

CARDIOVASCULAR SYSTEM

Pathology Practical

Presented by:
DR. Malak Alzahrani

Prepared by:

- *Prof. Ammar Al Rikabi*
- *Dr. Sayed Al Esawy*

Objectives:

At the end of the practical sessions of the cardiovascular block, the medical students will be able to:

- Identify the morphologic **gross** features of:
 - Chronic venous congestion of the liver.
 - Myocardial Infarction.
 - Vegetations of rheumatic mitral and aortic valves.
 - Left ventricular hypertrophy (LVH).
 - Aneurysm of abdominal aorta (AAA).
 - Atheroma of aorta.

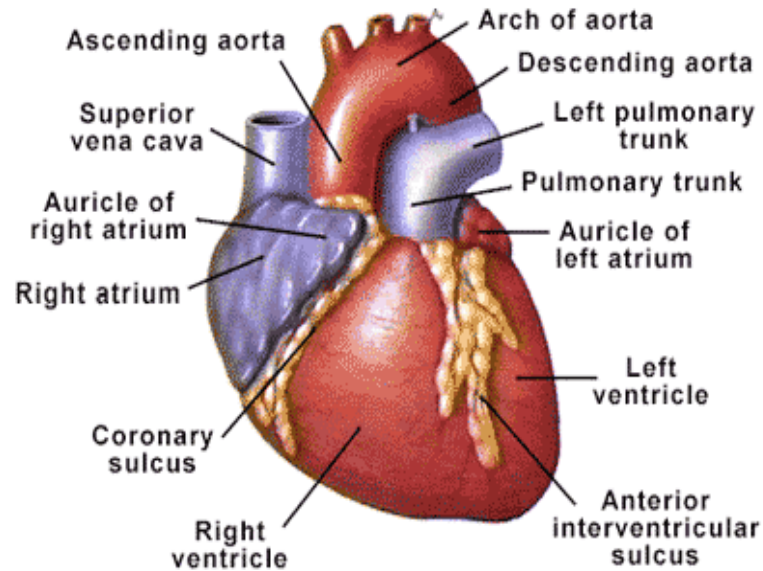
Objectives:

- Identify the morphologic **histopathological** features of:
 - Chronic venous congestion of the LIVER
 - Chronic venous congestion of the LUNG
 - Acute rheumatic myocarditis
 - Rheumatic valvulitis
 - Coronary atherosclerosis
 - Thromboangitis obliterans
 - Giant cell arteritis and leukocytoclastic vasculitis.

NORMAL ANATOMY AND HISTOLOGY

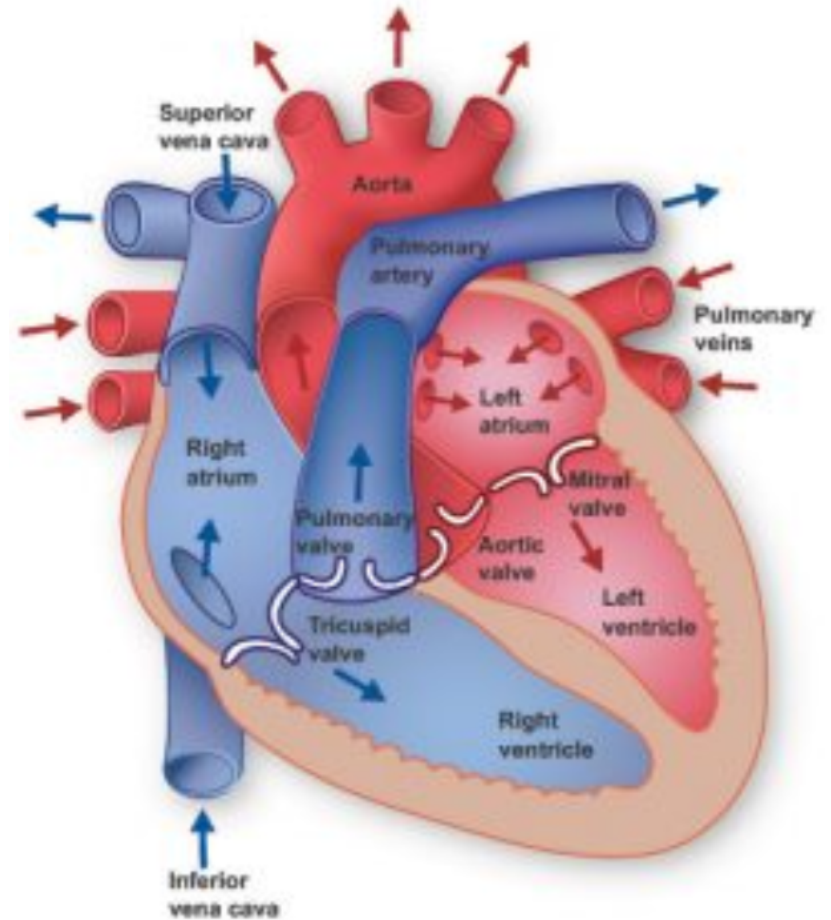
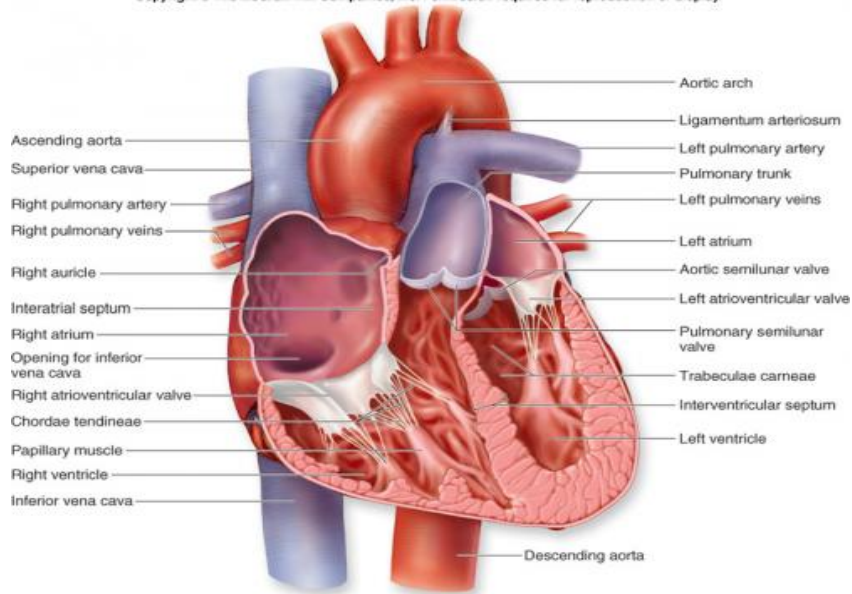
Anatomy of the Heart

- 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 → sup & inf venae cava → right atrium → right ventricle → lungs → left atrium → left ventricle → Aorta → body



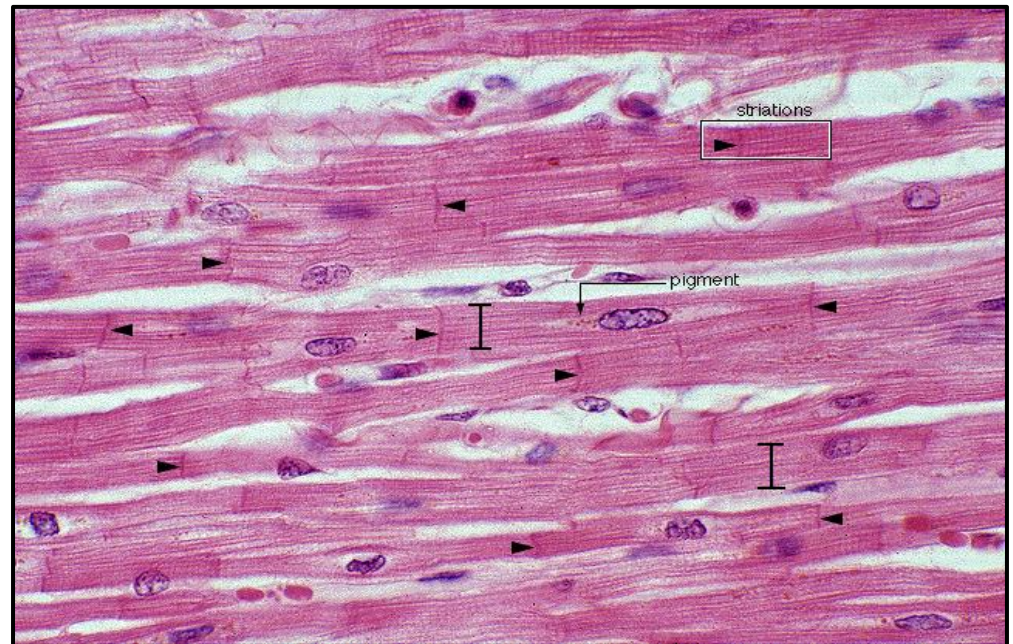
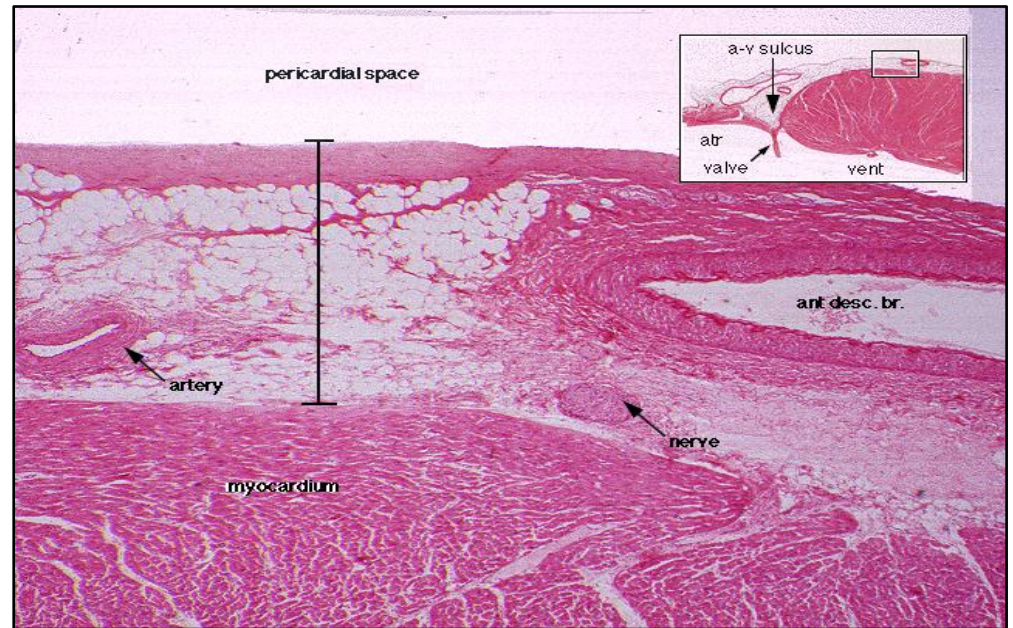
Anatomy of the Heart – inside view

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



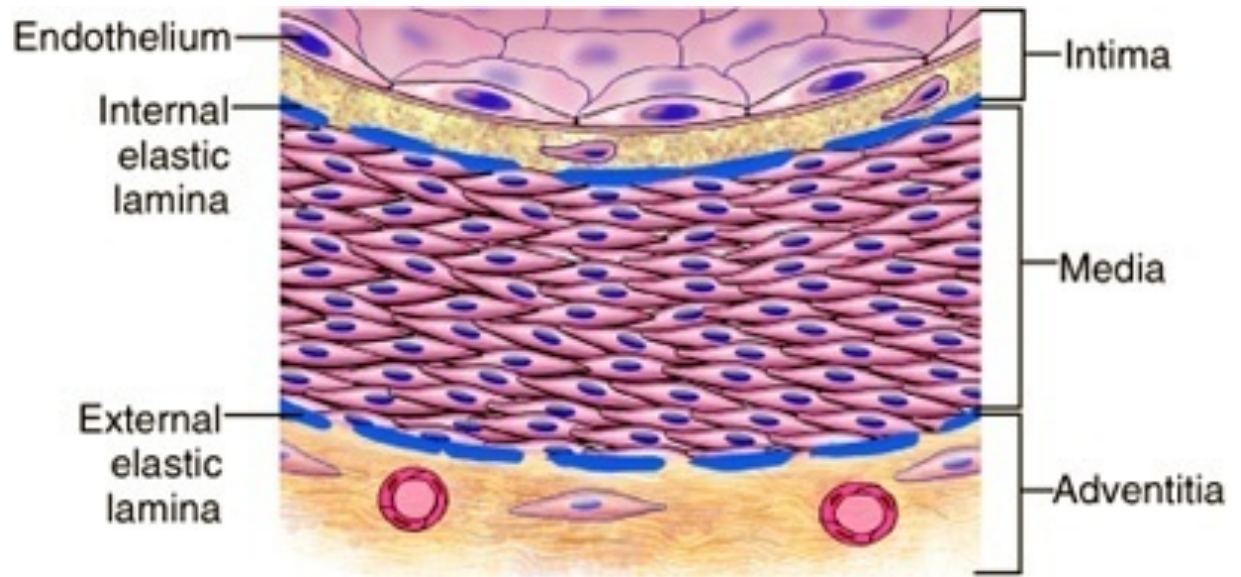
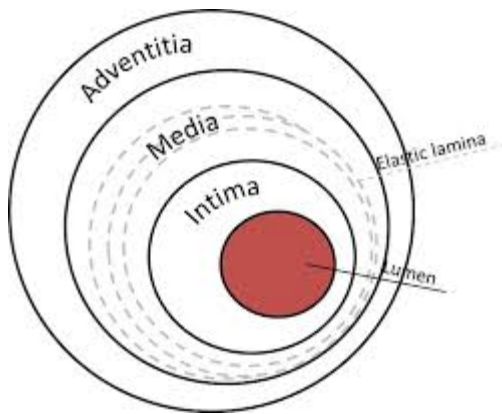
Histology of the Heart

- The heart consists of 3 layers
 - the **Endocardium**,
 - the **Myocardium**, and
 - the **Pericardium**.
- The **Pericardium** 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).



