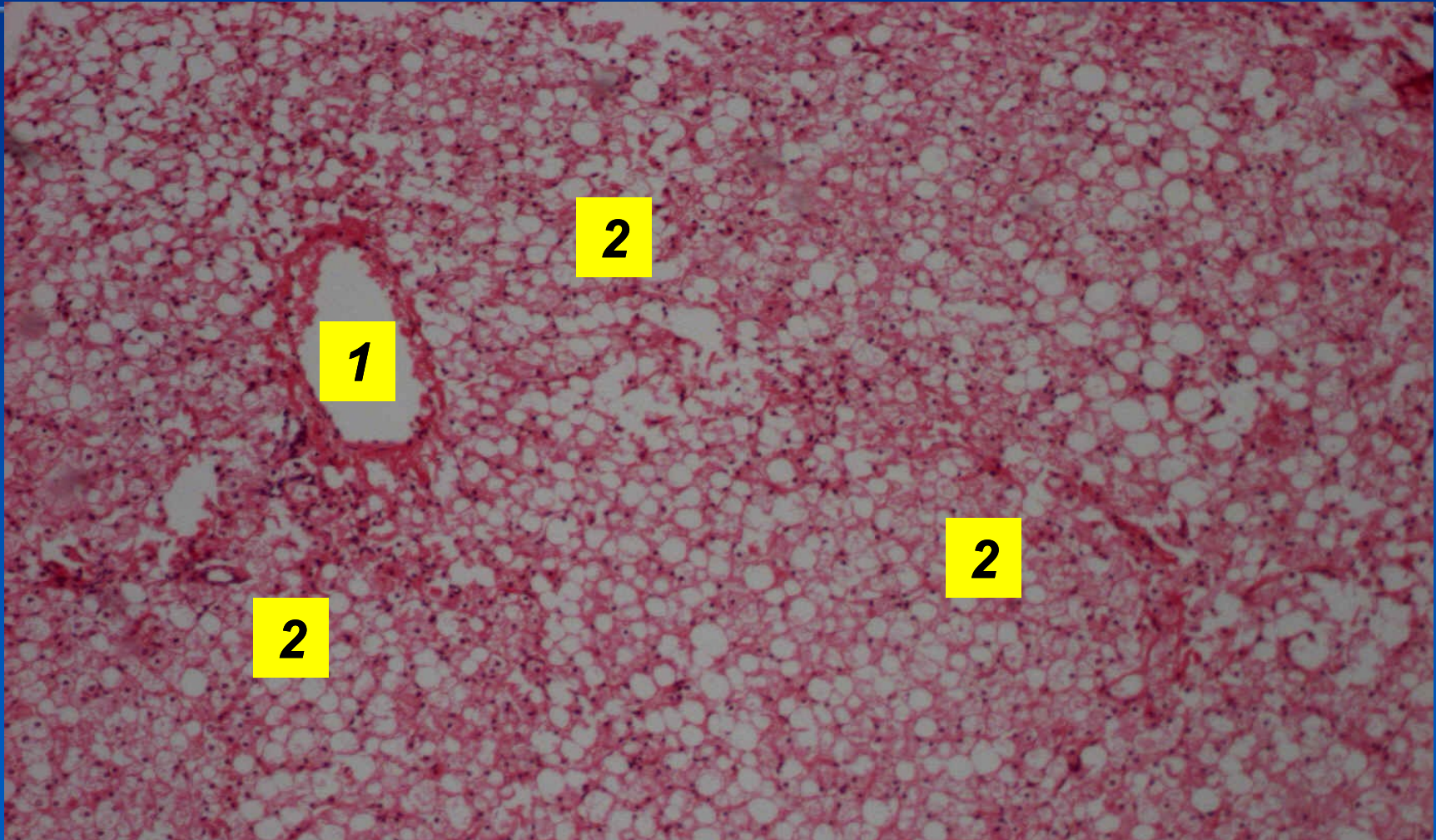
 - ⇒ *PAS+ nodular acellular material deposits at the tips of capillary loops*

