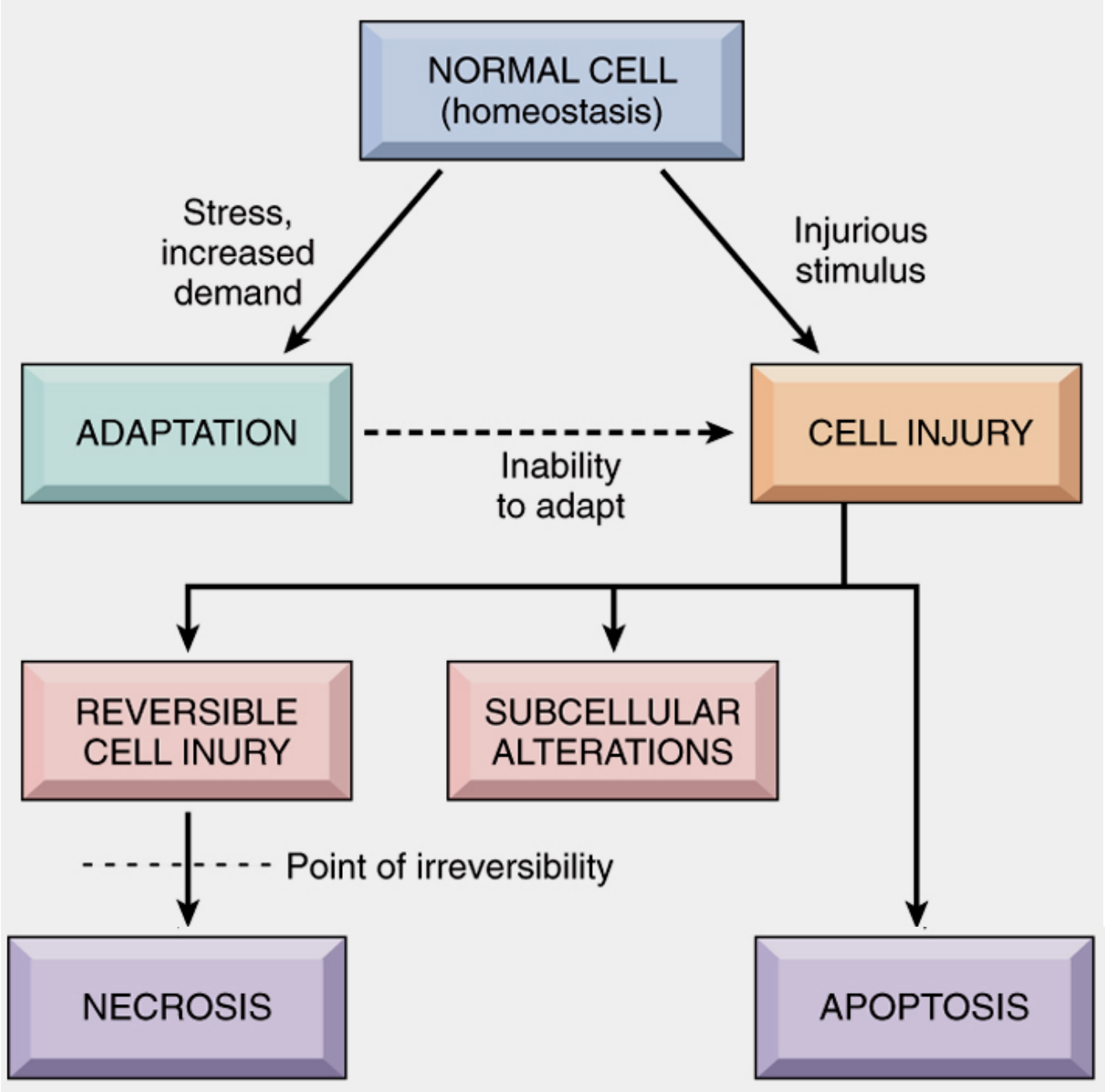
Cellular injury and adaptation

DR. AYSER HAMEED

Stages in the cellular response to stress and injurious stimuli



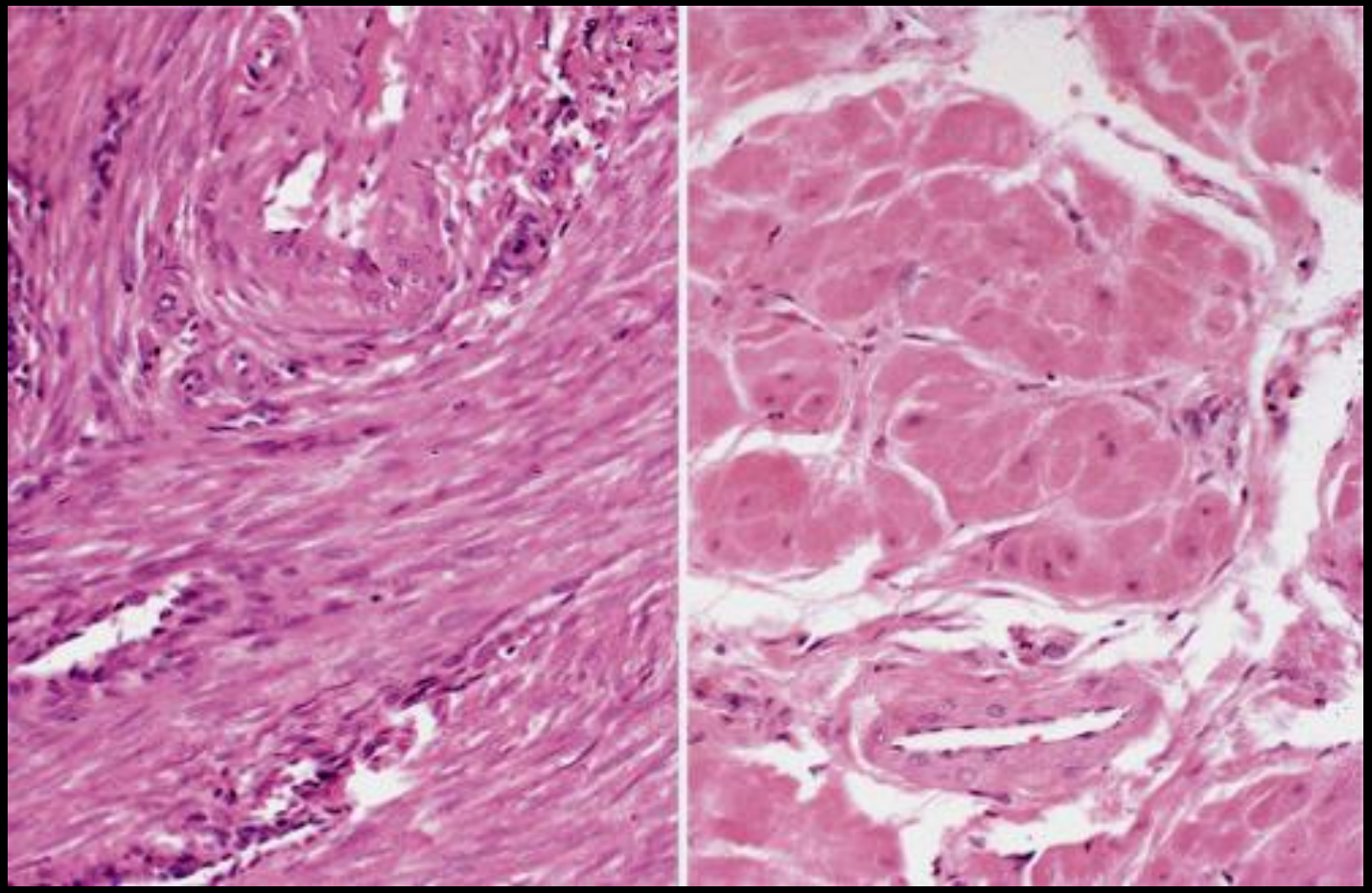
Lt. ventricular hypertrophy

This is cardiac hypertrophy. The number of myocardial fibers never increases, but their size can increase in response to an increased workload, leading to the marked thickening of the left ventricle in this patient with hypertension. Note: normal Lt. ventricular wall thickness is 1.2 cm. to 1.5 cm

Uterine hypertrophy in pregnancy

On the left is a normal uterus showing the normal mass of smooth muscle in its wall. On the right is a uterus from a pregnant women, in which the striking increase in mass of smooth muscle is evident. At cellular level this is due to both hyperplasia and hypertrophy of uterine smooth muscle.

Normal Vs hypertrophied uterine smooth muscle cells



Lt. small spindle-shaped uterine smooth muscle cells from a normal uterus. Compare this with (Rt) large, plump hypertrophied smooth muscle cells from a gravid uterus (same magnification).

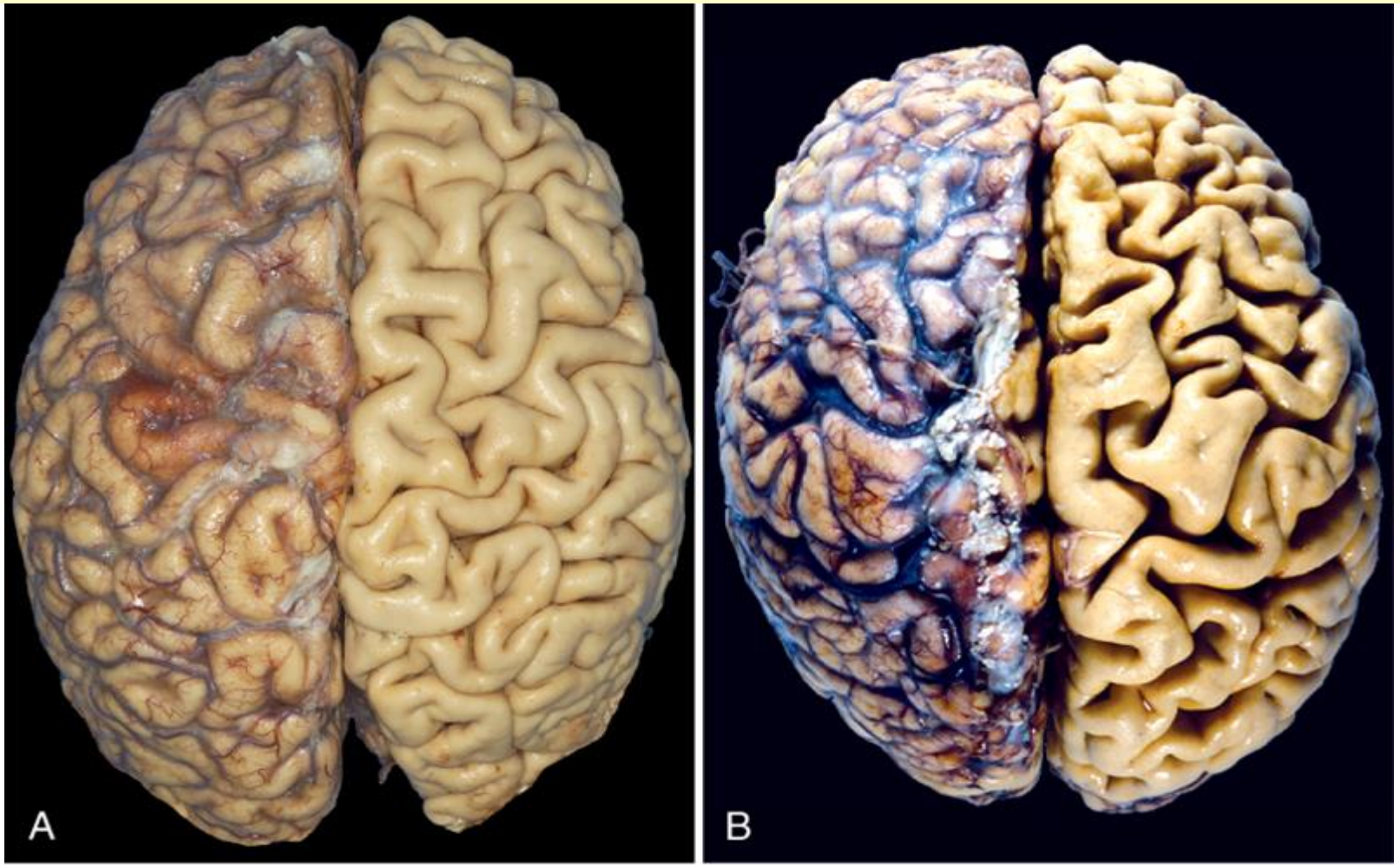
Endometrial hyperplasia

The prominent folds of endometrium in this uterus (opened to reveal the endometrial cavity) are an example of hyperplasia. The hyperplasia involves both endometrial glands and stroma.