Normal Blood Vessels

- The basic constituents of the walls of blood vessels are **endothelial cells** and **smooth muscle cells**.
- They are arranged in layers:



PRACTICAL 1:

12/02/2019



A: VASCULAR DISEASE:

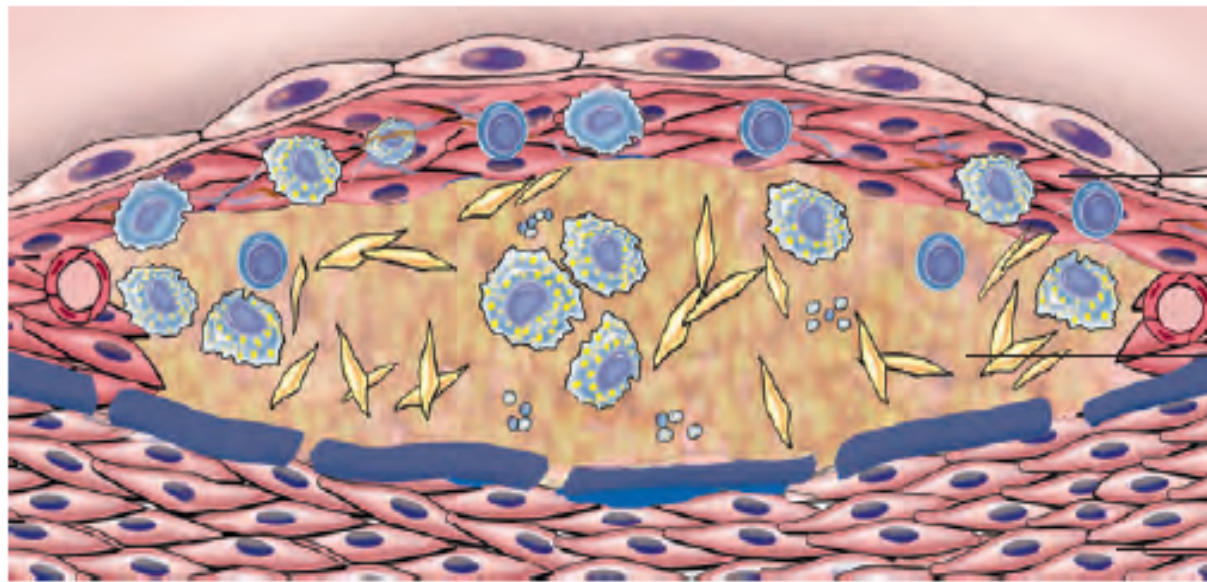
**AORTIC
ATHEROSCLEROSIS**

Vascular disease

- **Narrowing** (*stenosis*) or *complete obstruction* of vessel lumen, either progressively (e.g., by atherosclerosis) or precipitously (e.g., by thrombosis or embolism)
- **Weakening** of vessel walls, leading to dilation or rupture

ATHEROMA OF THE AORTA

- **An atheroma** is a swelling in arterial walls and accumulation made up of:
 - (mostly) foamy macrophages
 - lipids (cholesterol and fatty acids)
 - debris
 - variable amount of fibrous connective tissue.
- The four major risk factors are:
 - Hyperlipidemia
 - Hypertension
 - Diabetes
 - Cigarette smoking

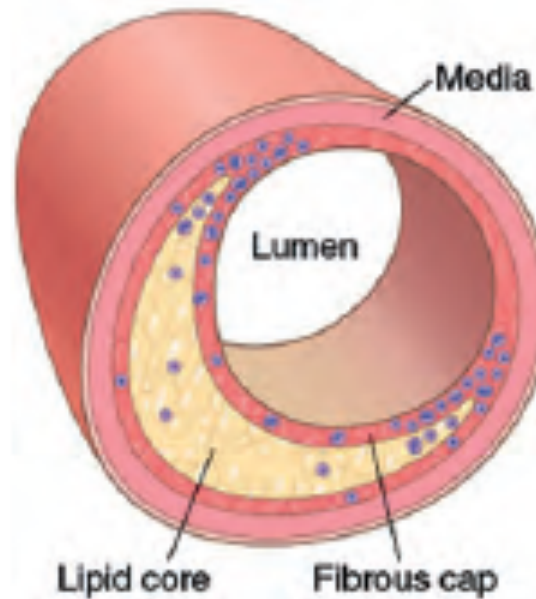


FIBROUS CAP
 (smooth muscle cells, macrophages,
 foam cells, lymphocytes, collagen,
 elastin, proteoglycans, neovascularization)

NECROTIC CENTER
 (cell debris, cholesterol crystals,
 foam cells, calcium)

MEDIA

Figure 11-7 Basic structure of an atherosclerotic plaque. Note that atherosclerosis is an intimal-based process.



Media

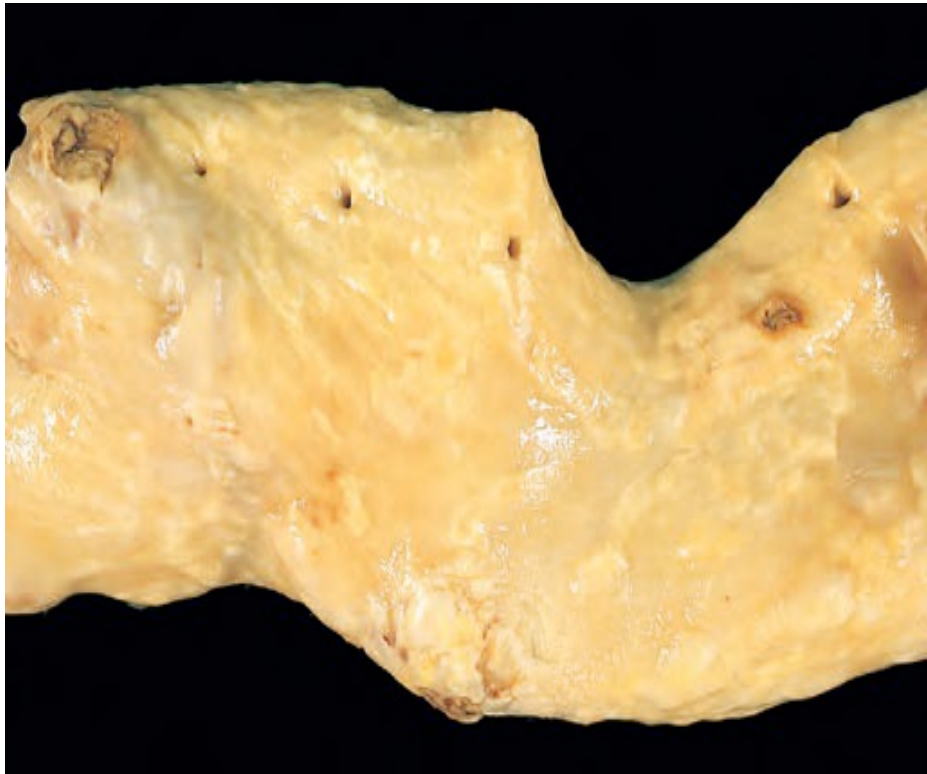
Lumen

Lipid core

Fibrous cap

Atheroma of the Aorta - Gross

Gross views of atherosclerosis in the aorta.



Mild atherosclerosis composed of fibrous plaques



Severe disease with diffuse and complicated lesions including an ulcerated plaque

Atheroma of the Aorta - Gross

Complications:

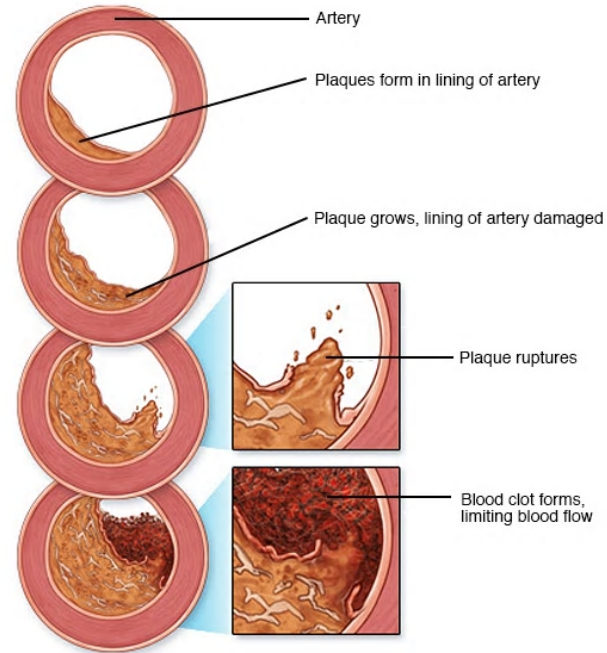
Thrombosis

Plaque rupture

Hemorrhage

Wall weakening

Calcification



© MAYO FOUNDATION FOR MEDICAL EDUCATION AND RESEARCH. ALL RIGHTS RESERVED.

Atheroma of the Aorta - Gross



Severe atherosclerosis of the aorta:

The atheromatous plaques have undergone **ulceration** along with formation of overlying mural **thrombus**.

Atheroma of the Aorta - Gross



Aorta: complicated atheromatous plaques

Note the fissured-appearing endothelial surface and raised plaque-like structures from the surface.

Red clot material is adherent to the plaques in multiple areas. These clots consist of platelets held together by fibrin strands.

Atheroma of the Aorta - Gross



Aorta: complicated atheromatous plaques

Note the raised yellow plaques and the fissures in between the plaques.

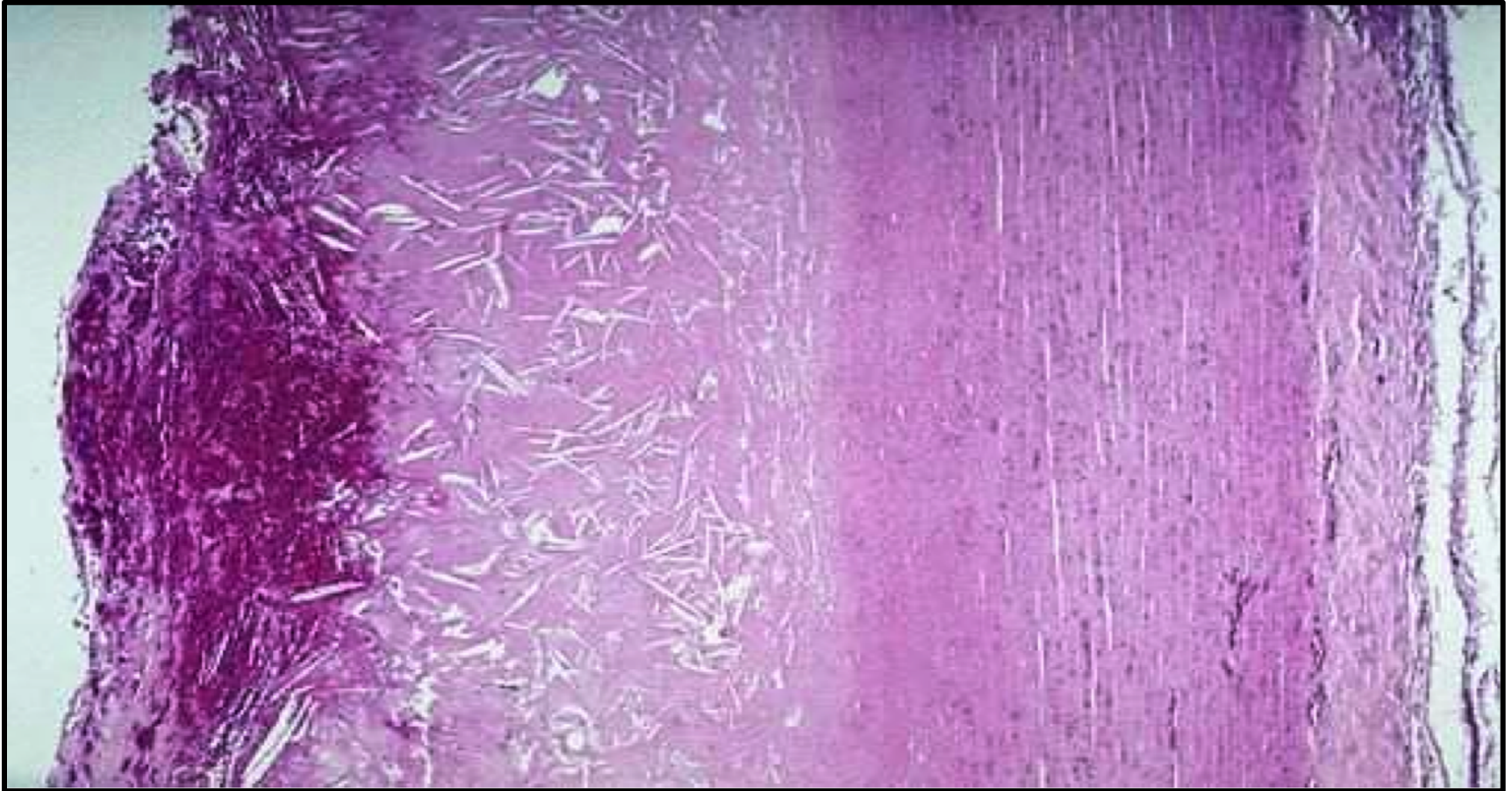
Dystrophic **calcification** is likely present as well