 - ⇒ *leads to chronic renal insufficiency*

Diabetic glomerulosclerosis



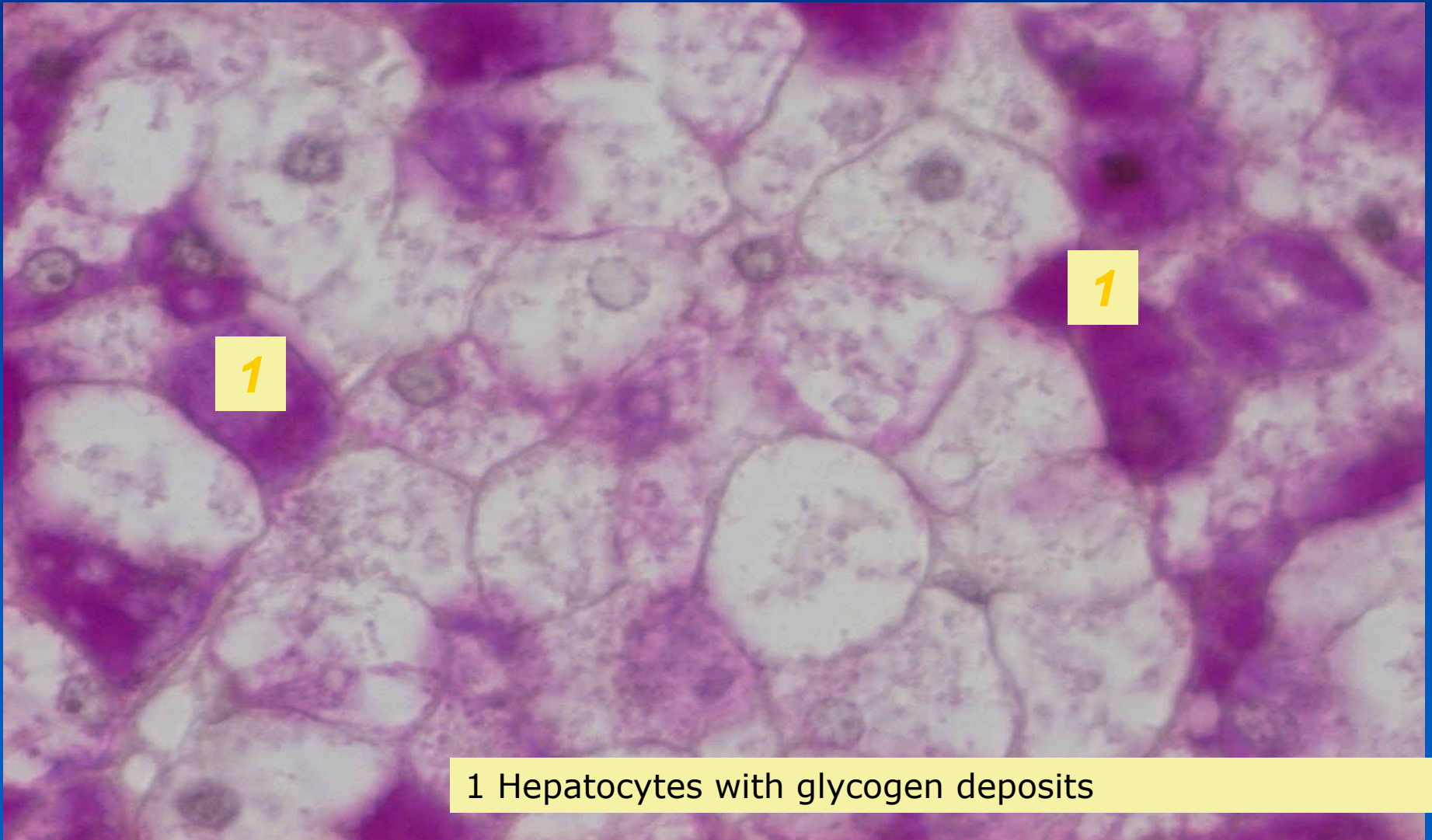
Glycogenosis – liver



- 1 Portal vein
- 2 Hepatocytes with glycogen deposits

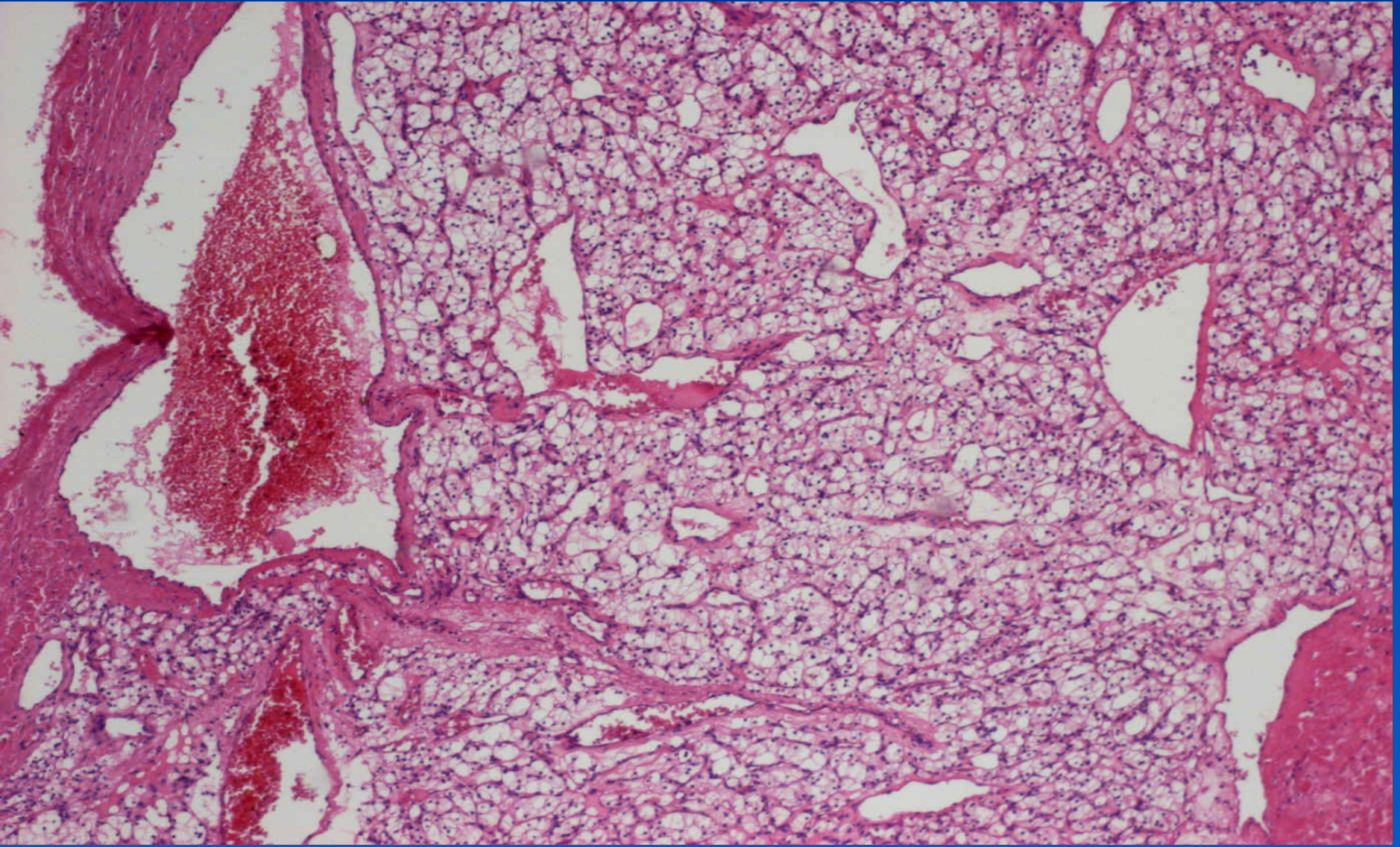
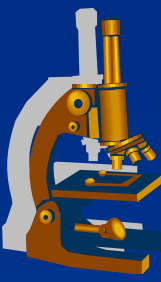
Glycogenosis - liver

PAS+ staining – hepatocytes with glycogen deposits



1 Hepatocytes with glycogen deposits

Renal cell carcinoma



Calcification



✗ dystrophic

⇒ *depositions of calcium in formerly altered tissues, in:*

- *necrosis*
- *dystrophy*
- *cell injury*

✗ metastatic

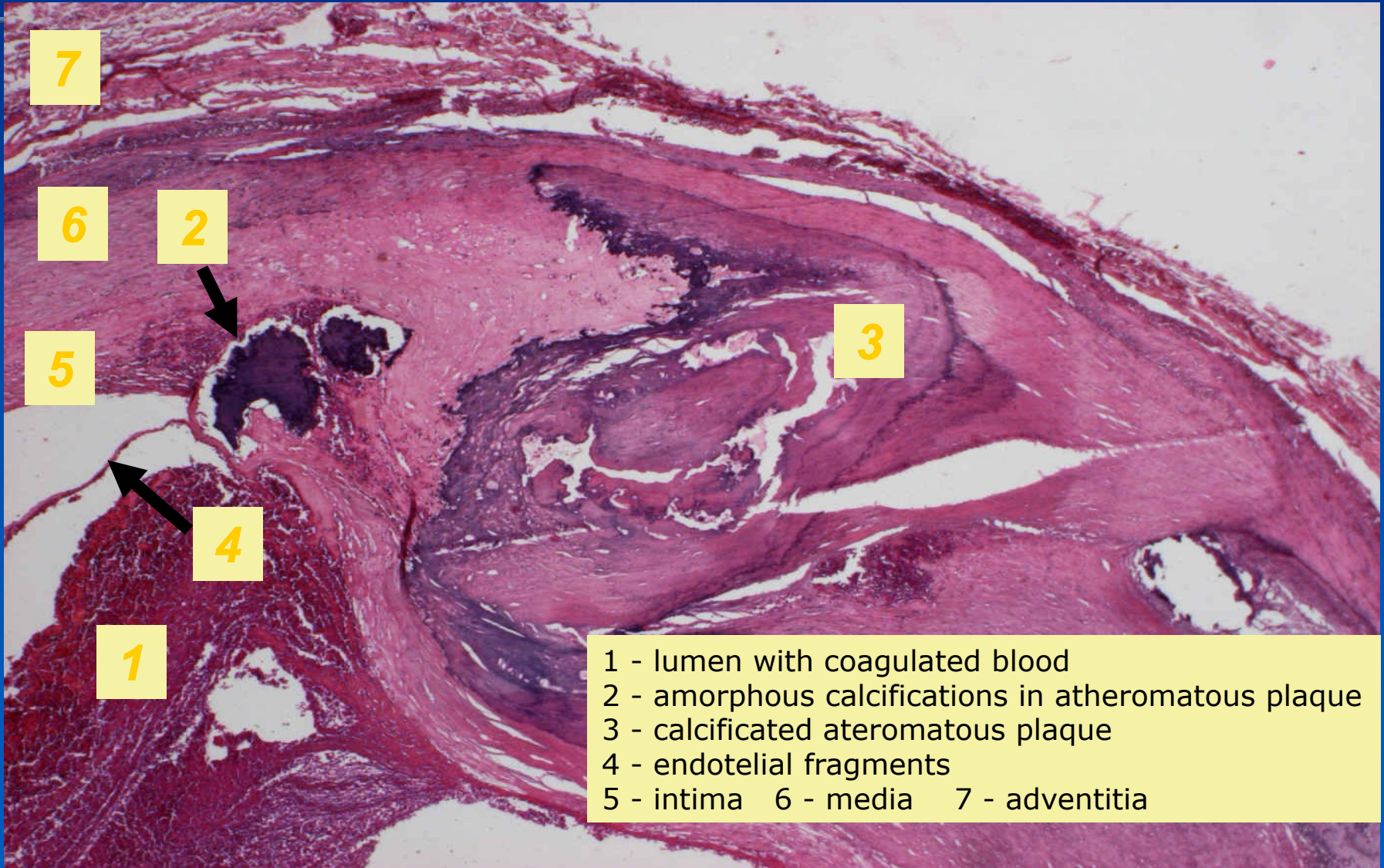
⇒ *affects lungs, gastric mucosa, kidneys, artery walls*

⇒ *caused by:*

- *hypercalcemia*
- *parathyroid hormone excess*
- *chronic renal diseases*

✗ visualization: von Kossa silver nitrate staining (black colour)

Dystrophic calcification - arterial wall with atheromatous plaque



- 1 - lumen with coagulated blood
- 2 - amorphous calcifications in atheromatous plaque
- 3 - calcificated ateromatous plaque
- 4 - endotelial fragments
- 5 - intima 6 - media 7 - adventitia

Lithiasis (stones, calculi)



- ✗ formation or presence of stony concretions, as calculi, in the body

- ✗ the most important risk factors:
 1. abnormal excess of the mineral
 2. local conditions – inflammation, slower fluid flow rate
 3. changes in pH

- ✗ **locations:** *gallbladder, renal system (kidney, ureter, urinary bladder, urethra), salivary glands/ducts, pancreas*

- ✗ **etiology:**
 - ⇒ *calcium oxalate*
 - ⇒ *uric acid*
 - ⇒ *bile*
 - ⇒ *pigments*

Lithiasis (stones, calculi)



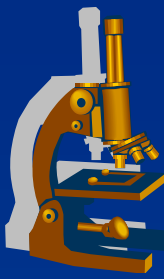
✘ complications:

- ⇒ irritation of nearby tissues, causing pain, swelling, and inflammation.
- ⇒ obstruction of an opening or duct, interfering with normal flow -> >
- ⇒ predisposition to infection !