Verruca vulgaris

Multiple papules with rough, pebble-like surfaces at infection sites

Brain atrophy

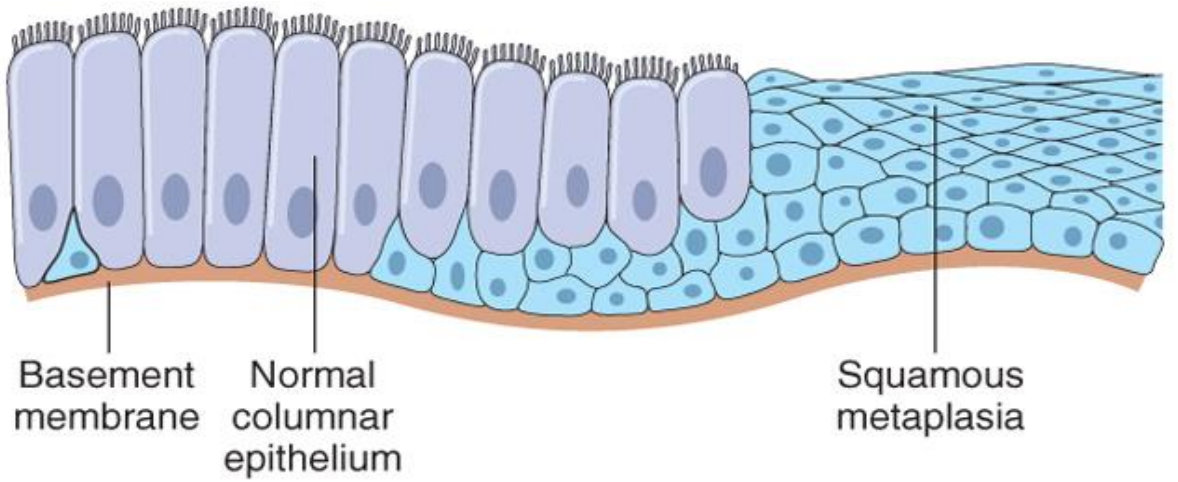


A, Normal brain of a young adult. B, Atrophy of the brain in an 82-year-old male with atherosclerotic disease. Atrophy of the brain is due to aging and reduced blood supply. Note that loss of brain substance narrows the gyri and widens the sulci. The meninges have been stripped from the right half of each specimen to reveal the surface of the brain.

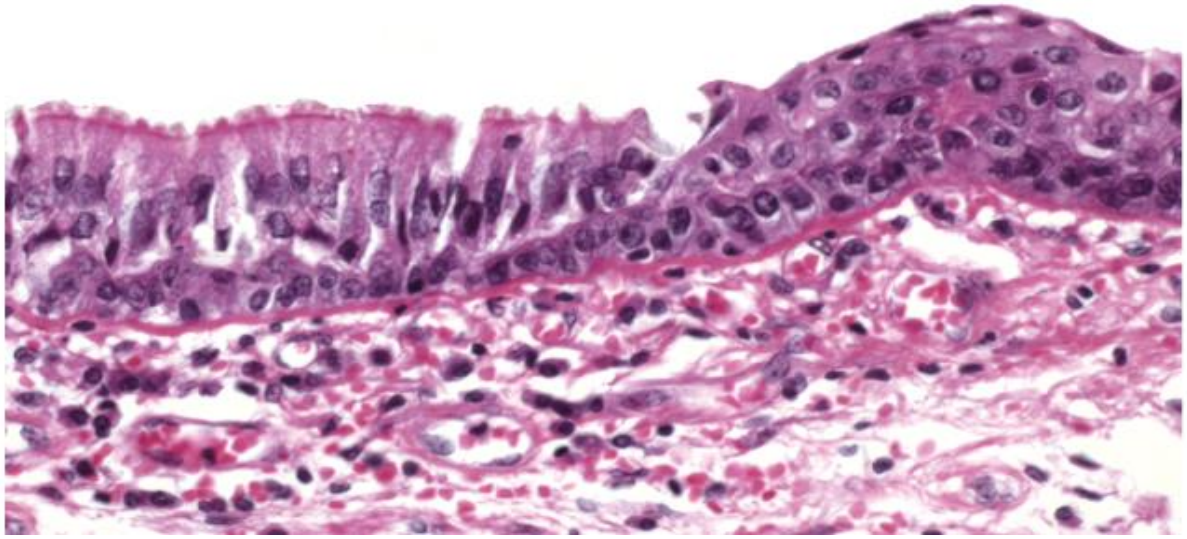
Testicular atrophy

On the left is a normal testis. On the right is a testis that has undergone atrophy. Bilateral atrophy may occur with a variety of conditions including chronic alcoholism, hypopituitarism, atherosclerosis, chemotherapy or radiation, and severe prolonged illness. A cryptorchid testis will also be atrophic.

Epithelial Metaplasia



A

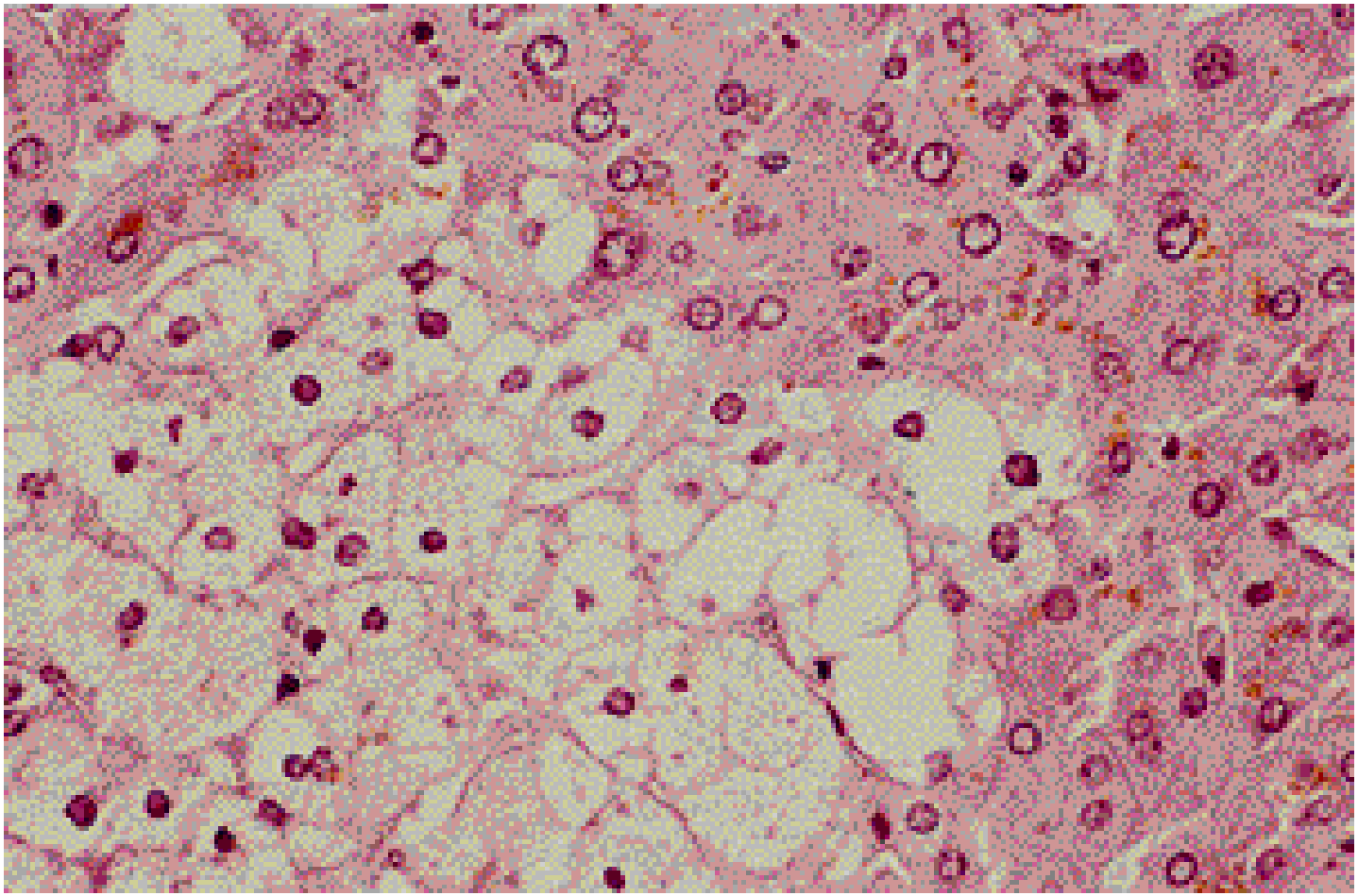


Metaplasia of normal columnar (left) to squamous epithelium (right) in a bronchus, shown (above) schematically and (down) histologically.

Columnar (intestinal) metaplasia esophagus

Metaplastic transformation (arrow) of the normal esophageal stratified squamous epithelium (Lt) to mature columnar epithelium (Barrett esophagus)

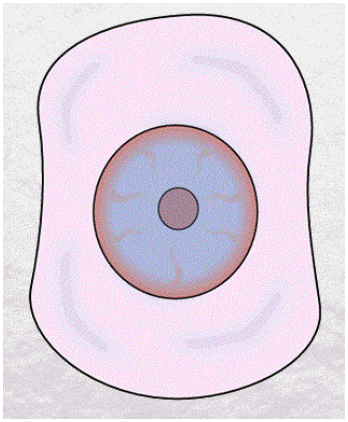
Cellular swelling (hydropic change)



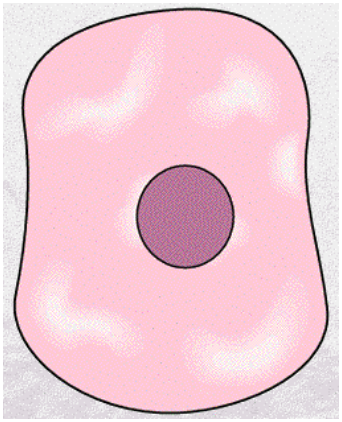
The affected hepatocytes are distended by accumulated water that imparts cytoplasmic pallor.