Atheroma of the Aorta - Gross



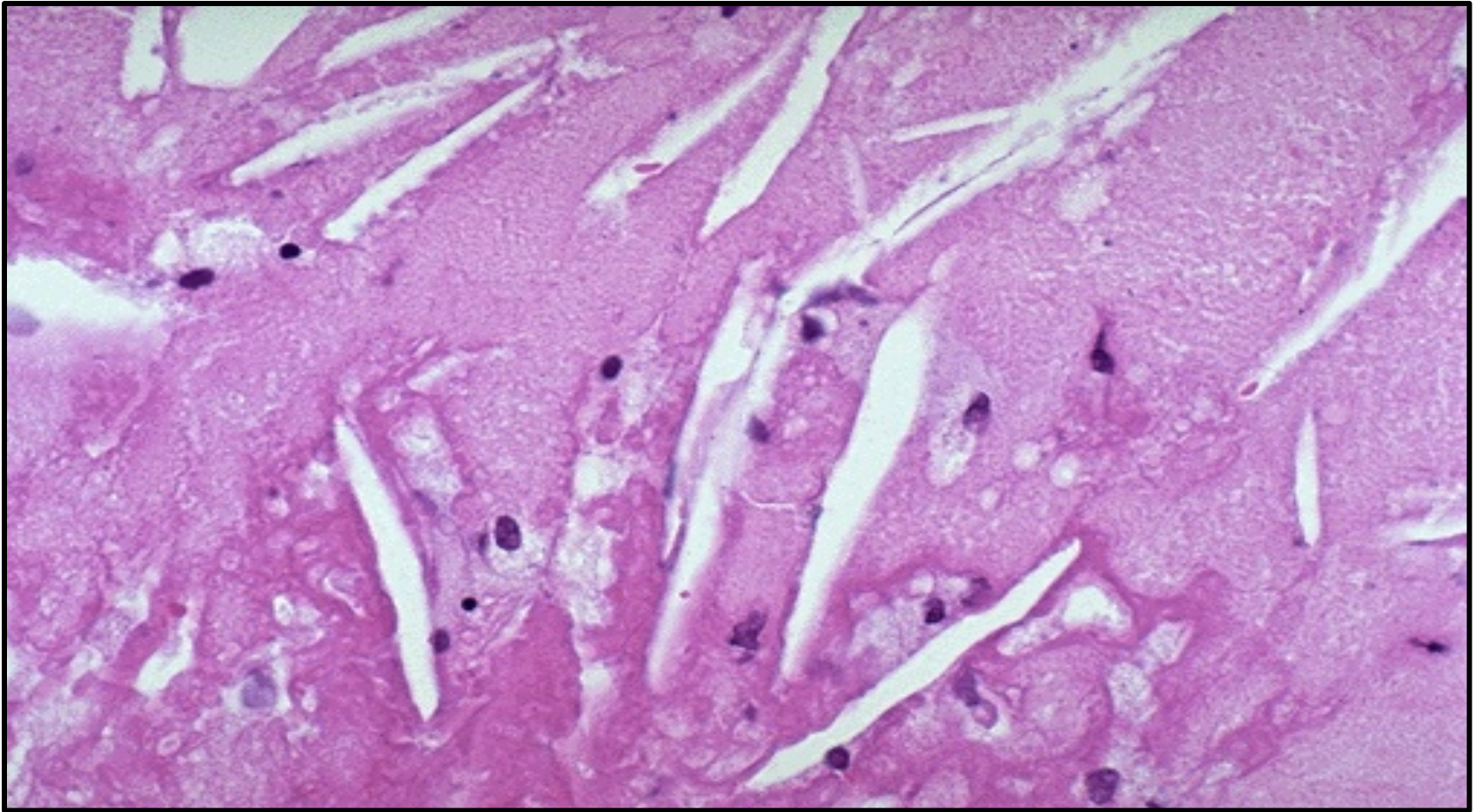
These three aortas demonstrate **mild, moderate, and severe** atherosclerosis from bottom to top. At the bottom, the mild atherosclerosis shows only **scattered** lipid plaques. The aorta in the middle shows many more **larger** plaques. The severe atherosclerosis in the aorta at the top shows extensive **ulceration** in the plaques.

Atheroma of the Aorta - LPF



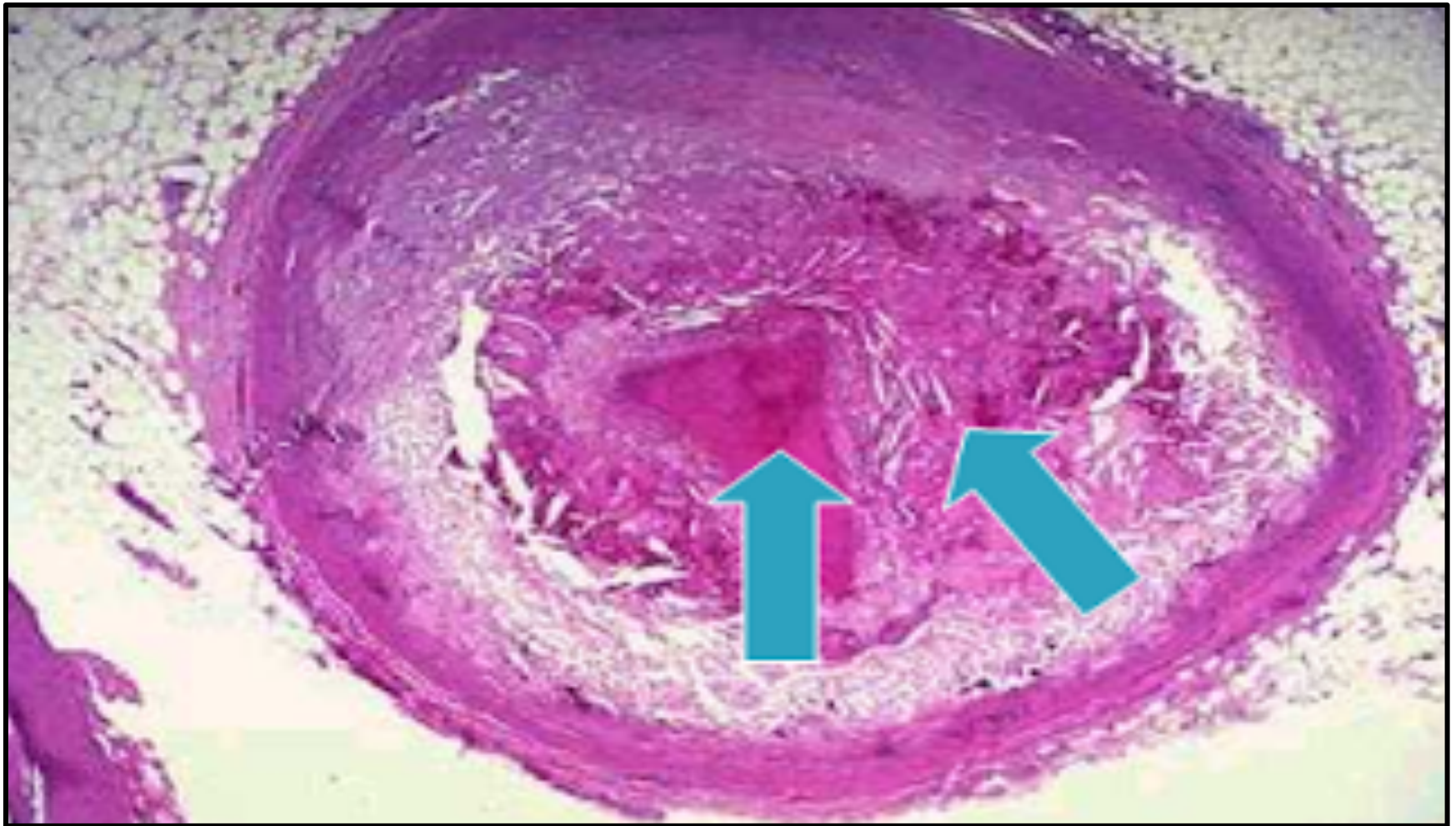
This *microscopic* cross section of the aorta shows a large overlying atheroma on the left. *Cholesterol clefts* are numerous in this atheroma. The surface on the far left shows *ulceration and hemorrhage*. Despite this ulceration, atheromatous emboli are rare

Atheroma of the Aorta



*A high magnification of the **aortic atheroma** with foam cells and cholesterol clefts.*

Atheroma of the Aorta - MPF

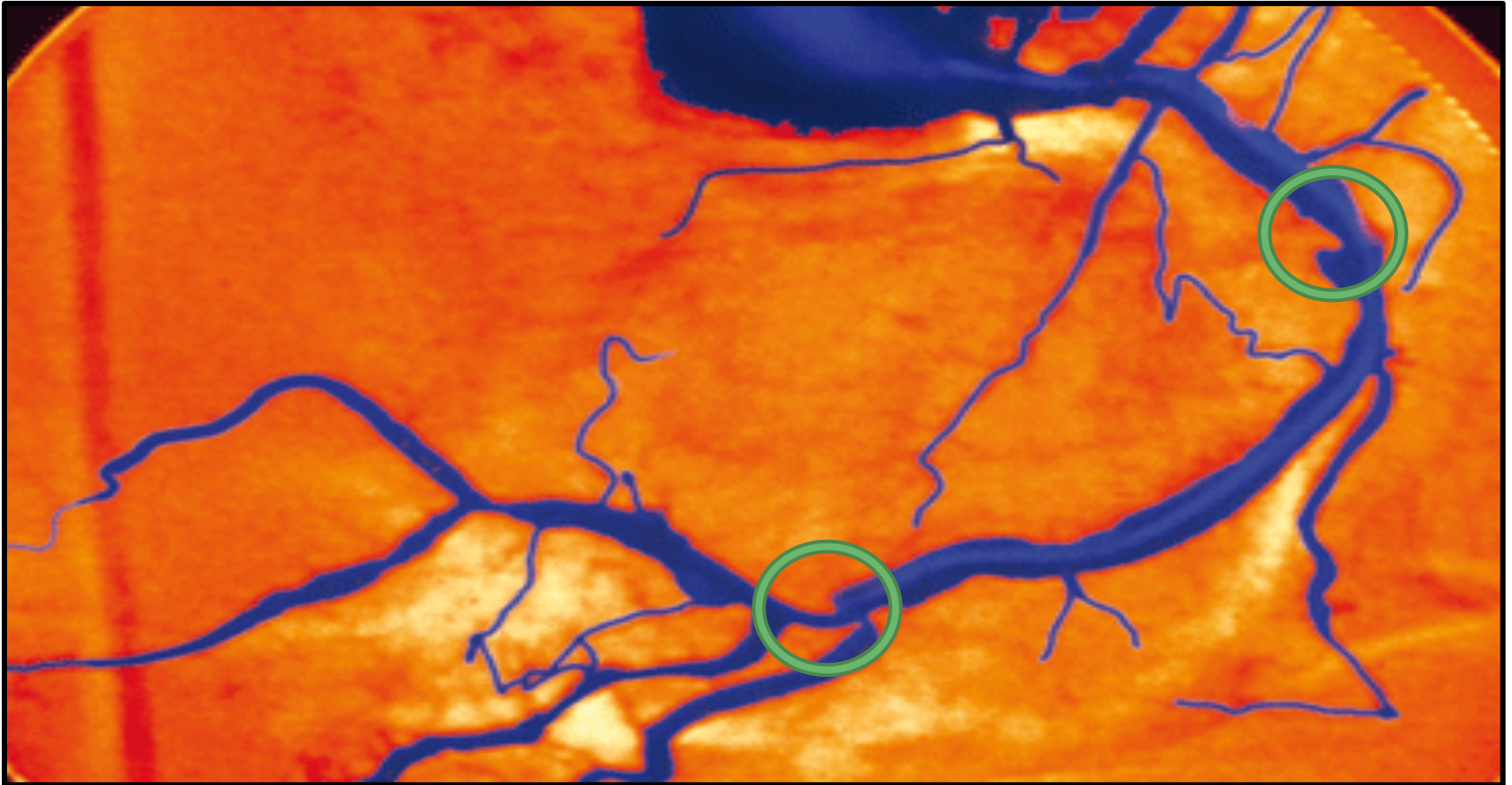


Aortic Atheroma with *Thrombosis*

A: VASCULAR DISEASE:

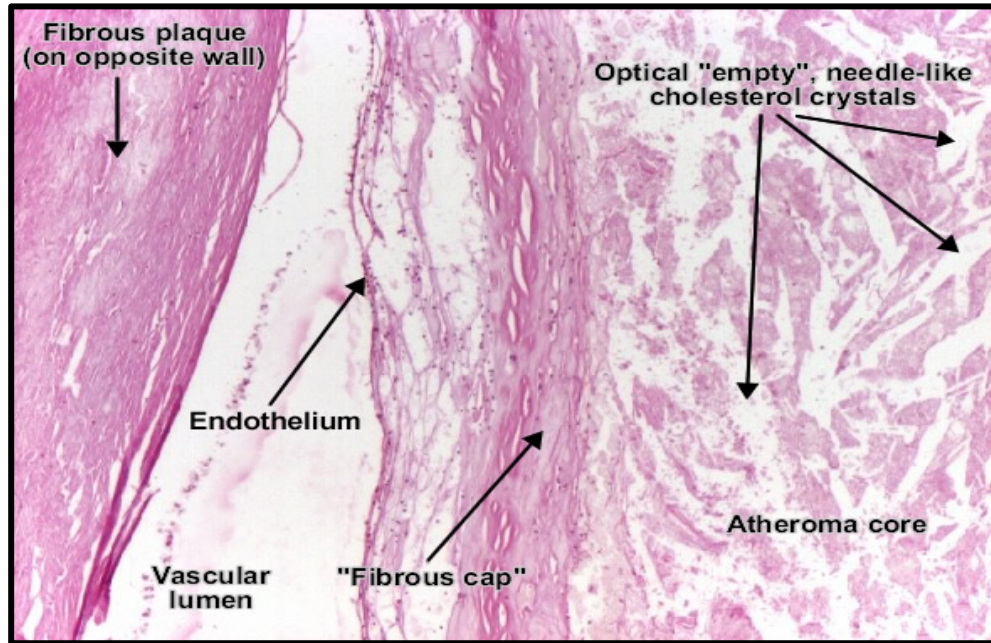
**CORONARY
ATHEROSCLEROSIS**

Coronary Atherosclerosis - Gross



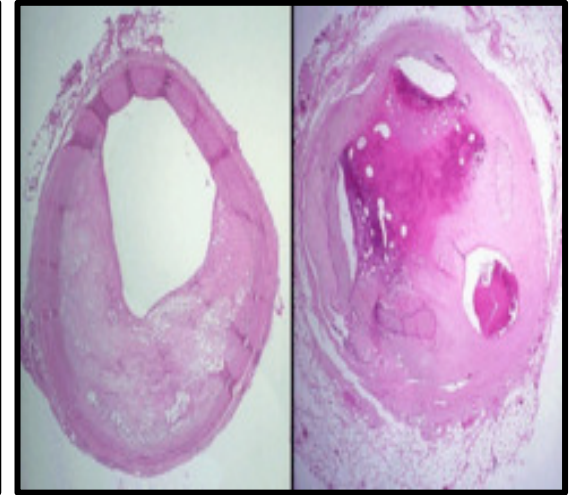
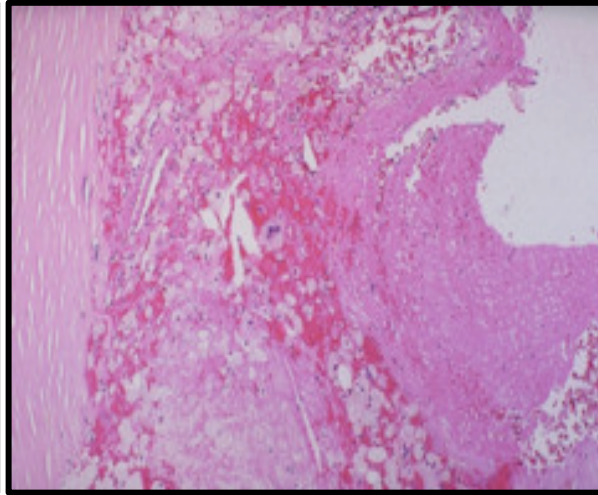
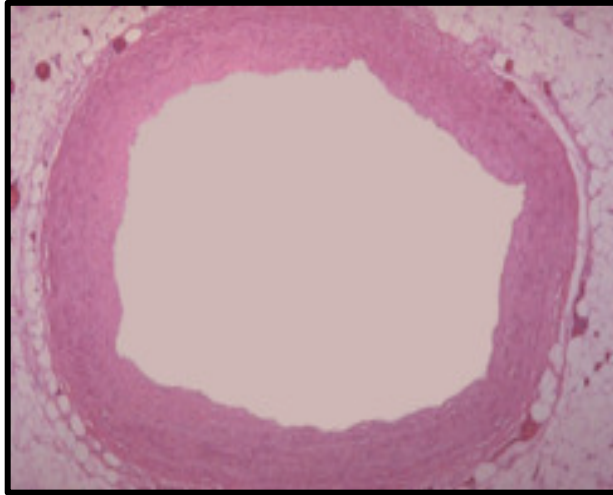
Coronary atherosclerosis. Coloured angiogram (X- ray) showing atherosclerosis in a coronary artery. The atherosclerosis is seen as the pinching in the blue- coloured artery at bottom centre

Coronary atherosclerosis - LPF



Coronary artery with atherosclerosis (fibro-lipid plaque). The atheromatous fibro-fatty plaque is characterized by the accumulation of lipids in the *intima* of the arteries, narrowing the lumen. Beneath the endothelium it has a "fibrous cap" covering the atheromatous "core" of the plaque, which consists in cholesterol crystals, cholesterol esters, fibrin, macrophages and smooth muscle cells, proteoglycans, collagen, elastin and cellular debris.

Coronary atherosclerosis - LPF

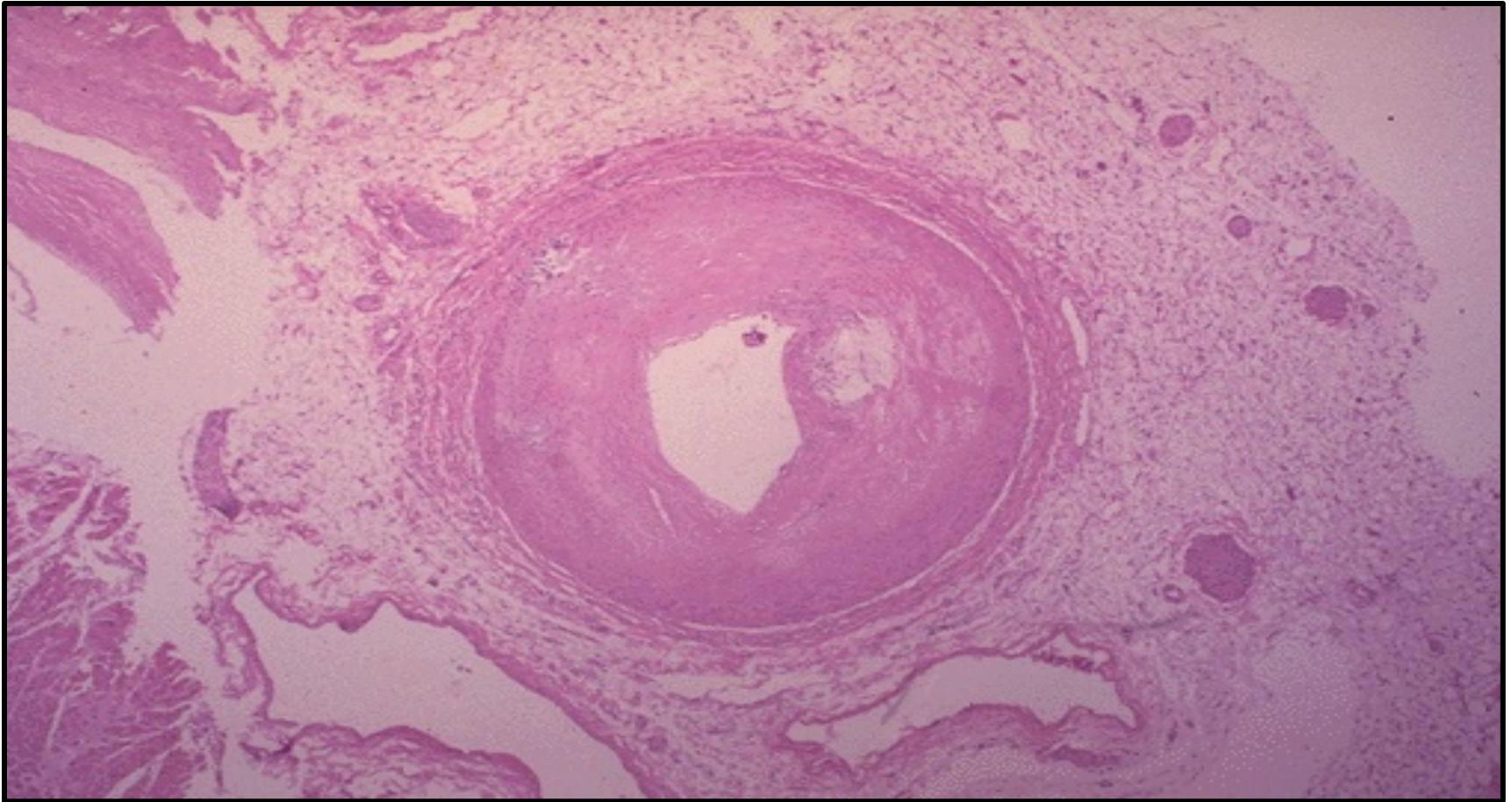


A normal coronary artery with no atherosclerosis and a widely patent lumen that can carry as much blood as the myocardium requires.

Atheromatous plaque in a coronary artery that shows endothelial denudation with **disruption** and overlying **thrombus** formation at the right. The arterial media is at the left

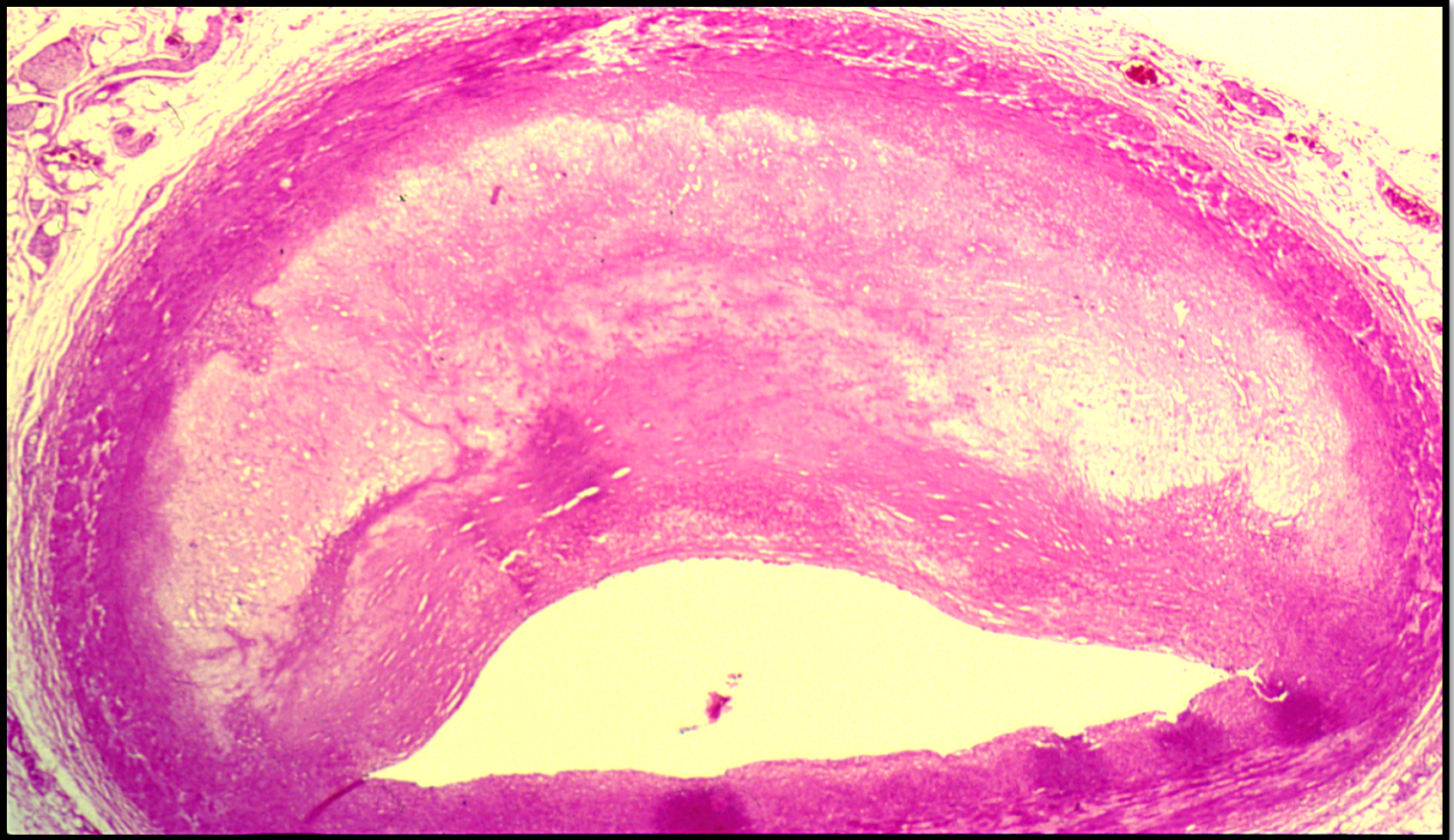
Occlusive coronary atherosclerosis. The coronary at the left is narrowed by 60 to 70%. The coronary at the right is even worse with evidence for previous thrombosis with organization of the thrombus