✘ medical conditions caused by stones:

- gallstones (cholelithiasis)
 - ⇒ acute cholecystitis -> ascending cholangitis
 - ⇒ pancreatitis
- kidney stones (nephrolithiasis)
 - ⇒ hydronephrosis
 - ⇒ pyelonephrosis
- urinary bladder stones (urolithiasis)

PIGMENTATION



× **pigments** - naturally colored substances

⇒ *endogenous:*

autogenous

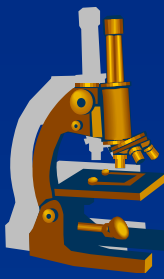
haematogenous

- **autogenous:** melanin, lipofuscin
- **haematogenous:** haematoidin, haemosiderin, haematin

⇒ *exogenous*

- carbon based – dust
- ink
- metal

autogenous pigments



× MELANIN

- ⇒ *brown / black pigment*
- ⇒ *melanin is the primary determinant of skin color*
- ⇒ *IHC: S-100, HMB-45, Melan A*

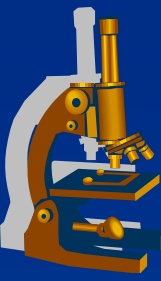
- + : - lentigo and naevi
- malignant melanoma
- Addison's disease
- neurofibromatosis

- : - albinism
- vitiligo

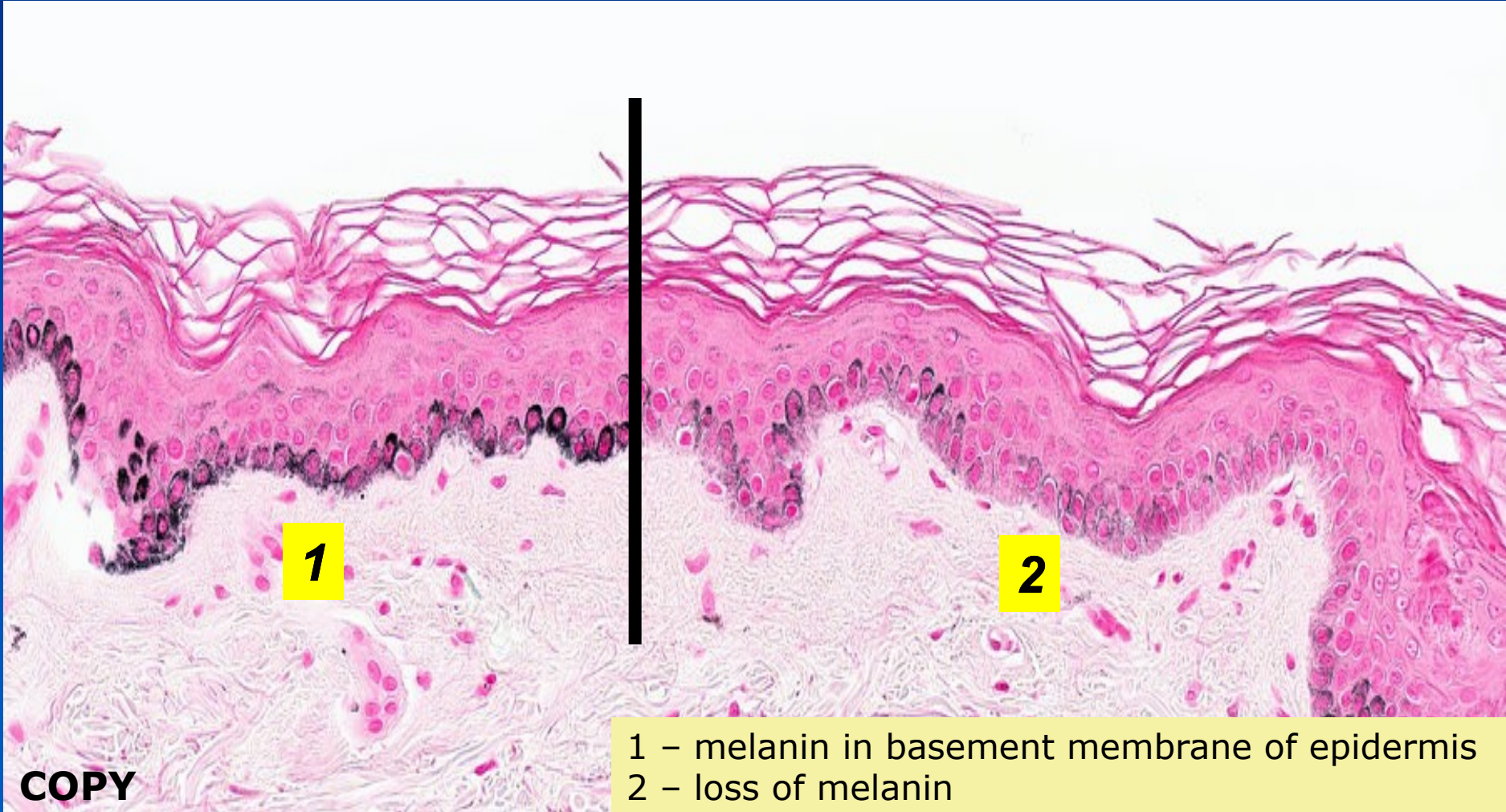
× LIPOFUSCIN

- ⇒ *one of the aging or "wear-and-tear" pigments*
- ⇒ *finely granular yellow-brown pigment granules (liver, myocardium)*