Cell necrosis: Nuclear changes

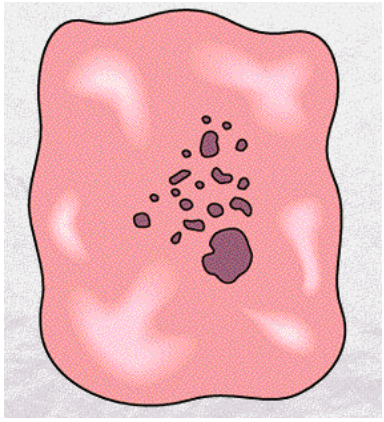
normal



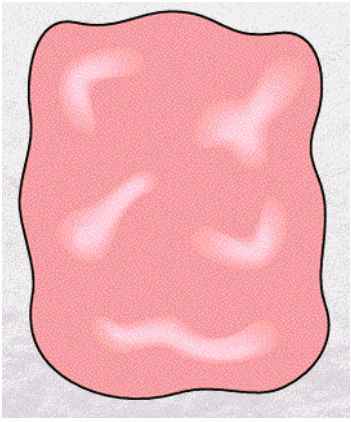
pyknosis



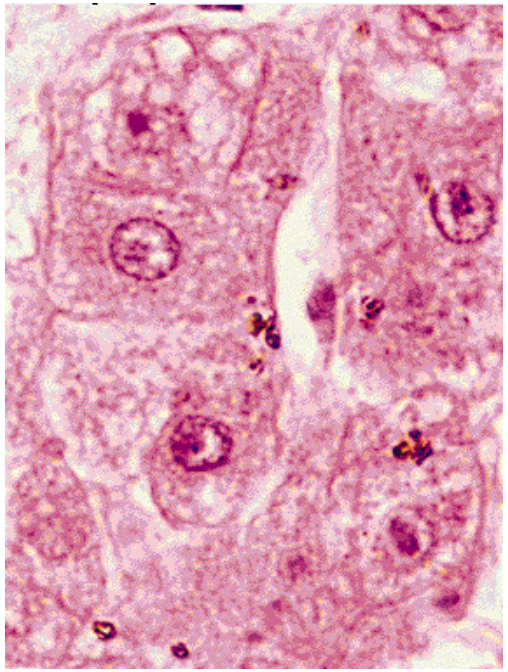
karyorrhexis



karyolysis

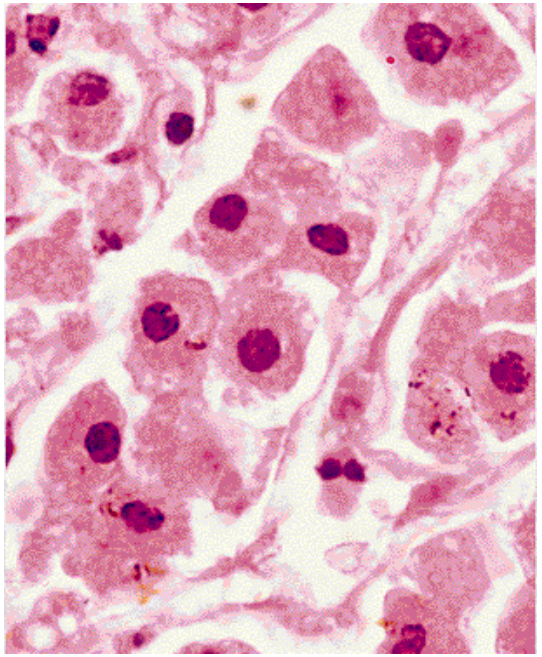


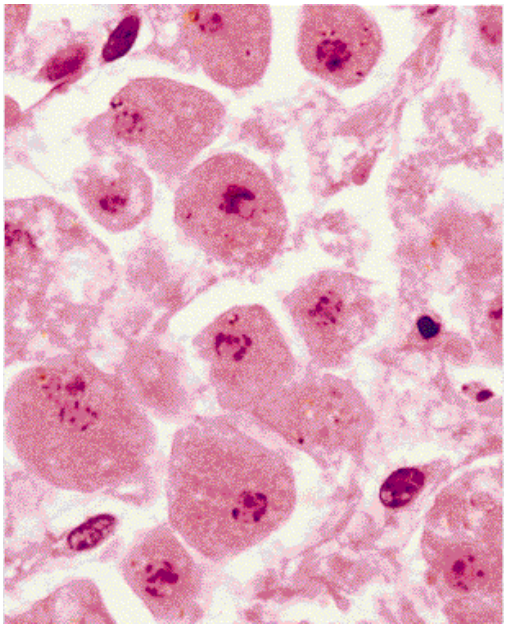
Liver cell necrosis: Nuclear changes



normal

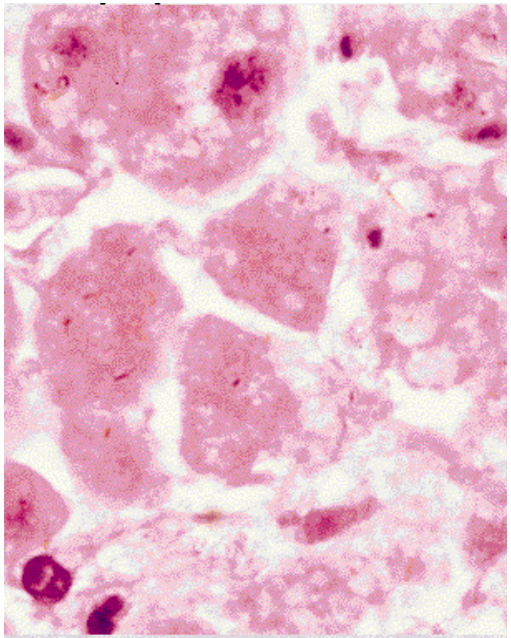
pyknosis



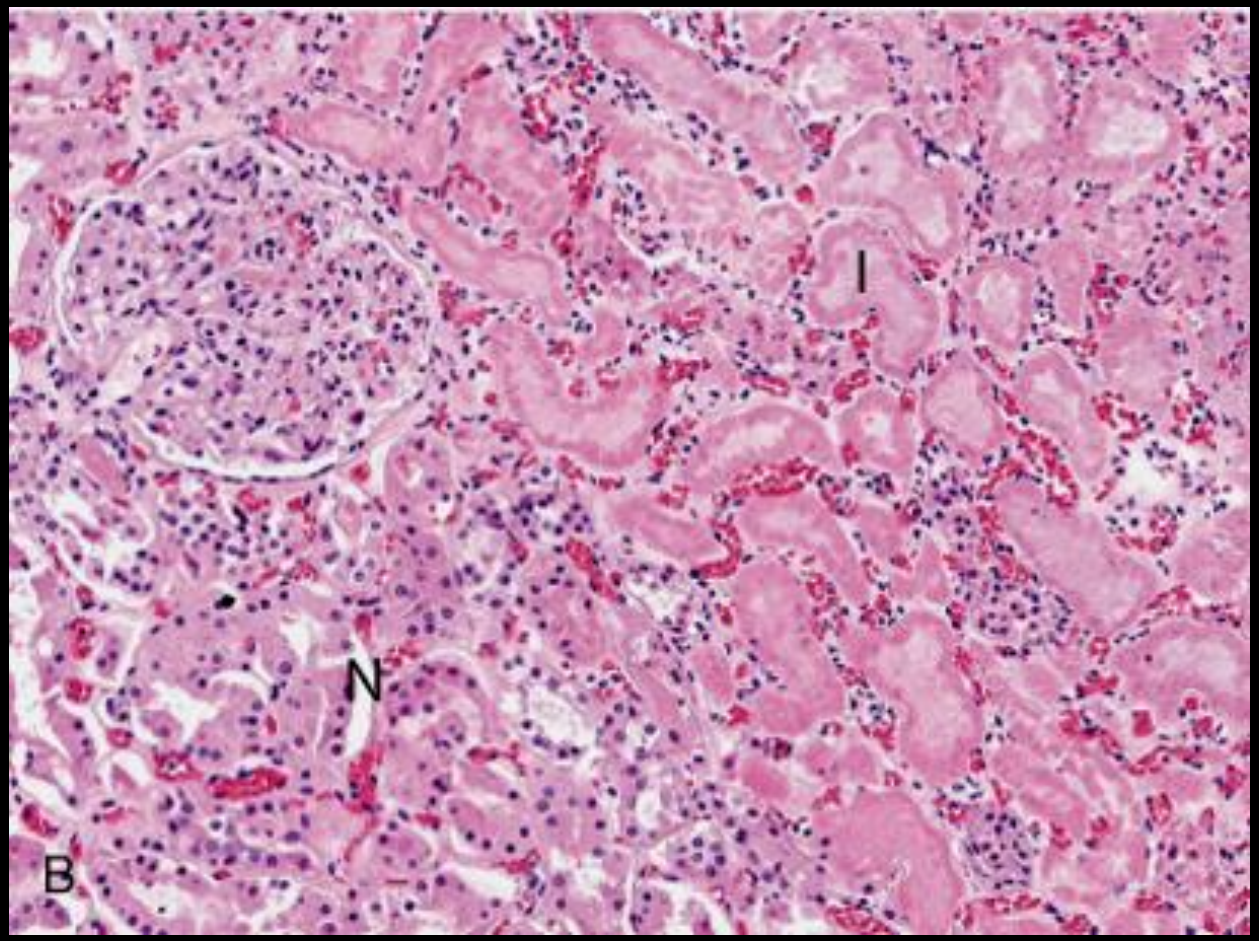


karyorrhexis

karyolysis

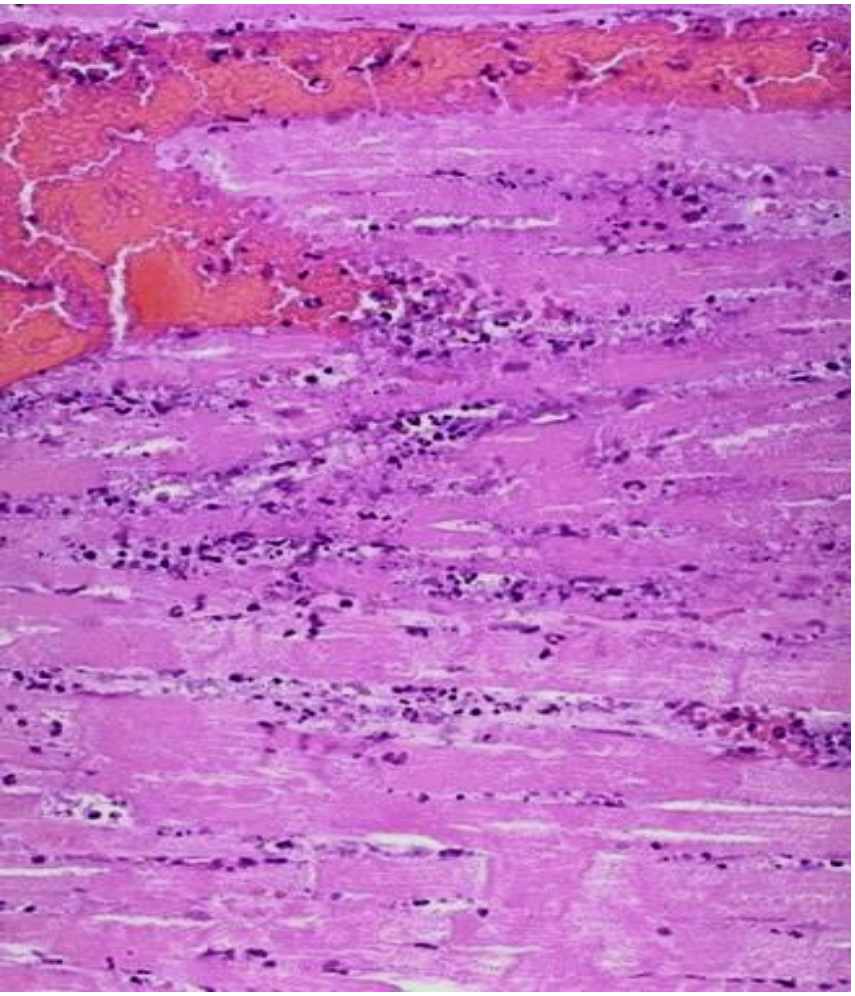


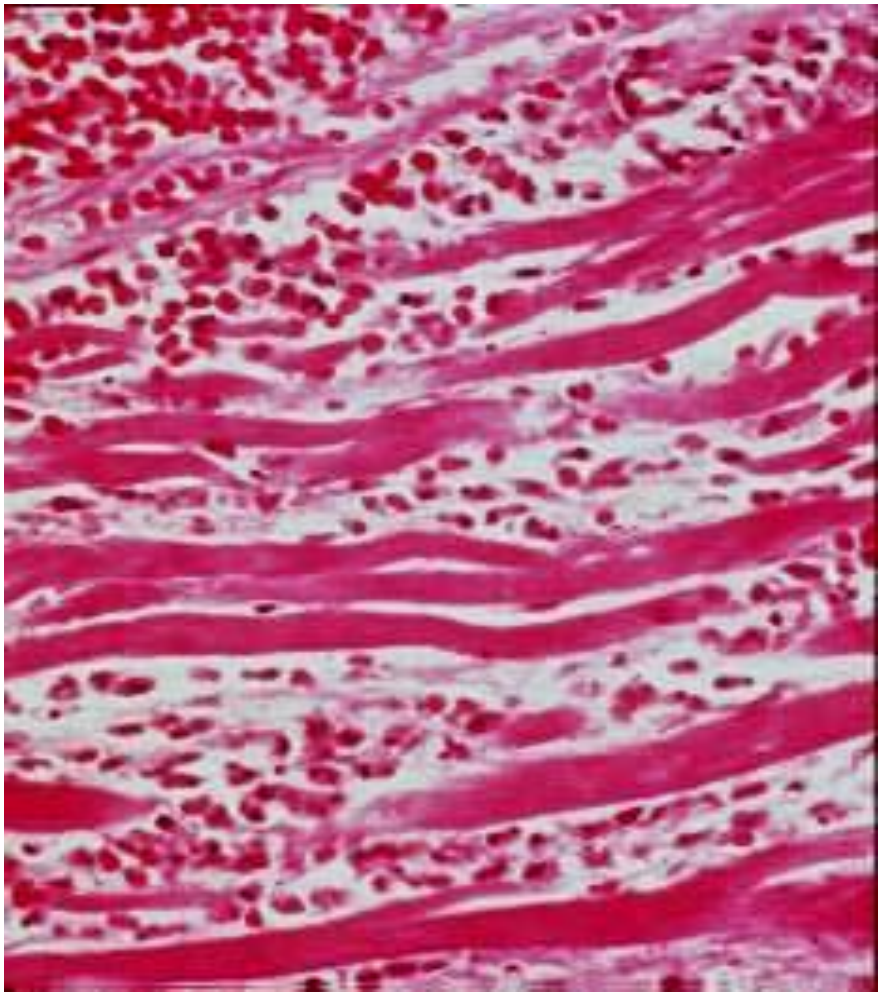
Coagulative necrosis Kidney



Microscopic view of the edge of the infarct, with normal kidney (N) and necrotic cells in the infarct (I). The necrotic cells show preserved outlines with loss of nuclei, and an inflammatory infiltrate is present (difficult to discern at this magnification).

Coagulative necrosis myocardium





The necrotic myocytes are intensely eosinophilic with loss of both cross striations & nuclei. The outlines of individual fibres are still maintained. There are inflammatory cells infiltration & RBCs in-between the necrotic fibers.

Lung abscess

This is an example of liquefactive necrosis. There is confluent bronchopneumonia (scattered pale areas) complicated by abscess formation, which is seen here as a cystic cavity (arrow). The contained pus poured off during the sectioning of the lung tissue.

Brain infarction

This is an example of liquefactive necrosis; the affected area is wedge-shaped, pale, soft & cystic.

