

# FOUNDATION BLOCK

## *Pathology Practical on Cell injury*

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- *Dr. Shaesta Zaidi*

# Objectives:

**By the end of these practical sessions, every student will be able to:**

- Describe the pathological changes (both macro and micro) which can occur and are seen in the diseases and lesions studied in the foundation block.
- Identify the clinical manifestations of each pathological lesion.
- Correlate the morphological features with the clinical manifestations seen in the lesions and diseases studied.
- Differentiate between the normal structure and the pathological changes of the given tissue.

# **PRACTICAL**

## **CELL INJURY**

# Contents:

Basic introduction to the anatomy and histology of the lung, liver, kidney and heart in order to enable the student to understand the related pathology.

## Cell injury

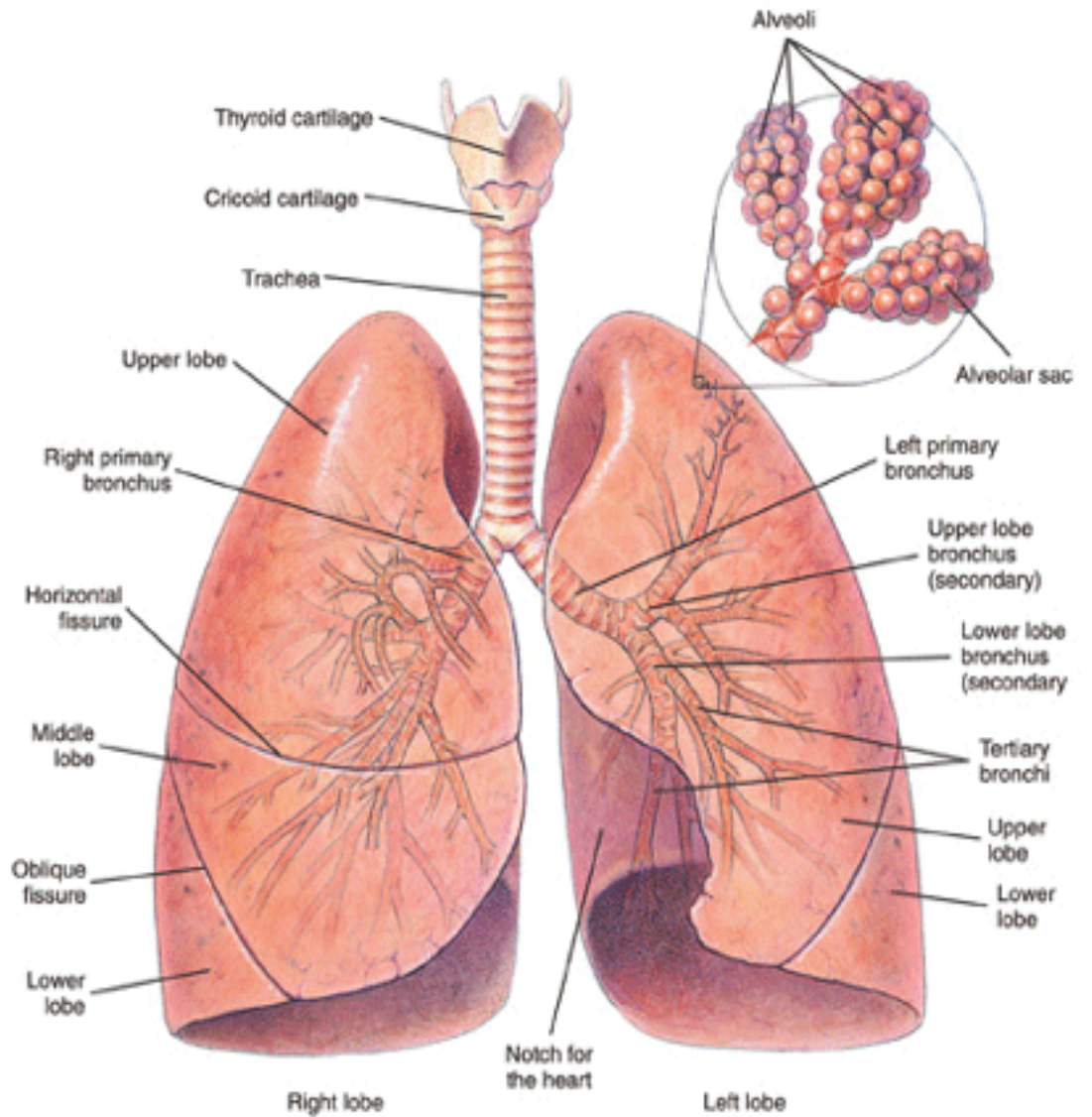
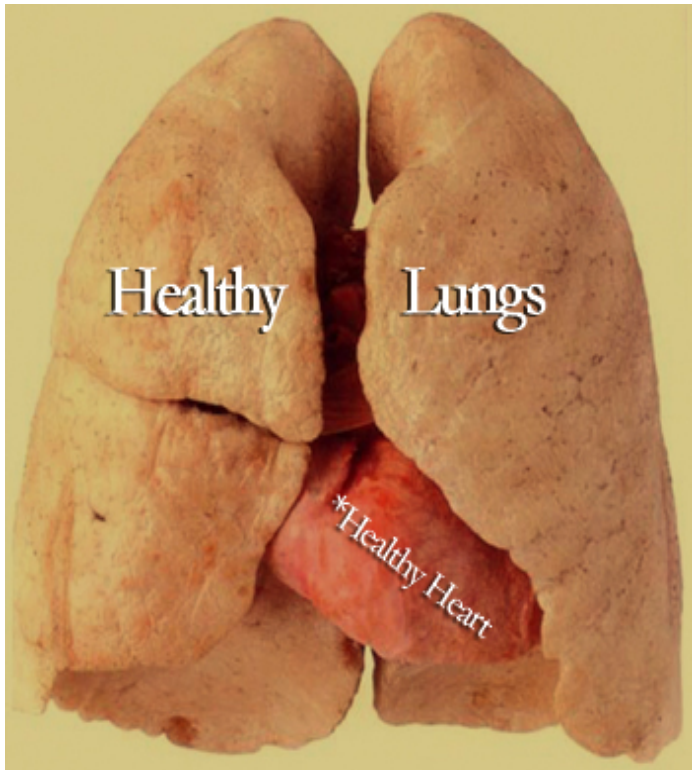
### □ Pictures of:

1. Fatty change of the liver.
2. Coagulative necrosis in an infarcted kidney, spleen and myocardium.
3. Liquefactive necrosis
4. Caseous necrosis
5. Fibrinoid necrosis
6. Fat necrosis
7. Dystrophic calcification in the aorta, stomach and skin.
8. Atrophy of brain and testis
9. Left ventricular hypertrophy
10. Hyperplasia of the prostate.
11. Squamous metaplasia.

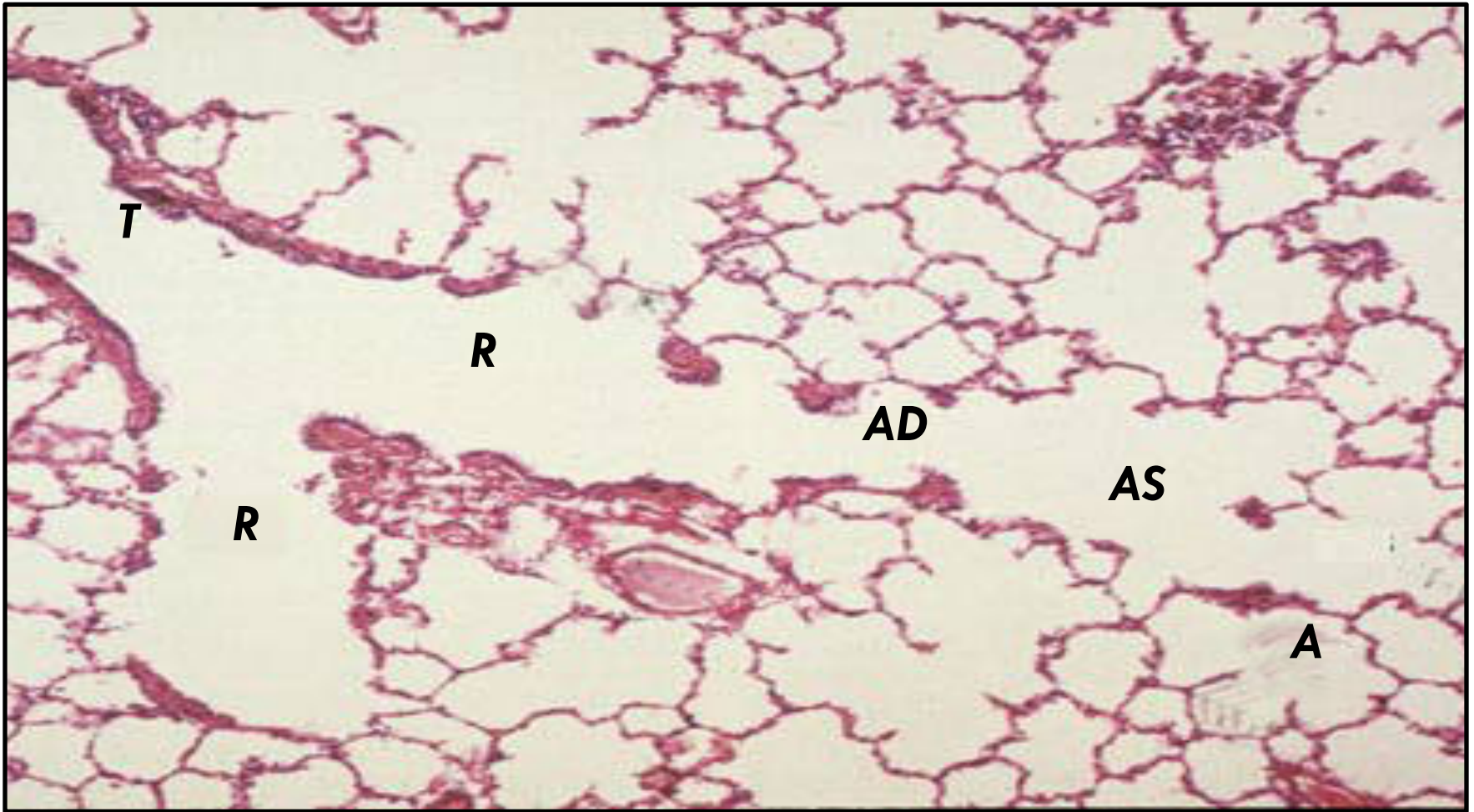


***NORMAL ANATOMY AND  
HISTOLOGY OF ORGANS RELATED  
TO THIS CHAPTER***

# Anatomy of the Respiratory System



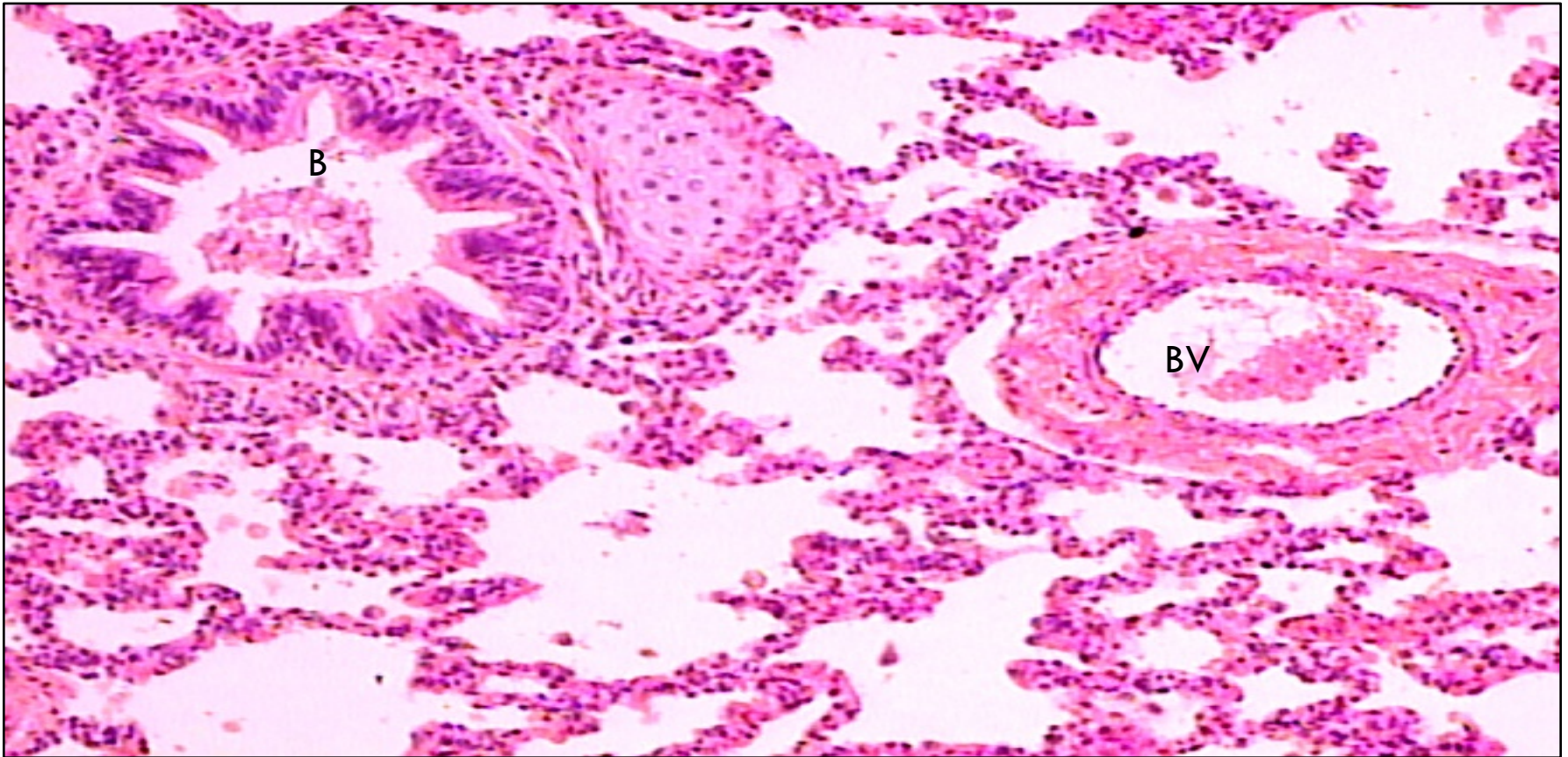
## Normal Histology of the Lung (Bronchiole, alveolar duct and alveoli)



**Microscopic section of normal lung showing:  
terminal bronchiole (T) , respiratory bronchiole (R), alveolar duct (AD),  
alveolar sac (AS), and alveoli (A).**



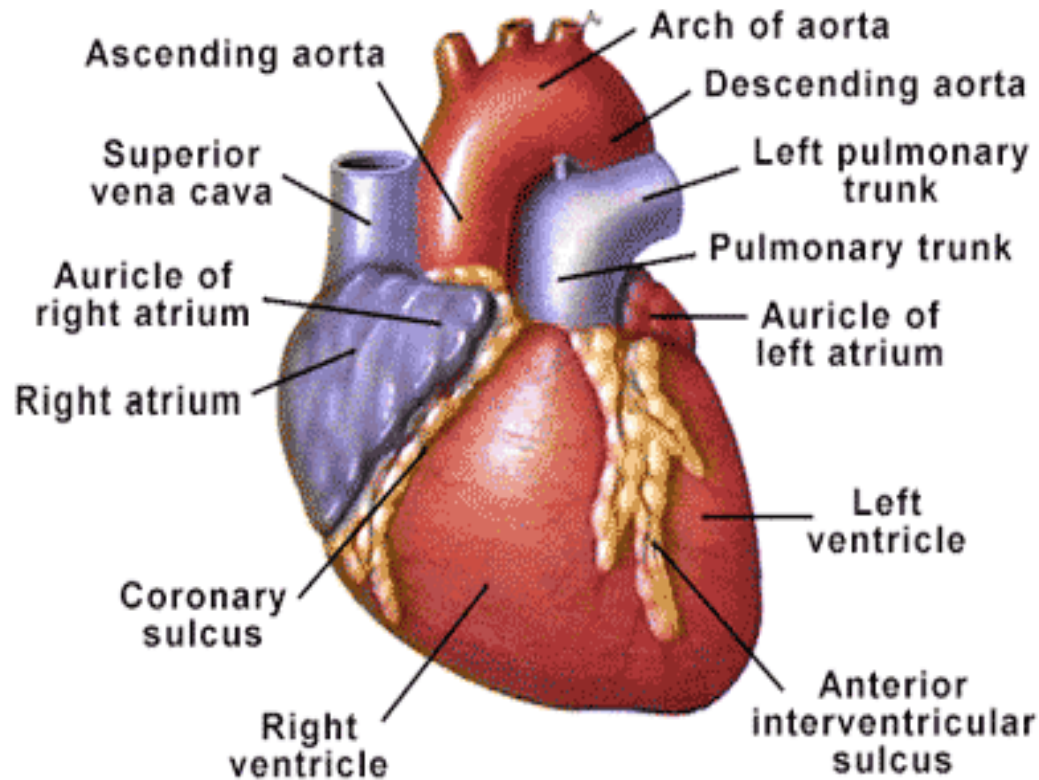
## Normal Histology of the Lungs - Bronchiole



***This view shows a BRONCHIOLE (right) and Blood Vessel (left) in cross-section as well as numerous ALVEOLI in The bronchiole inner membrane is composed of pseudostratified columnar epithelium.***

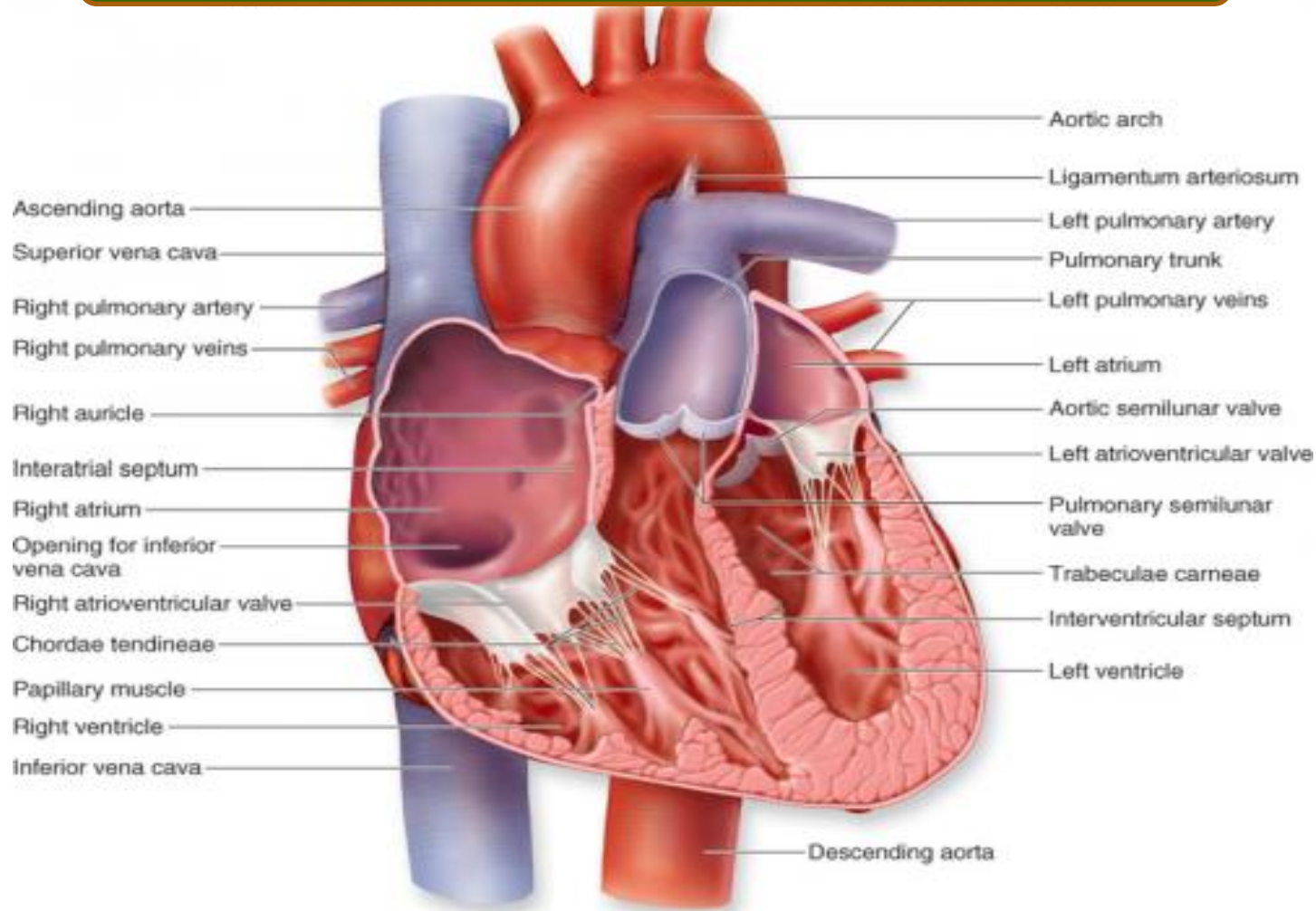
***Portions of hyaline cartilage rings can also be seen outside of the bronchiole.***

# Anatomy of the Heart



- **The heart serves as a mechanical pump to supply the entire body with blood, both providing nutrients and removing waste products.**
- **The great vessels exit the base of the heart.**
- **Blood flow: Body → venae cavae → right atrium → right ventricle → lungs → left atrium → left ventricle → Aorta → body**

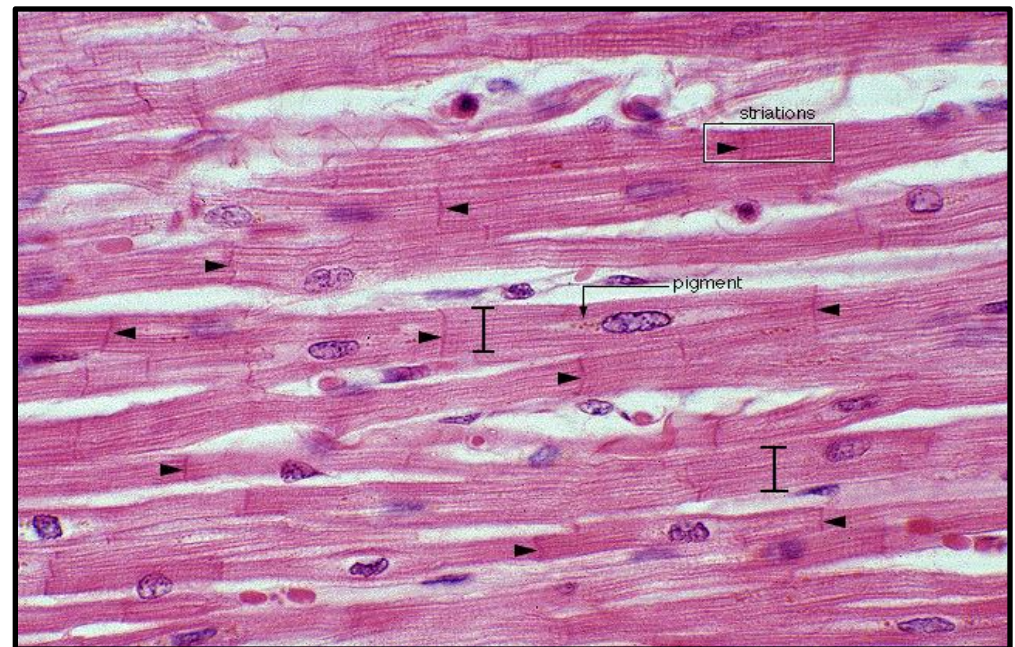
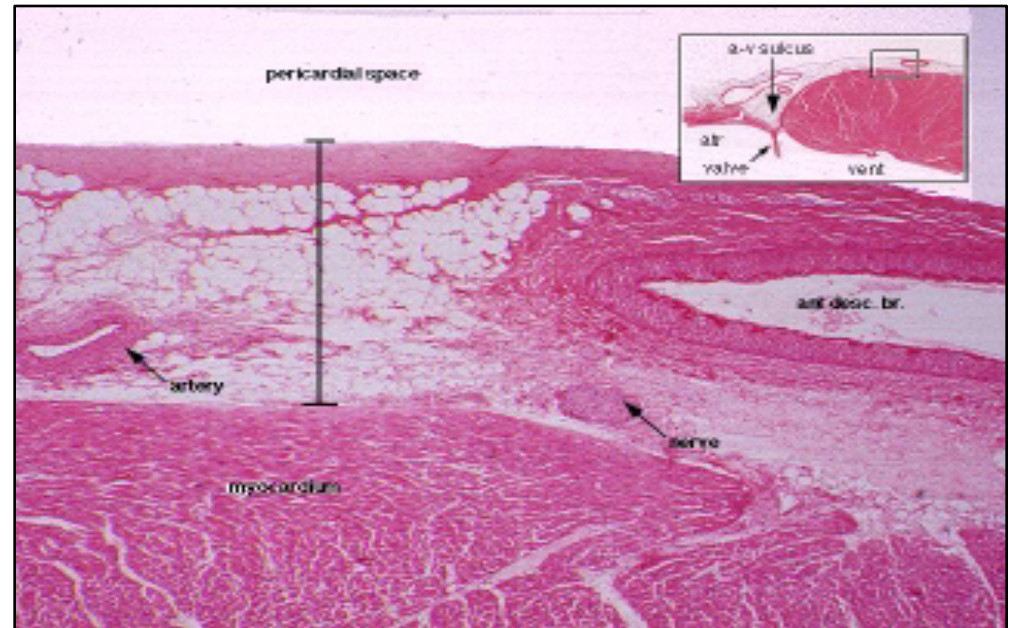
## Anatomy of the Heart – inside view