vitiligo



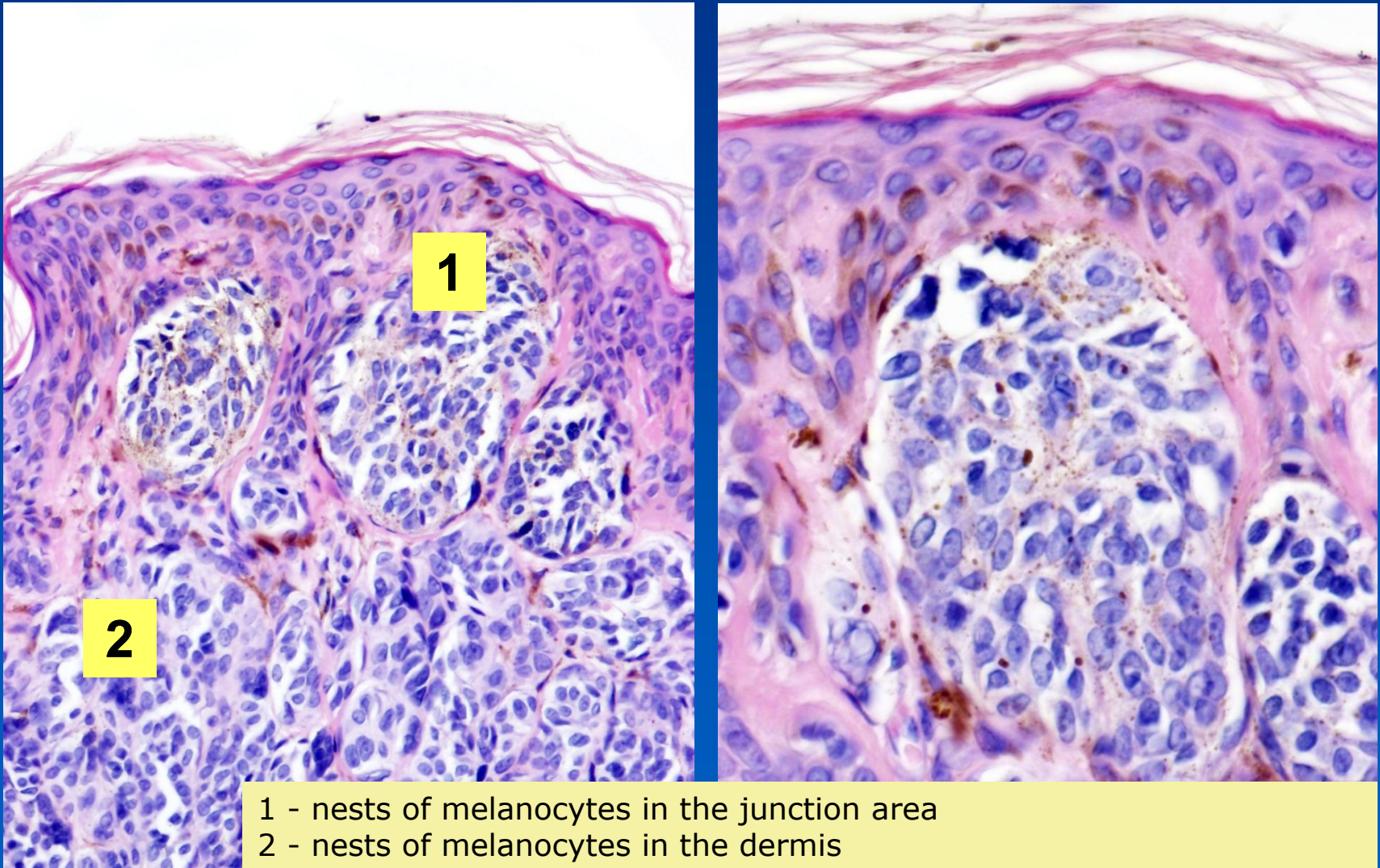
vitiligo



COPY

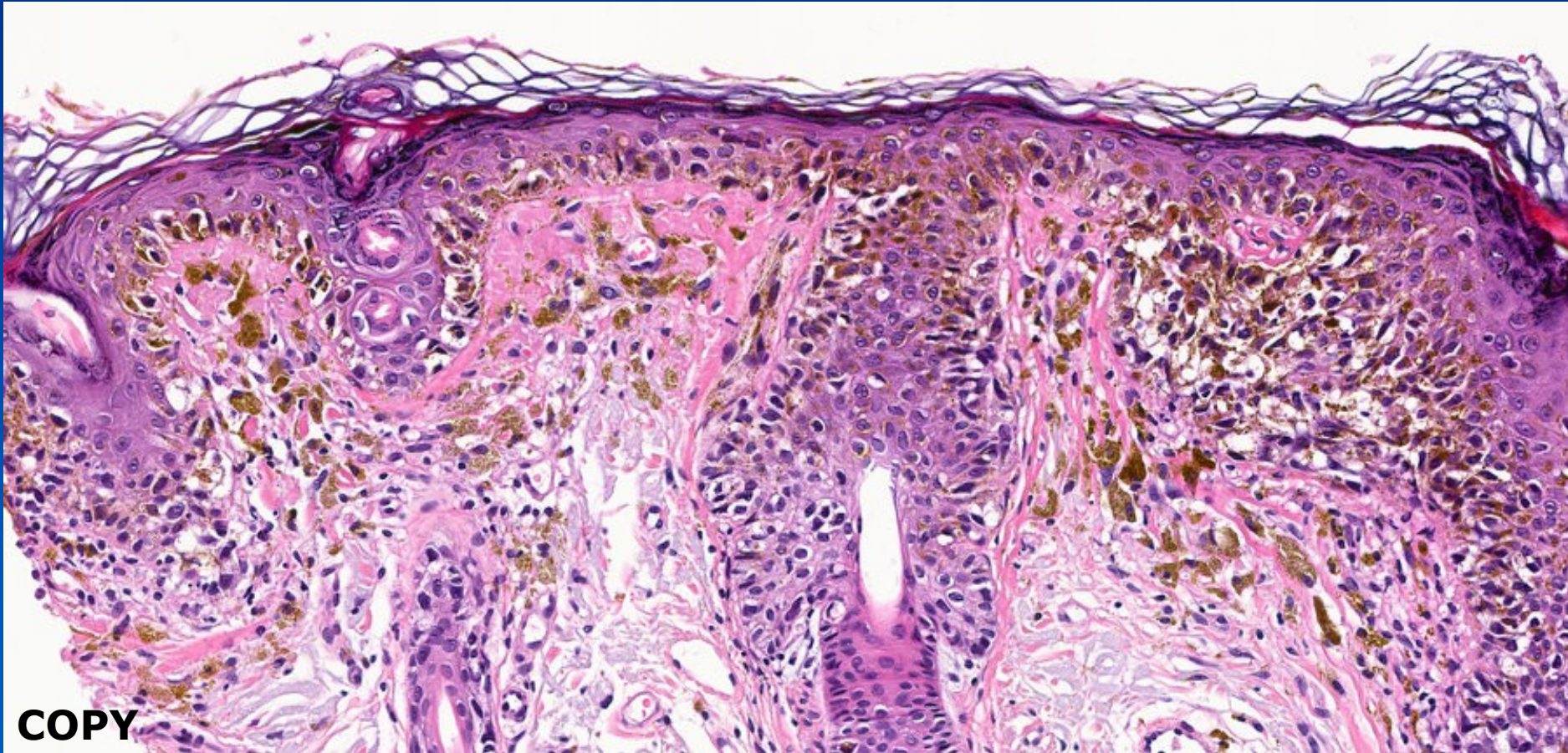
1 - melanin in basement membrane of epidermis
2 - loss of melanin

Compound pigmented (melanocytic) nevus



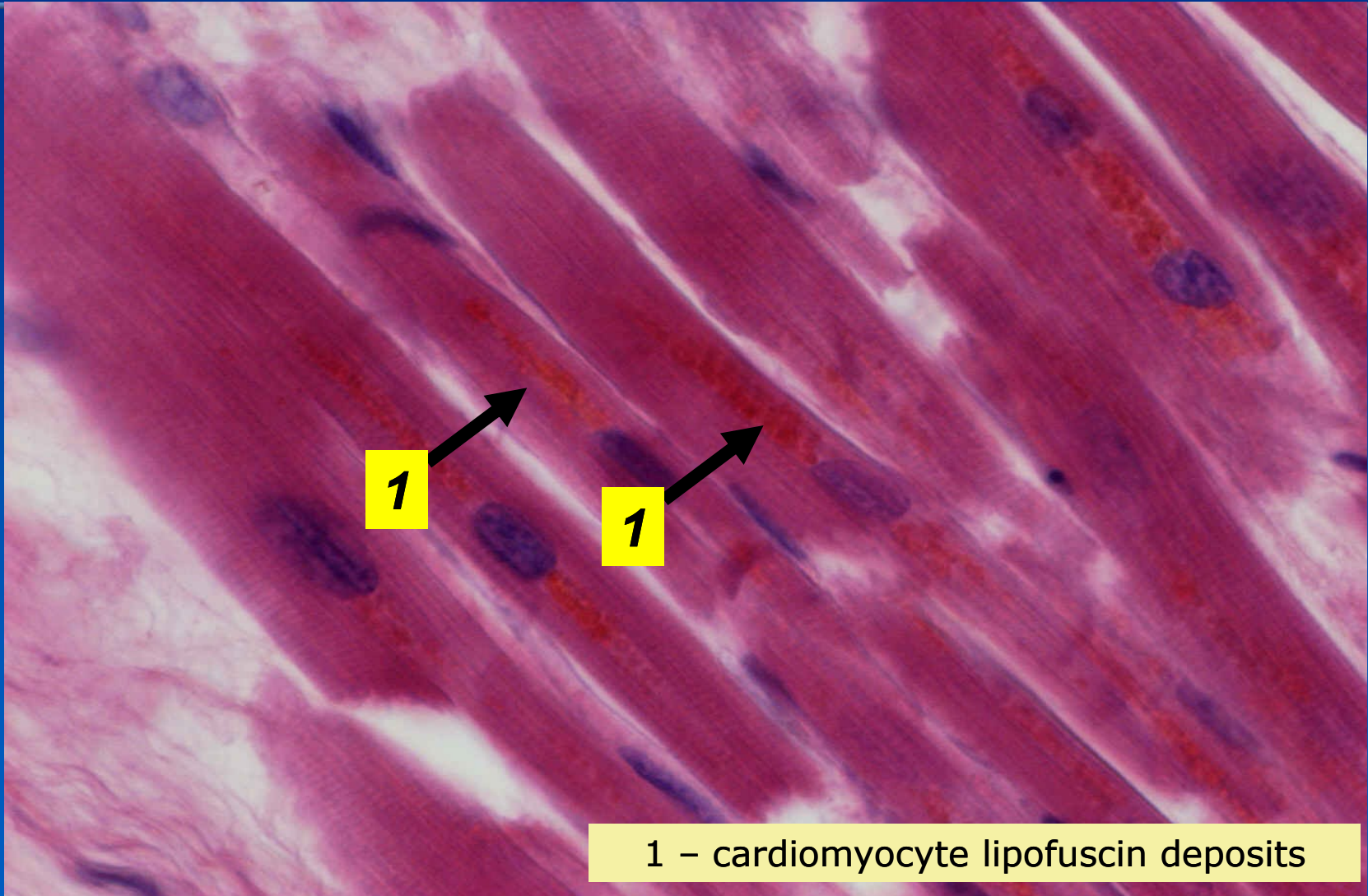
1 - nests of melanocytes in the junction area
2 - nests of melanocytes in the dermis

Melanin (malignant melanoma)



COPY

Lipofuscin - cardiomyocytes



1 - cardiomyocyte lipofuscin deposits

Hematogenous pigments



× Hemosiderin

⇒ granular brown pigment

⇒ IC i EC

⇒ **local hemosiderosis** ← most often result from hemorrhage into tissue

⇒ **systemic hemosiderosis** ← may result from hemorrhage, ...