Ganagrene of lower limb

Dry gangrene

Wet gangrene

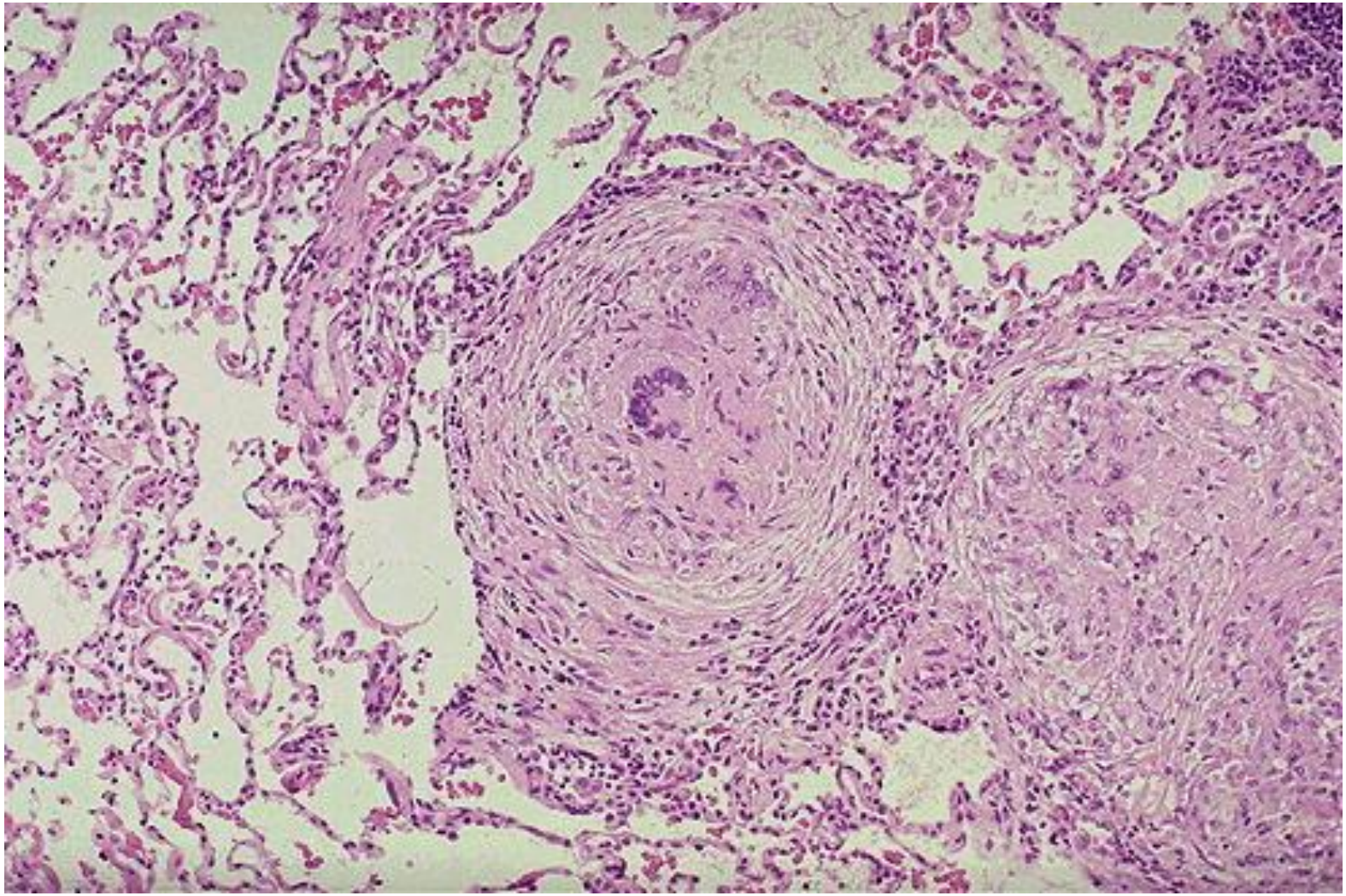
Caseous necrosis

A tuberculous lung with a large area of caseous necrosis containing yellow-white and cheesy debris.

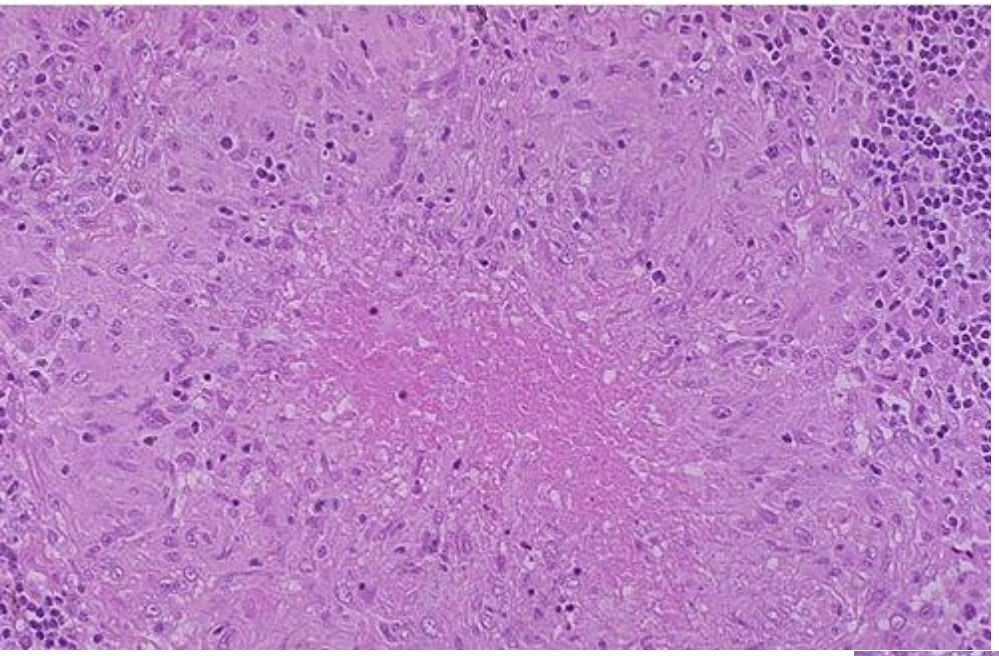
Caseous necrosis

This is the gross appearance of caseous necrosis in a hilar lymph node infected with tuberculosis. The node has a cheesy yellow to white appearance. Caseous necrosis is really just a combination of coagulative and liquefactive necroses

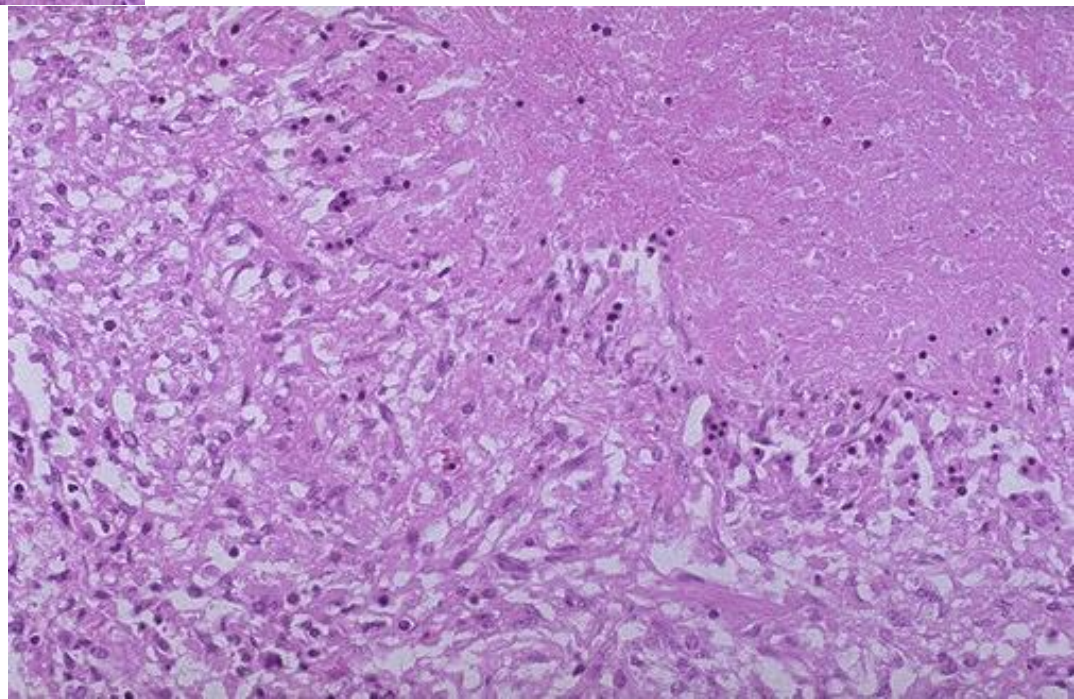
TB granulomas lung



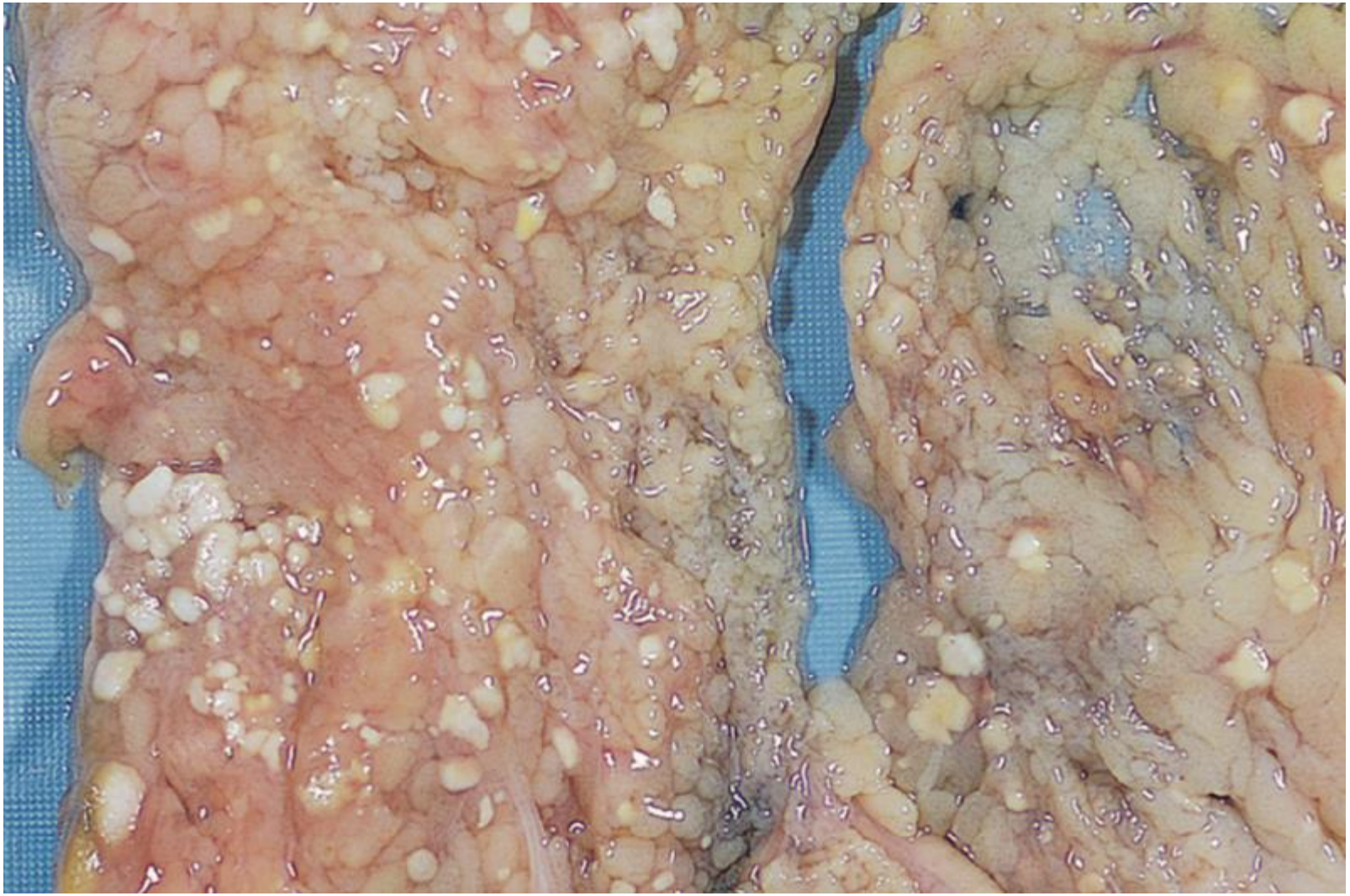
Caseating TB granuloma



Microscopically, caseous necrosis is characterized by amorphous (acellular), granular pink areas of necrosis, as seen here at the upper Lt, surrounded by a granulomatous inflammatory process. The lower Rt. Photo is a close up view

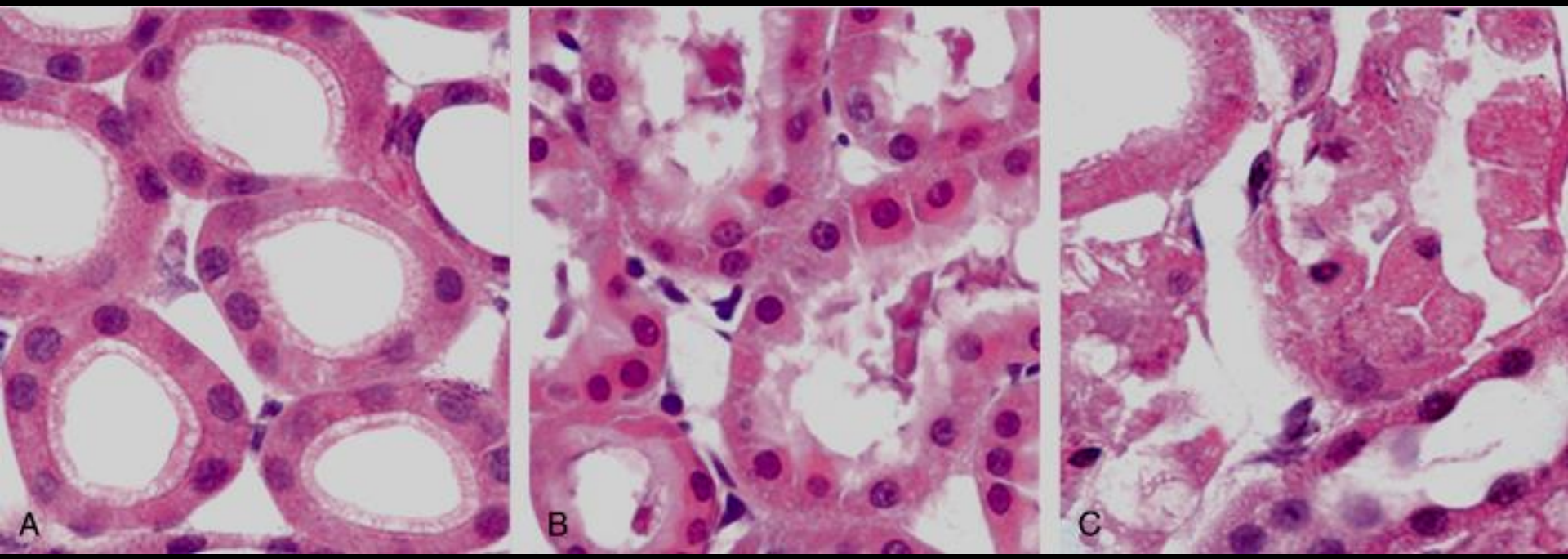


Fat necrosis in acute pancreatitis.