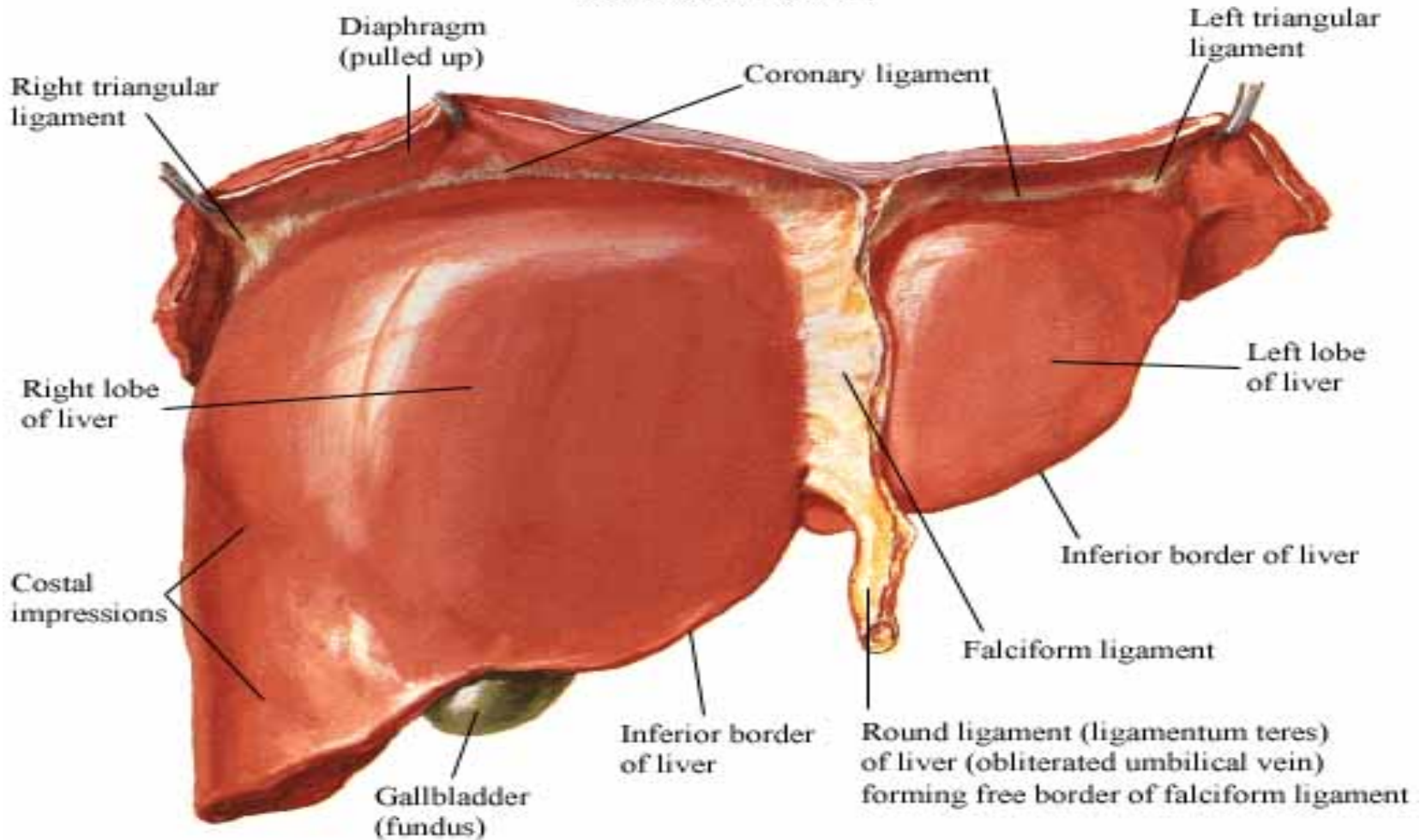
## Histology of the Heart

- The heart consists of 3 layers
  - the **endocardium**,
  - the **myocardium**, and
  - the **epicardium**.
- The **epicardium** consists of arteries, veins, nerves, connective tissue, and variable amounts of fat.
- The **myocardium** contains **branching, striated muscle cells with centrally located nuclei**. They are connected by **intercalated disks** (arrowheads).



# Anatomy of the Normal Liver

## Surfaces and Bed of Liver Anterior View





Rt

## Cut surface of a Normal Liver

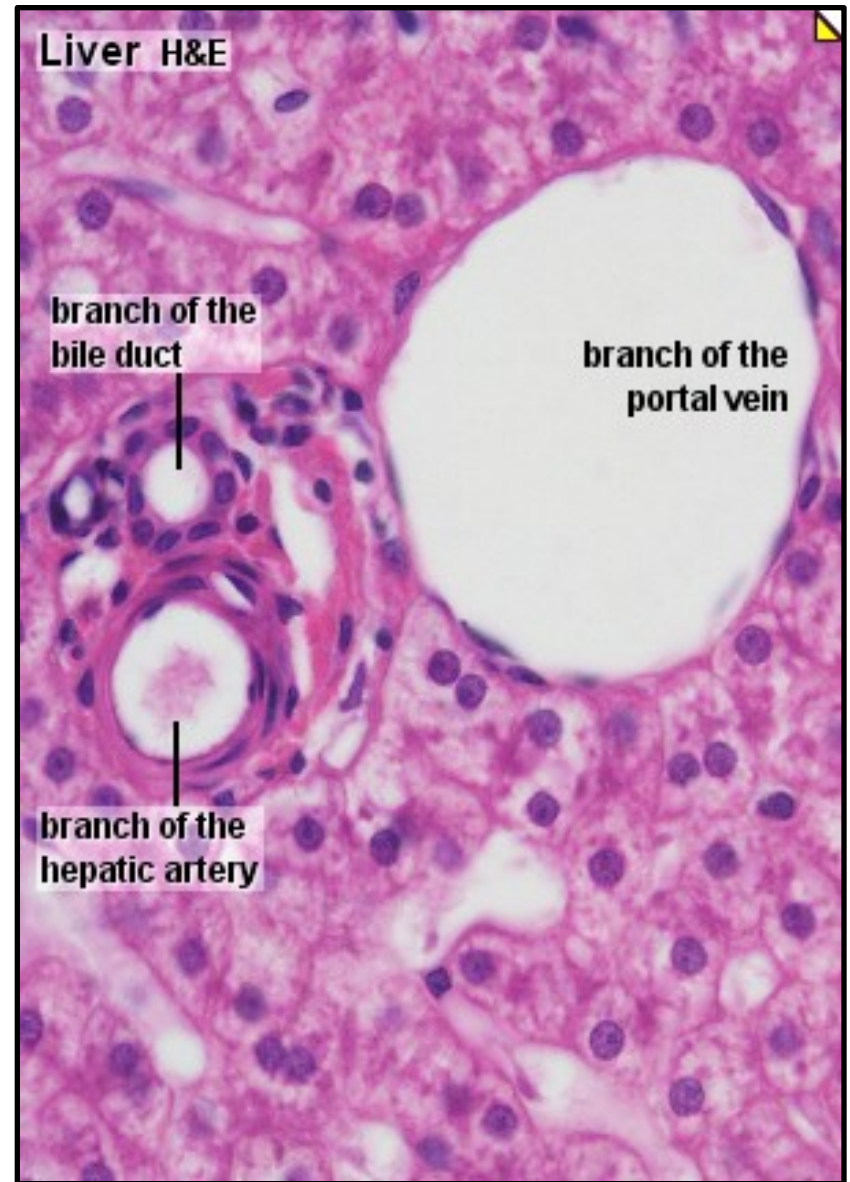
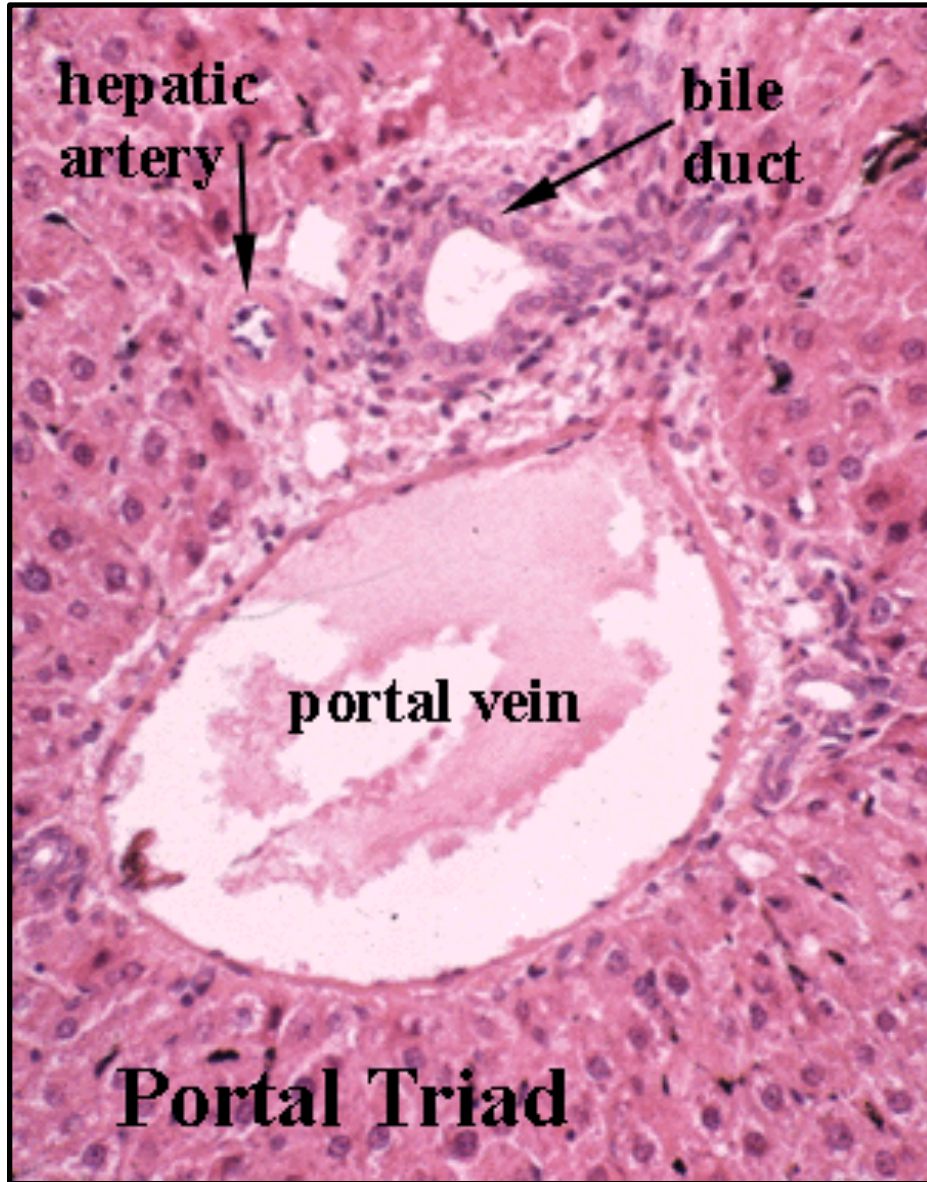
Lt



**The cut surface of a normal liver has a brown color. Near the hilum here, note the portal vein carrying blood to the liver, which branches at center right, with accompanying hepatic artery and bile ducts.**

**At the lower left is a branch of hepatic vein draining blood from the liver to the inferior vena cava**

# Histology of Normal Liver

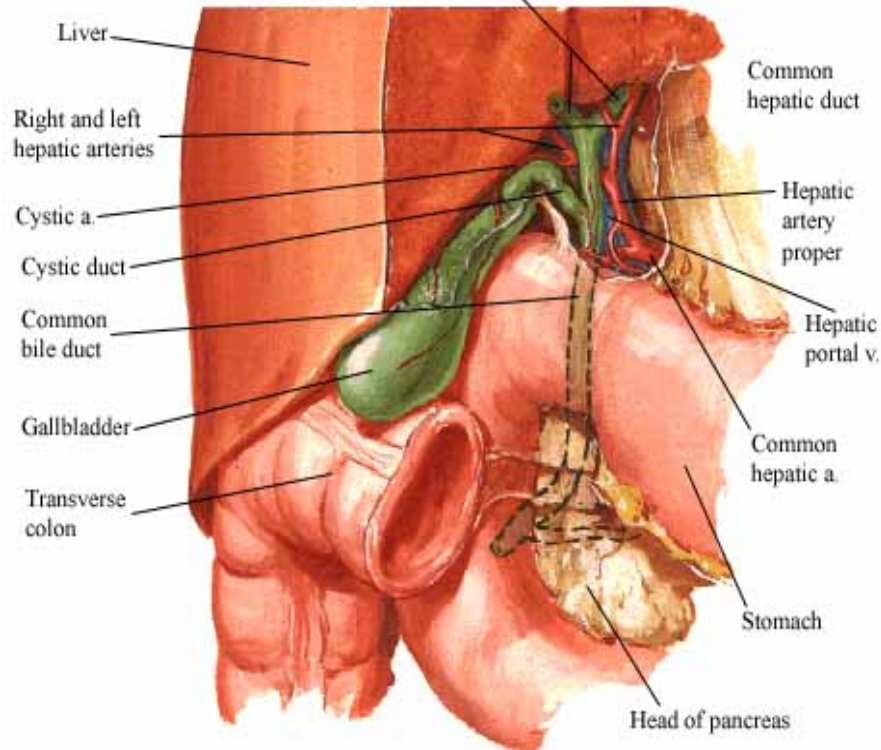




# Gall Bladder & Extrahepatic Bile Duct

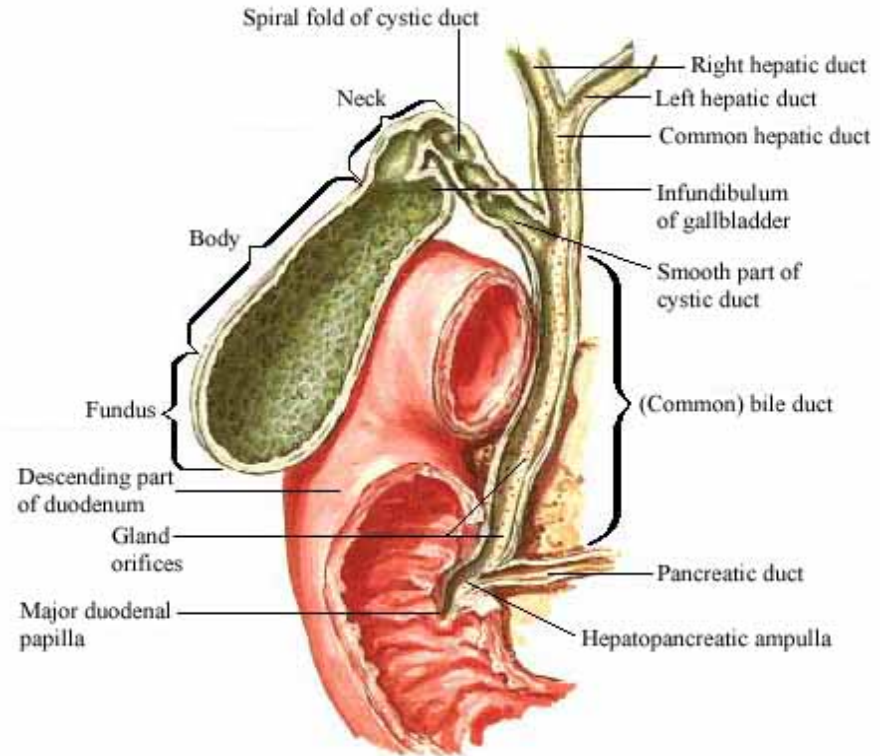
## Gallbladder and Extrahepatic Bile Ducts

Right and left hepatic ducts

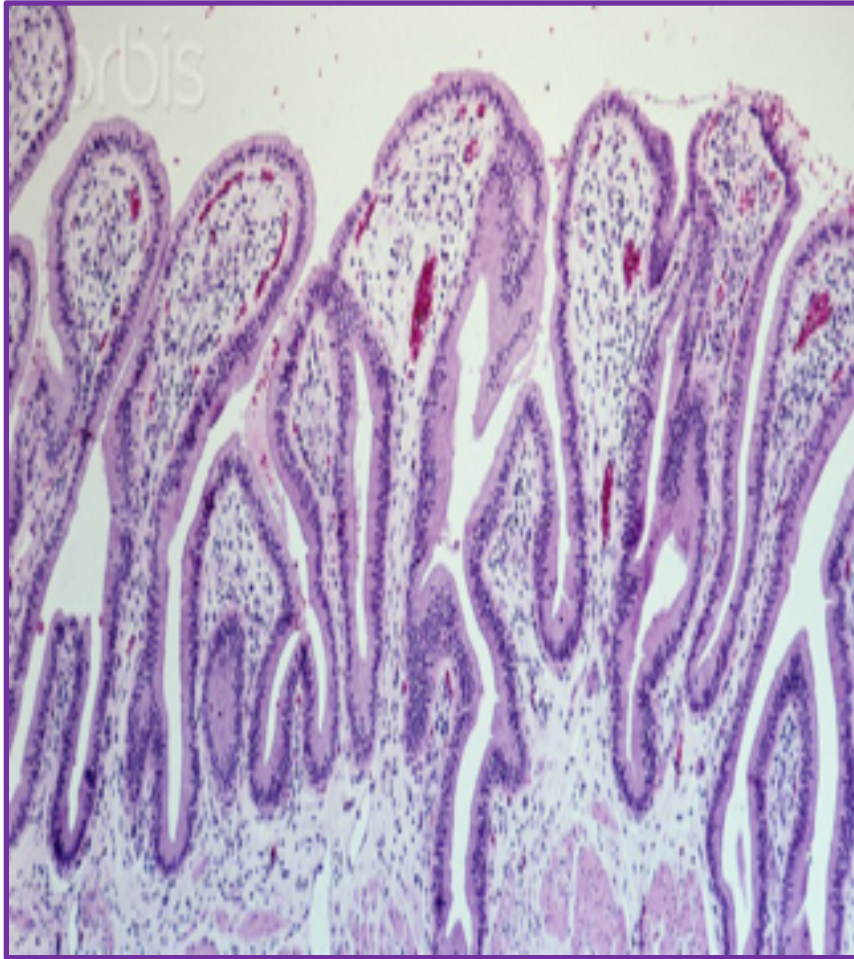


## Gallbladder and Extrahepatic Bile Ducts

Sectioned



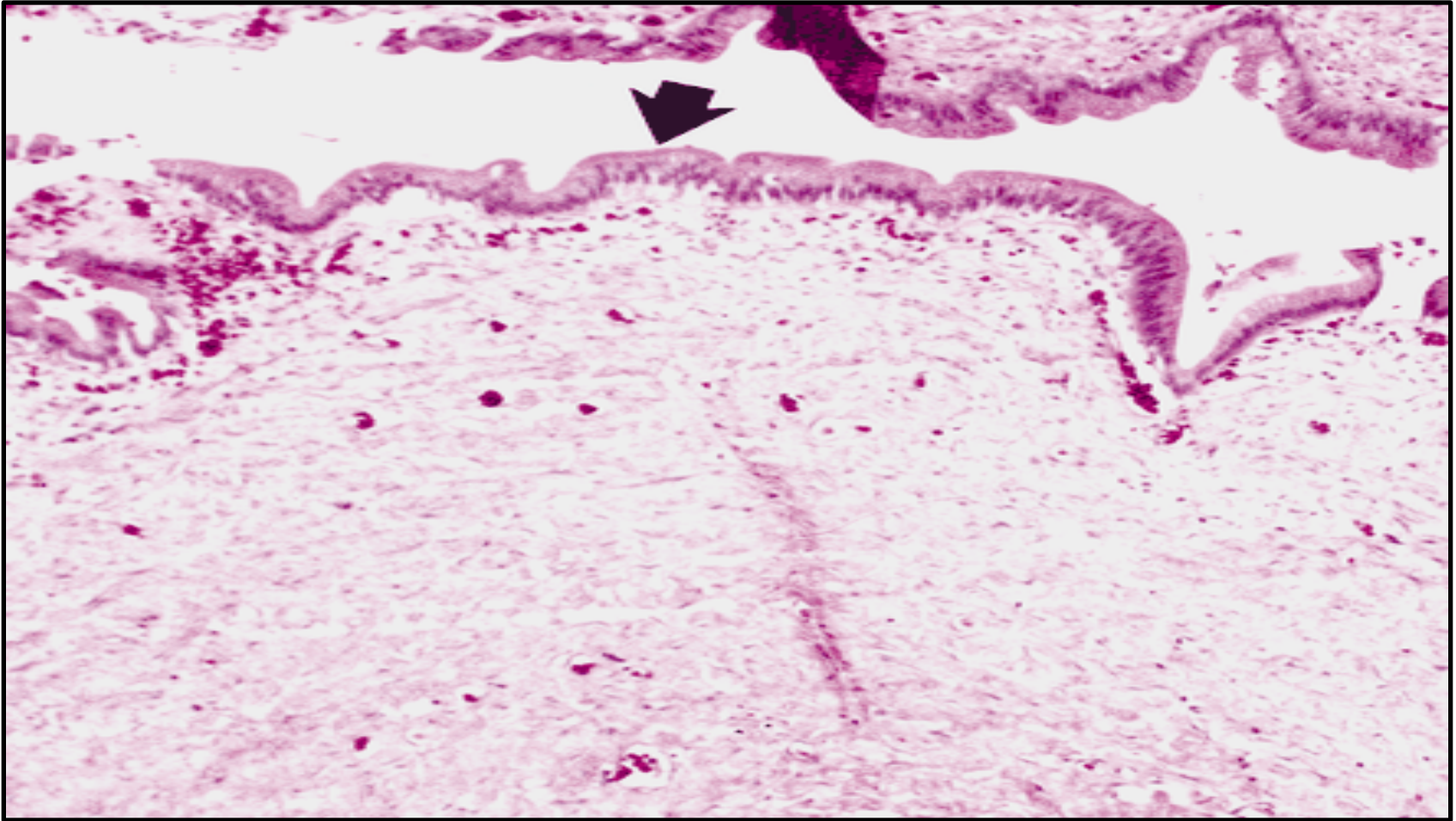
## Histology of Gall Bladder



**The gallbladder is a distensible sac and, when not distended, its mucosa is thrown into many folds. The lumen of the gallbladder is lined with a high columnar epithelium. The connective tissue wall contains abundant elastic fibers and layers of smooth muscle which predominantly run obliquely**



## ***Histology of Extra Hepatic Bile Duct***



***Normal histologic characteristics of the extra-hepatic bile duct. Photomicrograph (H&E stain) shows the epithelium as a single layer of columnar cells (arrow) with an underlying dense connective tissue wall.***

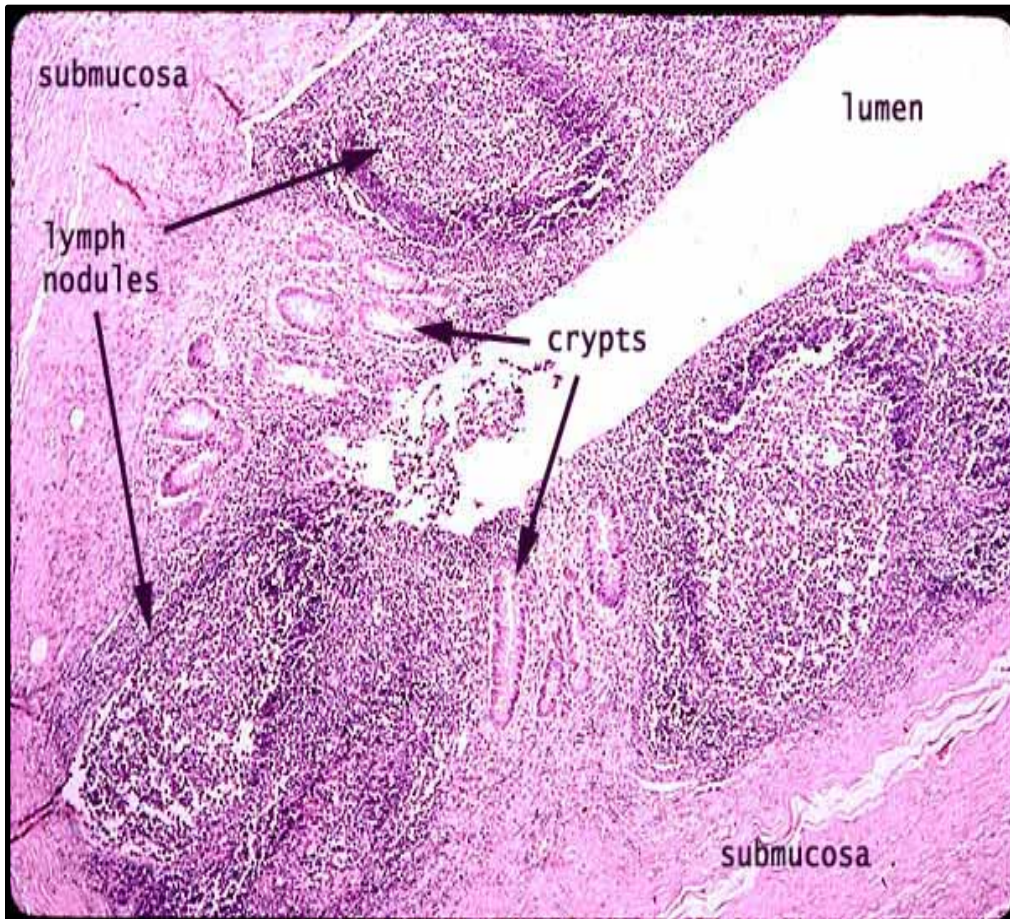
## Normal Appendix - Gross



**The appendix (arrow) is a coiled 8-12 cm tube attached to the caecum, usually located in the right lower abdominal quadrant.**