Coronary atherosclerosis - MPF



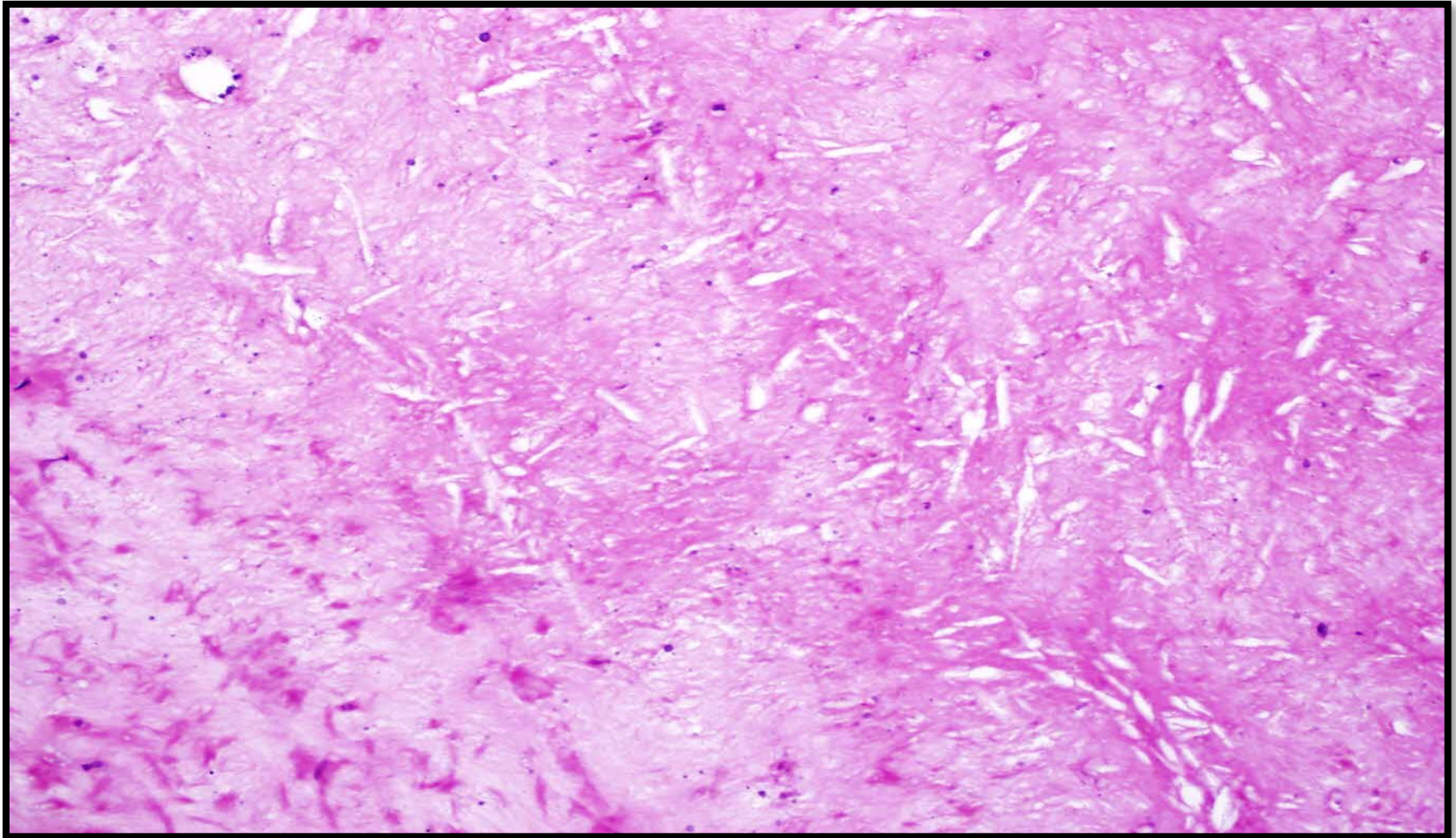
*This distal portion of coronary artery shows significant narrowing. Such distal involvement is typical of **severe** coronary atherosclerosis, due to diabetes mellitus or familial hypercholesterolemia.*

Coronary atherosclerosis - MPF



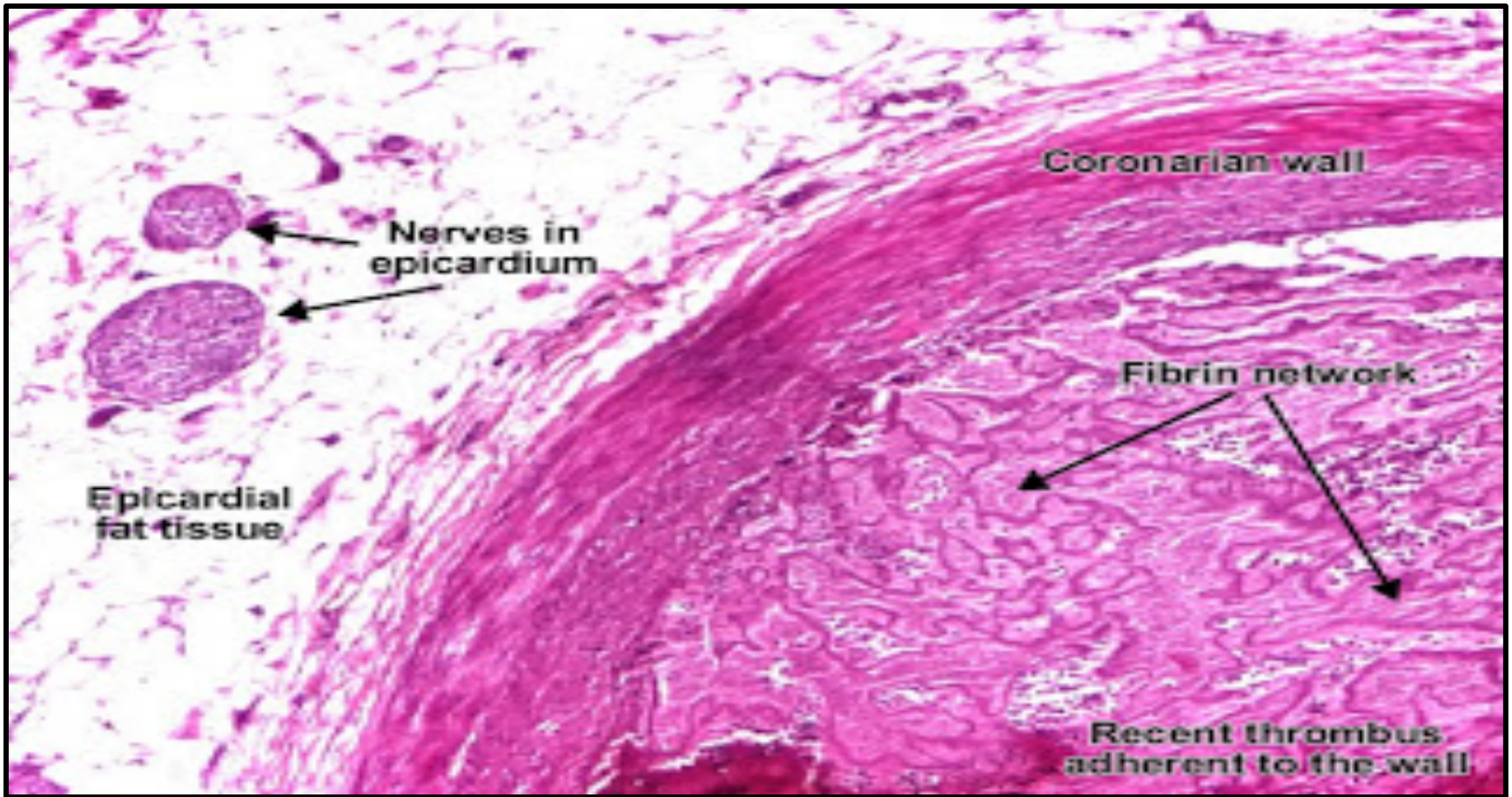
**Severe coronary atherosclerosis with narrowing
of the lumen**

Coronary atherosclerosis - HPF



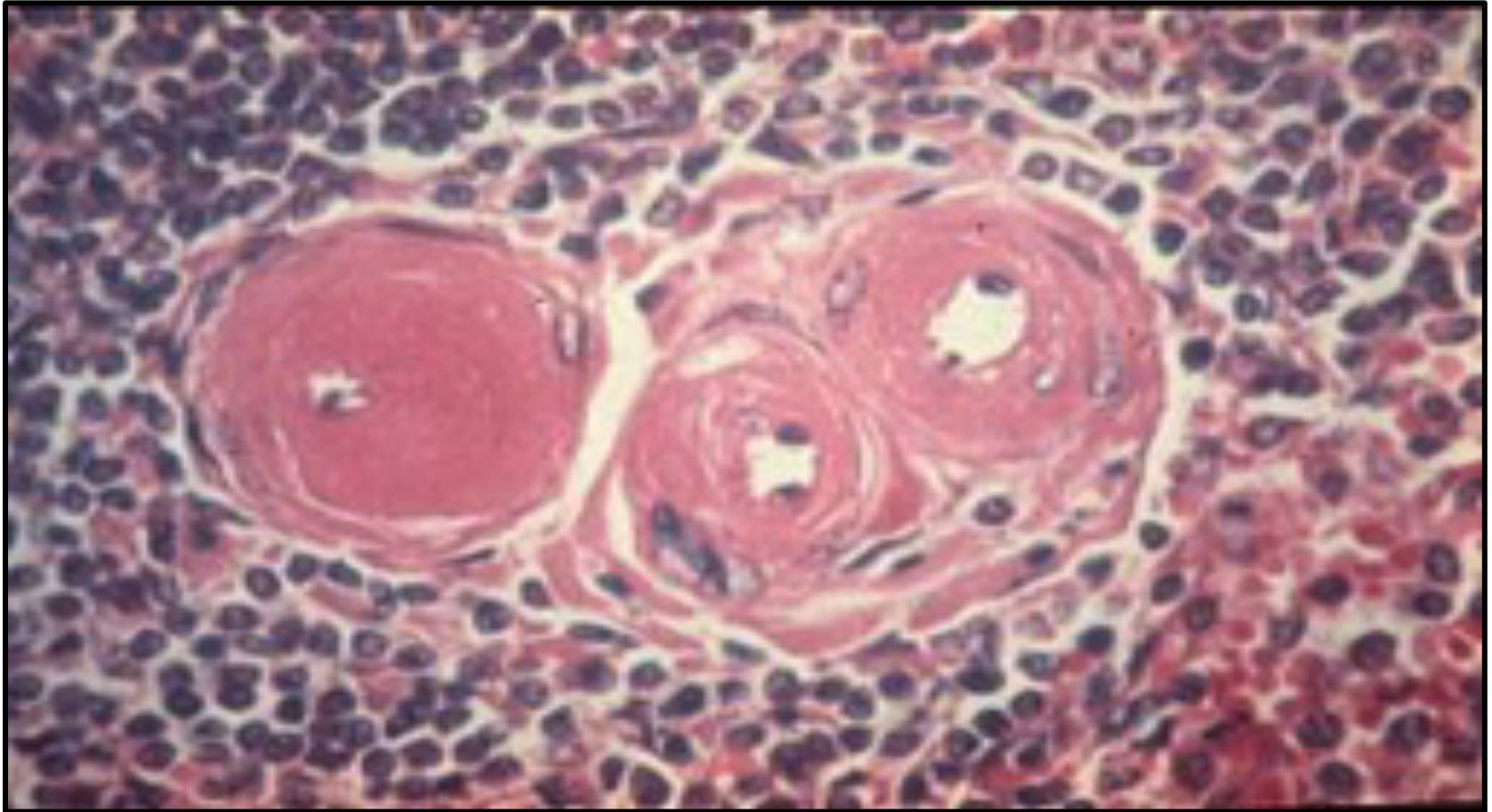
***The internal elastic lamina is thin and fragmented.
Pressure atrophy of the media opposite atheromatous plaque consists of
cholesterol clefts, hyaline fibrous tissue and some blood capillaries.***

Recent thrombus in a Coronary artery



Recent thrombus in a coronary artery: The arterial lumen is completely obstructed by a recent thrombus - **fibrin network (pink)** containing red blood cells and platelets. The thrombus is developed on an ulcerated atherosclerotic (fibrous) plaque and is adherent to the arterial wall.

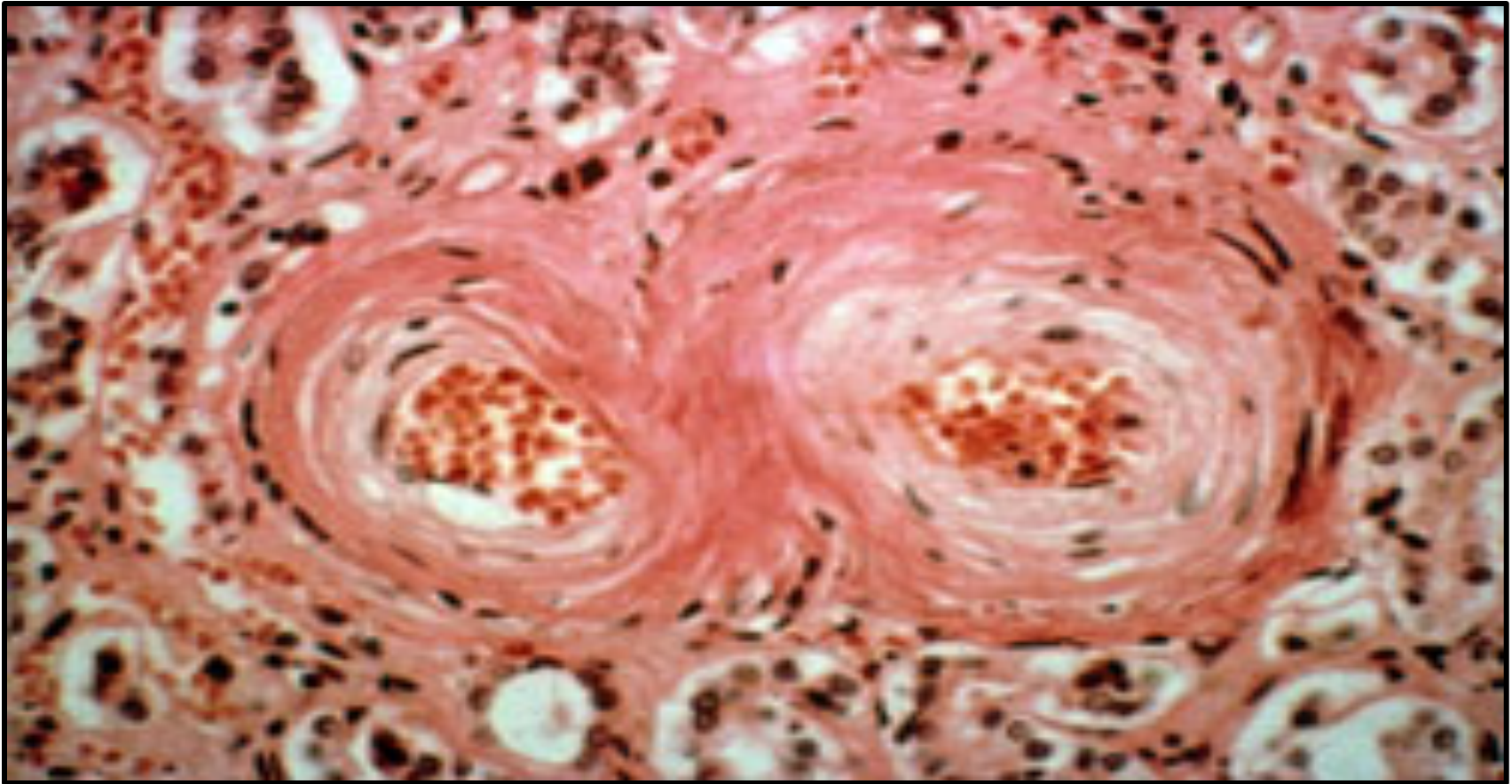
Small vessel arteriosclerosis:
Hyaline arteriolosclerosis - HPF