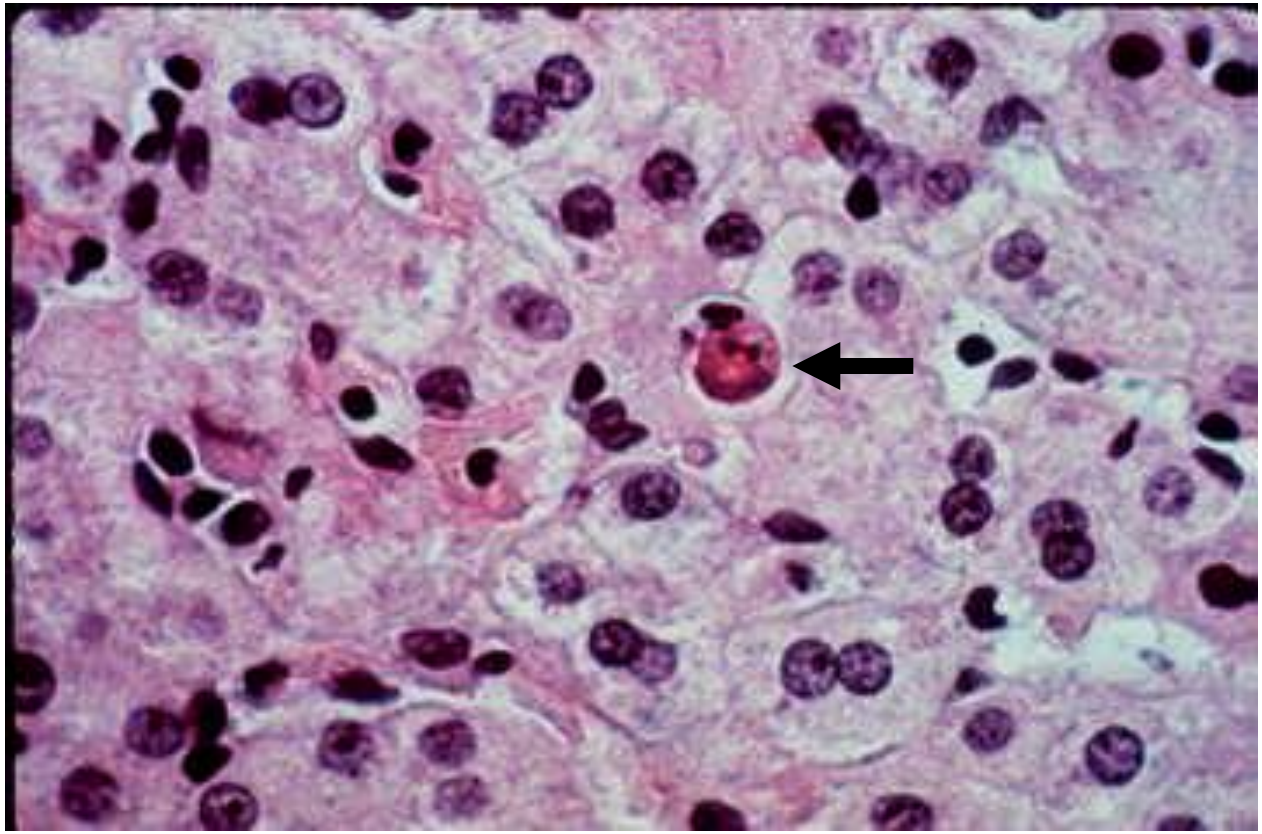
The areas of white chalky deposits represent foci of fat necrosis with calcium soap formation (saponification) at sites of lipid breakdown in the mesentery.

Morphologic changes in reversible and irreversible cell injury (necrosis).



A, Normal kidney tubules with viable epithelial cells. B, Early (reversible) ischemic injury showing loss of surface microvilli, surface blebs, increased eosinophilia of cytoplasm, and swelling of occasional cells. C, Necrotic (irreversible) injury of epithelial cells, with loss of nuclei and fragmentation of cells and leakage of contents.

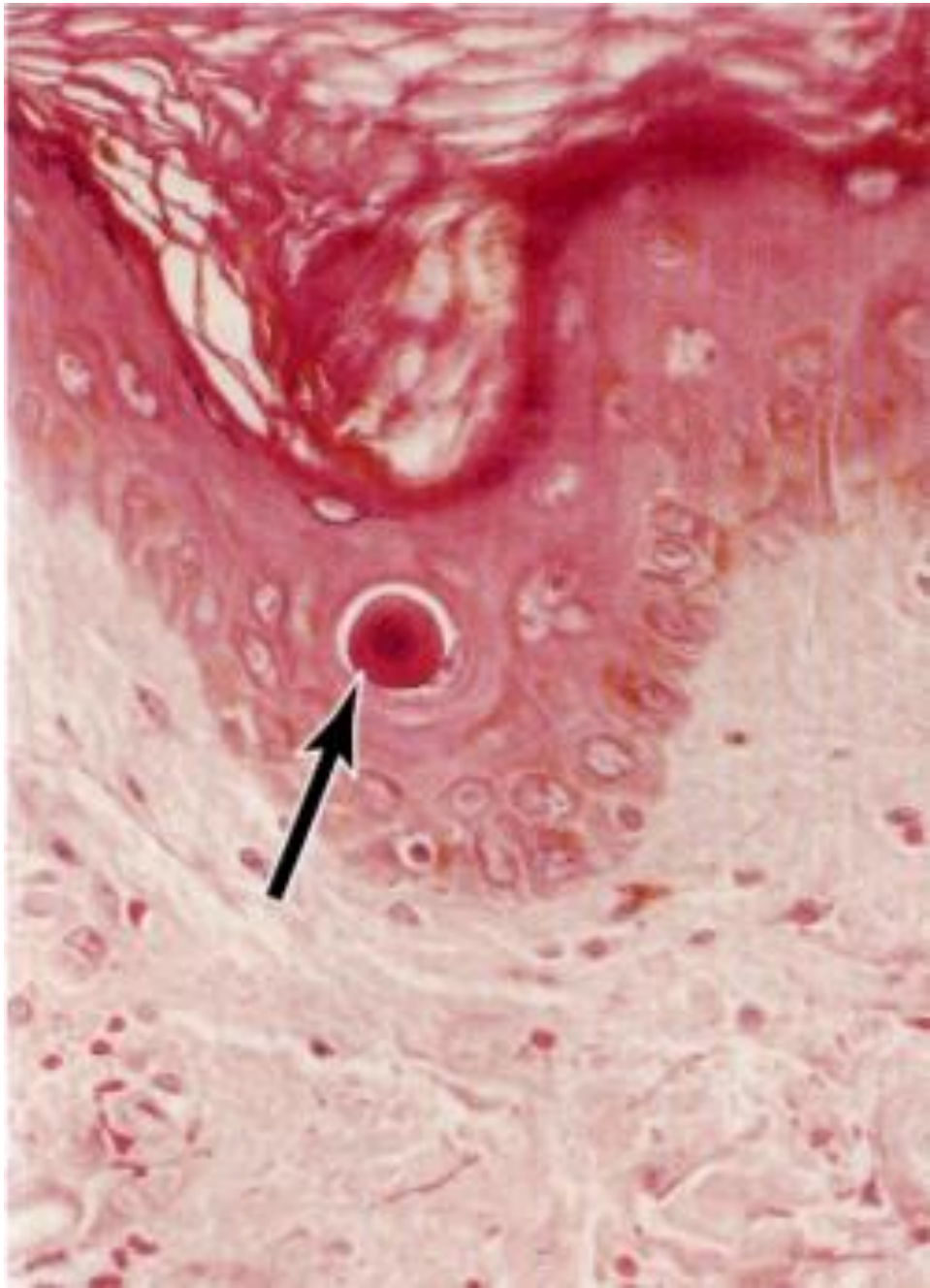
Apoptosis of a liver cell in viral hepatitis



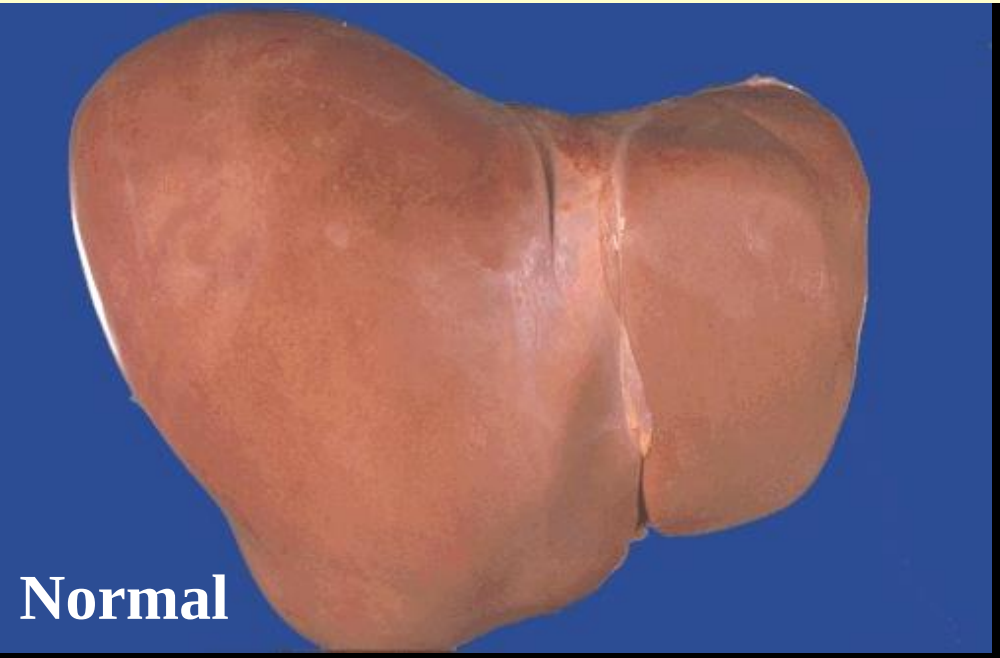
The cell is reduced in size and contains brightly eosinophilic cytoplasm and a condensed nucleus.