# Histology of the appendix



***The mucosa of the appendix, like that of the colon, is characterized by straight crypts with no villi. It is also characterized by an abundance of lymphoid tissue, including numerous well-organized lymph nodules.***

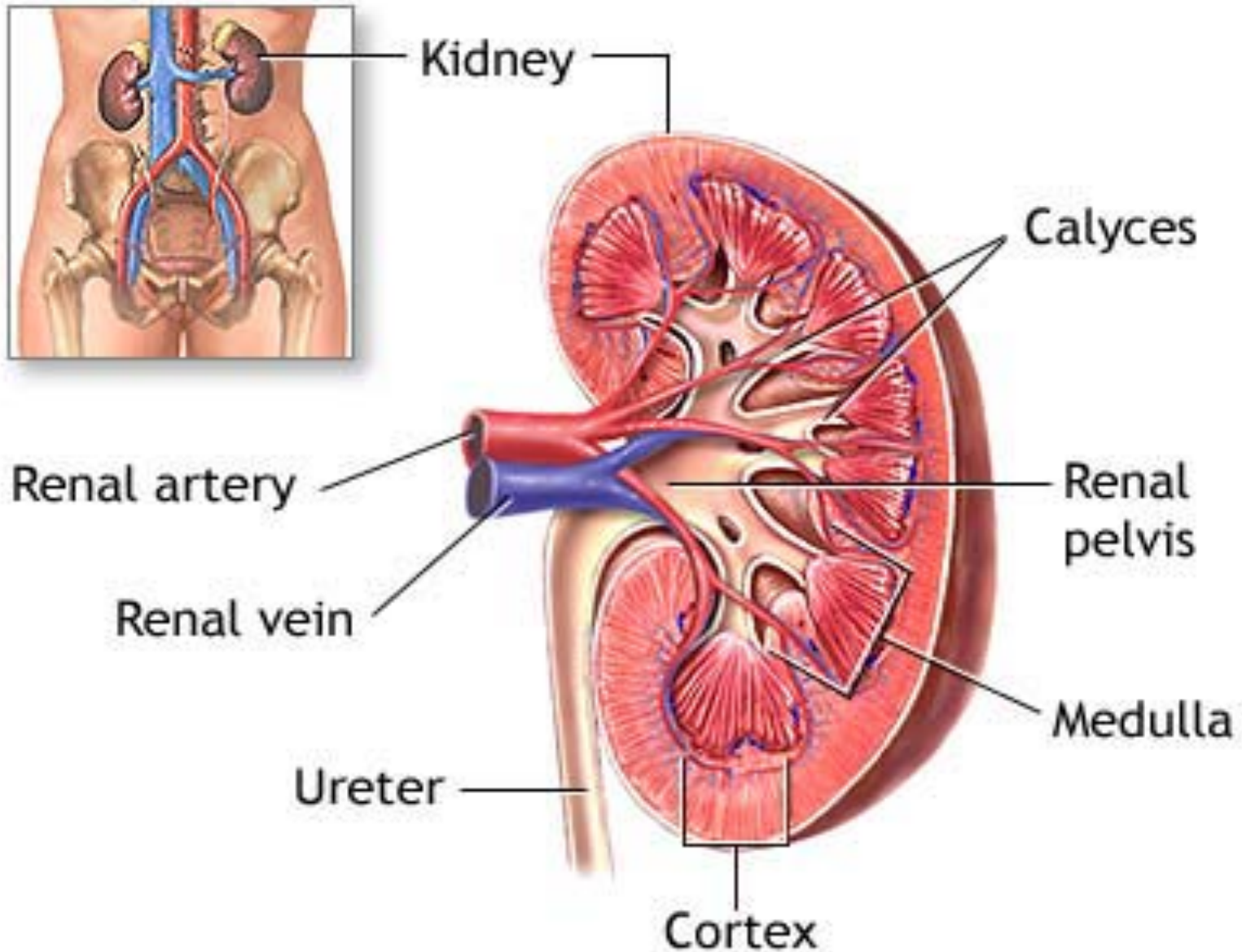
## Normal Kidney - Gross



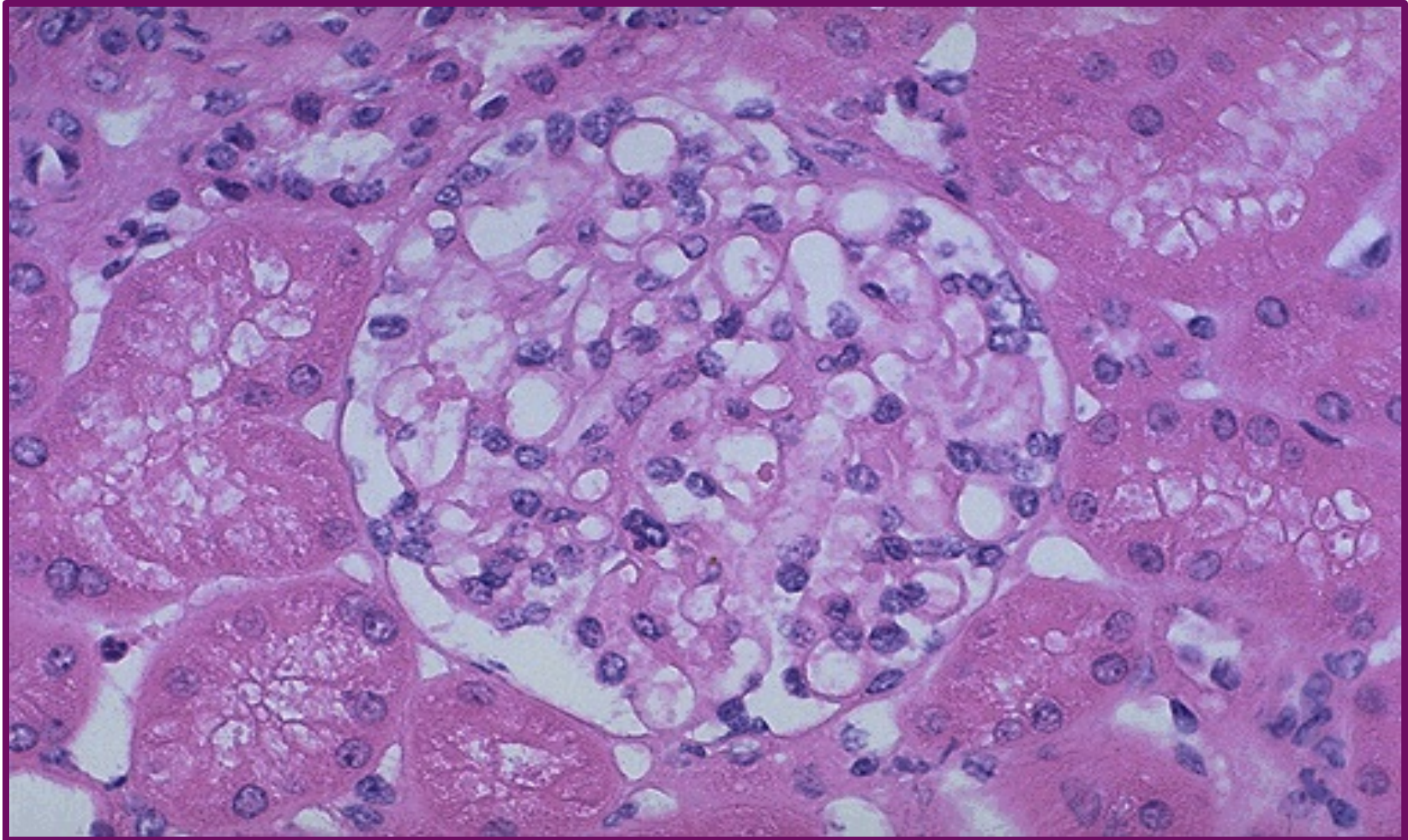
***In cross section, this normal adult kidney demonstrates the lighter outer cortex and the darker medulla, with the renal pyramids into which the collecting ducts coalesce and drain into the calyces and central pelvis.***



# Anatomy of the Kidney



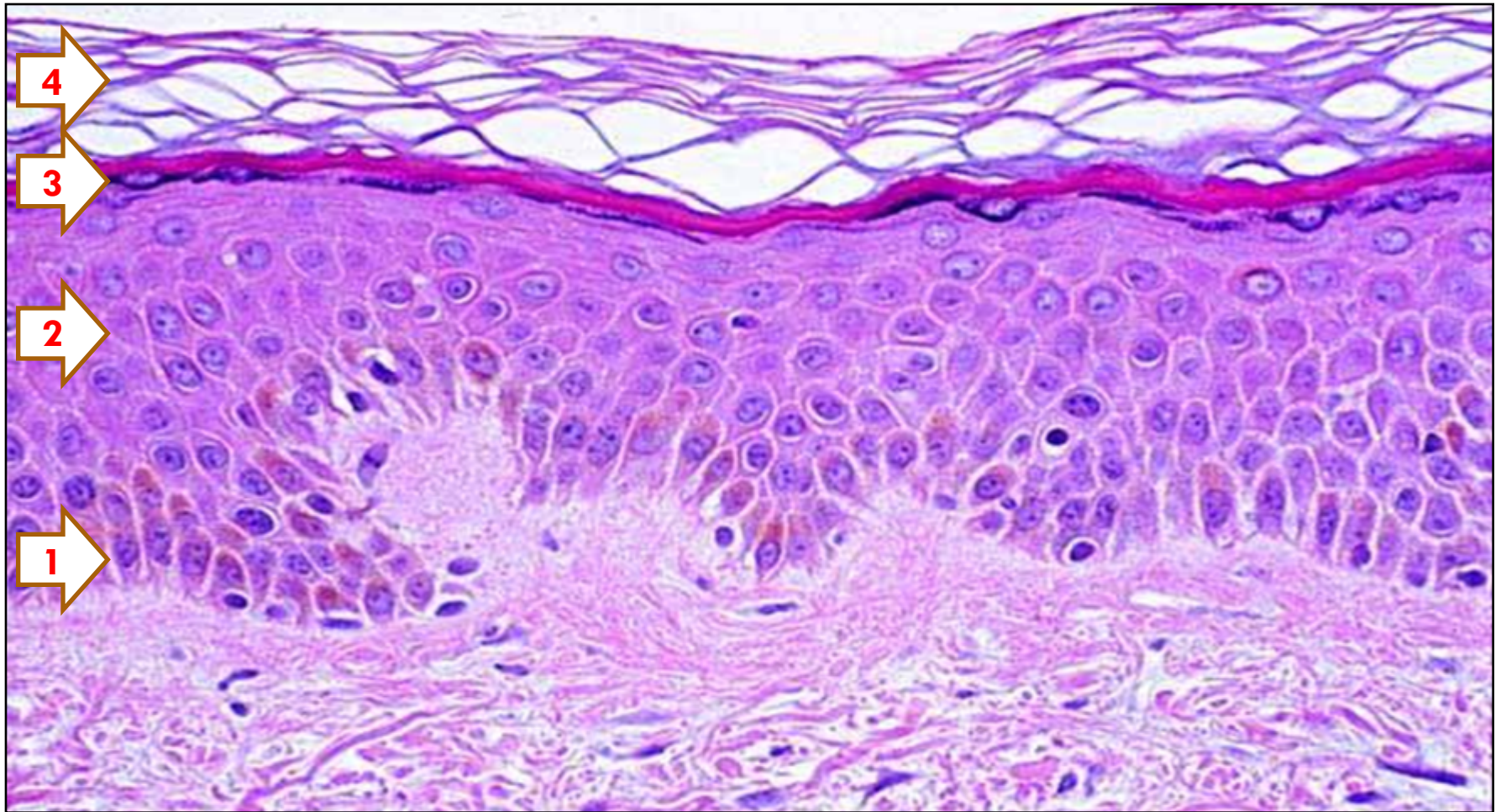
## Renal Corpuscle – Normal Histology



**Normal glomerulus by light microscopy. The glomerular capillary loops are thin and delicate. Endothelial and mesangial cells are normal in number. The surrounding tubules are normal**



# Histology of the SKIN

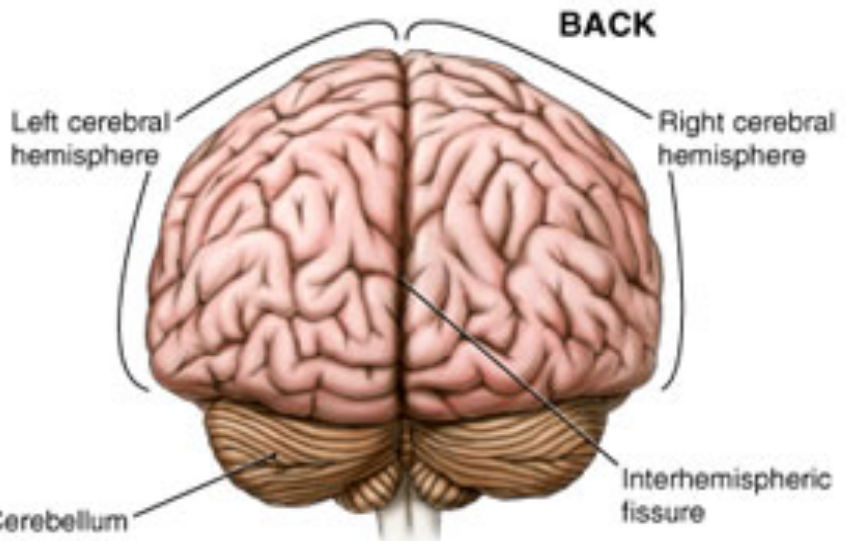
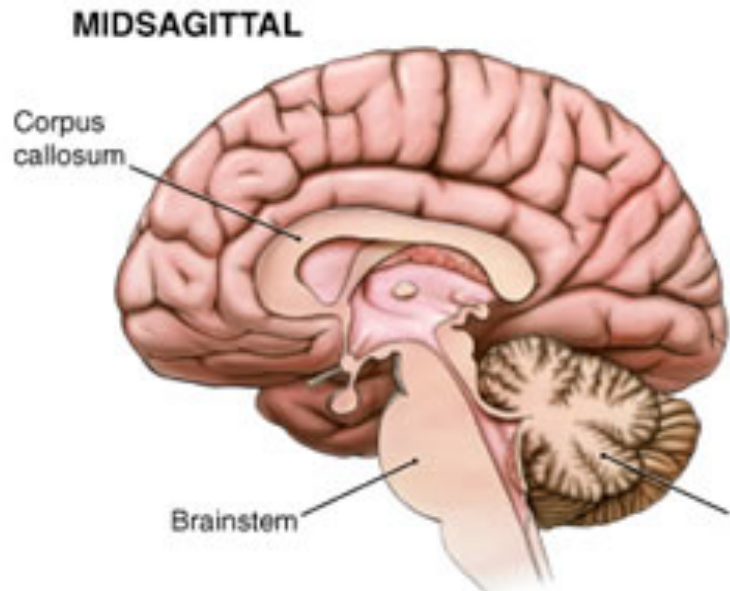
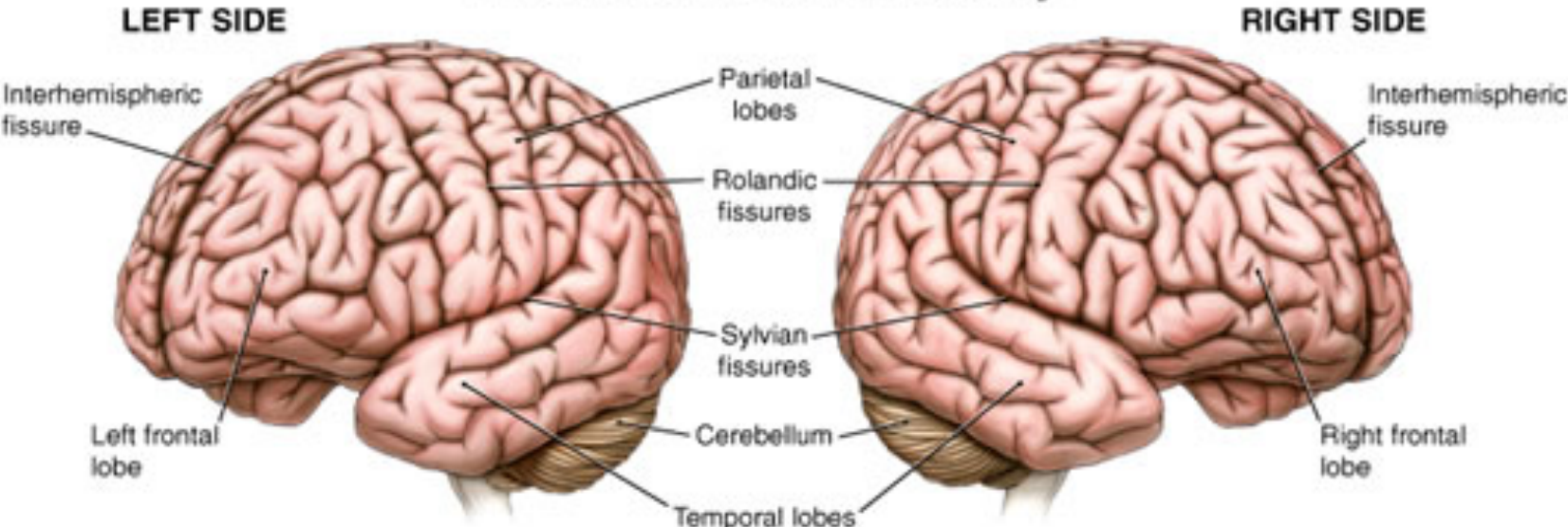


**Normal Skin. Epidermis has 4 layers :**

- 1. Stratum basale**
- 2. Stratum spinosum (cells gain more cytoplasm)**
- 3. Stratum granulosum**
- 4. Stratum corneum (anucleate layer)**

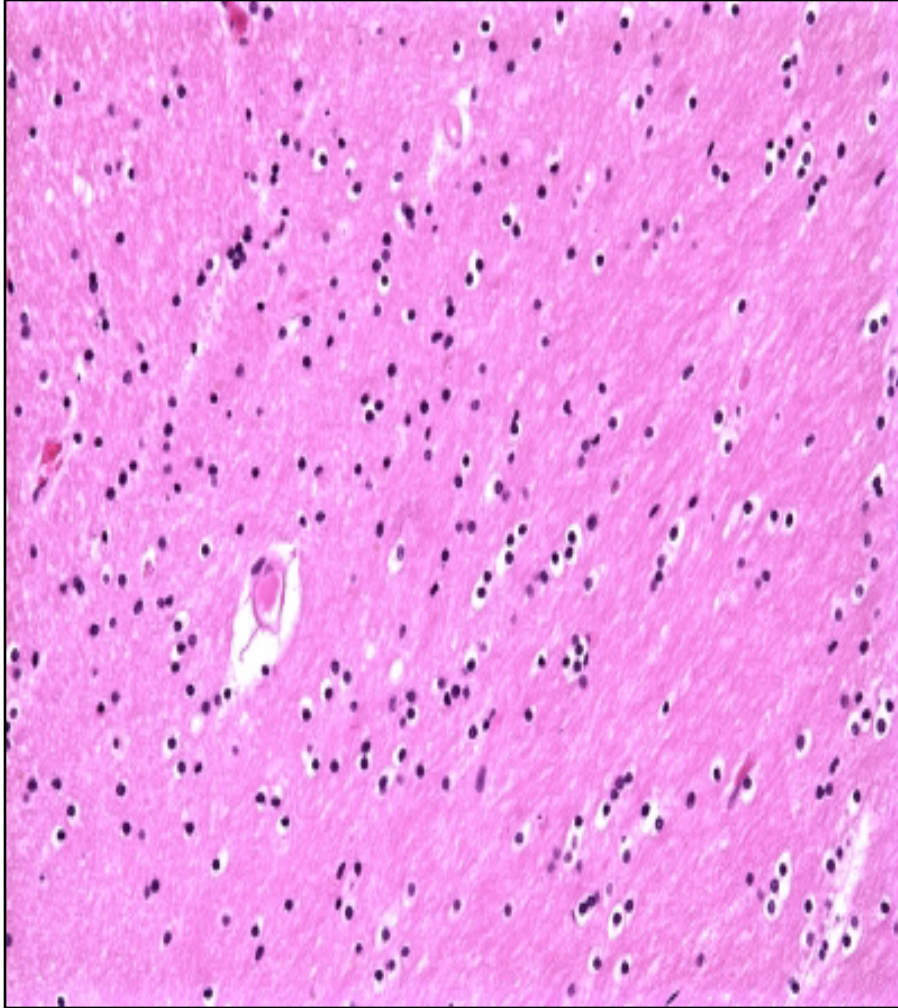
# Anatomy of the Brain

## Brain Surface Anatomy

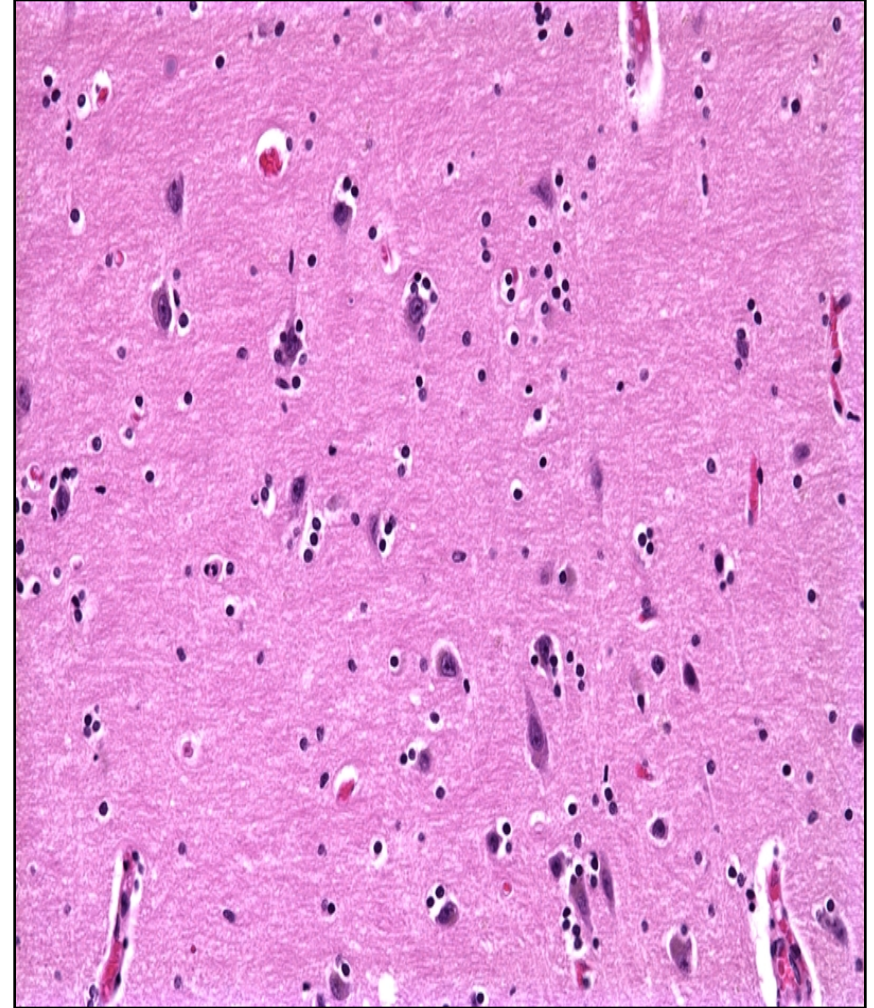




## Histology of the Brain



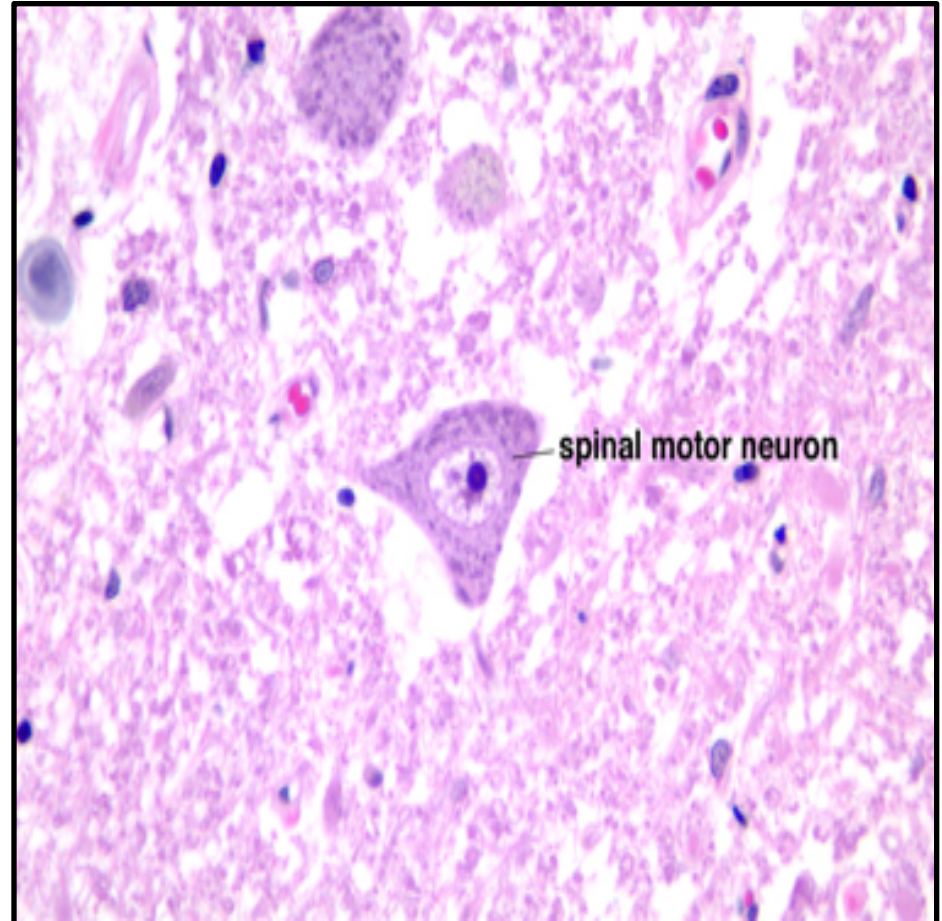
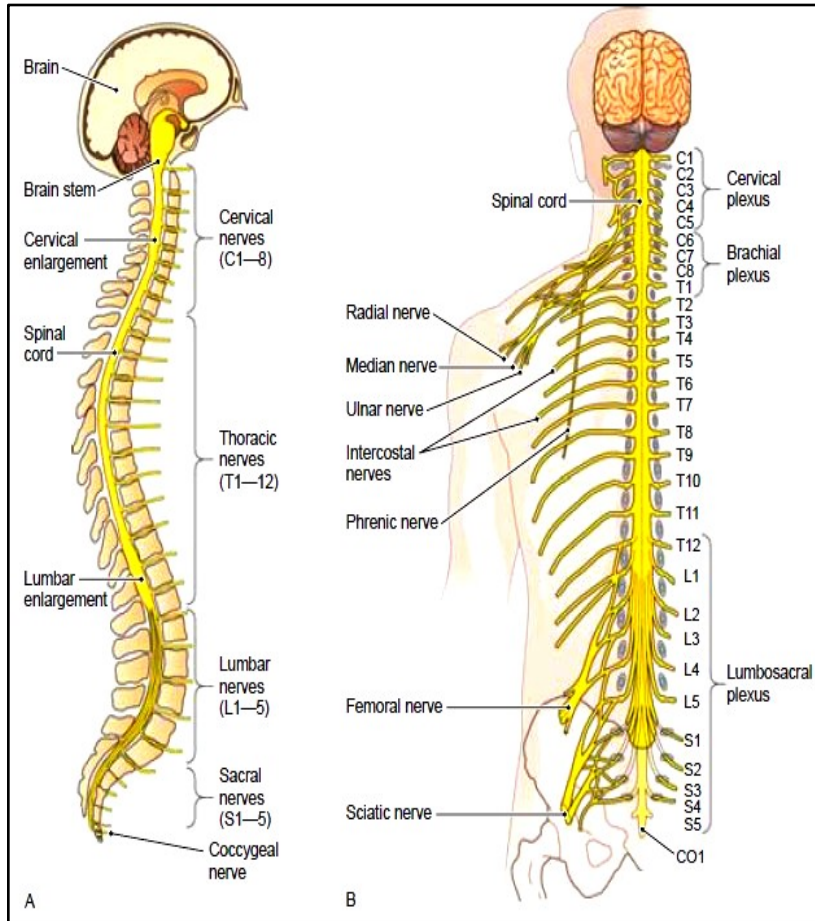
**Normal white matter:** 85% of the cells are oligodendrocytes. Note some tendency for the oligodendrocytes to line up in rows



**Cerebral cortex:** some degree of satellitosis (i.e., oligodendrocytes surrounding neurons) is a normal finding



# Spinal Cord Nerve Branches and Histology



**Spinal motor neuron**, with its prominent nucleolus in the nucleus and the basophilic tigroid appearance of its cytoplasm, which is due to the presence of abundant ribosomes

# ***CELL INJURY***

## ***Gross and Histopathology***

## Cell injury

### □ Pictures of:

1. Fatty change of the liver.
2. Coagulative necrosis in an infarcted kidney, spleen and myocardium.
3. Liquefactive necrosis
4. Caseous necrosis
5. Fibrinoid necrosis
6. Fat necrosis
7. Dystrophic calcification in the aorta, stomach and skin.
8. Atrophy of brain and testis
9. Left ventricular hypertrophy
10. Hyperplasia of the prostate.
11. Squamous metaplasia.