Hyaline arteriolosclerosis

Arteriosclerosis (hardening of the arteries) involves both small and large vessels. It is commonly found in **diabetics and hypertensives.**

Hyperplastic arteriosclerosis - HPF

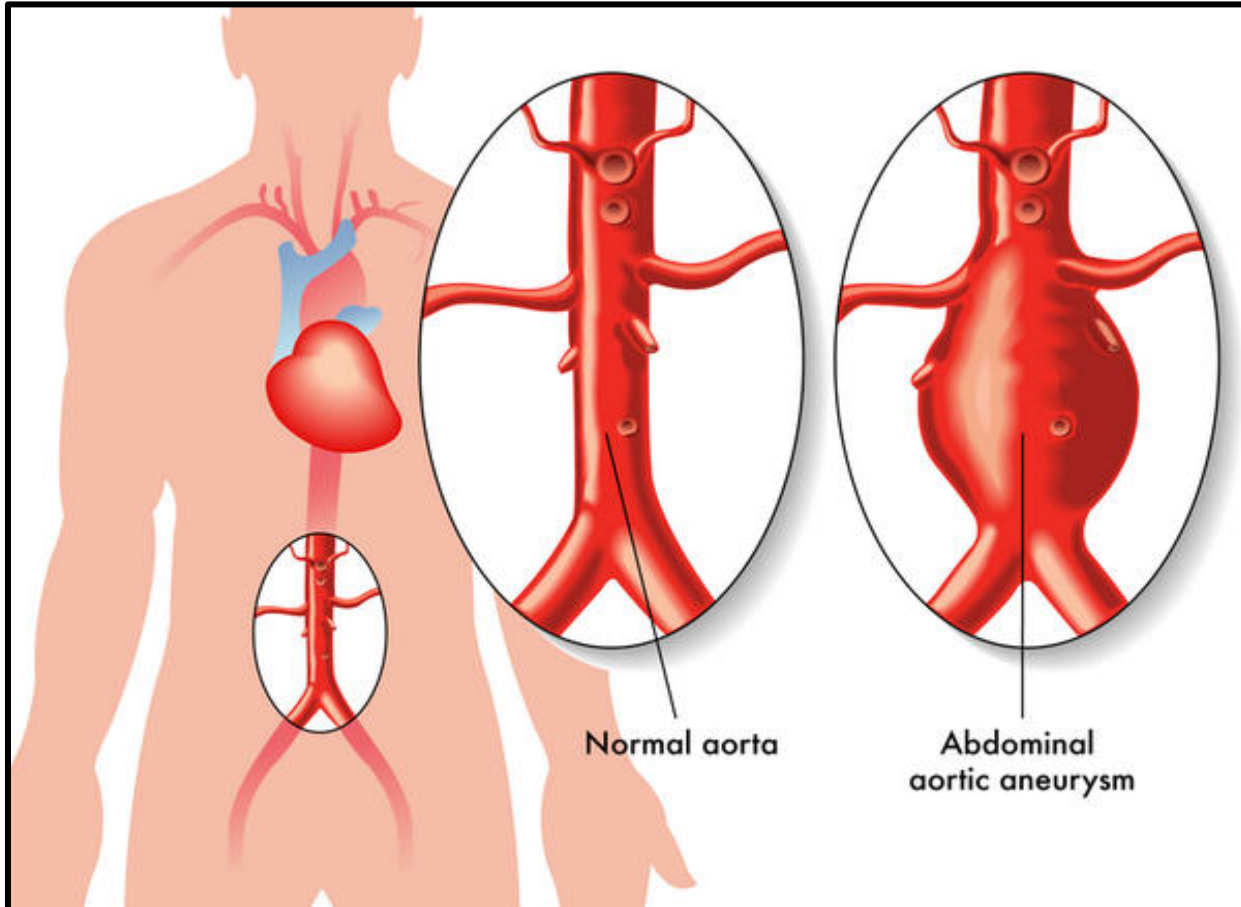


Hyperplastic arteriosclerosis: This is the other type of small vessel arteriosclerosis. It is predominantly seen in malignant hypertension and renal disease associated with polyarteritis nodosa and progressive systemic sclerosis.

A: VASCULAR DISEASE:

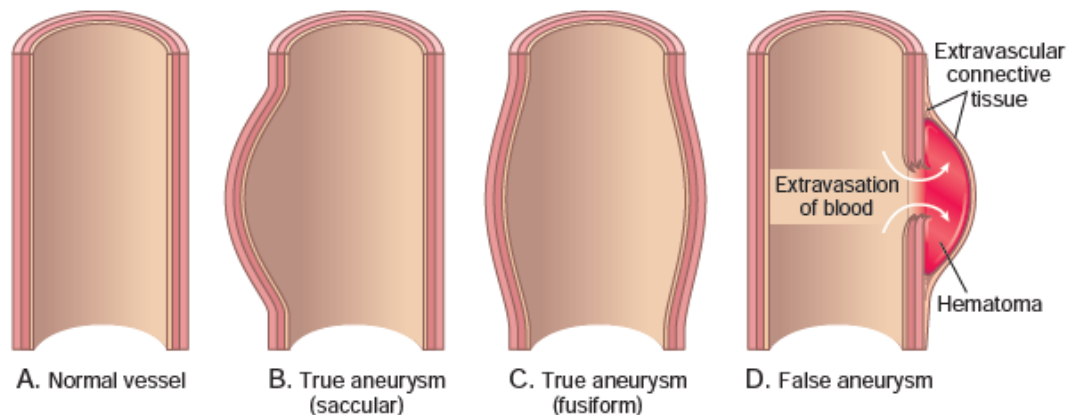
**ANEURYSM OF
ABDOMINAL AORTA**

Abdominal Aortic Aneurysm



Aneurysm

- **Definition:**
 - ▣ An aneurysm is a localized abnormal dilation of a blood vessel
- It may be **congenital or acquired**
- **It is divided into:**
 - ▣ True aneurysm
 - ▣ False aneurysm “pulsating hematoma”



Abdominal Aortic Aneurysm (AAA)

- Aneurysms occurring as a consequence of atherosclerosis form most commonly in the **abdominal aorta and common iliac arteries**.
- AAAs occur more frequently in MEN and in SMOKERS, rarely developing before age 50.
- **Atherosclerosis** is a major cause of AAA.
- Risk of rupture: is directly related to the size of the aneurysm:
 - < 4 cm: low risk of rupture
 - >4 cm: high risk of rupture

Abdominal Aortic Aneurysm (AAA)

□ **Clinical Features:**

- Most cases of AAA are asymptomatic.

- The other clinical manifestations of AAA include:
 - **Rupture** into the peritoneal cavity or retroperitoneal tissues with massive, potentially fatal hemorrhage.
 - **Obstruction** of a vessel branching off from the aorta, resulting in ischemic injury to the supplied tissue.
 - **Embolism** from atheroma or mural thrombus.
 - **Compression** of the ureter.

Types of Aneurysms



Saccular Aneurysm



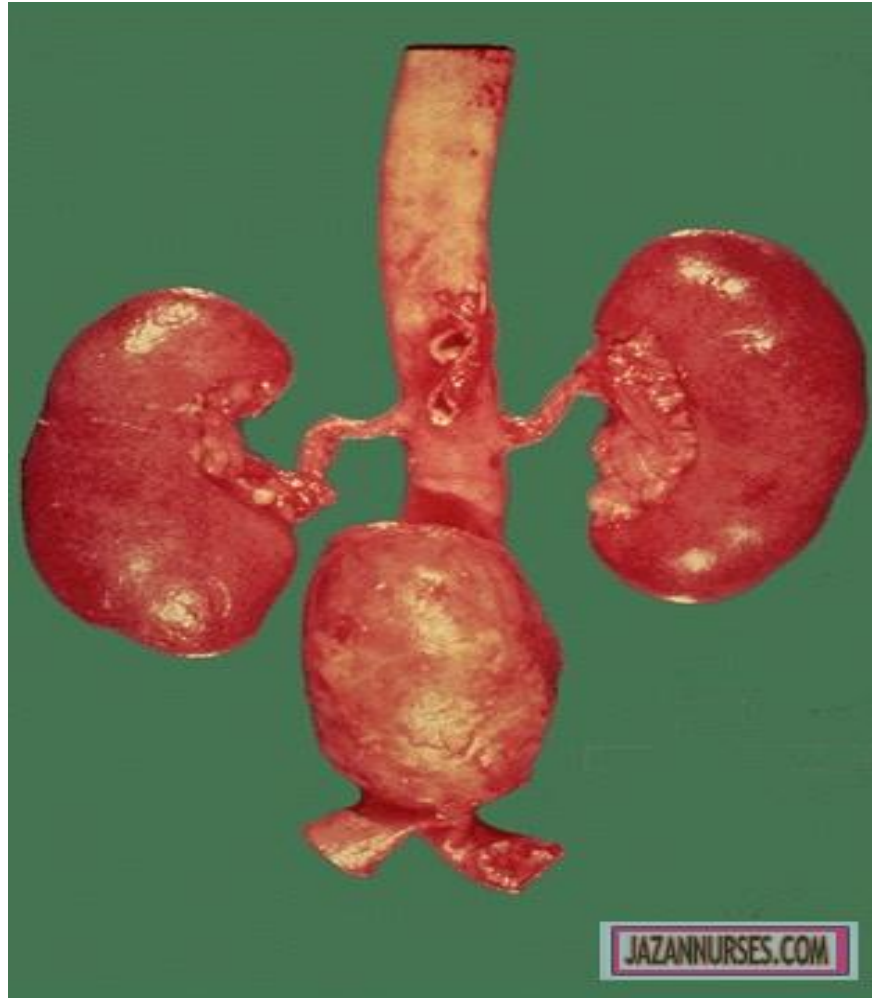
Fusiform Aneurysm



Ruptured Aneurysm

The most likely causes of aneurysms are atherosclerosis , mycotic, syphilitic and congenital

Abdominal Aortic Aneurysm



An example of an atherosclerotic aneurysm of the aorta in which a large "bulge" appears just above the aortic bifurcation.

Abdominal Aortic Aneurysm



Aneurysmal dilatation of the abdominal aorta with rupture , intraluminal thrombus and extensive aortic atherosclerosis .

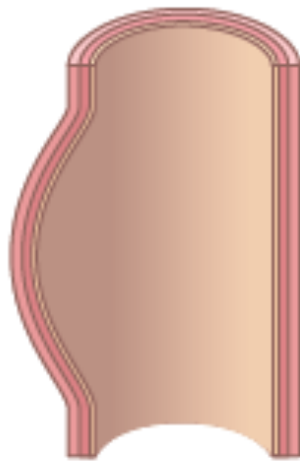
The patient had suddenly developed severe abdominal pain, shocked and collapsed

- ***Organ?***
- ***Diagnosis?***
- ***Etiology?***
- ***Modifiable risk-factors?***

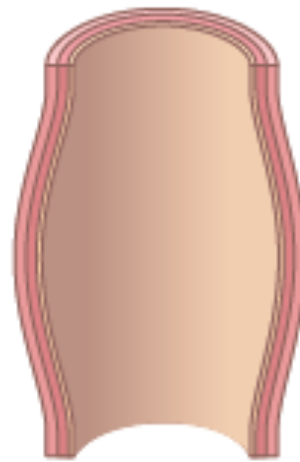
Dissecting aortic aneurysm



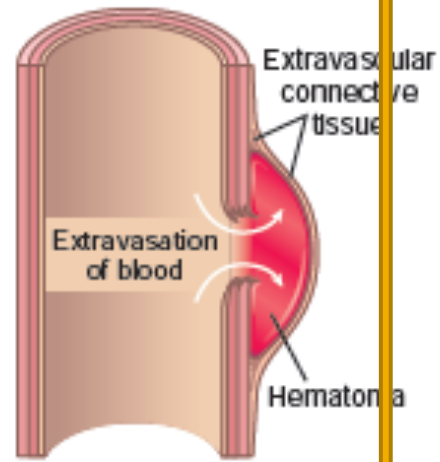
A. Normal vessel



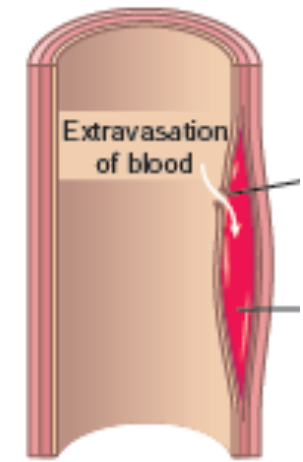
B. True aneurysm (saccular)