Apoptosis of epidermal keratinocyte

The cytoplasm is intensely esoniphilic (pinkish) and the nucleus condensed (pyknotic)



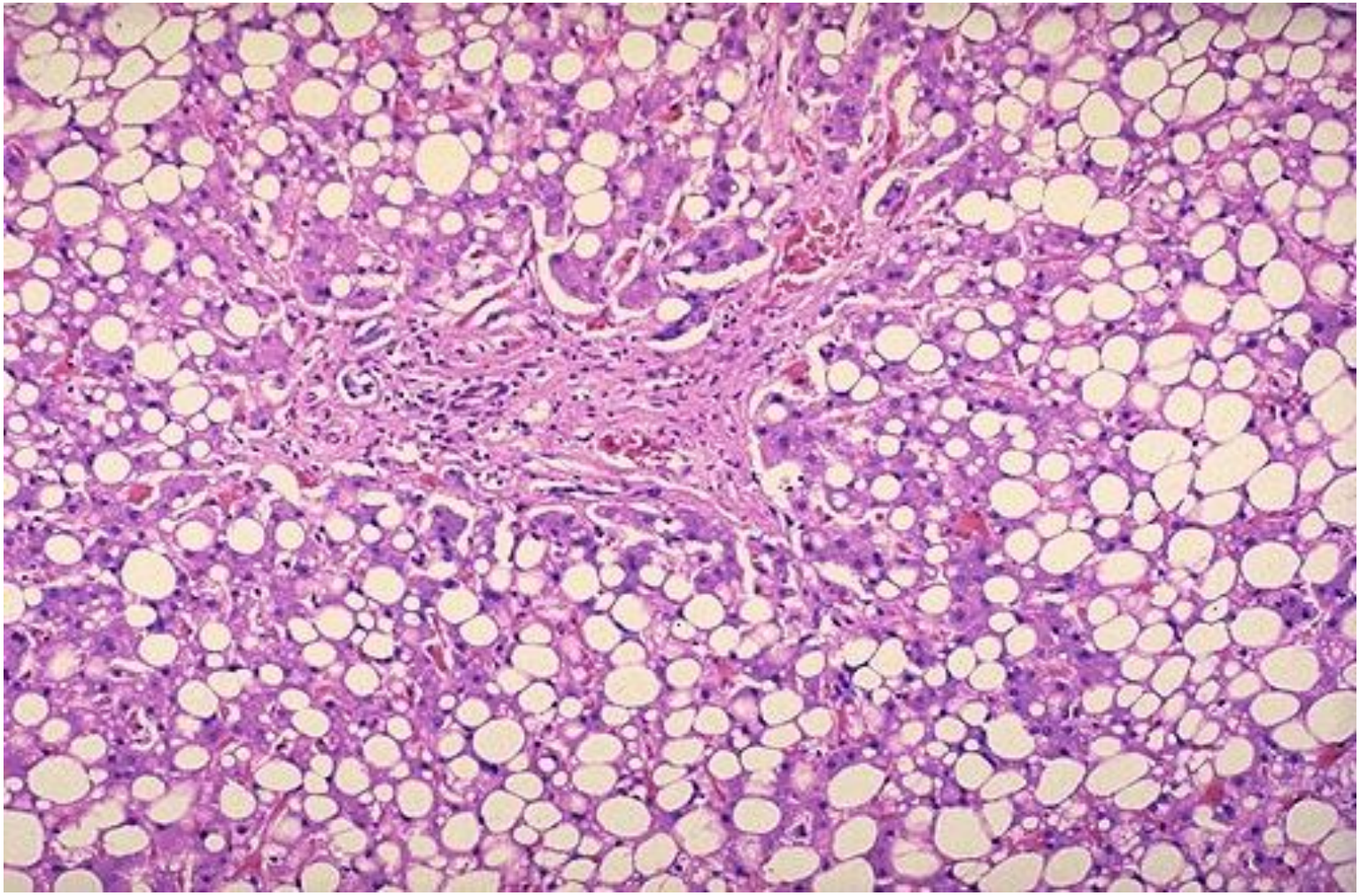
Fatty change liver



Severe fatty change liver

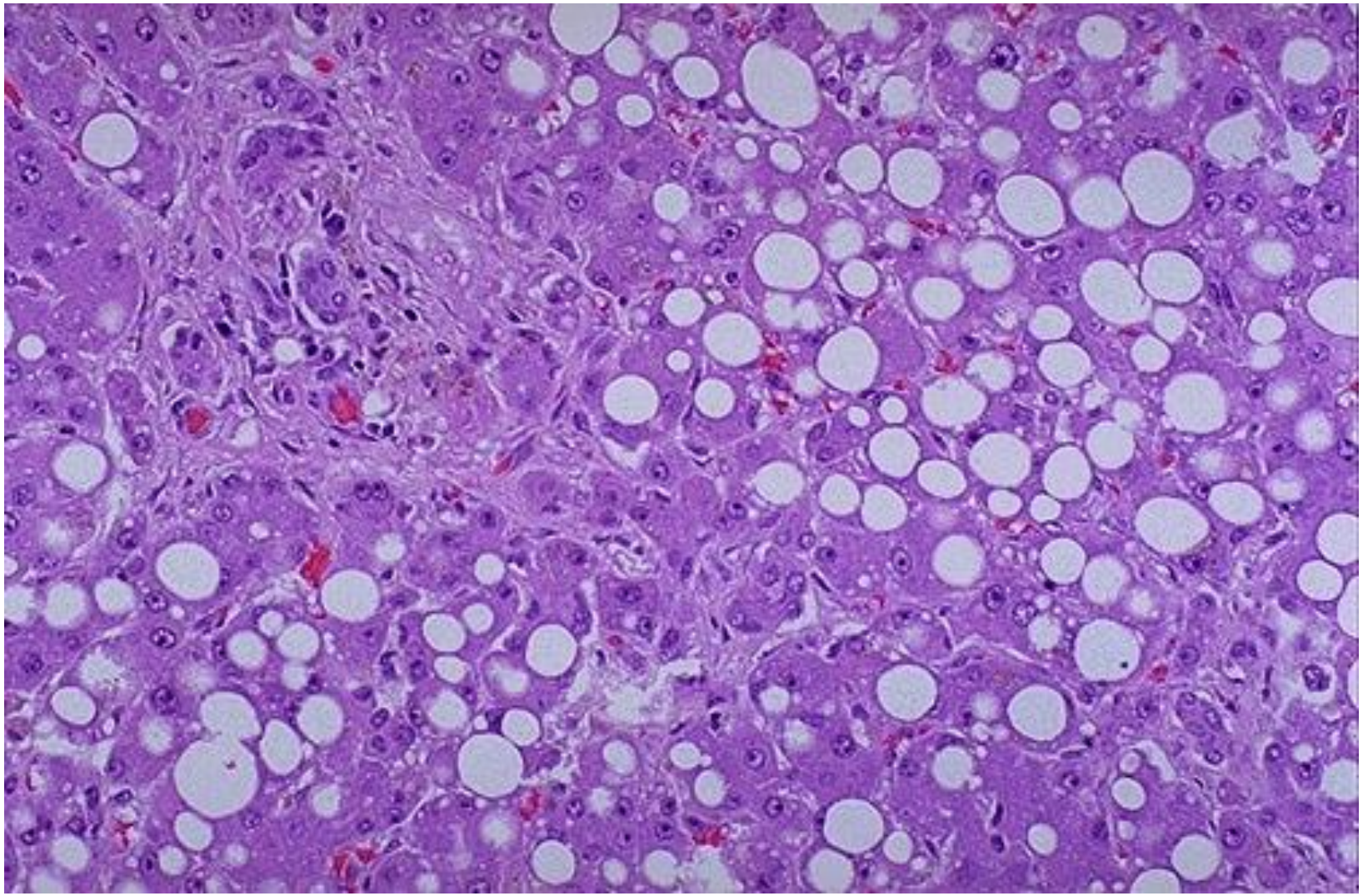
In the liver mild fatty change shows no gross changes, but with progressive accumulation, the organ enlarges and become increasingly yellow, soft and greasy to touch.

Fatty change liver



In the early stages: small fat vacuoles around the nucleus but with progression these coalesce into a large clear space that displaces the nucleus to the periphery (macrovesicular steatosis).

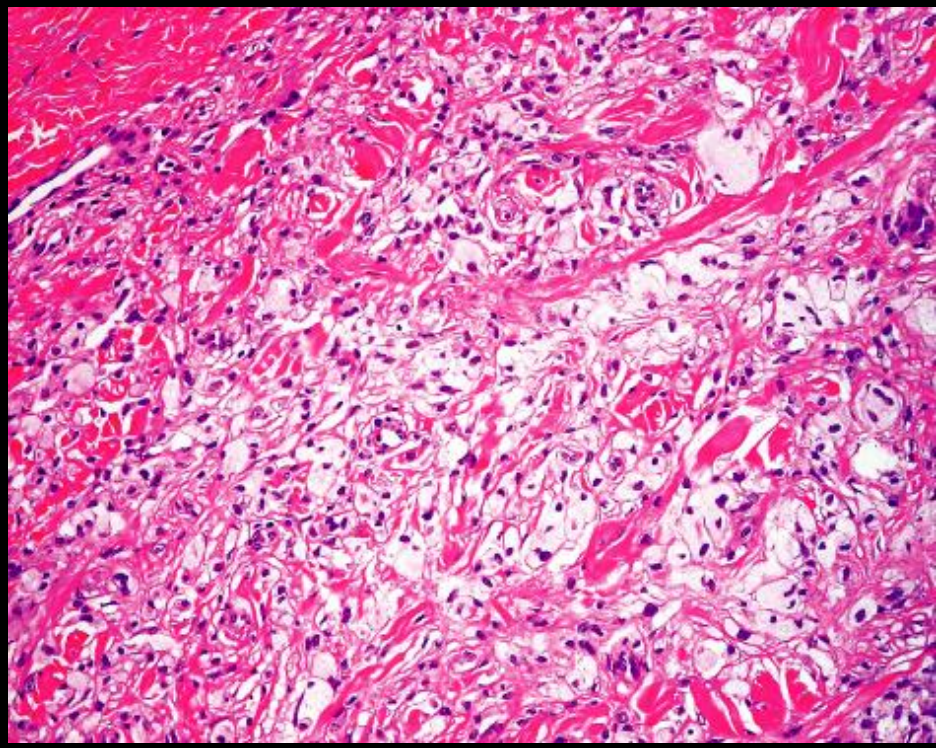
Fatty change liver



Macrovesicular steatosis a higher power of previous figure.

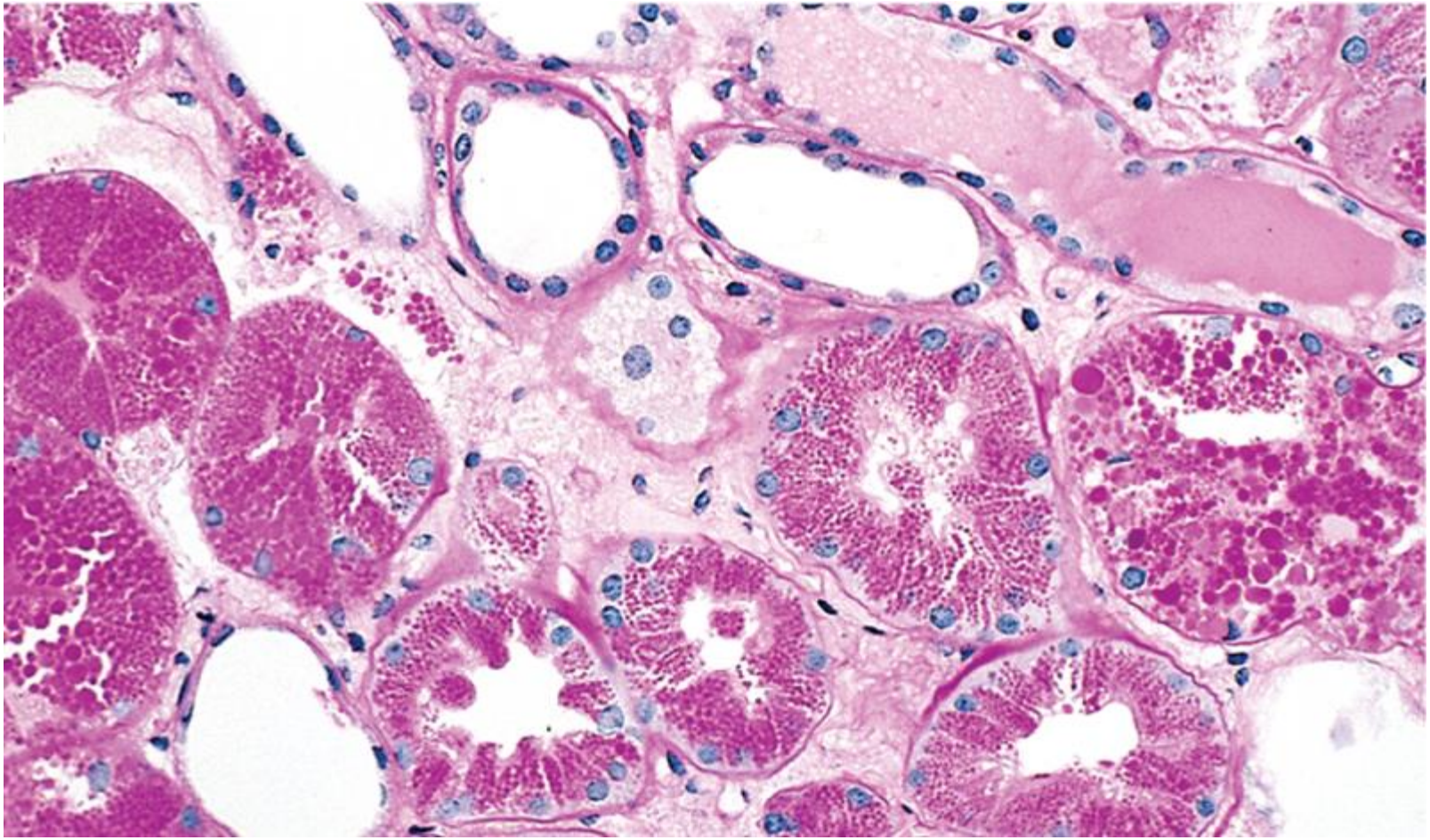
Xanthoma

Xanthoma tuberosum multiplex in patient with hypercholesterolemia.



Cutaneous xanthoma showing ill-defined collection of foamy macrophages in the dermis.