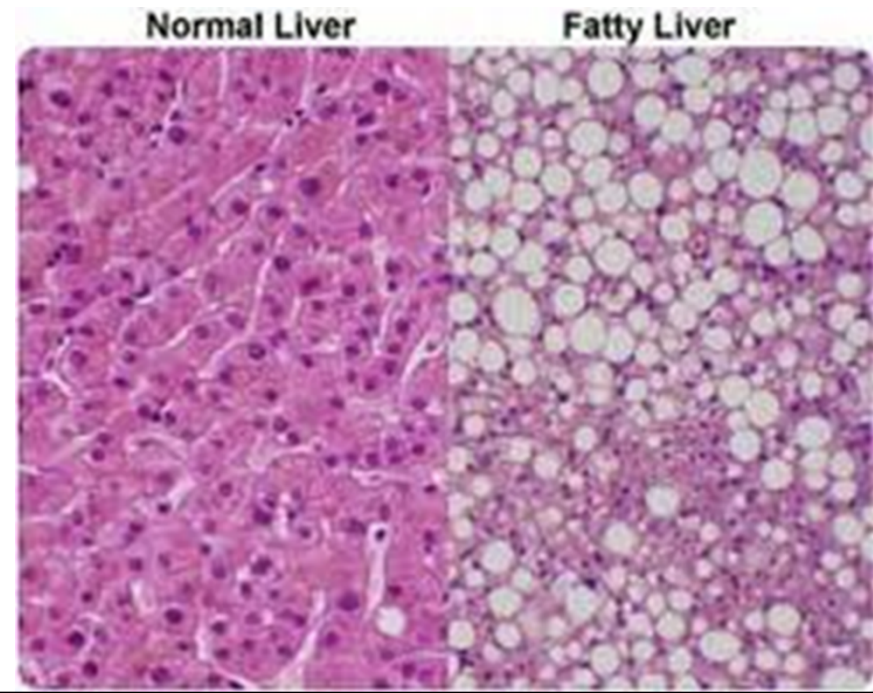
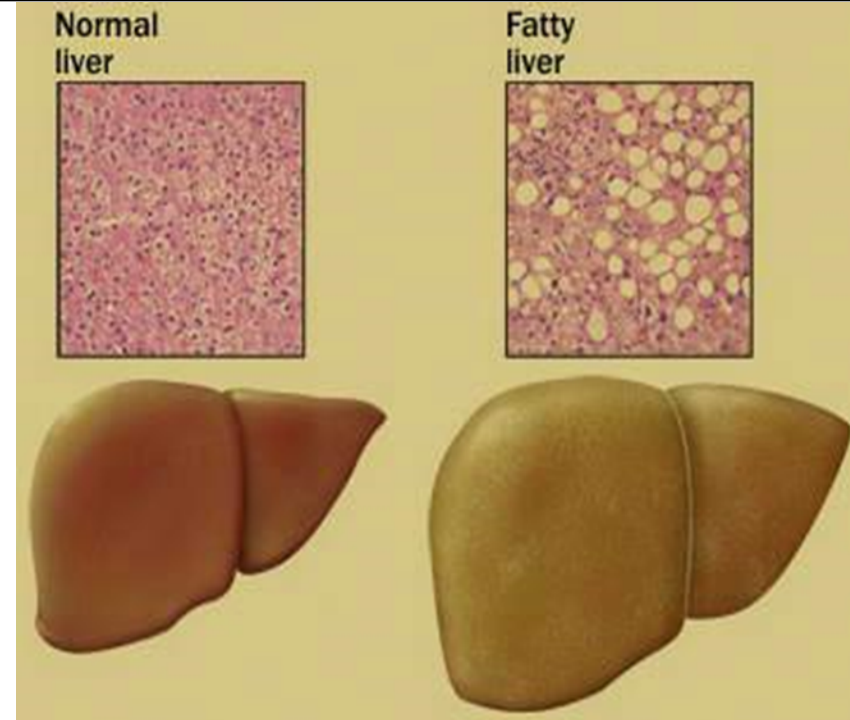


# **1 - FATTY LIVER (STEATOSIS)**

# Steatosis (Fatty Change)

## Morphology of Steatosis in liver:

- **Gross:** In mild cases liver looks normal. In severe cases liver is enlarged, yellow and greasy.
- **Light microscopy:** clear vacuoles in the cytoplasm displacing the nucleus to the periphery of the cell. Occasionally, cells rupture, and the fat globules merge, producing a so-called fatty cysts. The lipid stains orange-red with Sudan IV or Oil Red-O stains



## Normal Liver & Cut Section of Fatty Liver



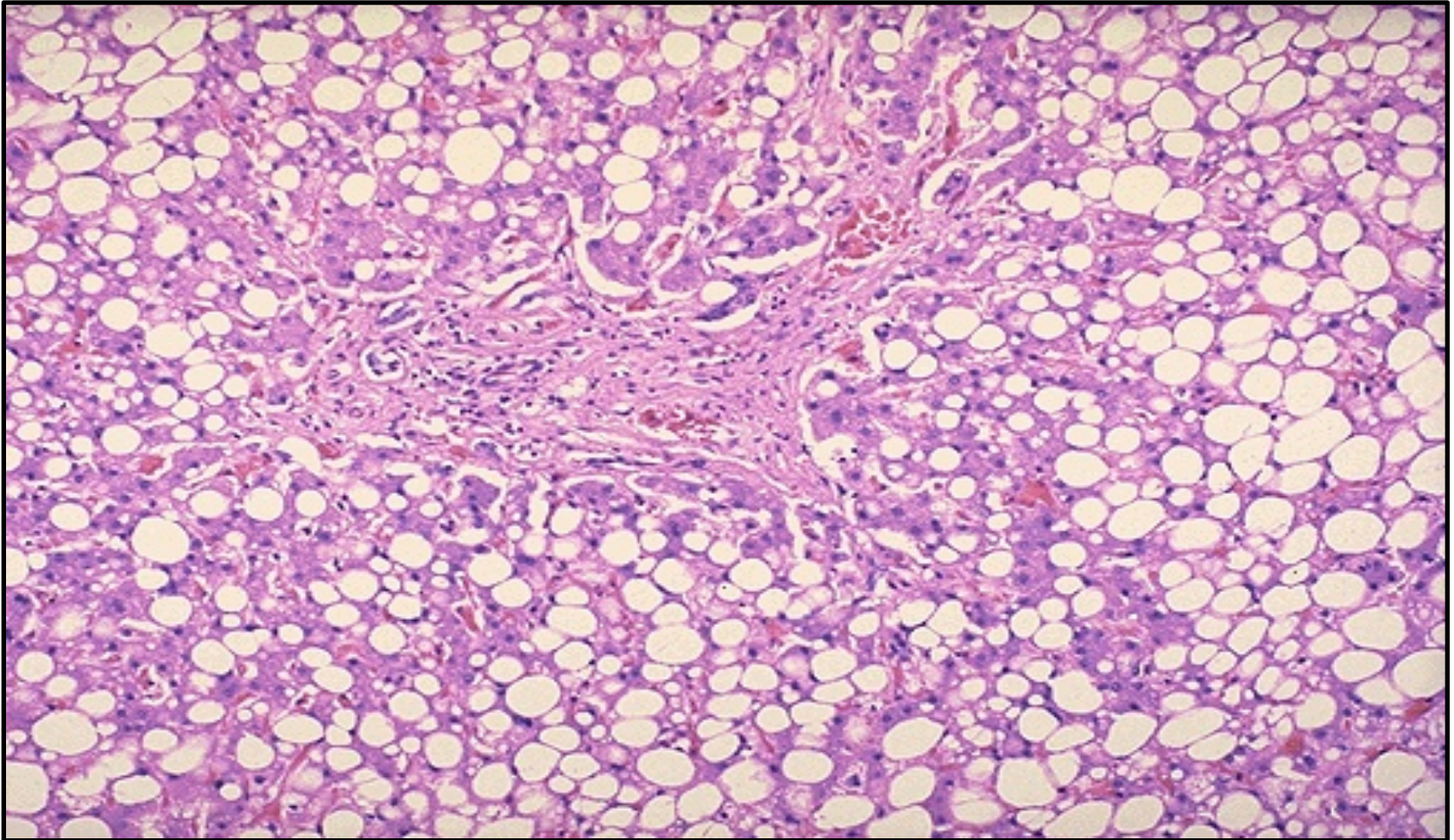
**Normal Liver** : This is the external surface of a normal liver. The color is brown and the surface is smooth



**Steatosis** : This liver is slightly enlarged and has a pale yellow appearance, seen both on the capsule and cut surface



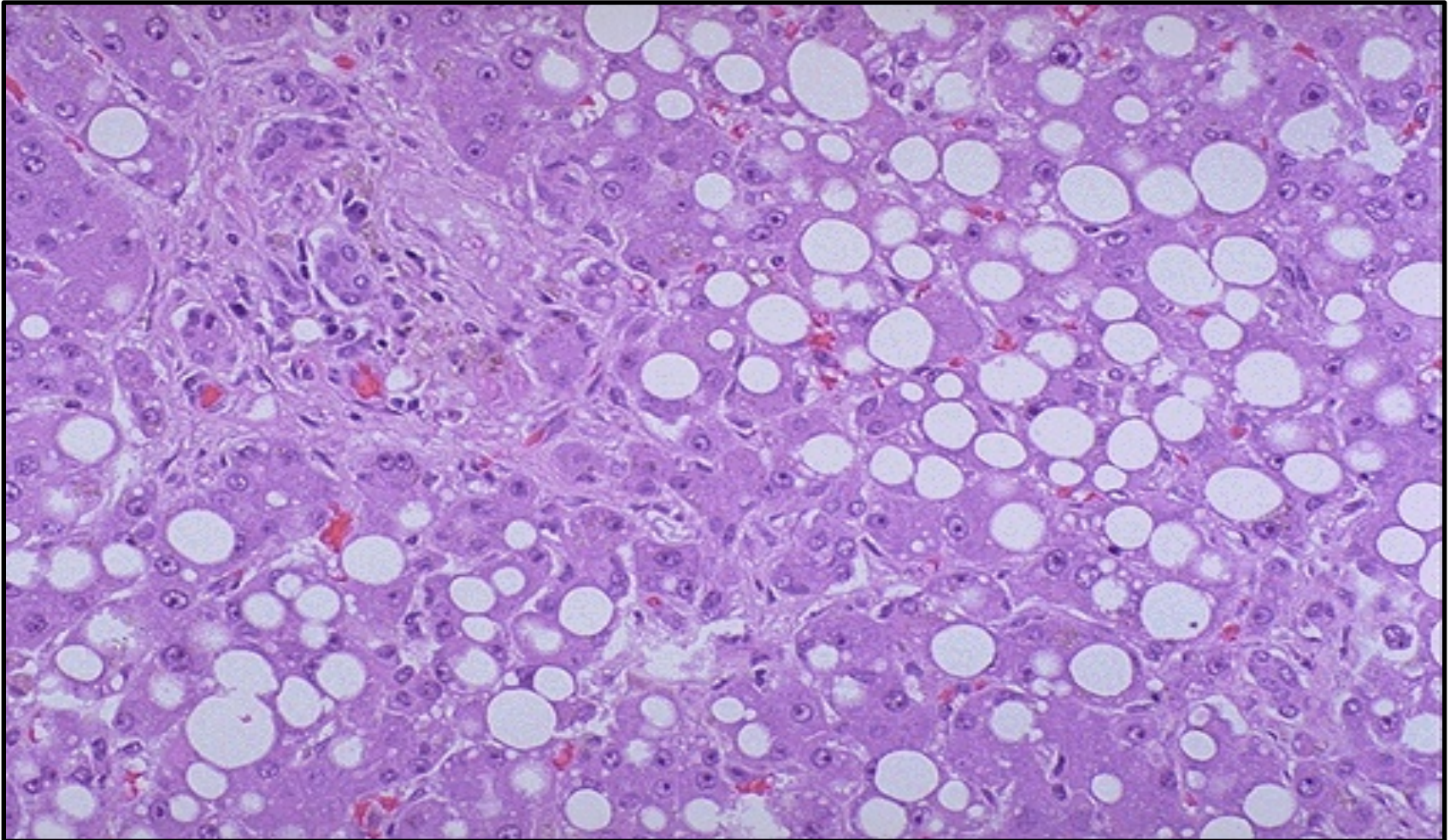
## Steatosis – Fatty Liver



***This is the histologic appearance of hepatic fatty change. The lipid accumulates in the hepatocytes as vacuoles. These vacuoles have a clear appearance with H&E staining. The most common cause of fatty change in developed nations is alcoholism.***



## **Steatosis – Fatty Liver**

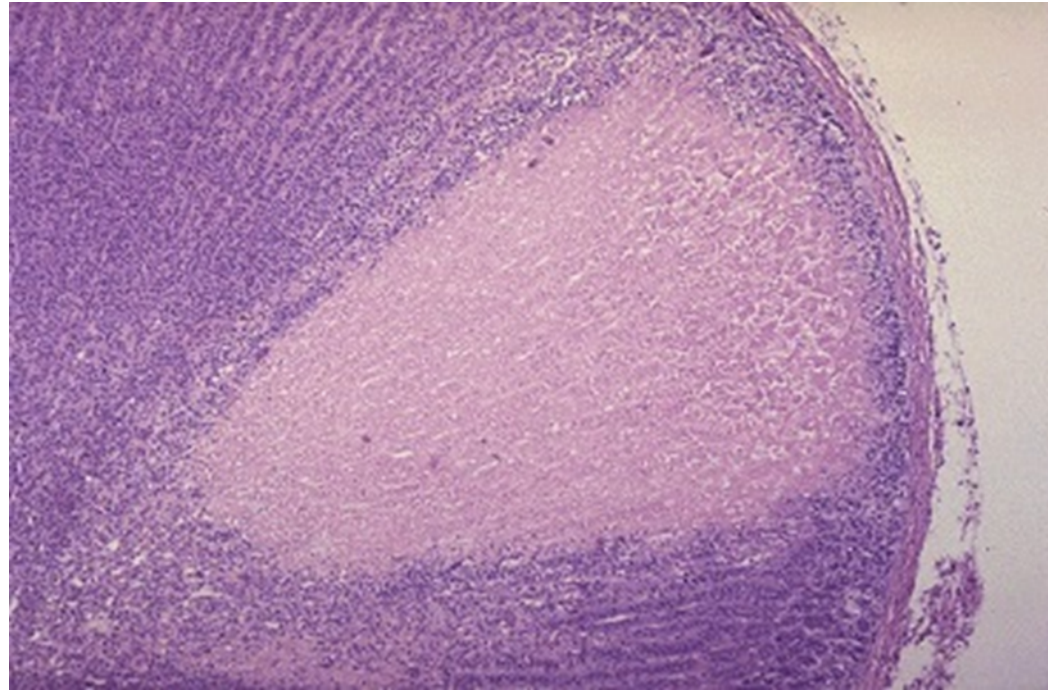


**Here are seen the lipid vacuoles within hepatocytes.  
The lipid accumulates when lipoprotein transport is disrupted and/or when  
fatty acids accumulate.  
Alcohol is the most common cause**

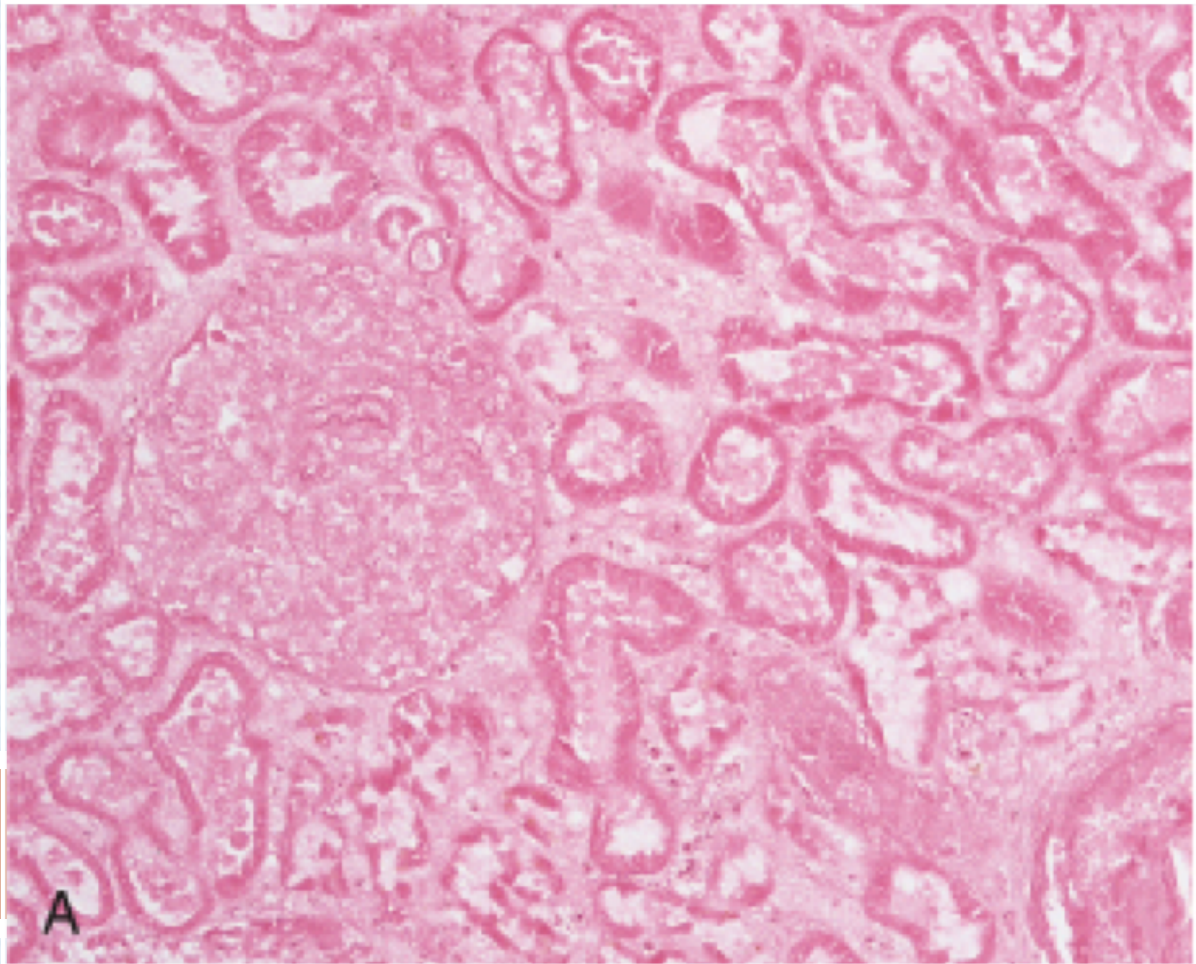
# 2- COAGULATIVE NECROSIS



## Coagulative Necrosis of the Kidney



***A typical pattern with ischemia and infarction of the kidney. Here, there is a wedge-shaped pale area of coagulative necrosis (infarction) in the renal cortex of the kidney.***

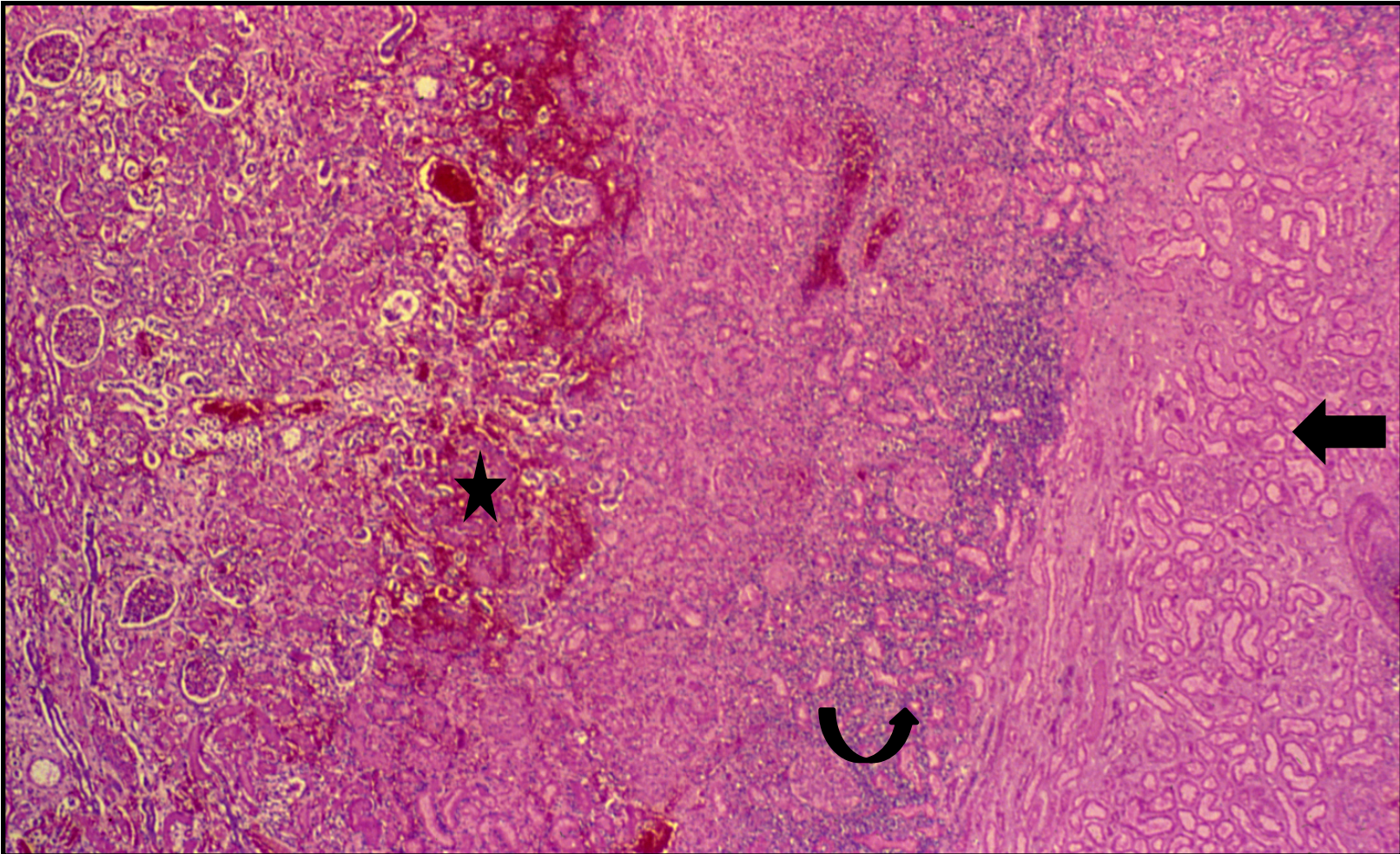


**Kidney:  
coagulative  
necrosis**

Micro: Cell outlines are preserved (cells look ghostly), and everything looks red