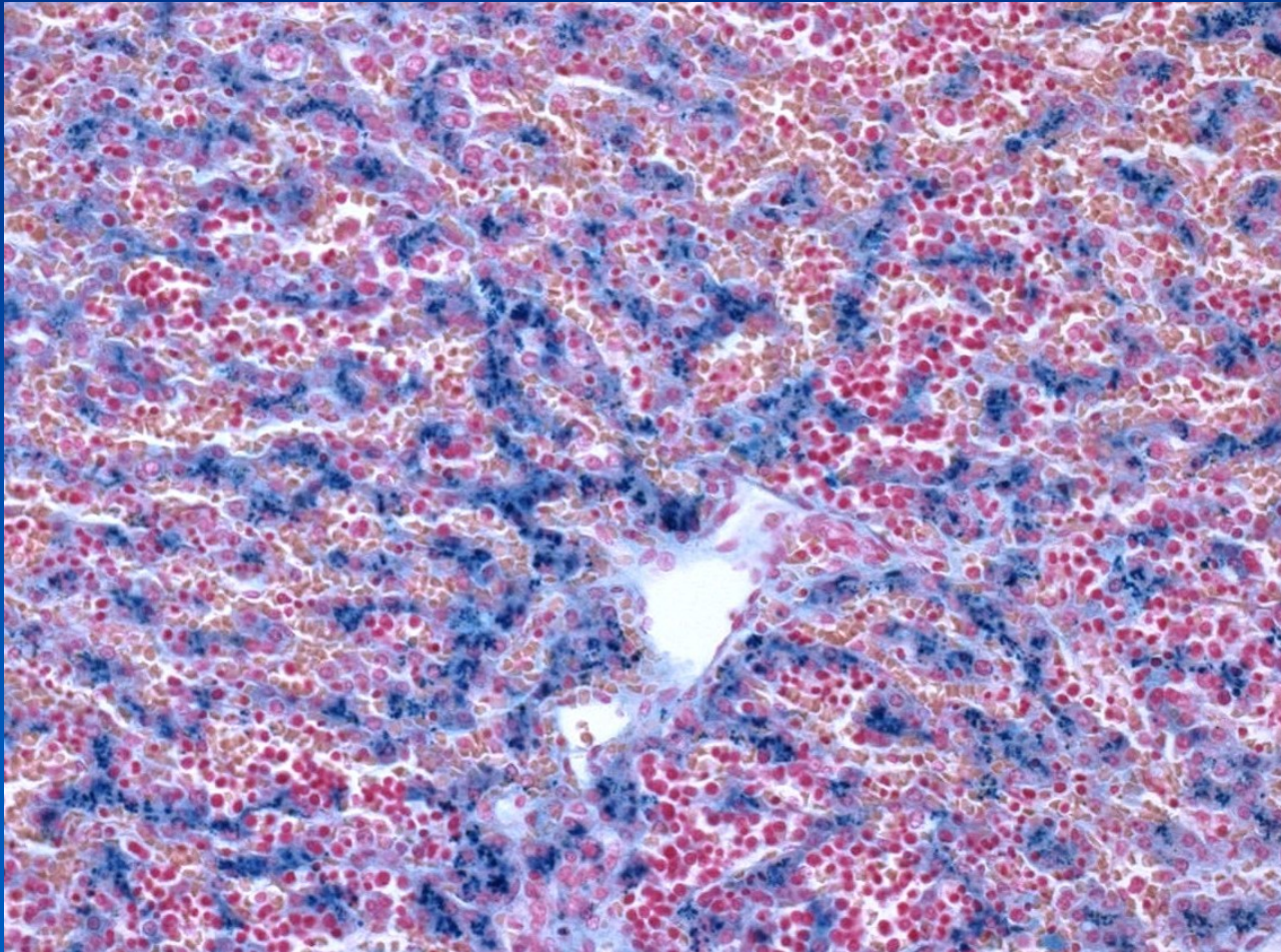
hemosiderosis (without organ or tissue damage !!!) X haemochromatosis

HAEMOCHROMATOSIS

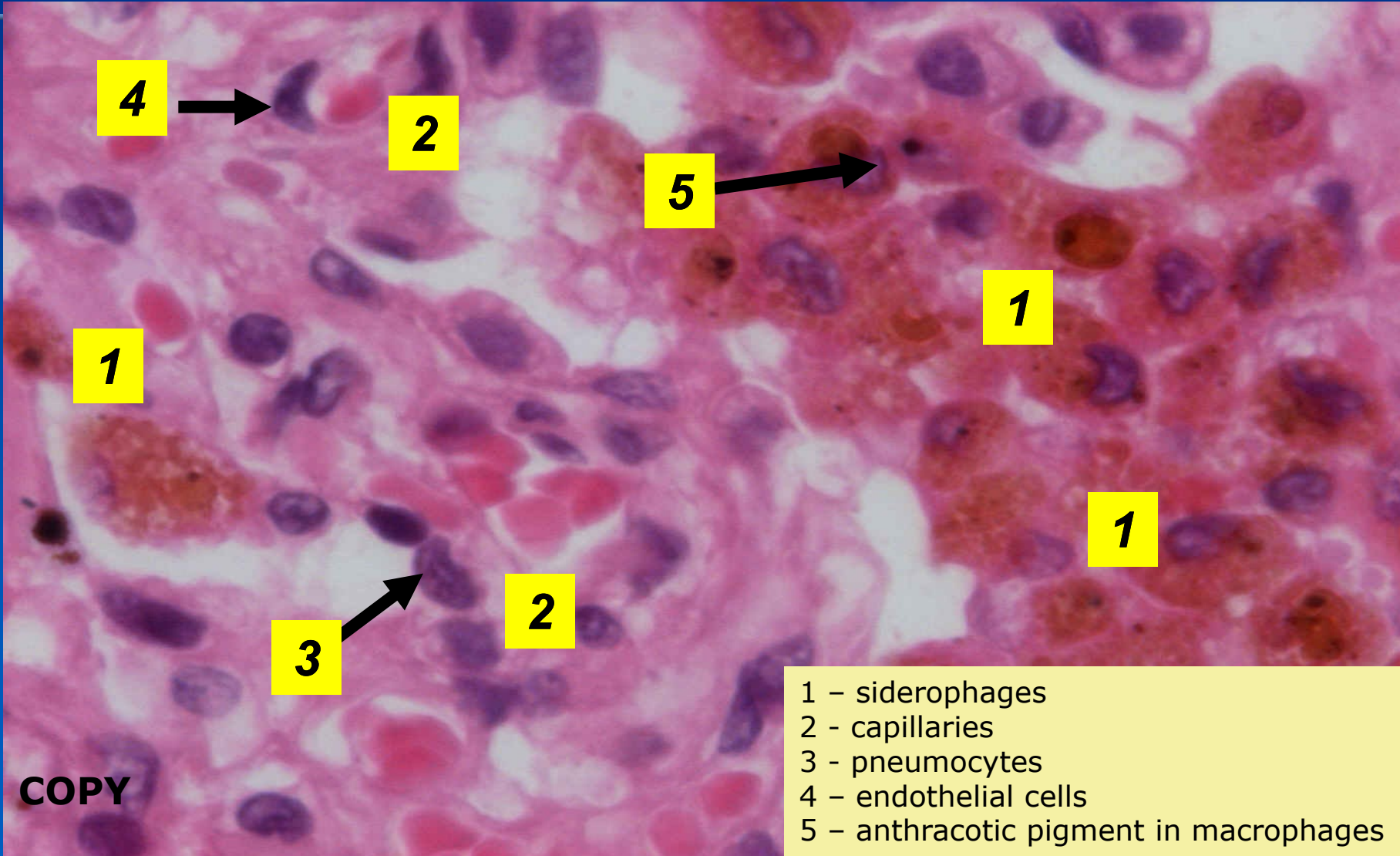
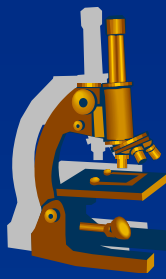


- ✗ serious disorder in which the presence of excess iron (as hemosiderin), is associated with a risk of progression to cirrhosis
- ✗ primary (genetic) haemochromatosis
 - ⇒ *excessive intestinal absorption of iron -> Fe (iron) overload -> hemosiderin accumulation in liver, spleen, pancreas, skin (bronze diabetes) → liver cirrhosis*
- ✗ secondary haemochromatosis
 - ⇒ *repeated transfusions, alcohol + iron pots*