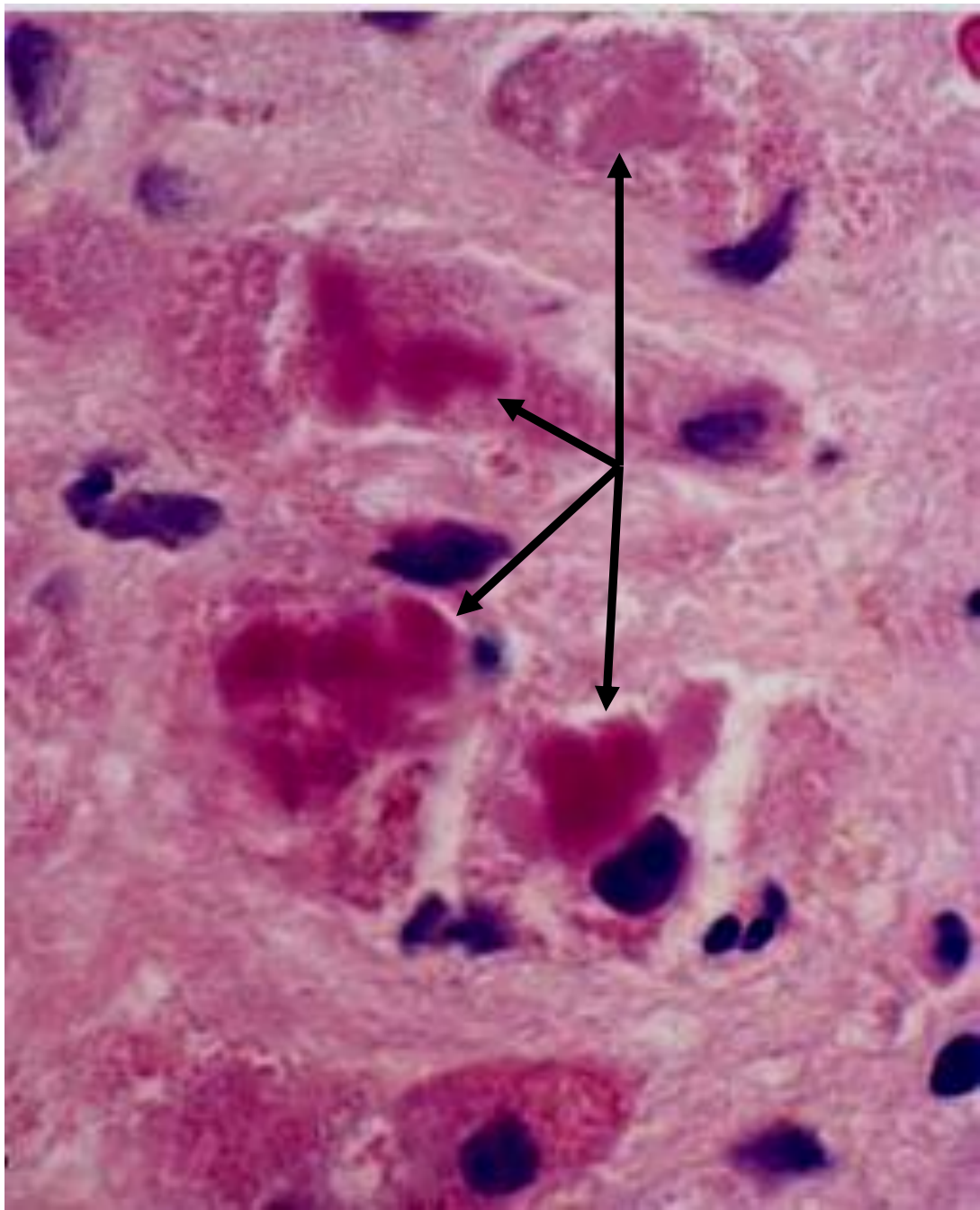
Protein reabsorption droplets in the renal tubular epithelium



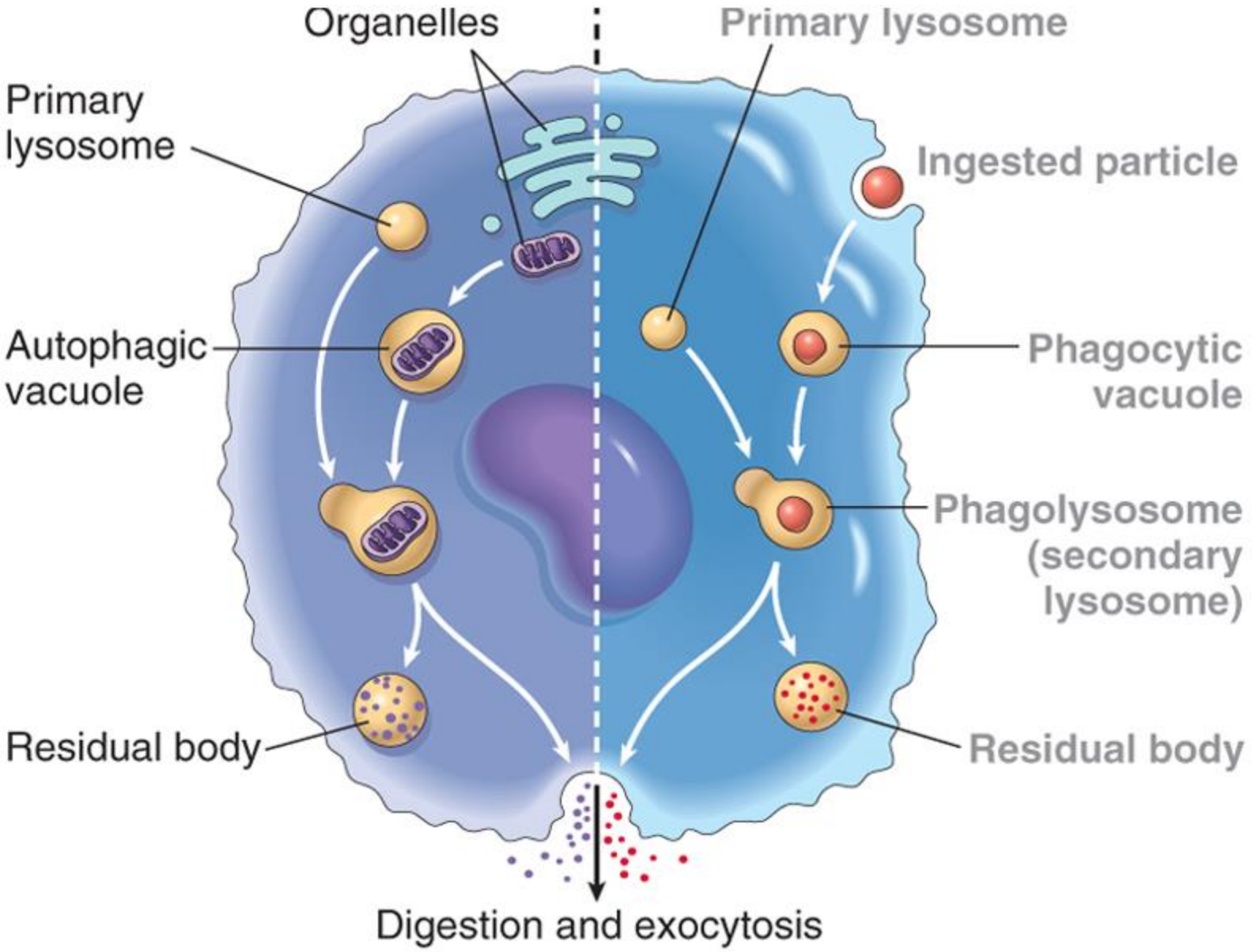
In nephrotic syndrome, there is a abnormally large reabsorption of the protein. Pinocytic vesicles containing this protein fuse with lysosomes, resulting in the histologic appearance of pink, hyaline cytoplasmic droplets

Alcoholic hepatitis

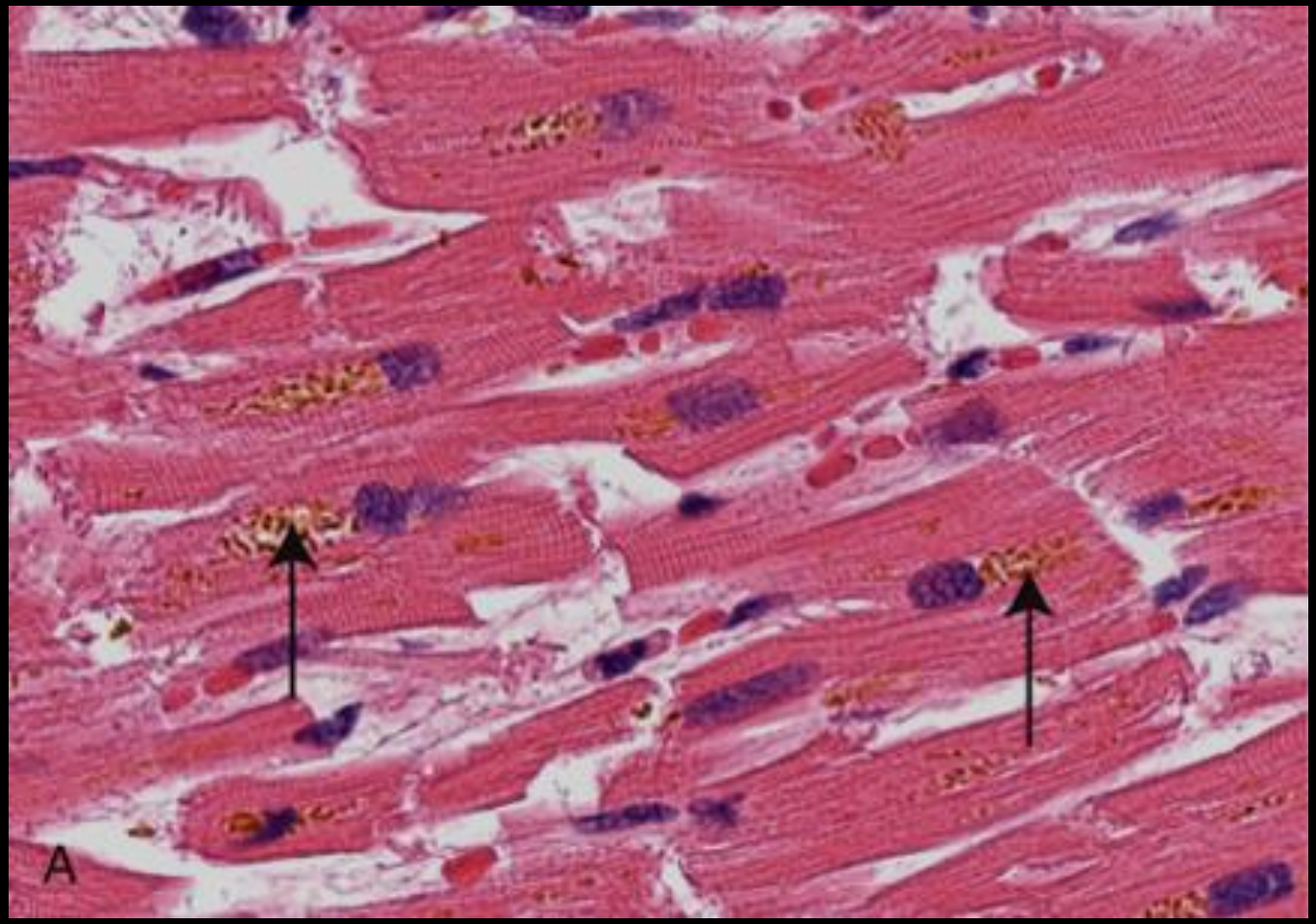
Eosinophilic Mallory bodies are seen in hepatocytes (arrows). (H&E).



Autophagy and heterophagy.