C. True aneurysm (fusiform)

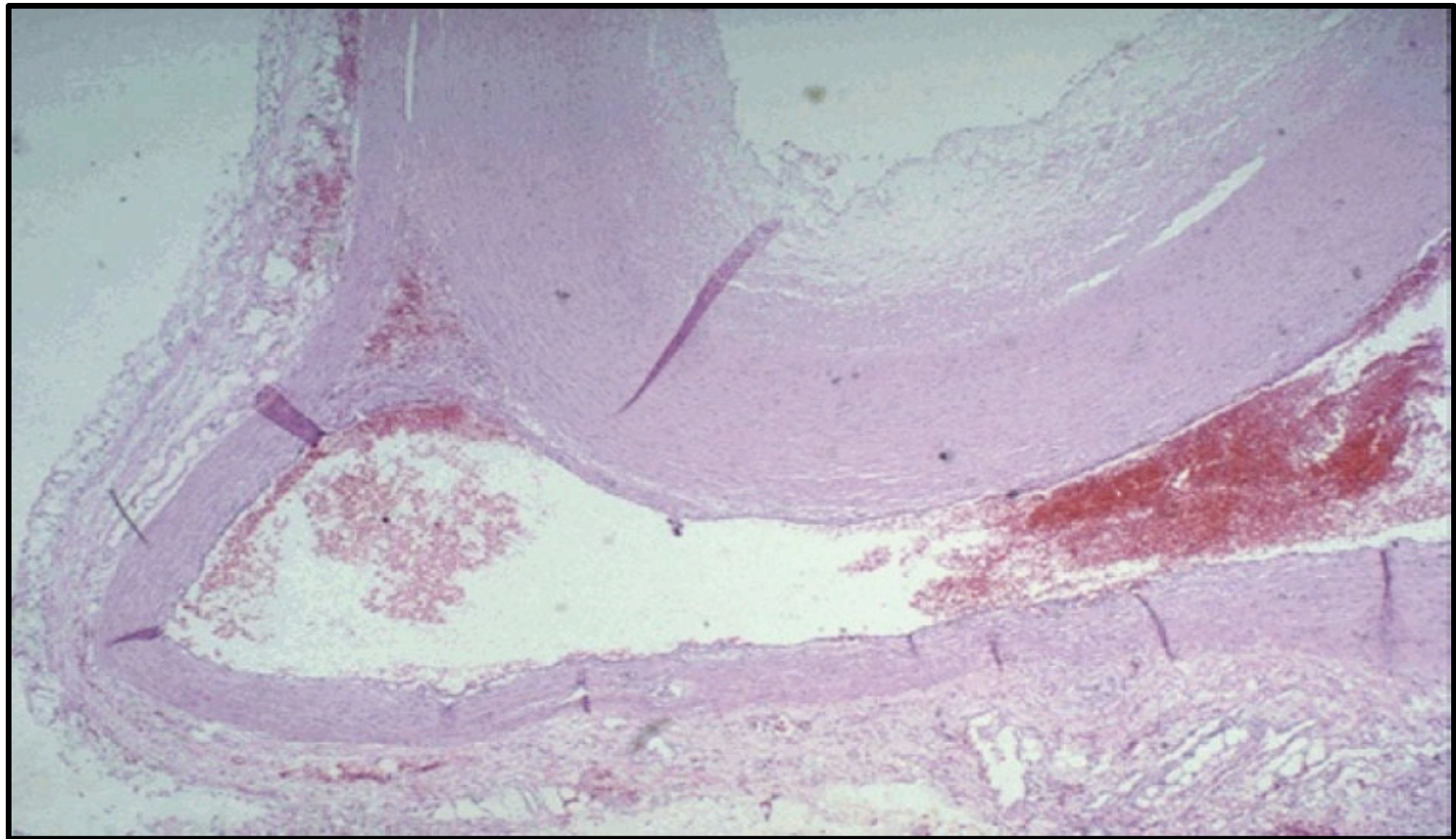


D. False aneurysm



E. Dissection

Dissecting aortic aneurysm - LPF

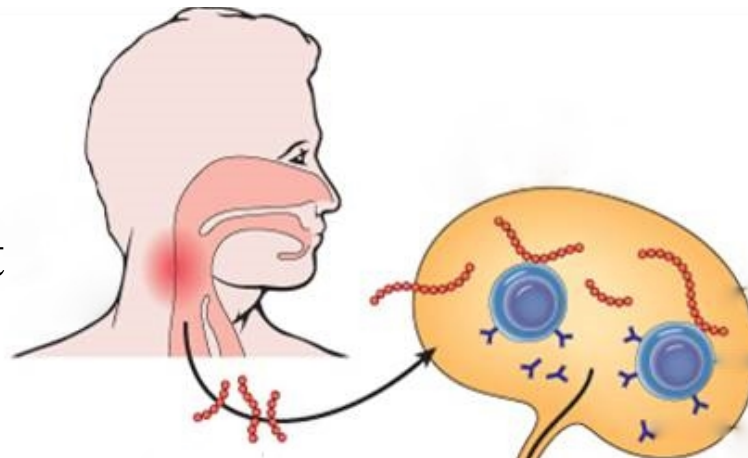


A dissecting aortic aneurysm occurs when blood enters the aortic wall through a defect and moves between two layers of the wall, stripping the inner layer from the outer layer. Usually associated with atherosclerosis, inflammation, and degeneration of the connective tissue of the tunica media

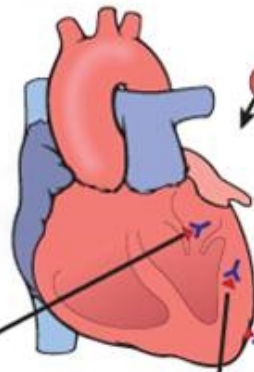
B: VALVE DISEASE:

Vegetations of rheumatic fever on:
Mitral and Aortic valves

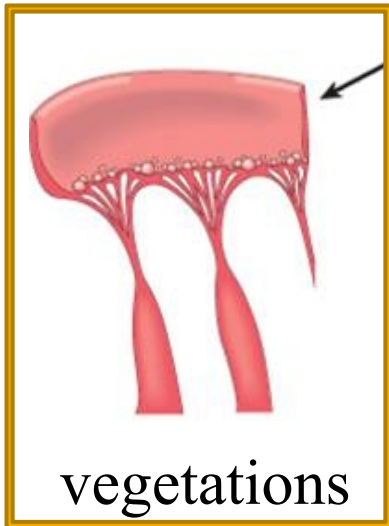
Strep throat



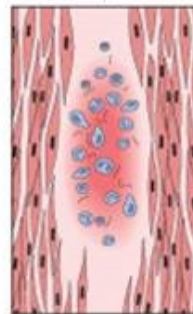
Antibody production



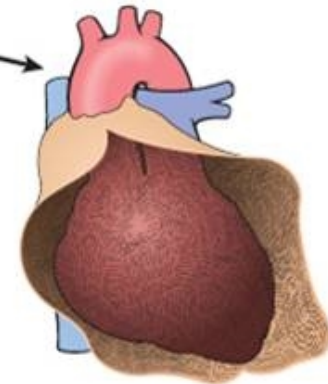
Antibody cross-reaction with heart



vegetations



Aschoff body



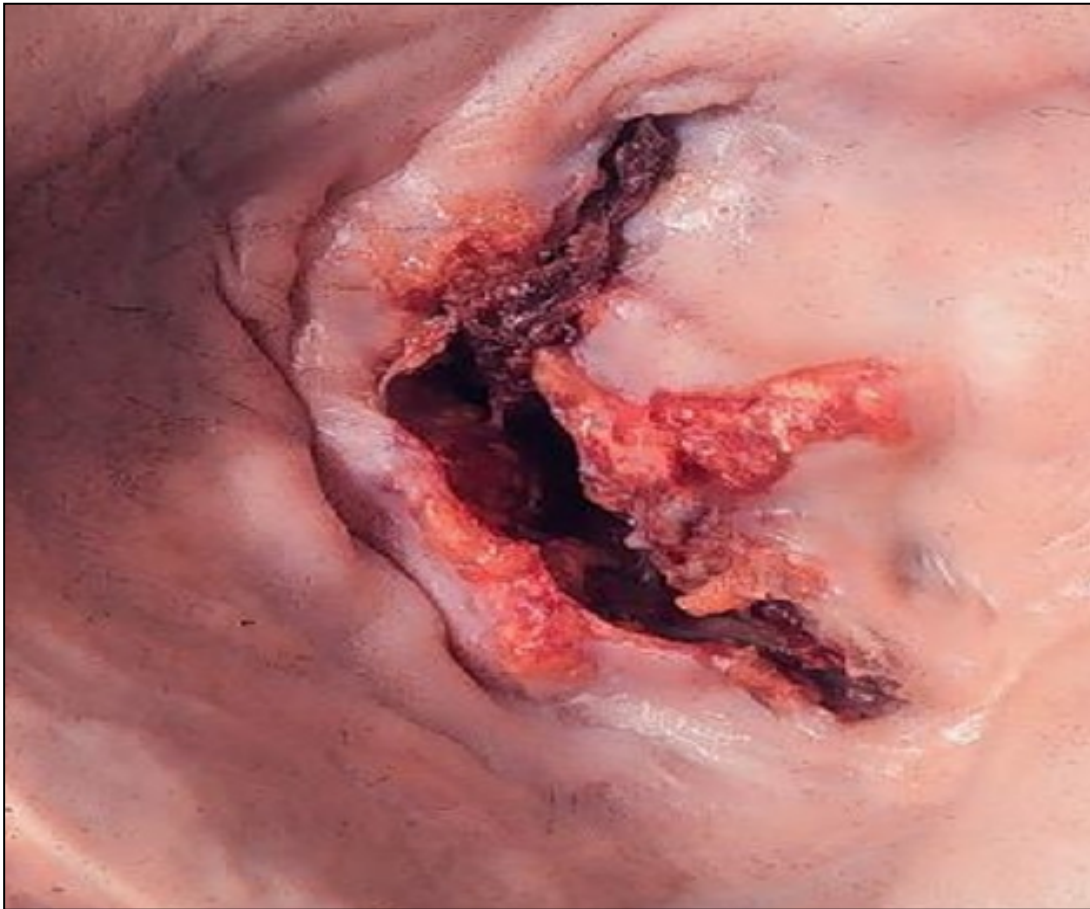
pericarditis

Chronic Rheumatic Mitral Valvulitis - Gross



large vegetations/hemorrhage along the free margins of the mitral valve.

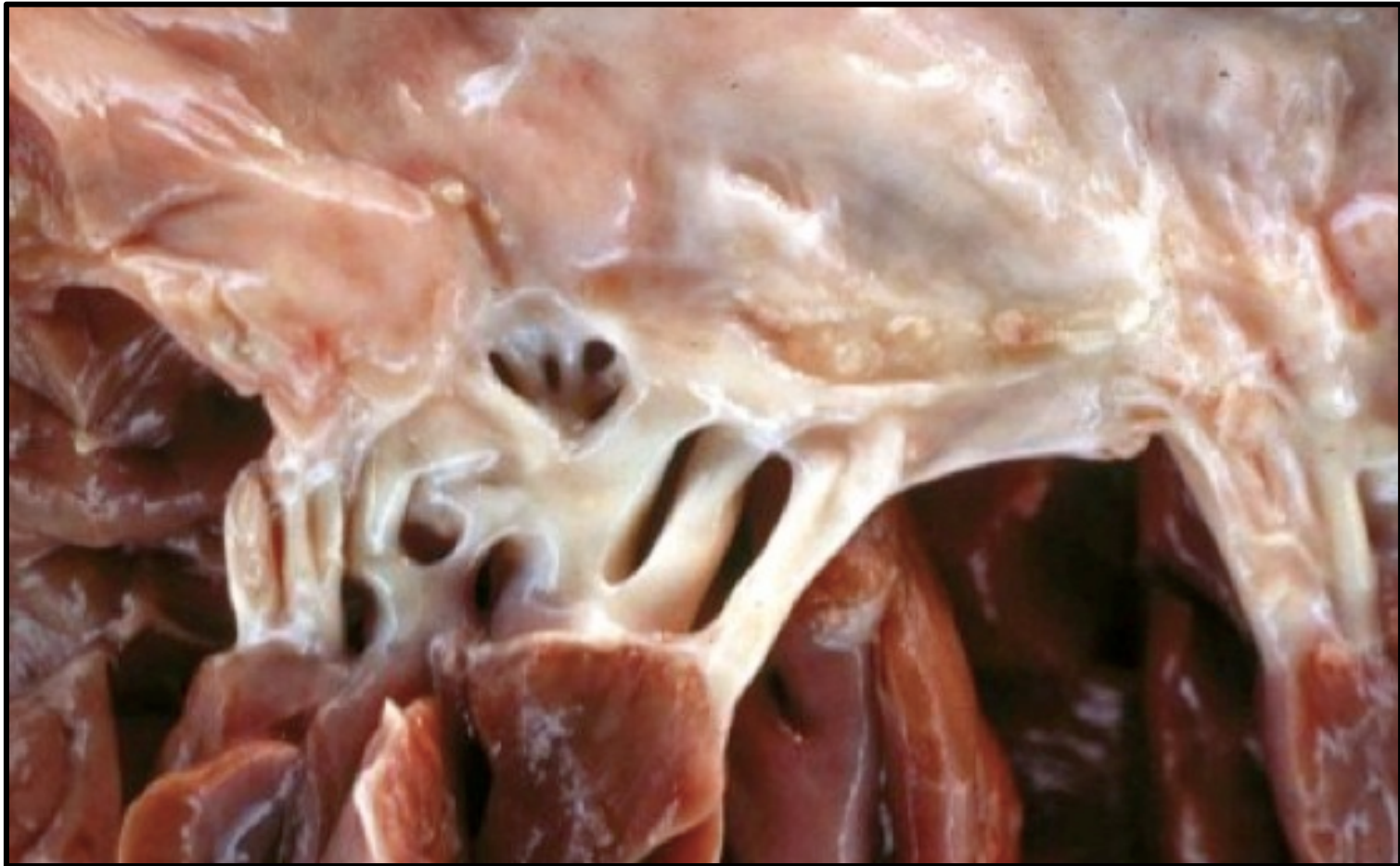
Chronic Rheumatic Mitral Valvulitis - Gross



- **Organ?**
- **Gross pathologic features?**
- **Diagnosis?**
- **Etiology?**

Stenotic mitral valve seen from left atrium (**Fish-Mouth**) showing fusion of commissures, thickening and calcification of the cusps, The vegetations undergo organization and the inflamed cusps heal by fibrosis.