## Coagulative Necrosis of the Kidney - LPF



**Coagulative necrosis (arrow) of glomeruli, tubules and interstitial tissue with loss of cell nuclei. The haemorrhagic zone (star) at the periphery of the infarct (arrow) shows dilated and congested blood vessels and cellular infiltrate by neutrophils, red blood cells and lymphocytes (curved arrow)**



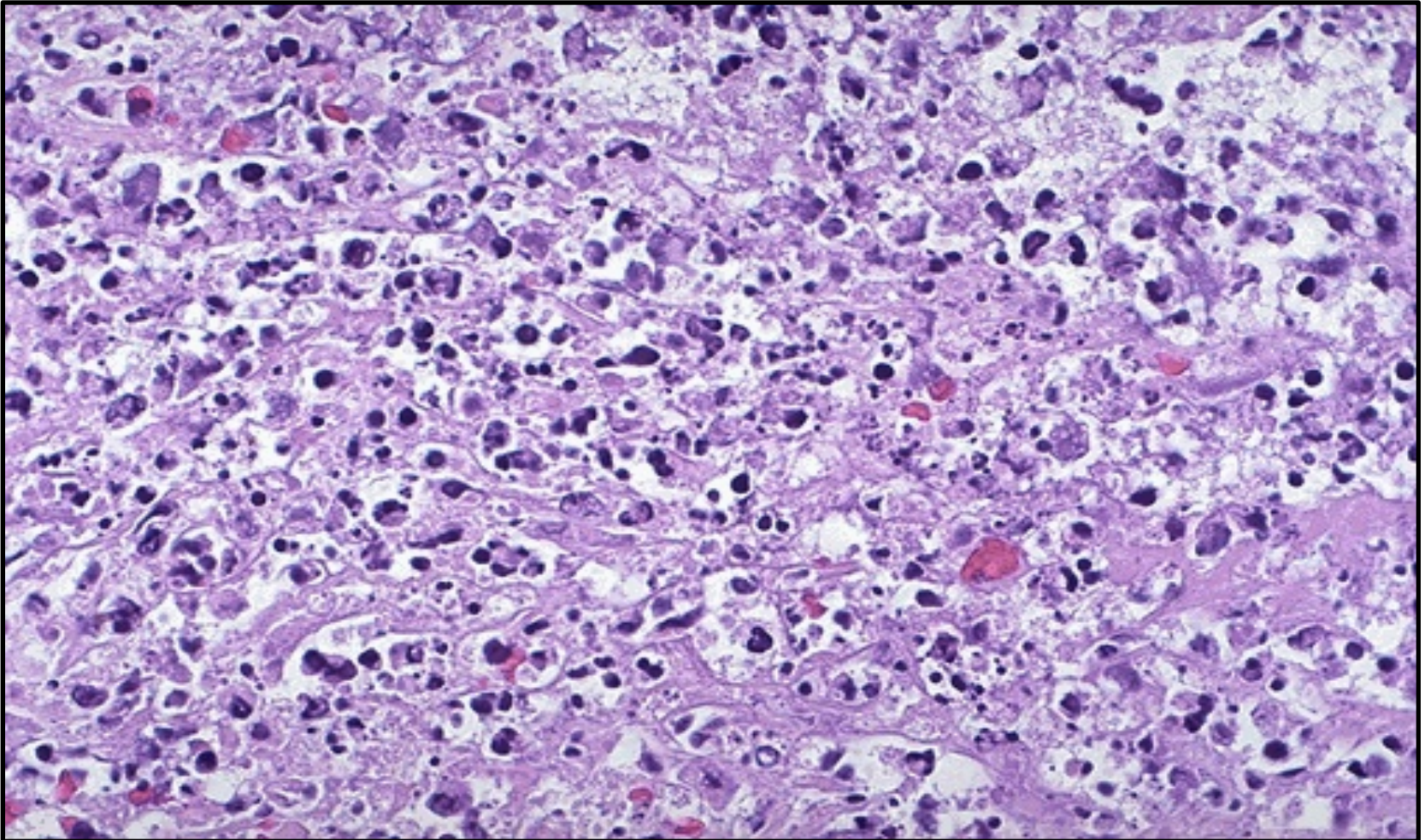
## Coagulative Necrosis of the Spleen



**Two large infarctions (areas of coagulative necrosis) are seen in this sectioned spleen**



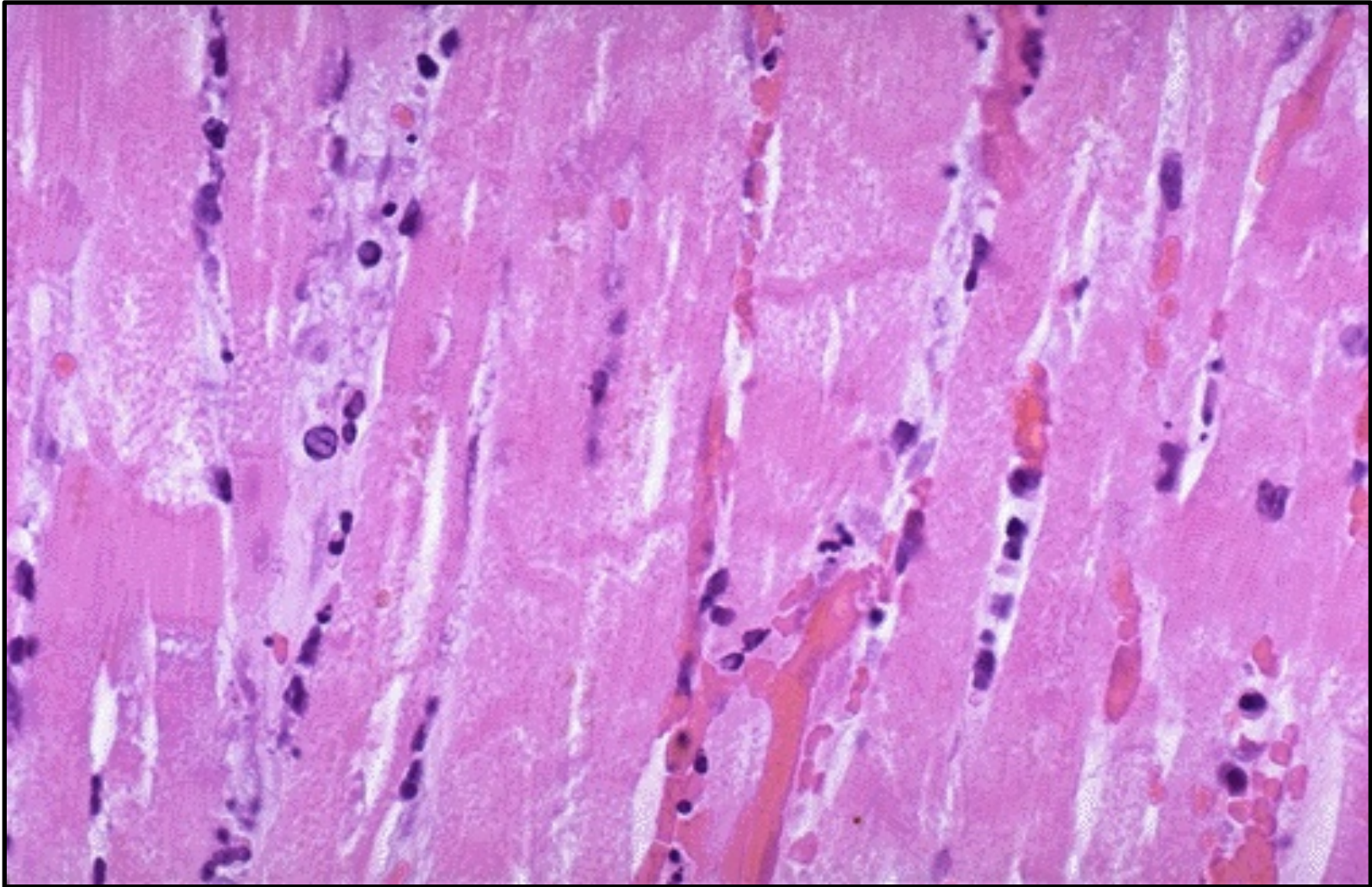
## Coagulative Necrosis of Infarcted Myocardium



**Many nuclei have become pyknotic (shrunken and dark) and have then undergone karyorrhexis (fragmentation) and karyolysis (dissolution). The cytoplasm and cell borders are not recognizable.**



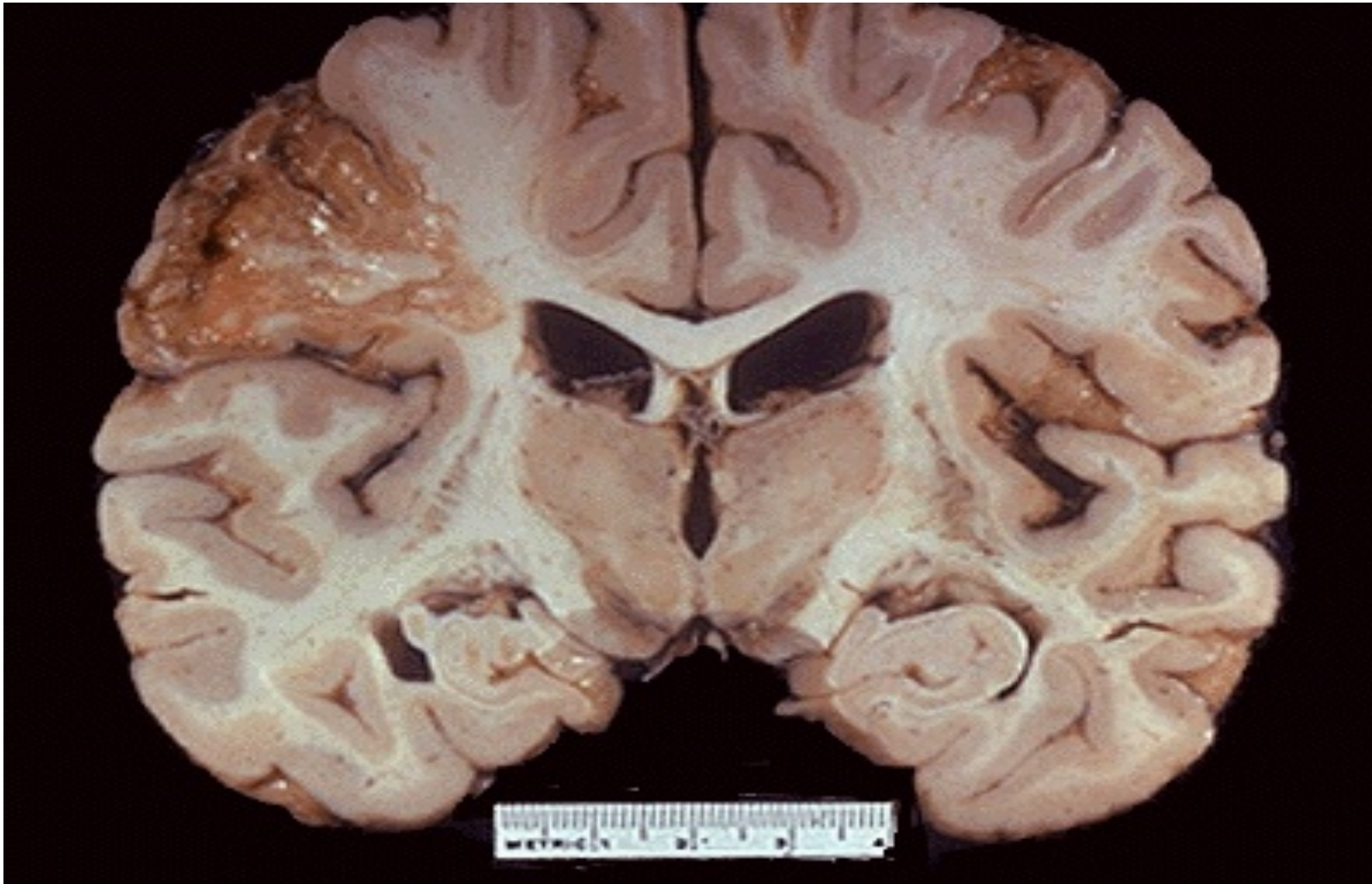
## Coagulative Necrosis of Infarcted Myocardium



**The nuclei of the myocardial fibers are being lost.  
The cytoplasm is losing its structure, because no well-defined cross-striations  
are seen.**

# 3- LIQUEFACTIVE NECROSIS

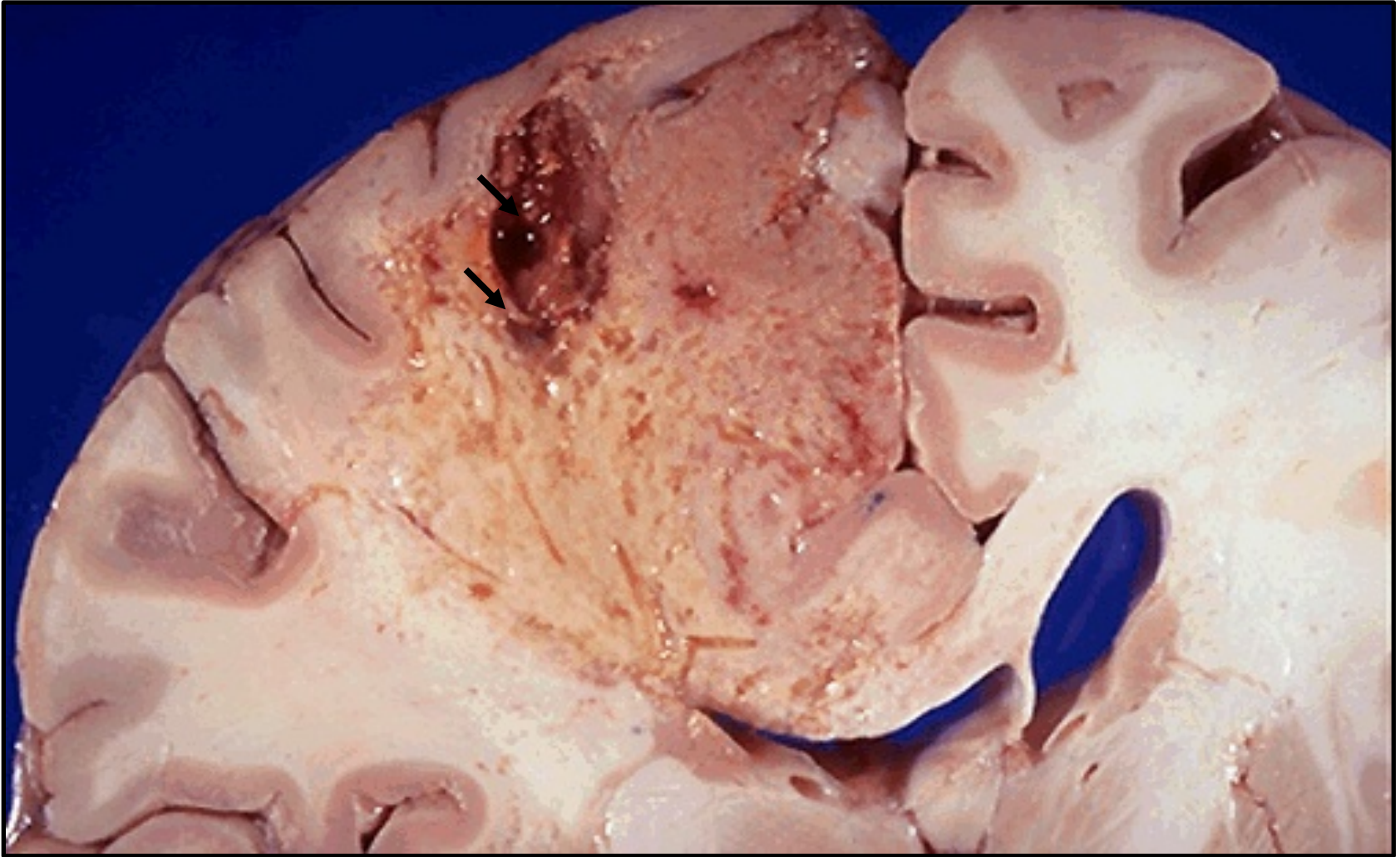
## Liquefactive Necrosis of the Brain



***Grossly, the cerebral infarction at the upper left here demonstrates liquefactive necrosis. Eventually, the removal of the dead tissue leaves behind a cavity.***

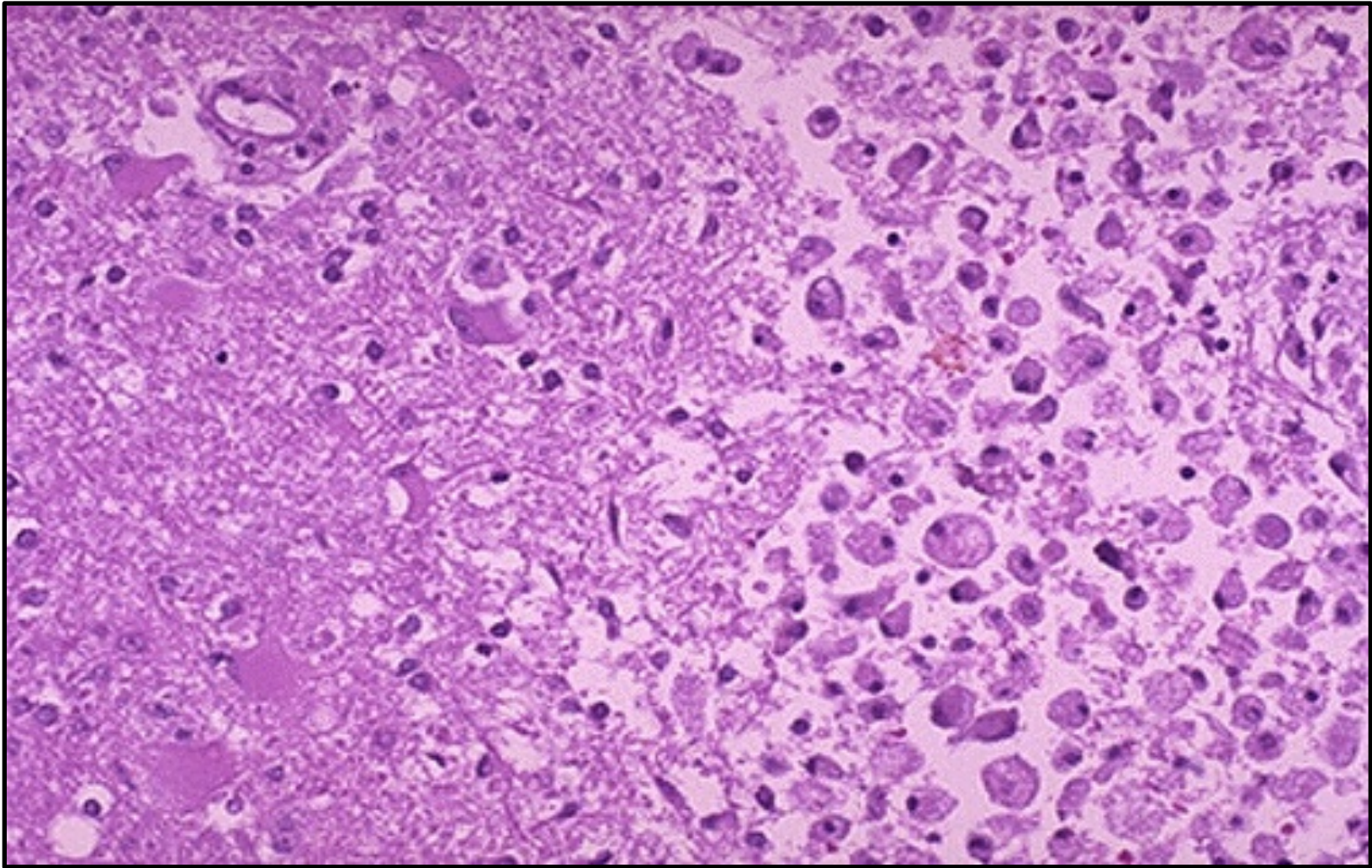


## Liquefactive Necrosis of the Brain



**Liquefactive necrosis in brain leads to resolution with cystic spaces. The necrotic area is found in the upper left quadrant of the visual field.**

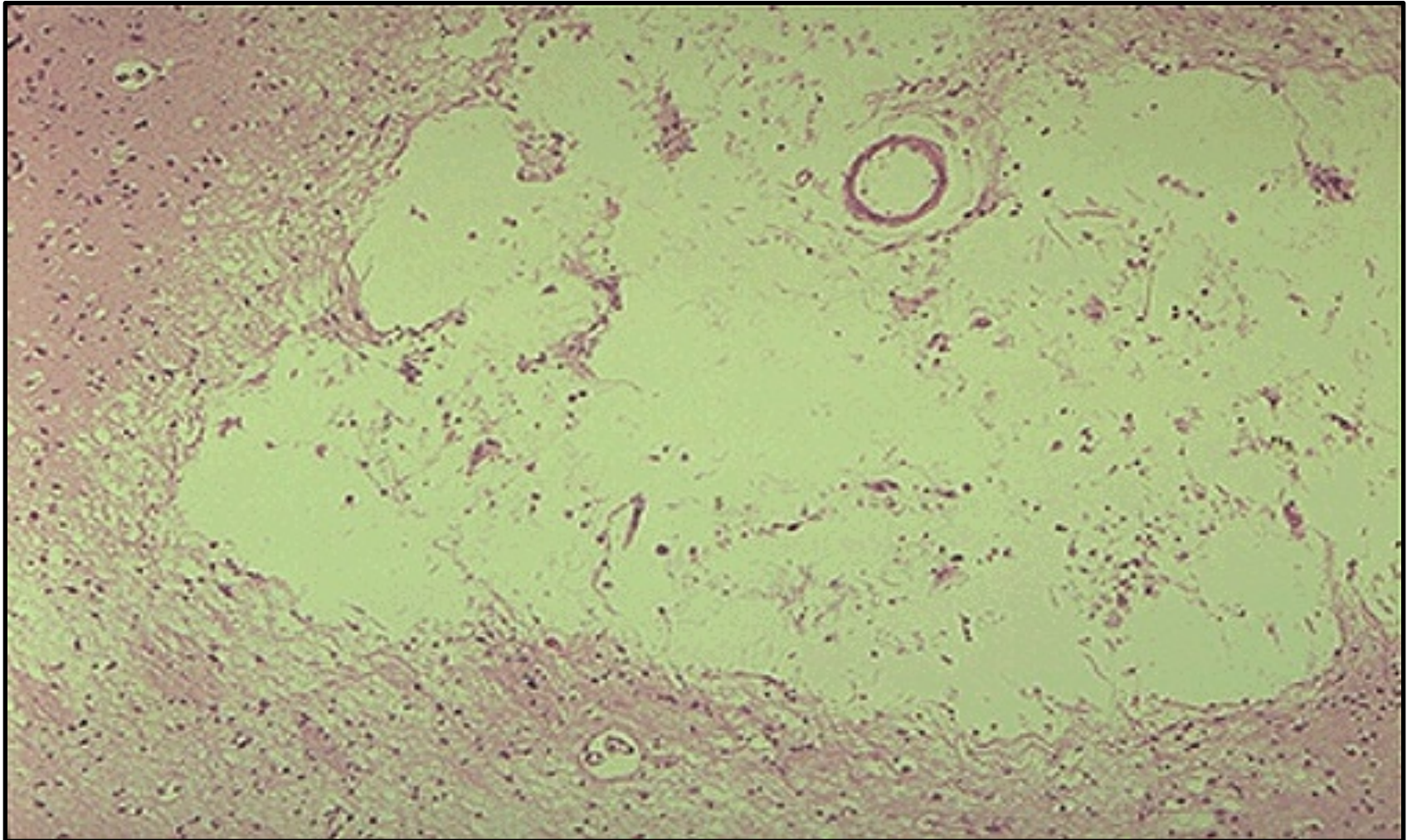
## Liquefactive Necrosis of the Brain



***This cerebral infarction demonstrates the presence of many macrophages at the right which are cleaning up the lipid debris from the liquefactive necrosis.***