HAEMOSIDEROSIS - Perls



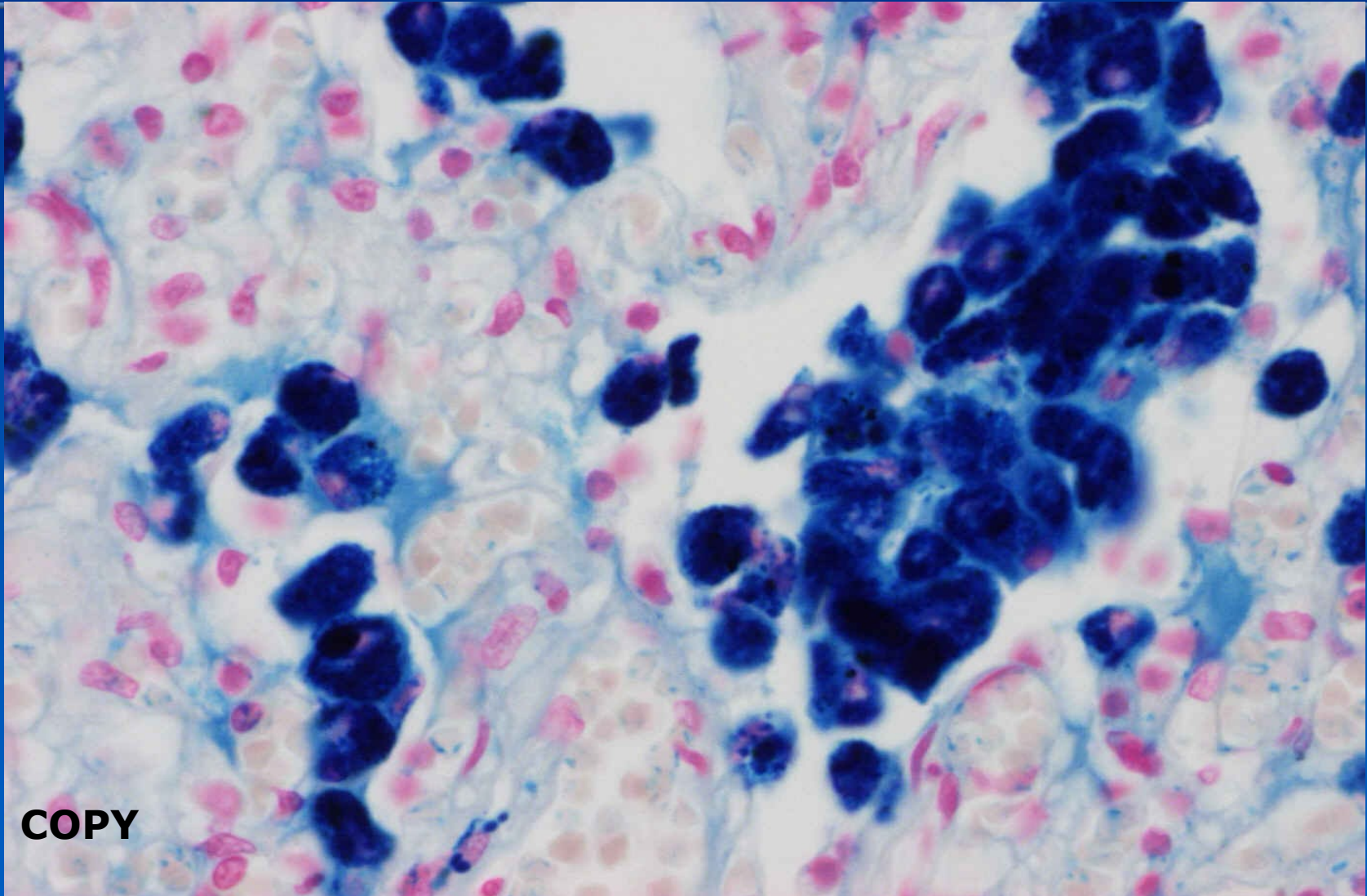
Hematogenous pigments – pulmonary siderophages



COPY

- 1 – siderophages
- 2 - capillaries
- 3 - pneumocytes
- 4 - endothelial cells
- 5 - anthracotic pigment in macrophages

**Hematogenous pigments – pulmonary siderophages
(Perls reaction) – granules of hemosiderin stains blue**



COPY

Hematogenous pigments – bilirubin, cholestasis



✗ BILIRUBIN

⇒ *breakdown product of haem moiety of haemoglobin*

CHOLESTASIS :

- *disturbance/stop of normal bile flow from the liver to the duodenum*

- *conjugated icterus*

⇒ *biliary obstruction*

- *lithiasis, tumors incl. pancreatic, inflammation, congenital disorders – atresia*

⇒ *hepatocyte excretory dysfunction*

- *viral hepatitis, toxins, drugs, etc.*

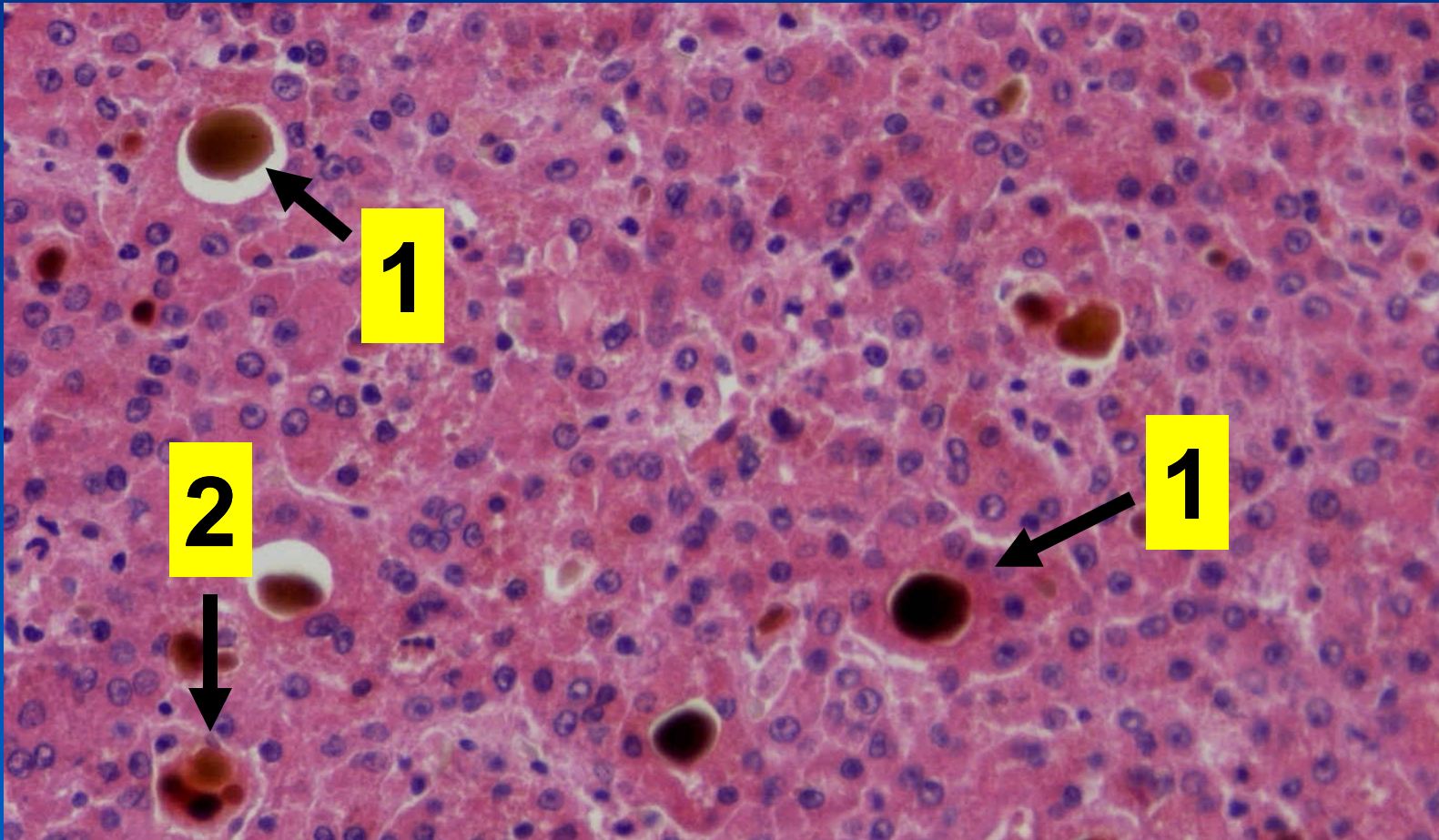
⇒ *inborn excretory defect*

- *Dubin- Johnson syndrome*

❖ **GROSS** : *brownish green color of liver*

❖ **MICRO**: *hepatocanalicular cholestasis, perivenous localisation, reactive canalicular hyperplasia*