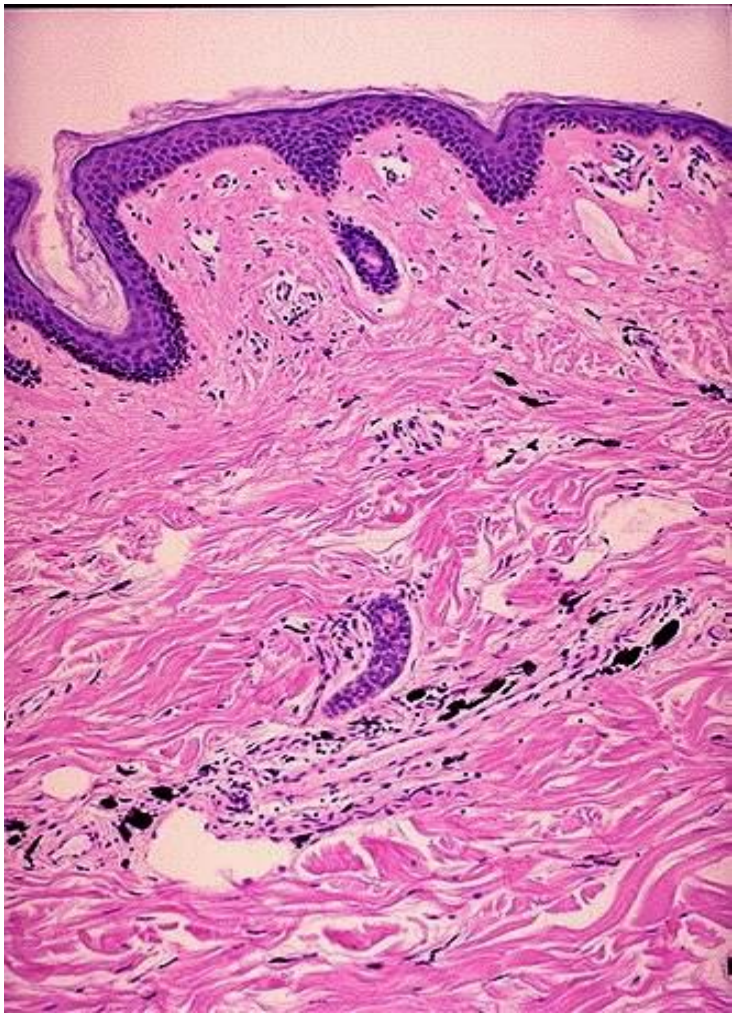


Lipofuscin granules in a cardiac myocytes



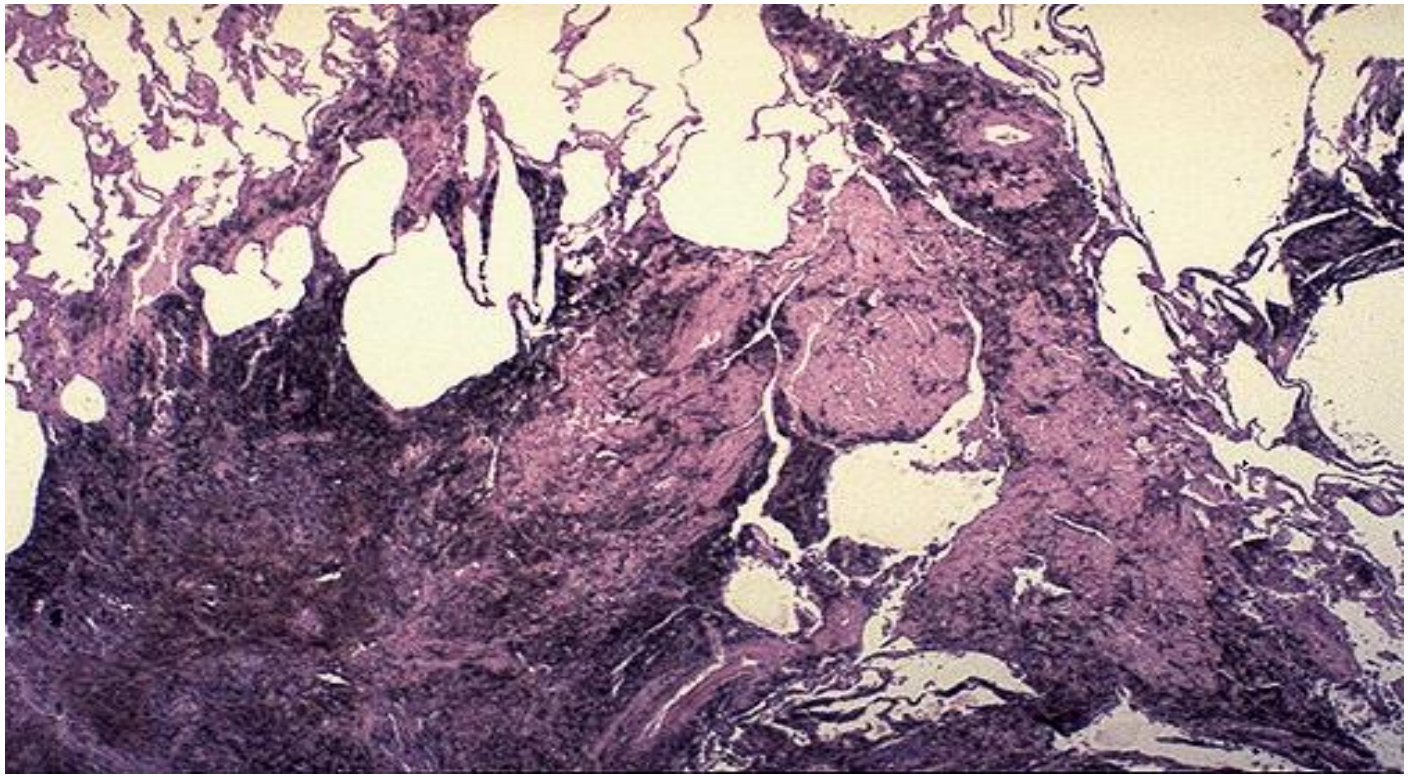
Brownish-yellow granular intracellular material (deposits indicated by arrows).

Skin tattoo



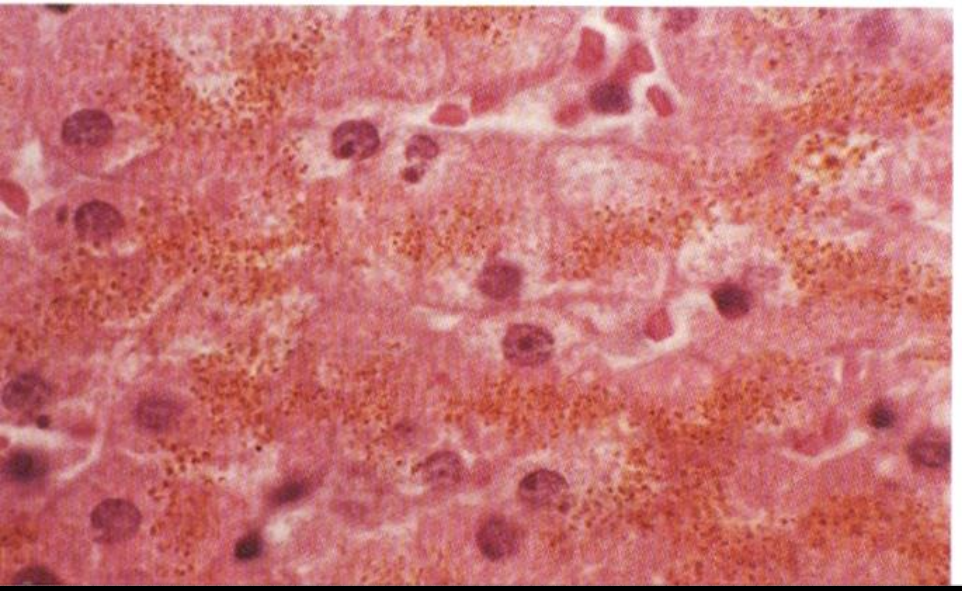
Lt. Here is a tattoo. Tattooing is a practice that is thousands of years old. In many cultures, tattoos have great significance. The pigment in tattoos is transferred to the dermis with a needle. Rt. This is the microscopic appearance of tattoo pigment (black) in the dermis. Note that this pigment is well within the dermis and, therefore, difficult to remove.

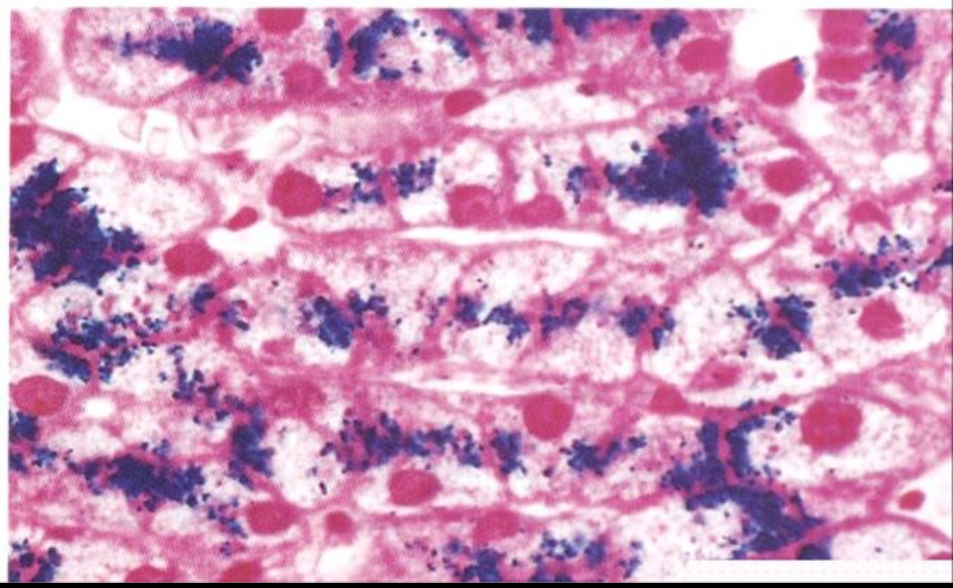
Lung: coal worker’s pneumoconiosis



Anthracotic pigment ordinarily is not fibrogenic, but in massive amounts (as in "black lung disease" in coal miners) a fibrogenic response can be elicited to produce excessive collagenous fibrosis impregnated with the black pigment.

Hemosiderin granules liver cells





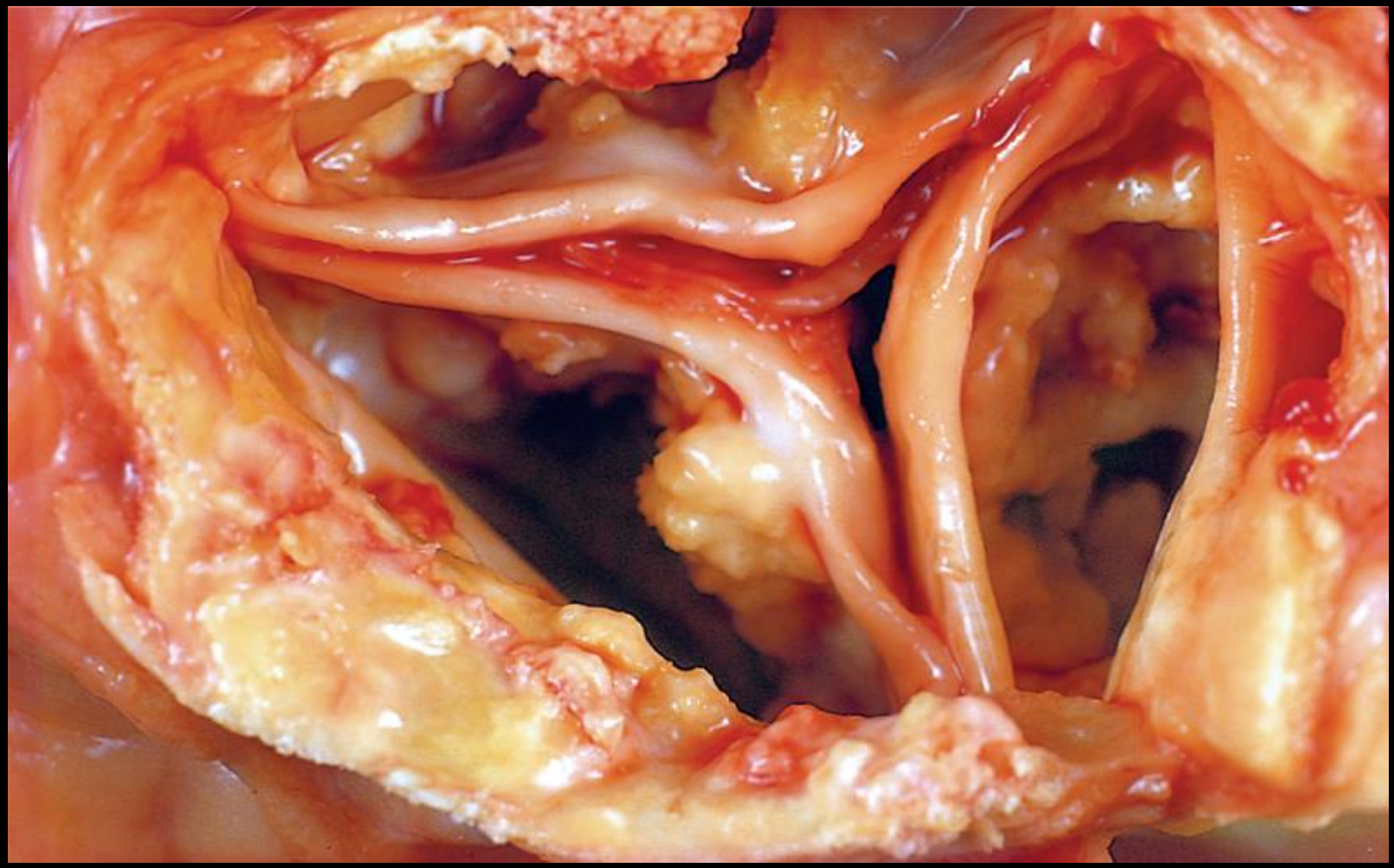
Rt: H&E stained section showing hemosiderin as yellow-brown finely granular pigment within hepatocytes.

Lt.: same section stained with an iron stain (Prussian blue); the hemosiderin granules are deep blue.

Bile-stained liver

This 3-month-old child died with extrahepatic biliary atresia, a disease in which there is inflammation with stricture of hepatic or common bile ducts. The dark green color comes from formalin acting on bile pigments in the liver from marked cholestasis, turning bilirubin to biliverdin.

Calcification of the aortic valve.



A view looking down onto the unopened aortic valve in a heart with calcific aortic stenosis. The semilunar cusps are thickened and fibrotic. Behind each cusp are large, irregular masses of dystrophic calcification that will prevent normal opening of the cusps.