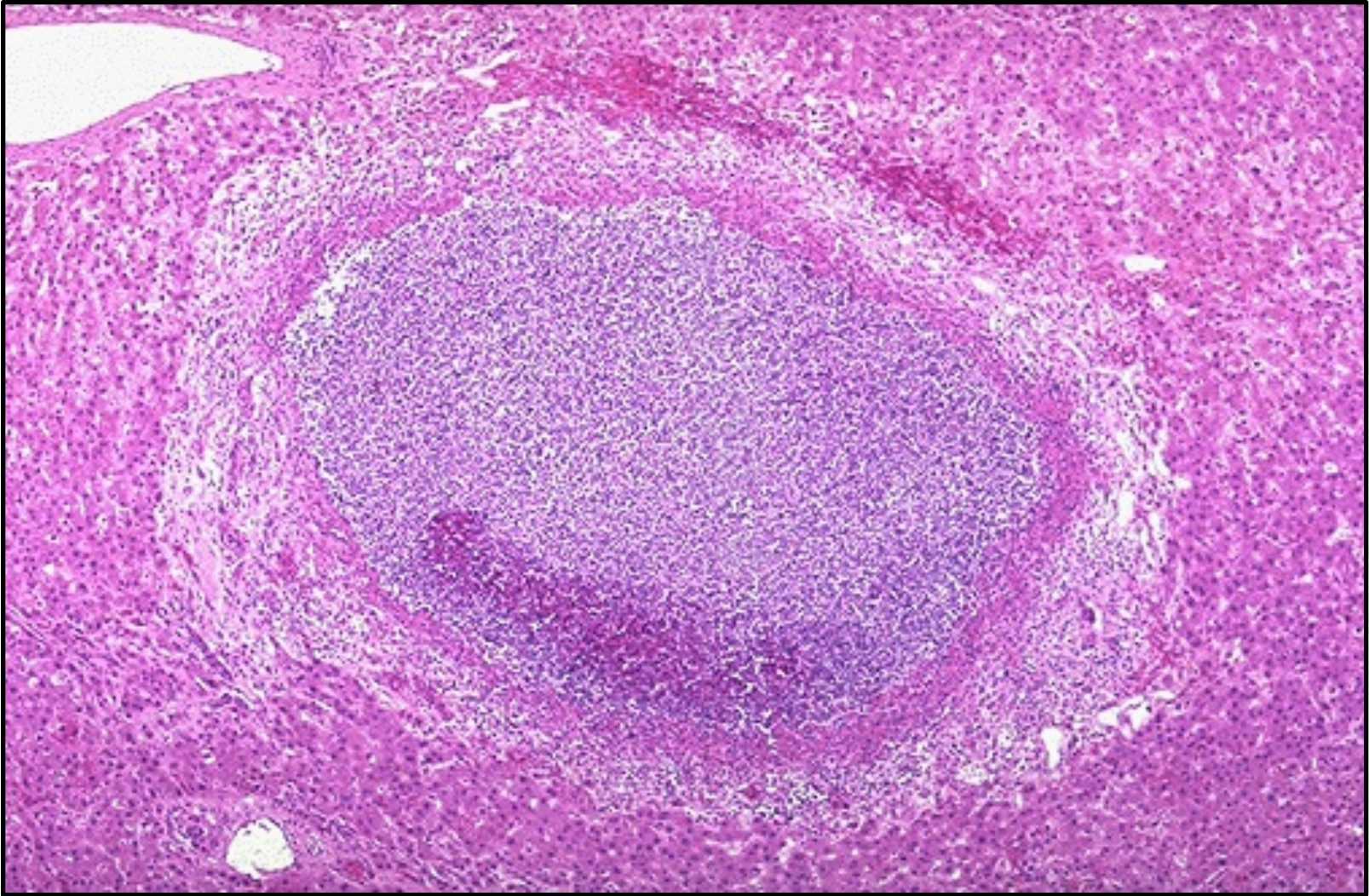
## Liquefactive Necrosis of the Brain



***This is the microscopic appearance of a lacunar infarct. Note that it is a cystic space from the resolved liquefactive necrosis. There can be hemosiderin pigment from hemorrhage as well.***



## Liquefactive Necrosis - Liver Abscess



***The liver shows a small abscess here filled with many neutrophils. This abscess is an example of localized liquefactive necrosis***

# 4- CASEOUS NECROSIS



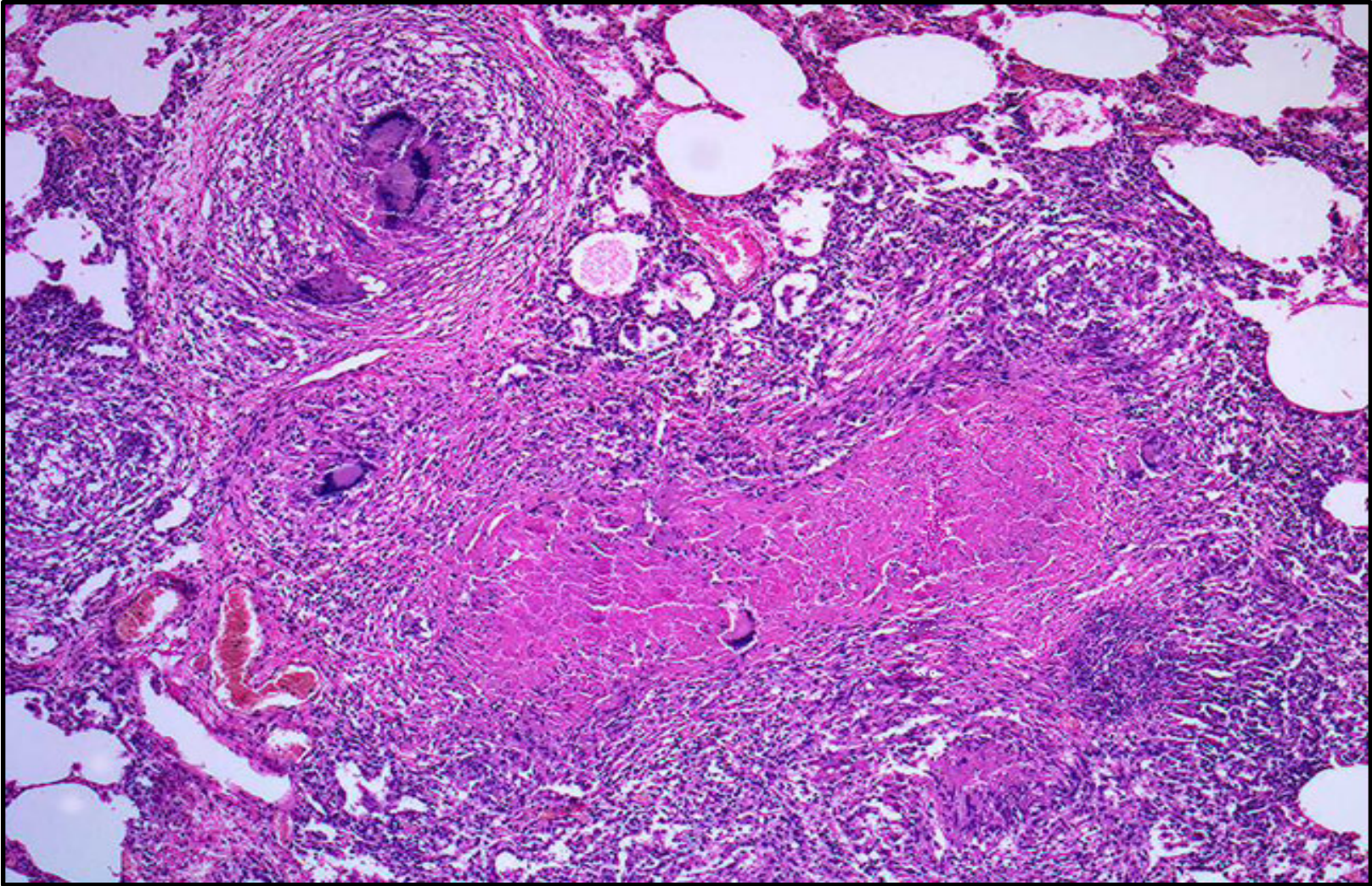
## **Caseous Necrosis of the Lung “ TB. Lung”**



***Tuberculosis of the lung, with a large area of caseous necrosis containing yellow-white and cheesy debris***



## **T.B. Granuloma with Central Caseous Necrosis**

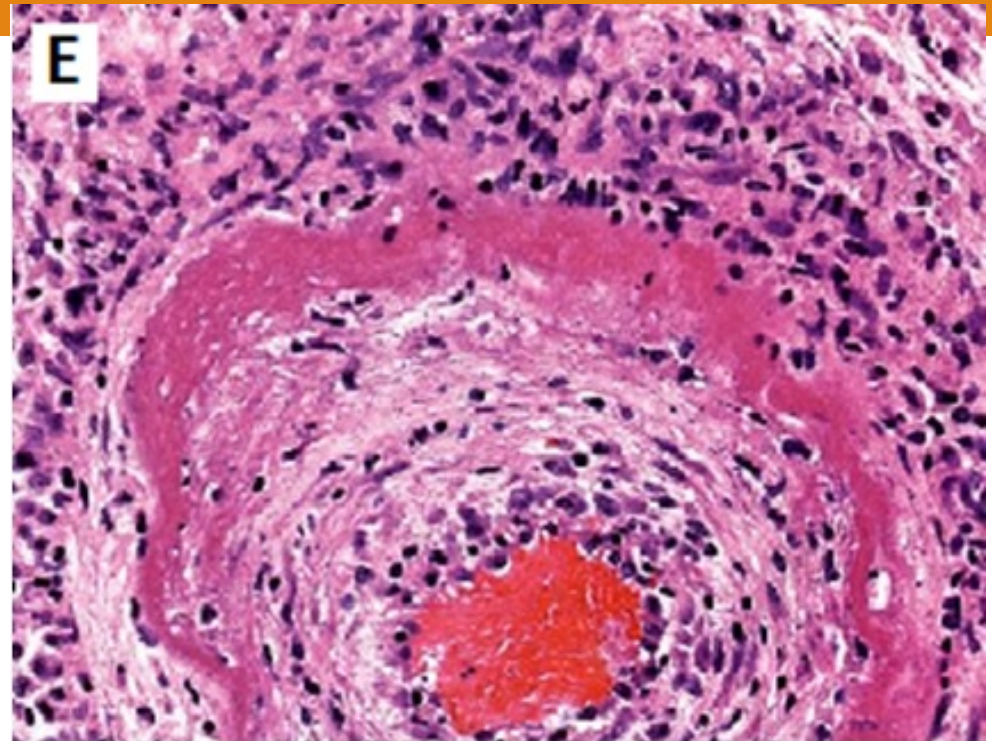


**Multiple caseating granulomas with giant cells and caseous necrosis. Note preserved alveolar spaces at the margins of the field.**

# ***5 – FIBRINOID NECROSIS***

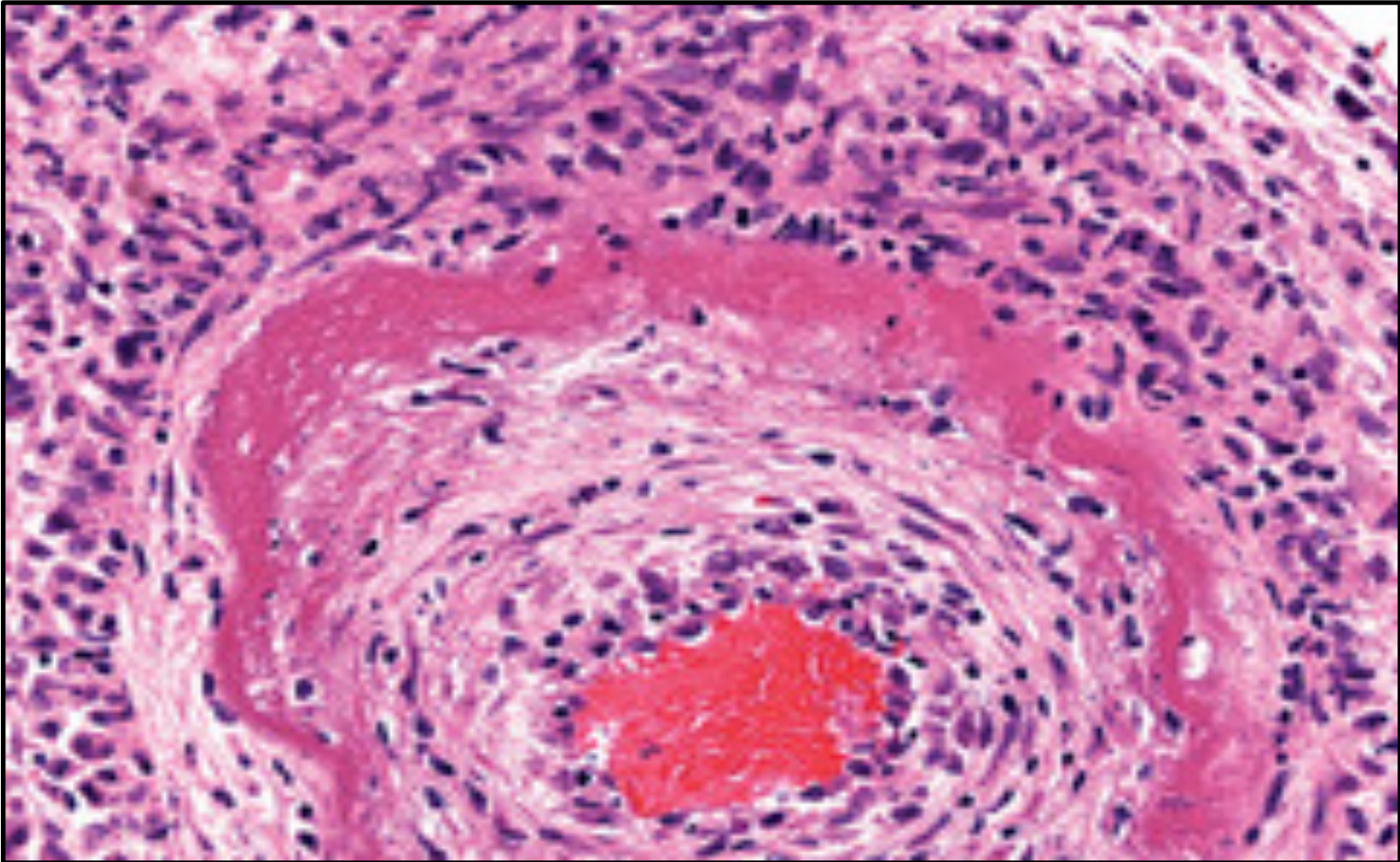


# Fibrinoid necrosis



Fibrinoid necrosis in an artery. The wall of the artery is bright pink with dark neutrophils

## *Fibrinoid Necrosis of an Artery - HPF*

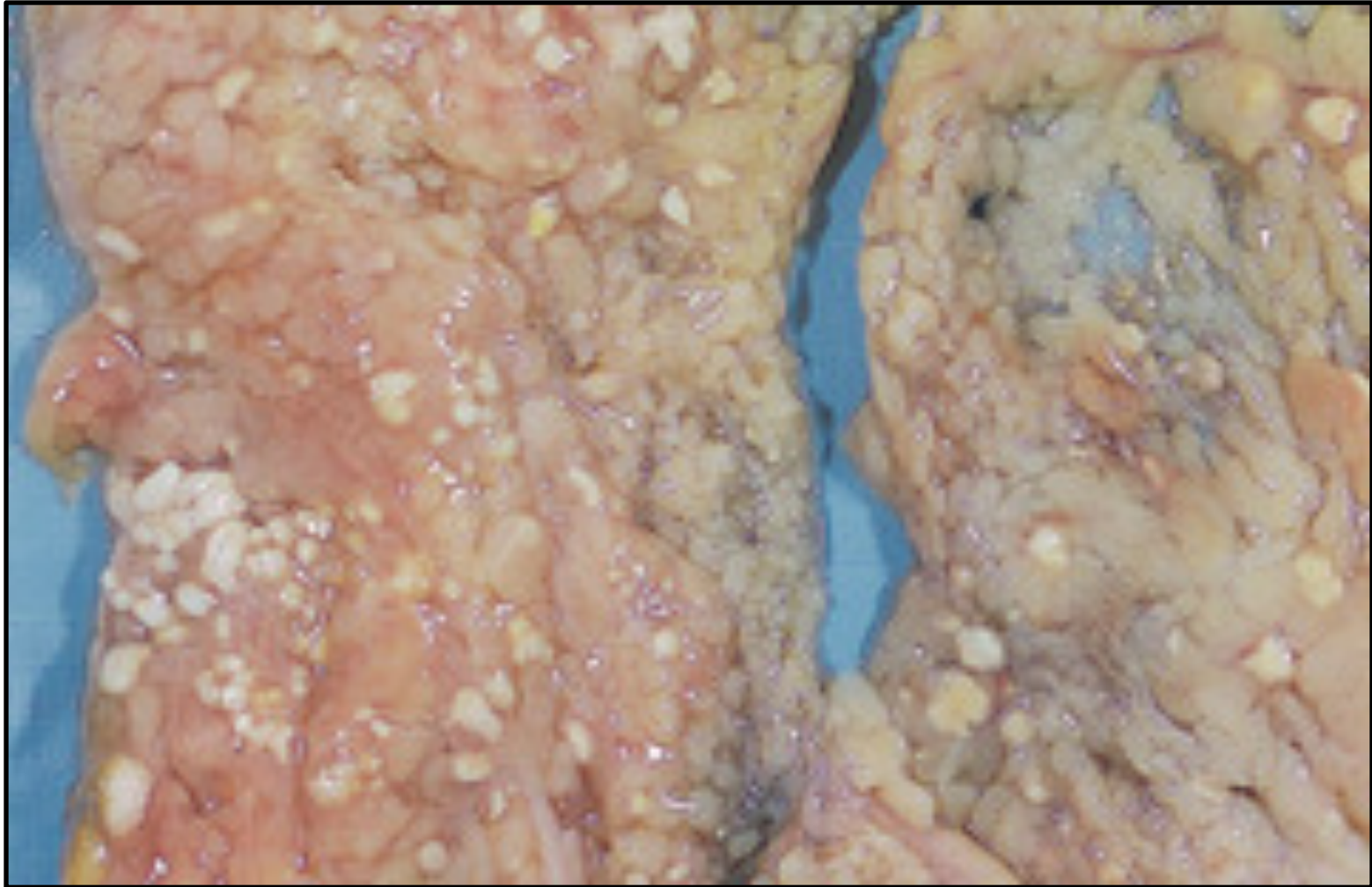


***Fibrinoid necrosis in an artery. The wall of the artery shows a circumferential bright pink area of necrosis with inflammation (neutrophils with dark nuclei).***