Hepatocellular carcinoma - cholestasis



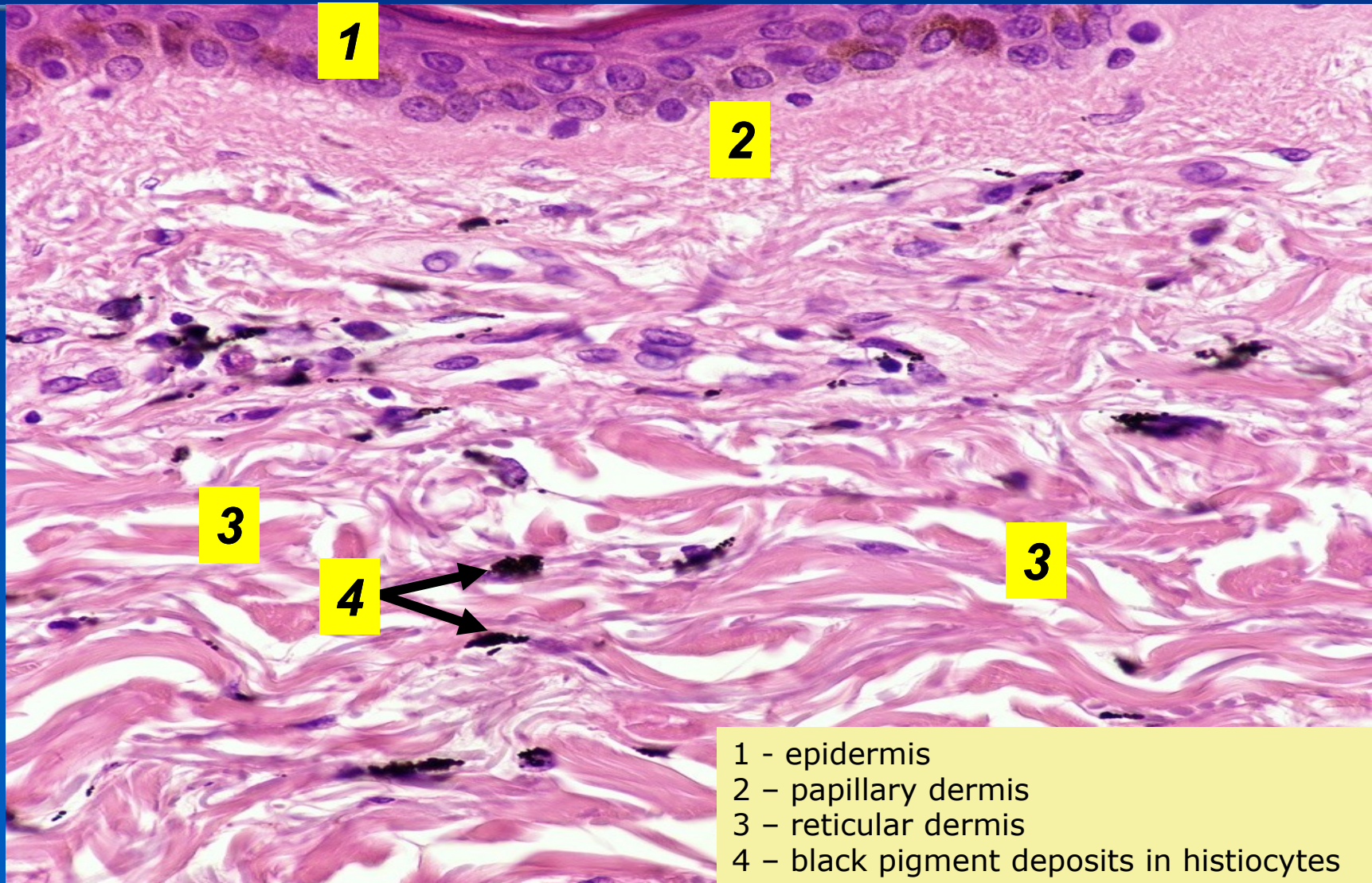
- 1 - Bile retention in pseudoglandular formations
- 2 - Bile pigment in the cytoplasm of the hepatocyte

Exogenous pigments



- **anthracosis simplex**
 - black pigmentation in the respiratory tract, without peripheral fibrous reaction
- **amalgam pigmentation**
 - gingiva, mucous membranes, tongue; **no inflammation!**
- **tattoo**

Exogenous pigments - tattoos (stable, inert pigment in dermis)



- 1 - epidermis
- 2 - papillary dermis
- 3 - reticular dermis
- 4 - black pigment deposits in histiocytes

Pneumoconioses



- ✘ lung disease caused by inhaled dusts

- ✘ dusts:
 - ⇒ *inorganic (mineral)*
 - ⇒ *organic*

- ✘ variable reaction changes:
 - ⇒ *inert*
 - ⇒ *fibrous*
 - ⇒ *allergic*
 - ⇒ *neoplastic*

Coal-workers pneumoconiosis (CWP)



1) Anthracosis

- ⇒ *only presence of coal dust in the lung*
- ⇒ *not associated with disability*

2) Anthracosilicosis (stages depends on amount of inhaled silica)

- ⇒ macular CWP
 - *focal aggregates of dust laden macrophages in and around respiratory bronchioles, arterioles*
- ⇒ nodular CWP
 - *small nodules < 10mm in diameter, no significant scarring*
- ⇒ progressive massive fibrosis
 - *large, irregular nodules with scarring, greater than 10mm,*

Silicosis



- ✗ chronic **progressive** pneumoconiosis

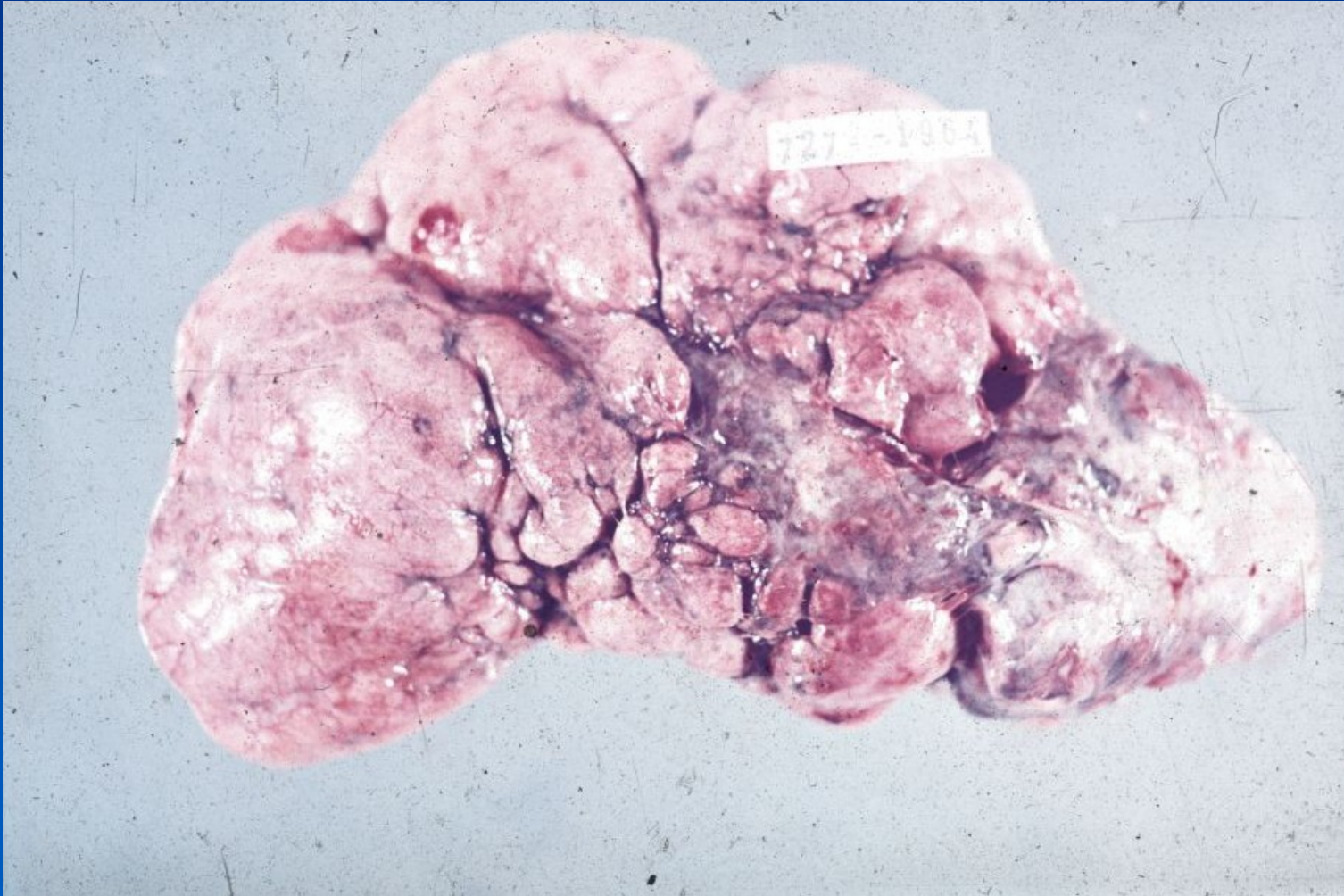
- ✗ parts of silica -> terminal respiratory units -> ingestion by alveolar macrophages -> toxic to macrophages -> focal necrosis -> fibrosis -> pulmonary hypertension -> cor pulmonale

- ✗ gross:
 - ⇒ *small nodules in upper lobes, later confluent nodes and scars, reactive emphysema*