# 6 – FAT NECROSIS

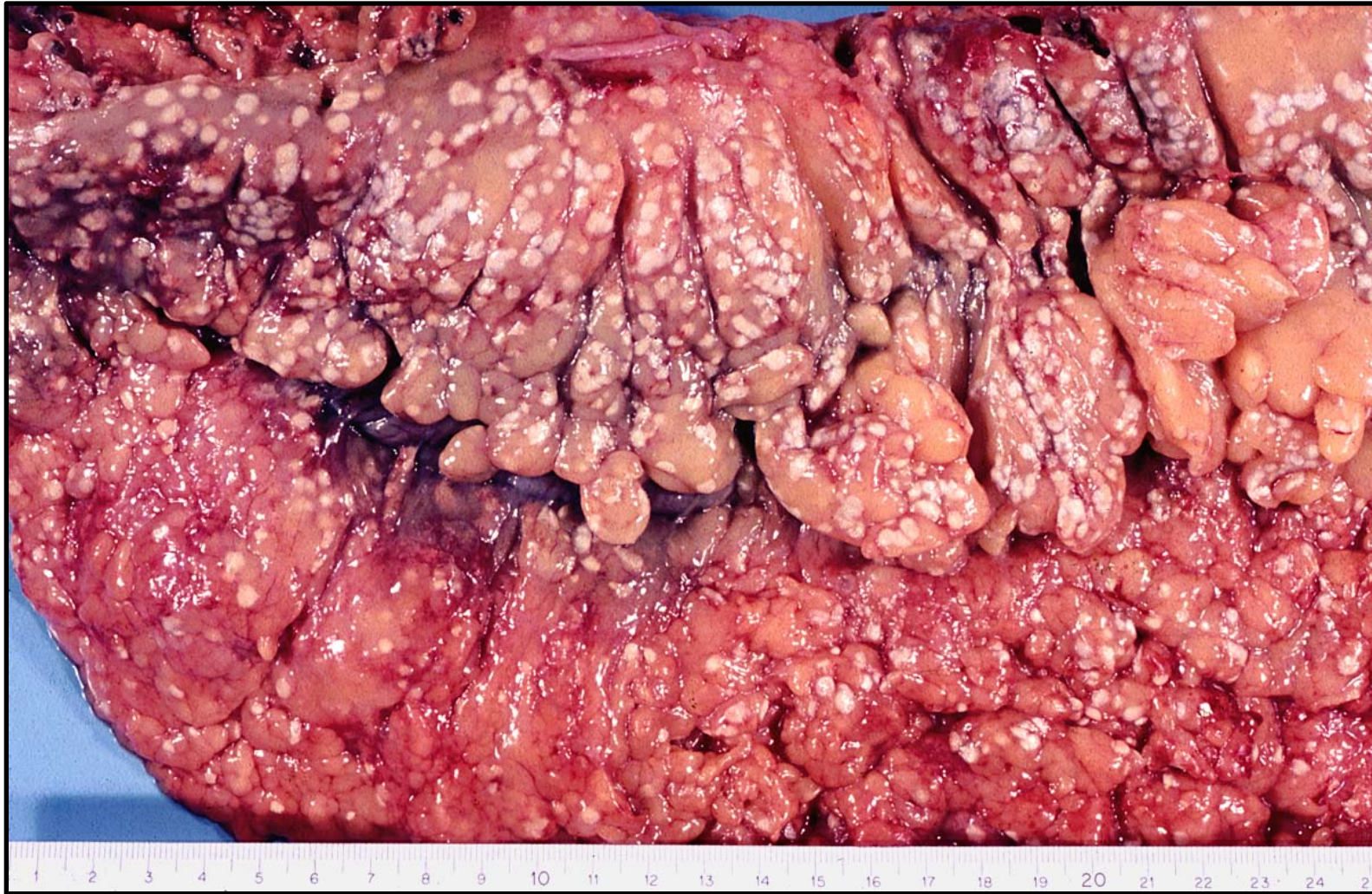
## ***Fat Necrosis in the Mesentery***



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



## ***Fat Necrosis in the Mesentery***

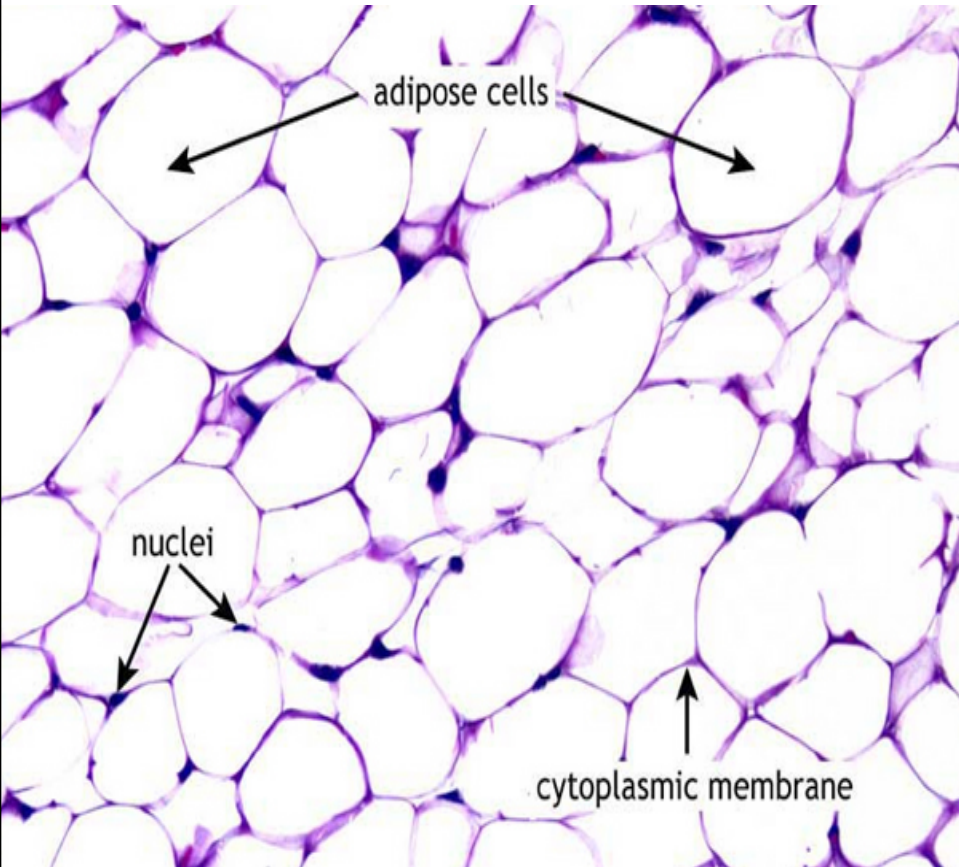


***Fat necrosis of the mesentery in a case of acute pancreatitis  
Numerous round white fat necroses***

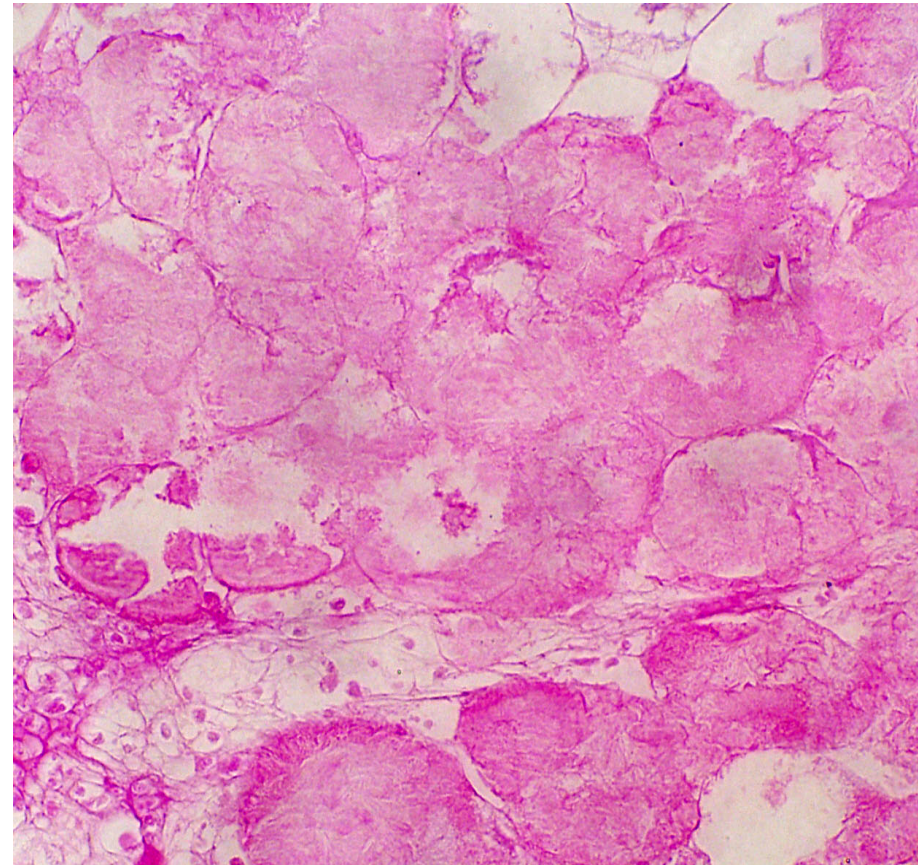


# Fat Necrosis – Histopathology

## □ Normal adipocytes

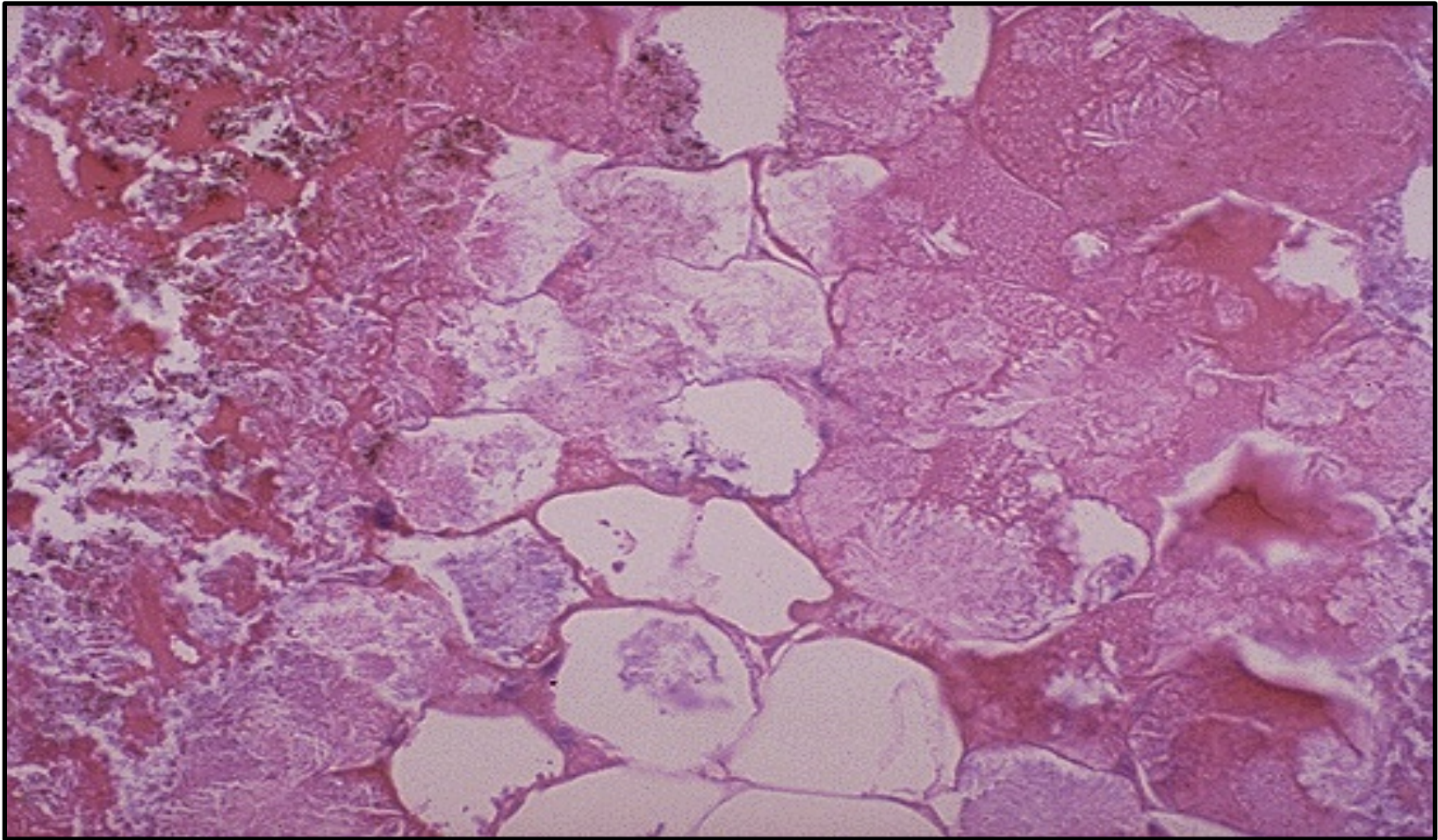


## □ Fat necrosis





## Fat Necrosis – Histopathology



***Picture of fat necrosis in the fat surrounding the pancreas is seen here. The fat cell (adipocytes) are necrotic. The necrotic fat cells have vague cellular outlines, have lost their peripheral nuclei, and their cytoplasm has become pink and amorphous***

# **7 - DYSTROPHIC CALCIFICATION**

**(AORTIC VALVE – STOMACH - SKIN)**



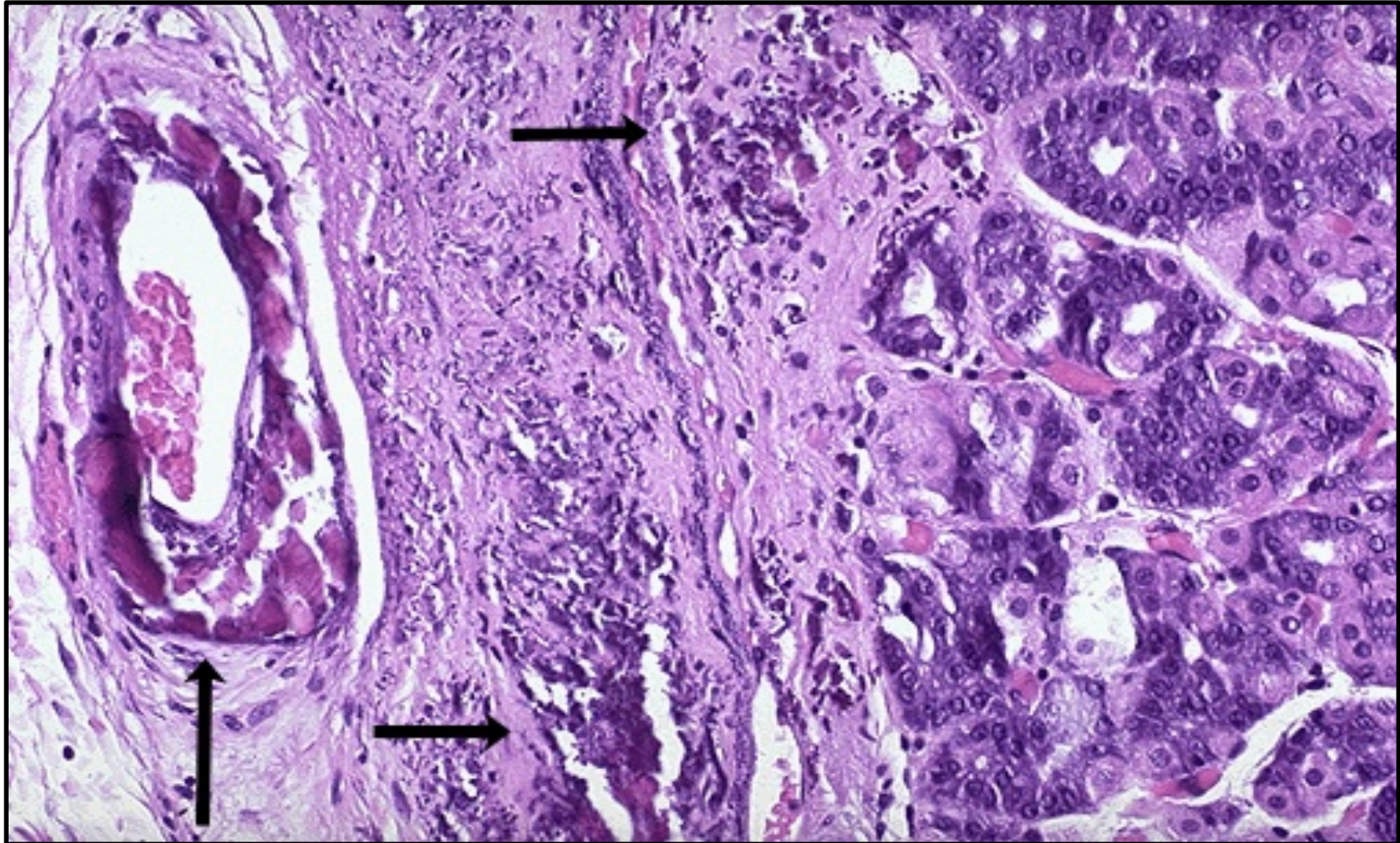
## Dystrophic calcification of Aortic Valve



- Normal calcium metabolism
- Deposition of Calcium in dying tissue.
- Seen in aging or damaged heart valves (e.g. atherosclerosis)

***View looking down onto the unopened aortic valve in a heart with calcific aortic stenosis. It is markedly narrowed (stenosis). The semilunar cusps are thickened and fibrotic, and behind each cusp are irregular masses of piled-up dystrophic calcification***

## Dystrophic Calcification of Stomach



***This is a dystrophic calcification in the wall of the stomach. At the far left is an artery with calcification in its wall. There are also irregular bluish-purple deposits of calcium in the submucosa. On the right are normal glands of the stomach.***

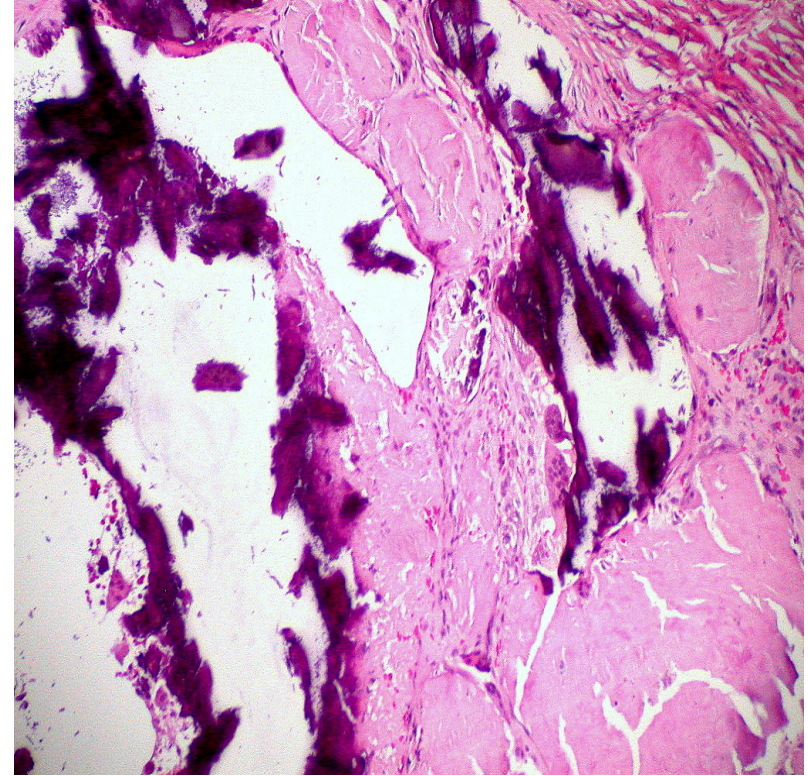
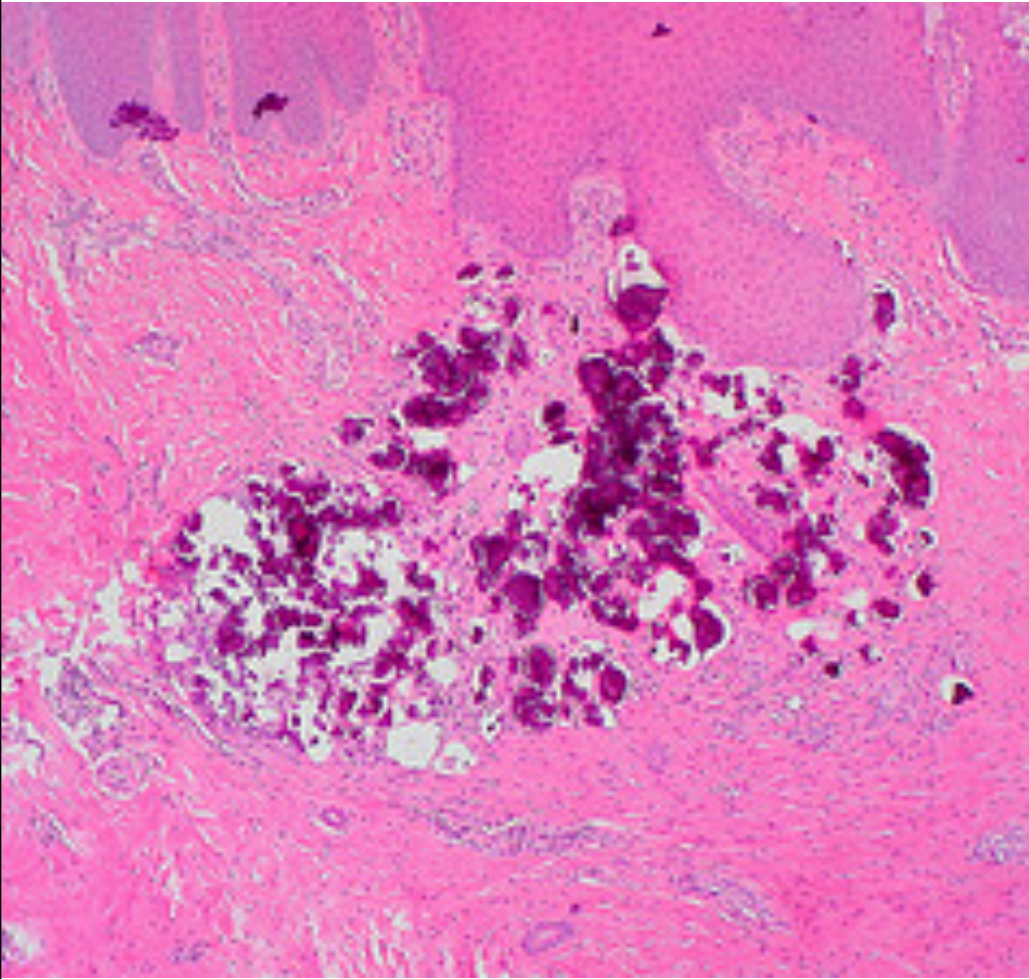


## **Dystrophic Calcification of the Skin**



***Multiple erythematous hard papules in linear configuration on the extensor aspect of the arm. Within the lesion there were several 2-5 mm white calcifications***

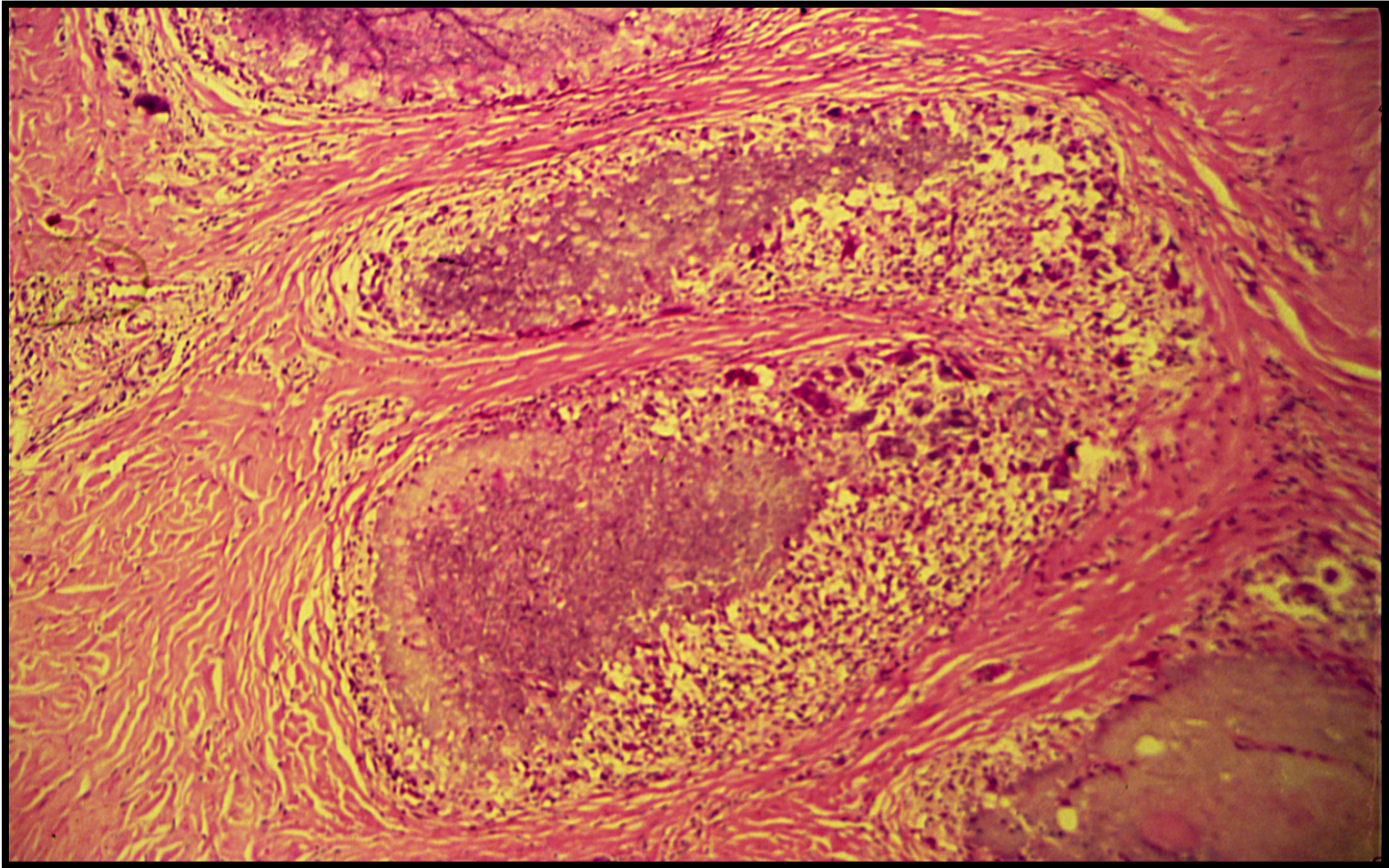
# Pathologic Calcification



***Irregular blue/purplish/violet granular nodule or deposits of calcium in the dermis***



## Dystrophic Calcification of the Skin



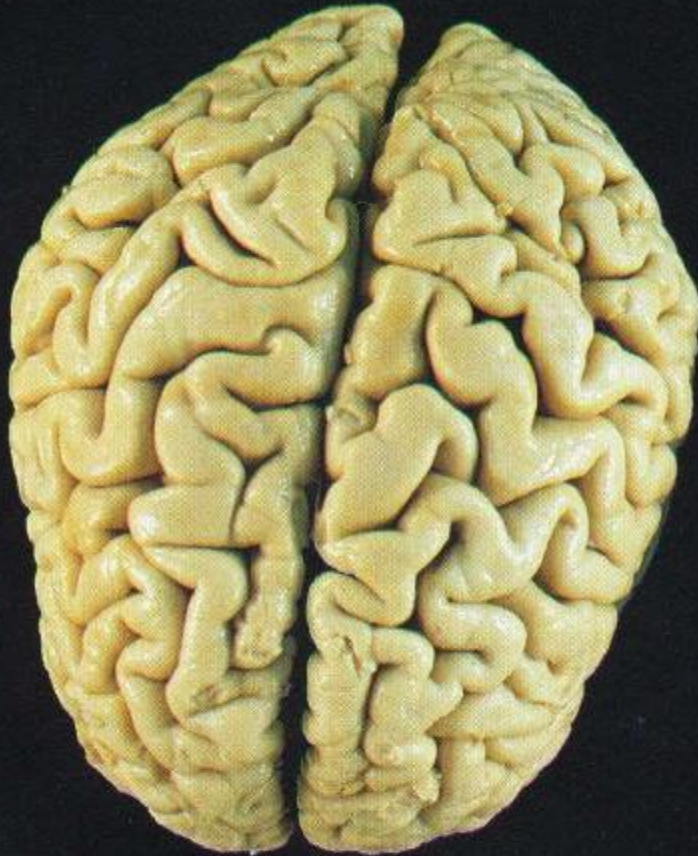
***Irregular blue granular nodule or deposits of calcium in the dermis surrounded by fibrous, inflammatory cell like histiocytes and also multinucleated giant cells ( called as foreign body giant cell reaction)***

# **8- ATROPHY OF THE ORGANS**

**(BRAIN – TESTIS)**



## *Atrophy of the Brain*



**Normal Brain**



**Alzheimers Brain**

A normal brain is shown on the left and a brain with cortical atrophy caused by Alzheimer's disease is shown on the right with thinning of the gyri and prominence of the sulci.

# Atrophy of the Brain



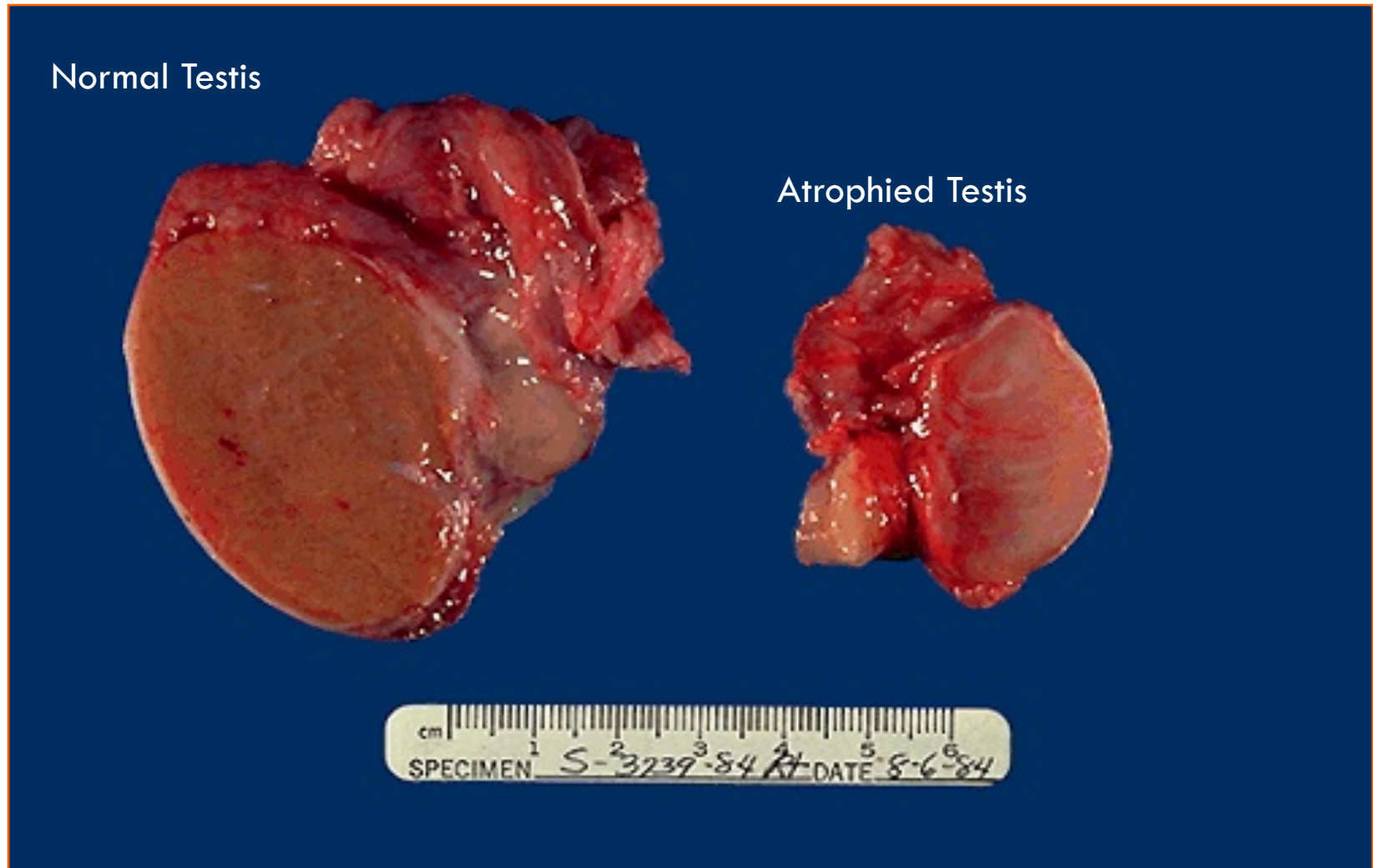
***This is cerebral atrophy in a patient with Alzheimer disease. The gyri are narrowed and the intervening sulci are widened, particularly pronounced toward the frontal lobe region.***