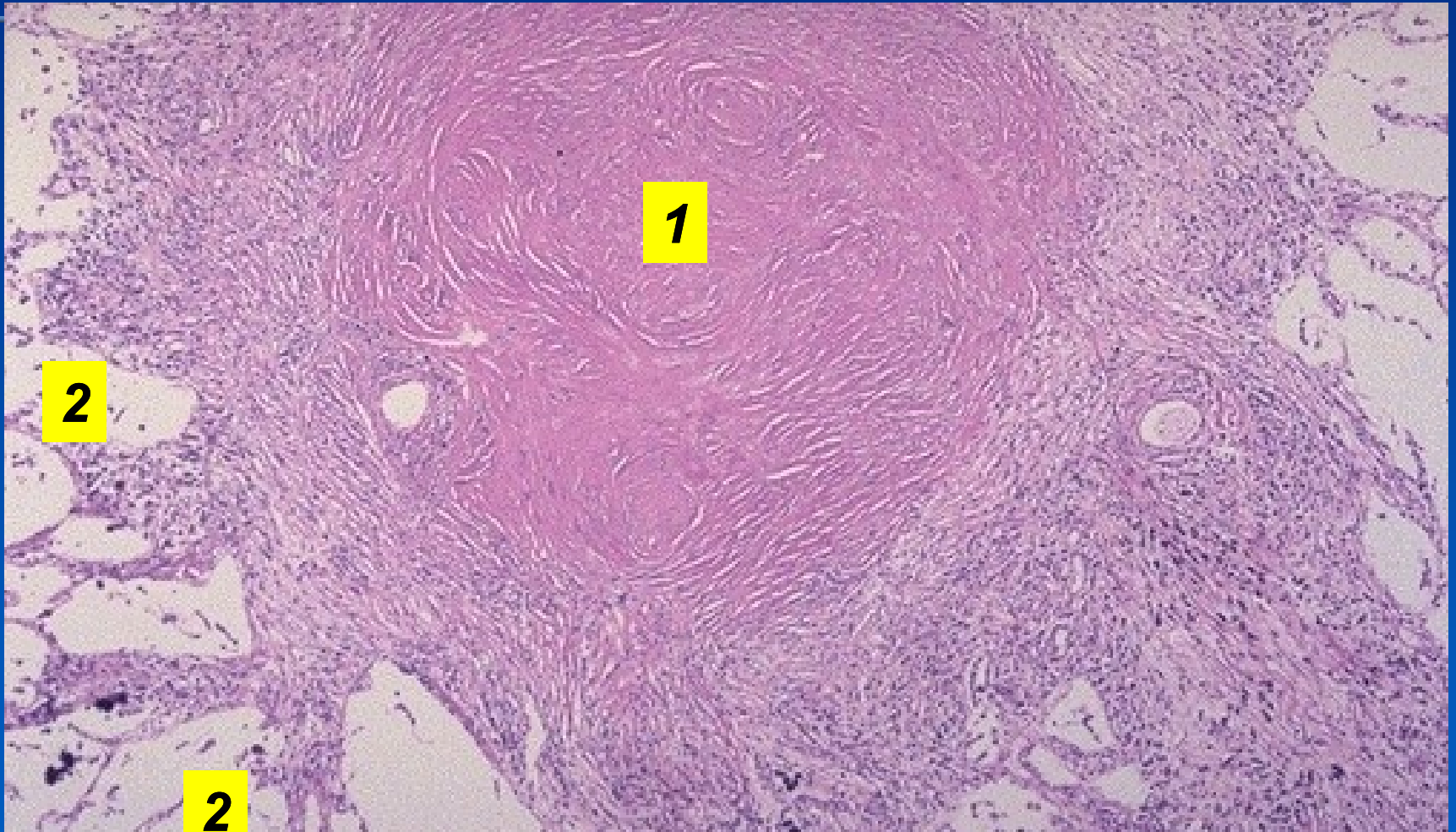
- ✗ micro:
 - ⇒ *silikotic nodule - concentric layers of hyalinised fibrotic tissue, commonly with anthracosis*

- ✗ RTG – 3 stages:
 - ⇒ *reticular fibrosis*
 - ⇒ *nodules*
 - ⇒ *diffuse fibrosis*

Silicotic nodule - lung



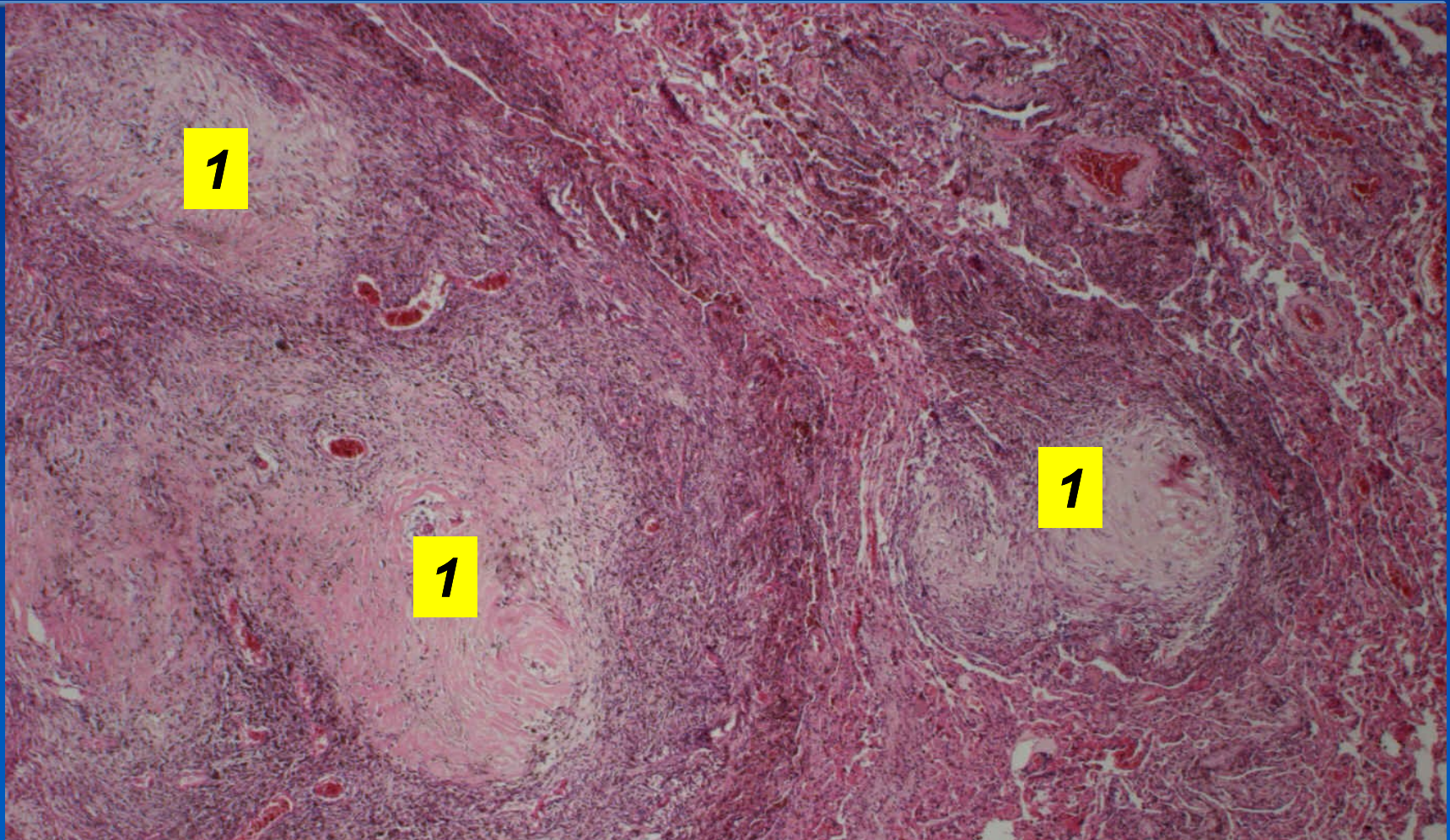
Silicotic nodule- lung



COPY

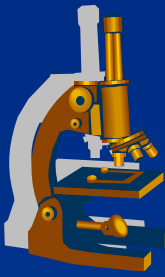
- 1 - concentric layers of hyalinised fibrotic tissue
- 2 - surrounding reactive emphysema

Silicosis - confluent nodes, scarring of lung tissue



1 - concentric layers of hyalinized fibrotic tissue

Asbestosis



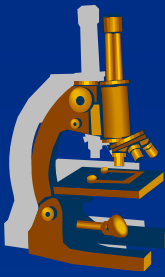
- ✗ asbestos fibres (**carcinogenic !!!**)
- ✗ later encrusted with hemosiderin to form **asbestos bodies**
- ✗ symptoms:
 - ⇒ cough
 - ⇒ dyspnoe
- ✗ progression to:
 - ⇒ progressive massive fibrosis
 - ⇒ mesothelioma
 - ⇒ lung carcinoma

asbestosis – asbestos fibres (bodies) in lung tissue



COPY

extrinsic allergic alveolitis (hypersensitivity pneumonitis)



- ✗ farmer's lung = most typical example
- ✗ inhalation of fungus present in poorly stored, mouldy hay
-> hypersensitivity reaction -> pneumonitis -> can lead to pulmonary fibrosis
- ✗ other types: cotton fibres, bird faeces, ...