Right

# Atrophy of the Testis

Left

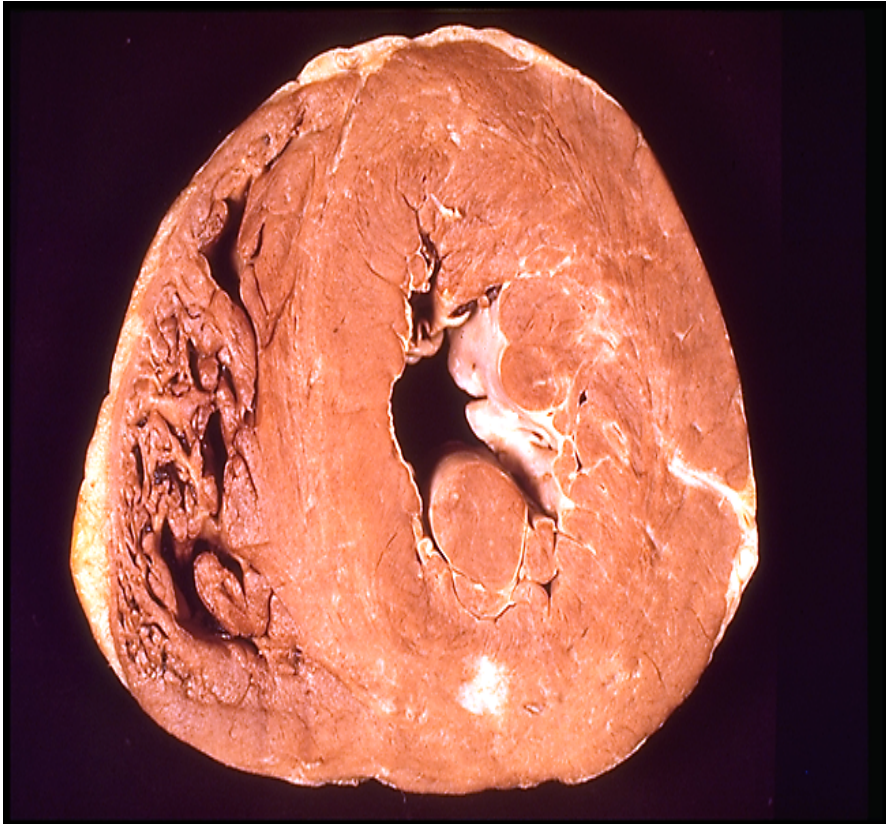


**The testis at the left has undergone atrophy and is much smaller than the normal testis at the right.**

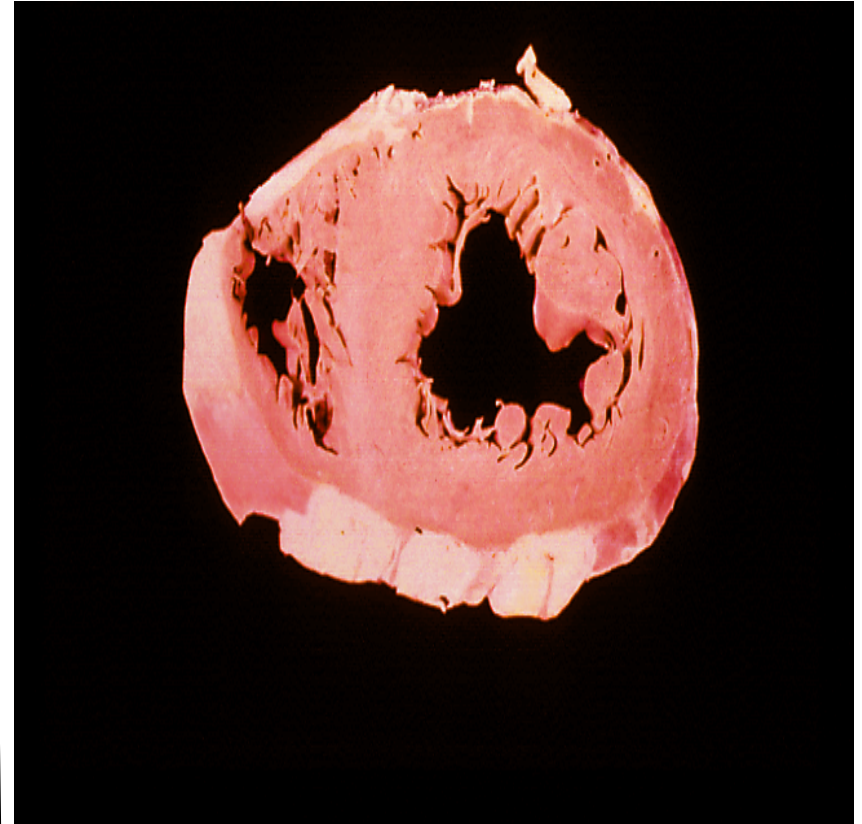
# 9 - LEFT VENTRICULAR HYPERTROPHY



## Normal and Hypertrophied Left Ventricle

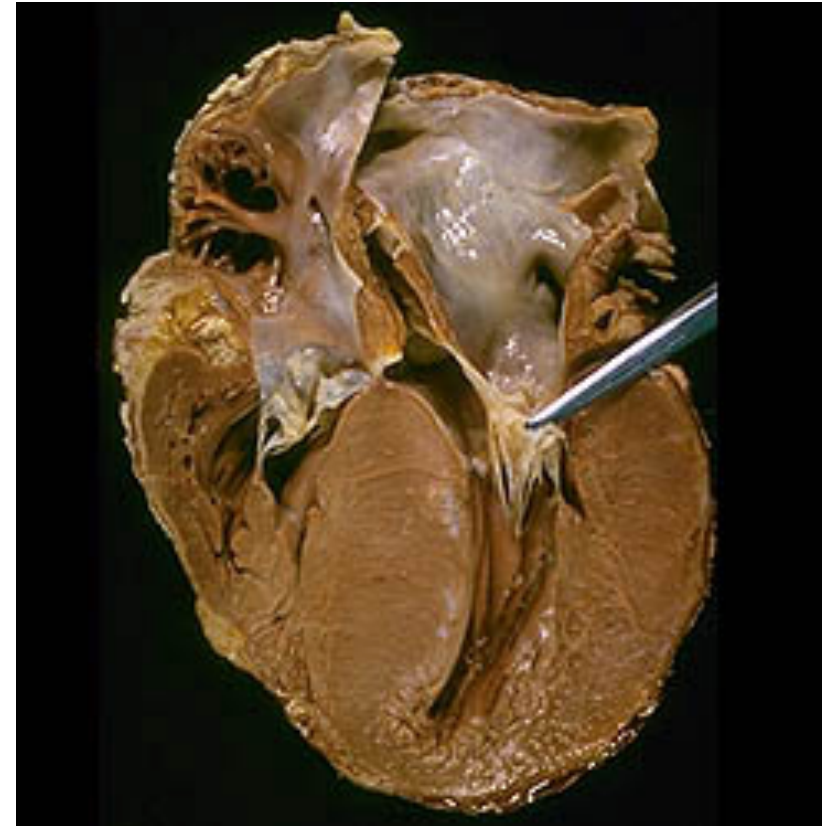


**Left ventricular hypertrophy:** The number of myocardial fibers does not increase, but their size increased in response to an increased workload



**Normal ventricles**

## Left Ventricular Hypertrophy

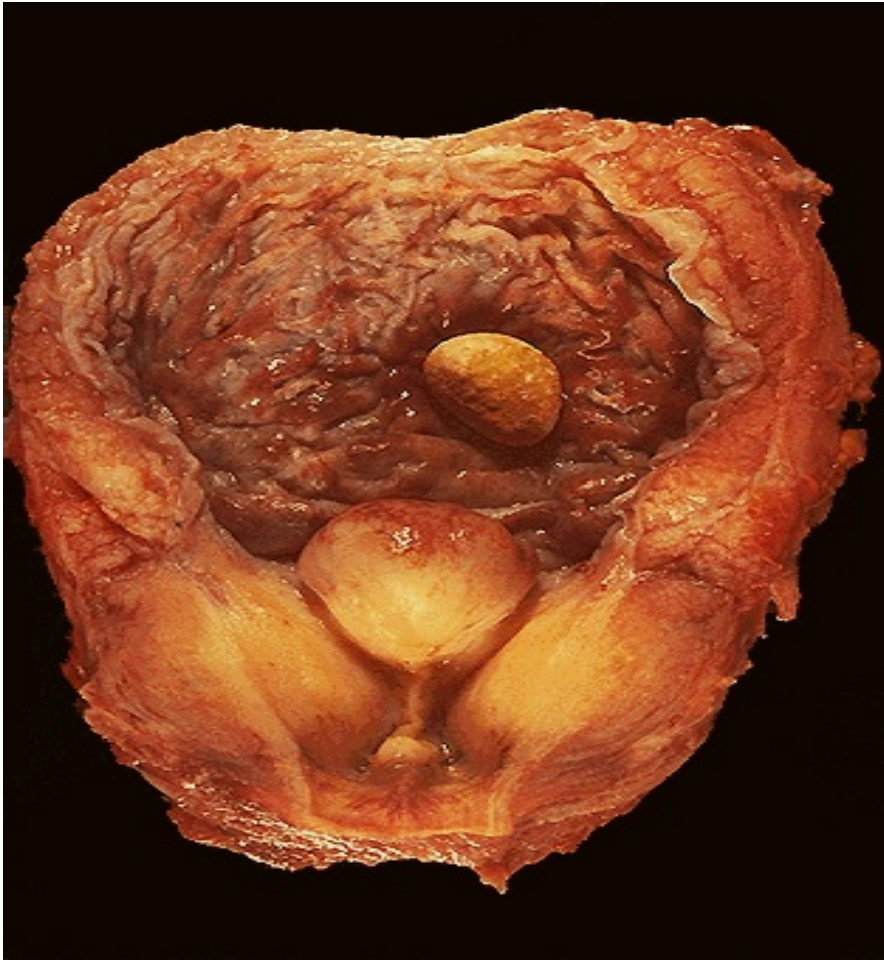


**This cross section view (left) and longitudinal section view (right) of the heart. The heart is from a severe hypertensive patient. The left ventricle is grossly thickened. The myocardial fibers have undergone hypertrophy.**



# 10- PROSTATIC HYPERPLASIA

## Prostatic Hyperplasia - Gross



**The normal adult male prostate is about 3 to 4 cm in diameter. The number of prostatic glands, as well as the stroma, has increased in this enlarged prostate**



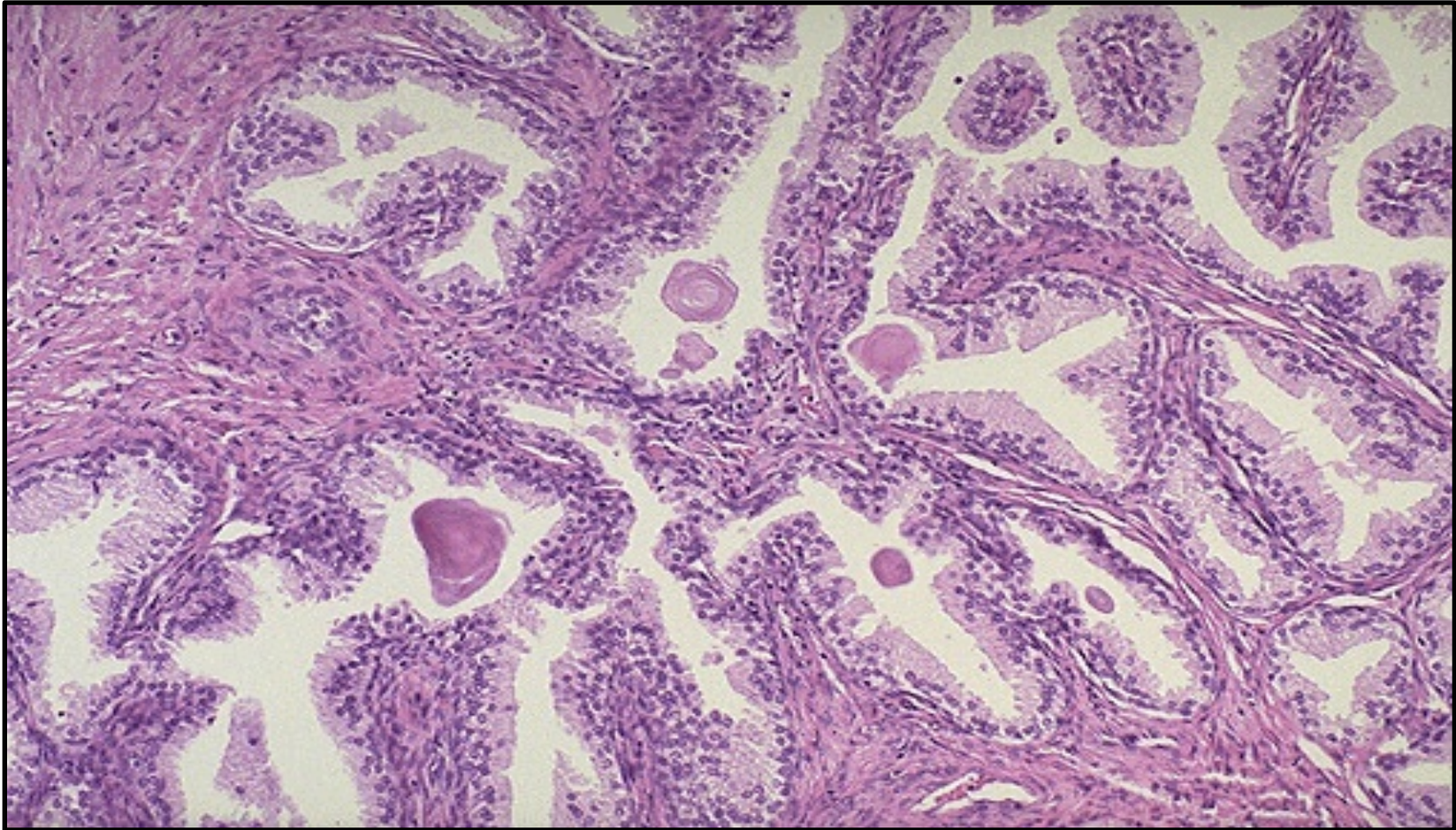
## Prostatic Hyperplasia



***Nodular hyperplasia of glandular and fibromuscular stromal tissue. Each nodule shows large number of glands of variable sizes lined by tall columnar epithelium and some are cystically dilated.***



## Prostatic Hyperplasia



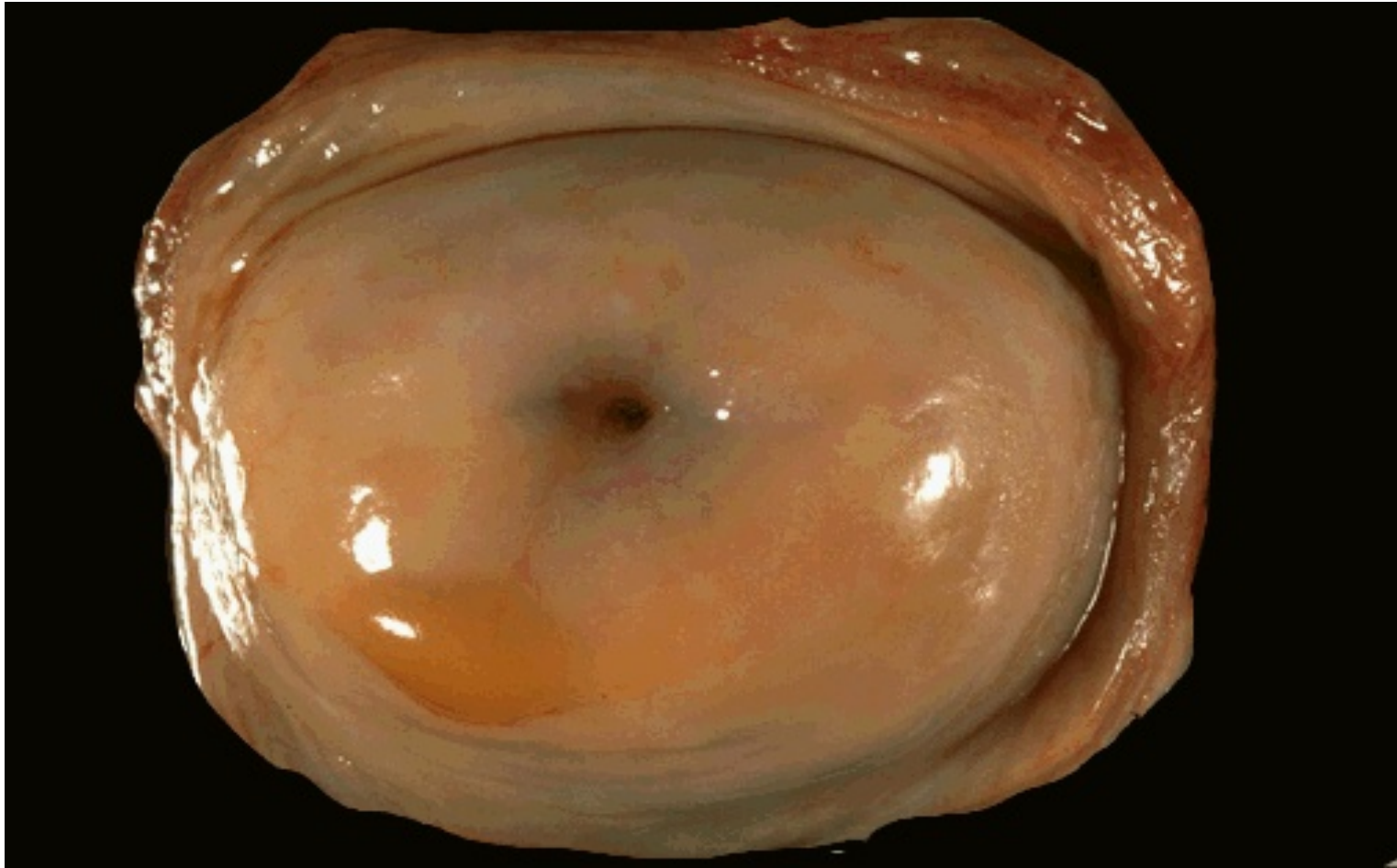
***Here is one of the nodules of hyperplastic prostate, with many glands along with some intervening stroma.***

***The cells making up the glands are normal in appearance, but there are just too many of them. Eosinophilic hyaline corpora amylacea is present in some glands.***



# **11 - SQUAMOUS METAPLASIA**

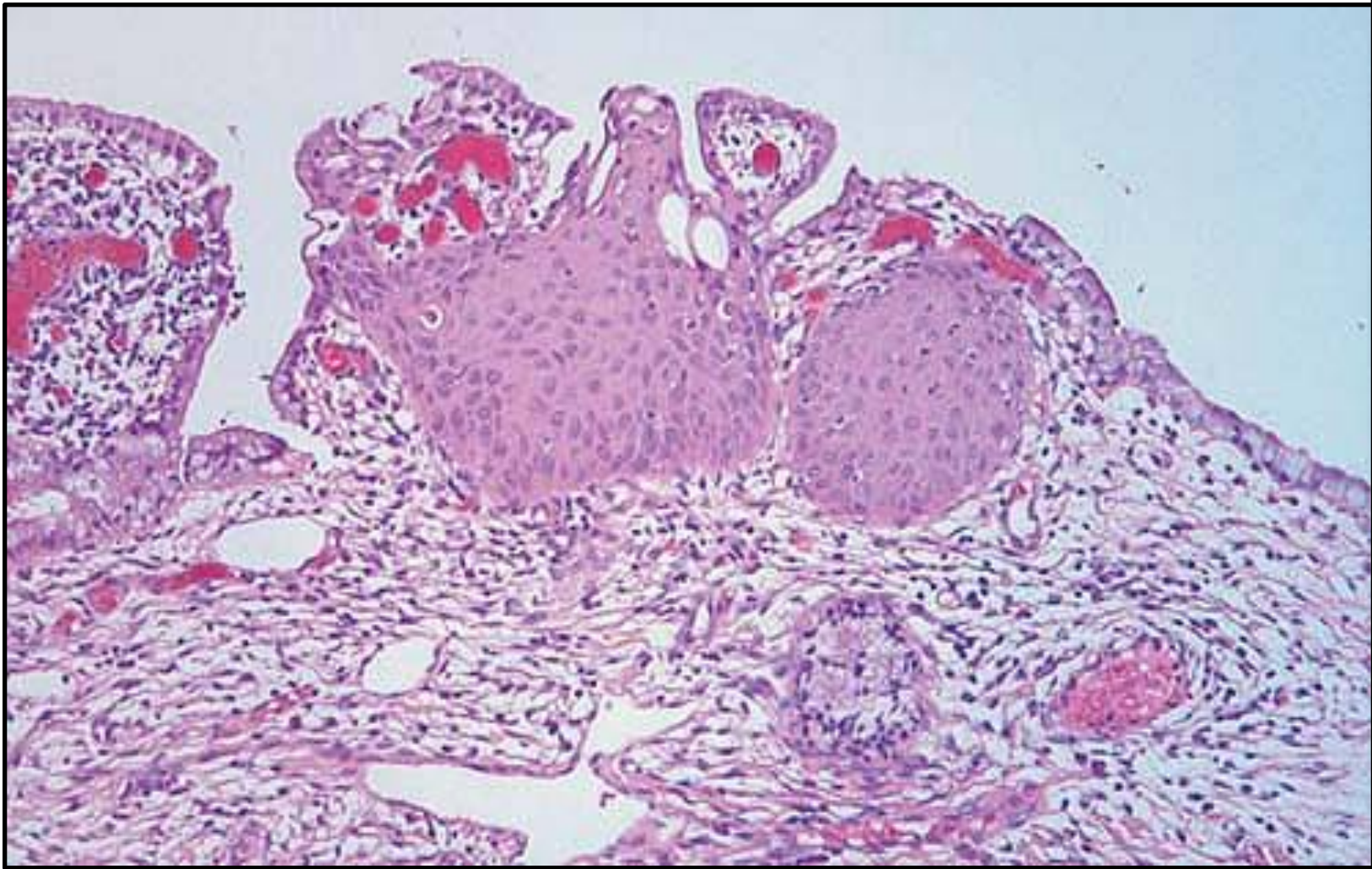
## Normal Uterine Cervix



**Normal cervix with a smooth, glistening mucosal surface. There is a small rim of vaginal cuff from this hysterectomy specimen. The cervical os is small and round, typical for a nulliparous woman. The os will have a fish-mouth shape after one or more pregnancies**



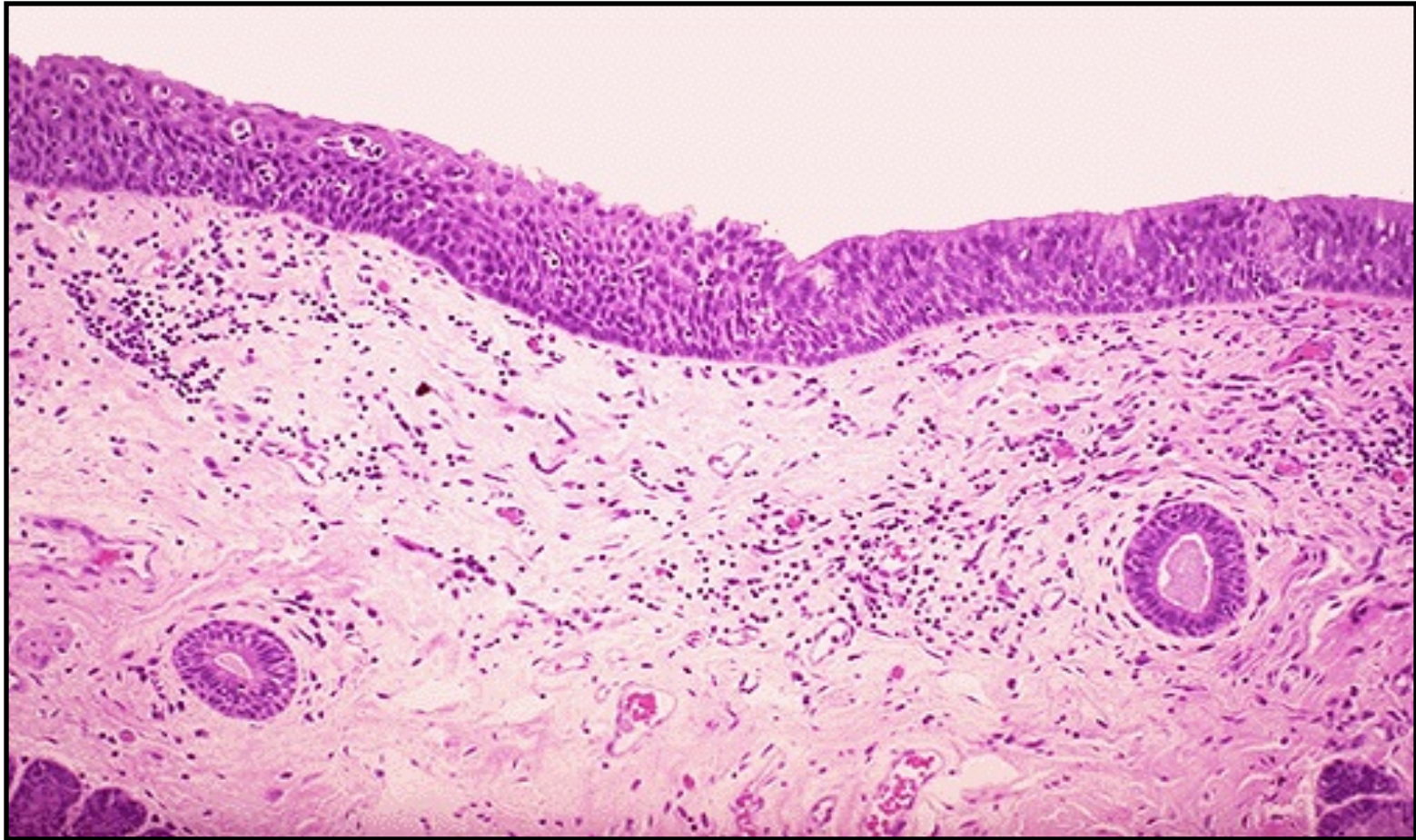
## Endocervical Squamous Metaplasia



***A section of endocervix shows the normal columnar epithelium at both margins and a focus of squamous metaplasia in the center.***



## Laryngeal Squamous Metaplasia



***Metaplasia of laryngeal respiratory epithelium has occurred here in a smoker .The chronic irritation has led to an exchanging of one type of epithelium (the normal respiratory epithelium at the right) for another (the more resilient squamous epithelium at the left)***



**GOOD *LUCK***