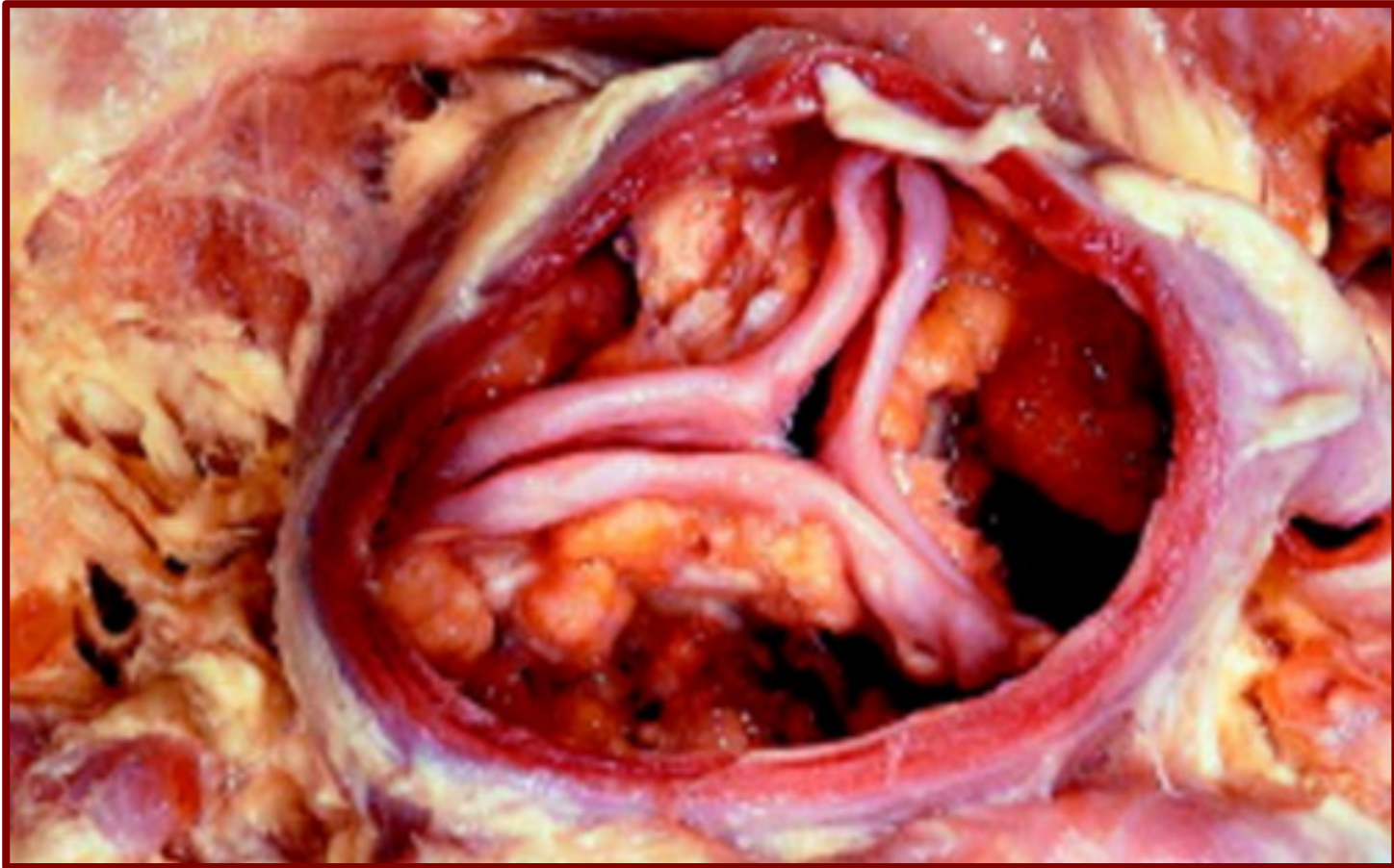
Chronic Rheumatic Mitral Valvulitis - Gross



Chronic rheumatic mitral valvulitis

the valve leaflets are thick, fibrotic, fused. Short, thickened, fused chordae tendinae → stenosis and / or incompetence

Rheumatic Aortic Valvulitis - Gross



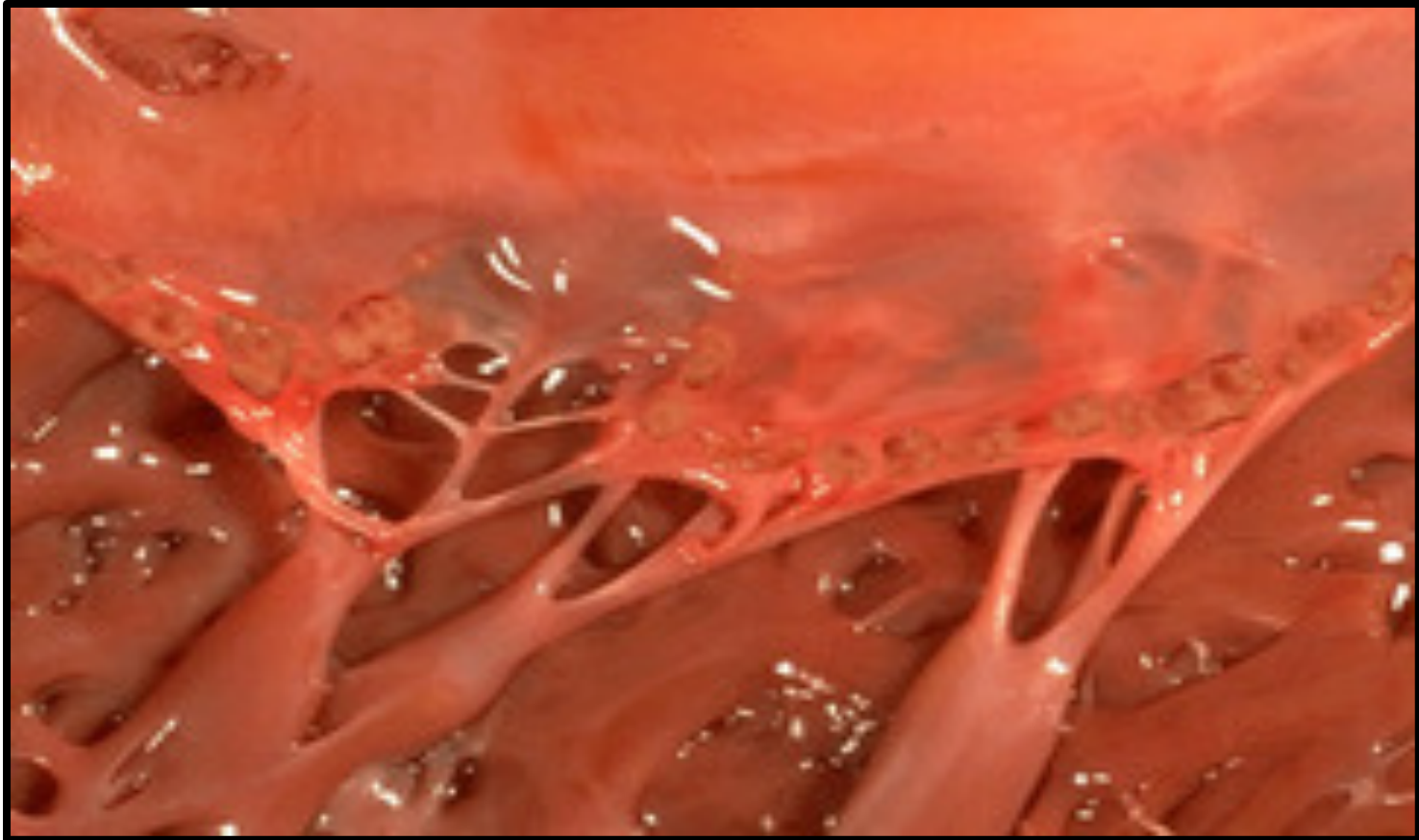
**Gross pathology of rheumatic heart disease (Aortic stenosis):
Aorta has been removed to show thickened, fused aortic
valve leaflets**

Acute Rheumatic Mitral Valvulitis - Gross



Close-up view of an opened-out rheumatic mitral valve showing severe thickening and retraction of the cusps. The chordae tendineae are shortened and fused into short thick cords. This rigid valve would have been stenosed

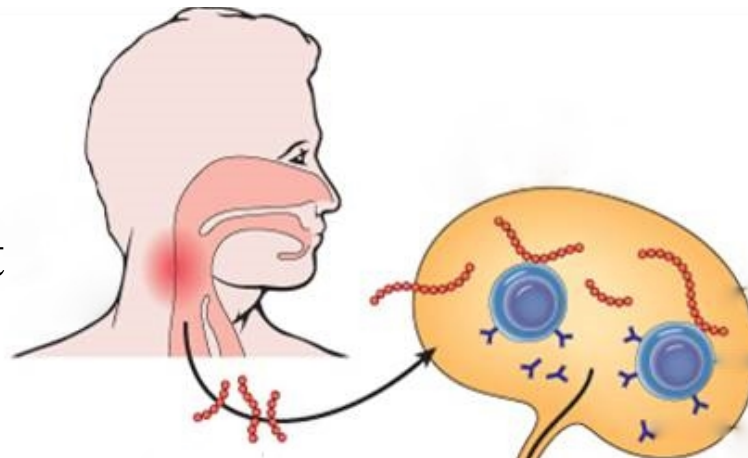
Acute Rheumatic Mitral Valvulitis - Gross



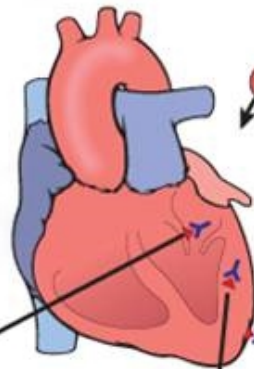
The small verrucous *vegetations* are associated with acute rheumatic fever. These warty vegetations are multiple, firm, adherent, small , 1-3 mm in- diameter and form along the line of valve closure over areas of endocardial inflammation. Affects mainly Aortic & Mitral valves

Acute rheumatic myocarditis

Strep throat



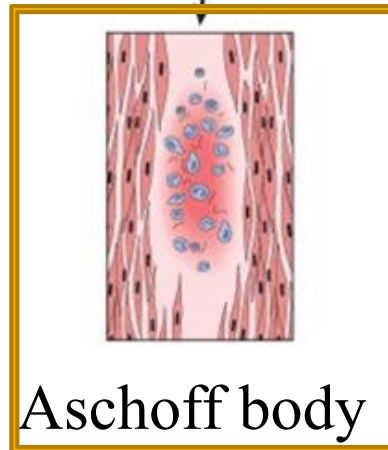
Antibody production



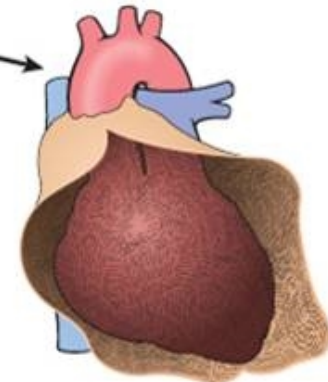
Antibody cross-reaction with heart



vegetations

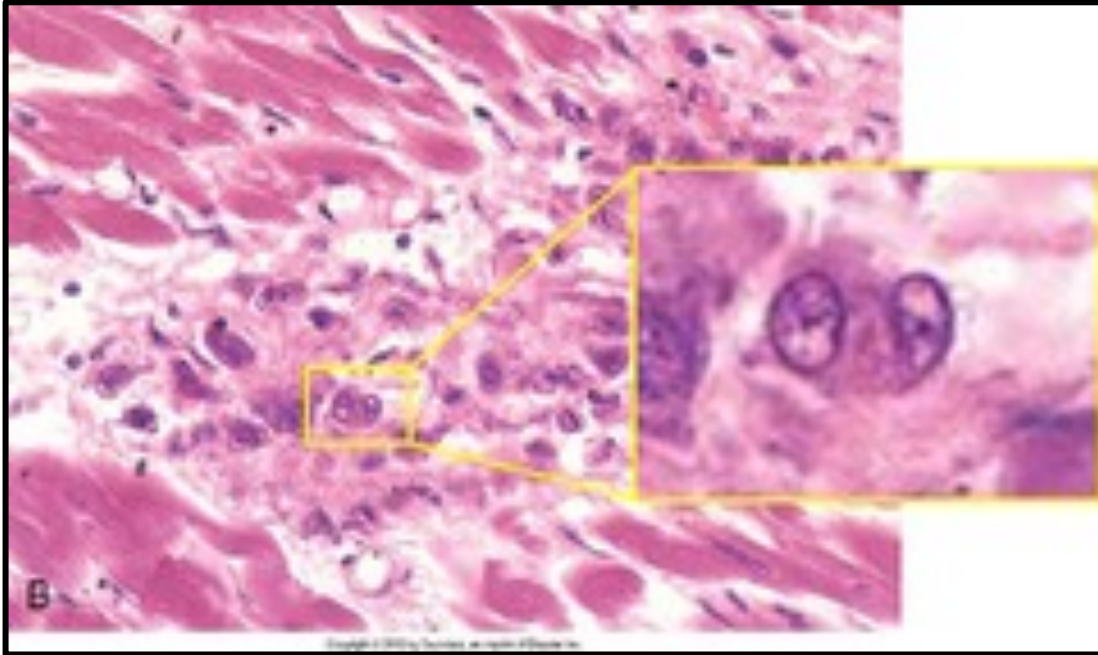


Aschoff body



pericarditis

Acute Rheumatic Carditis - HPF

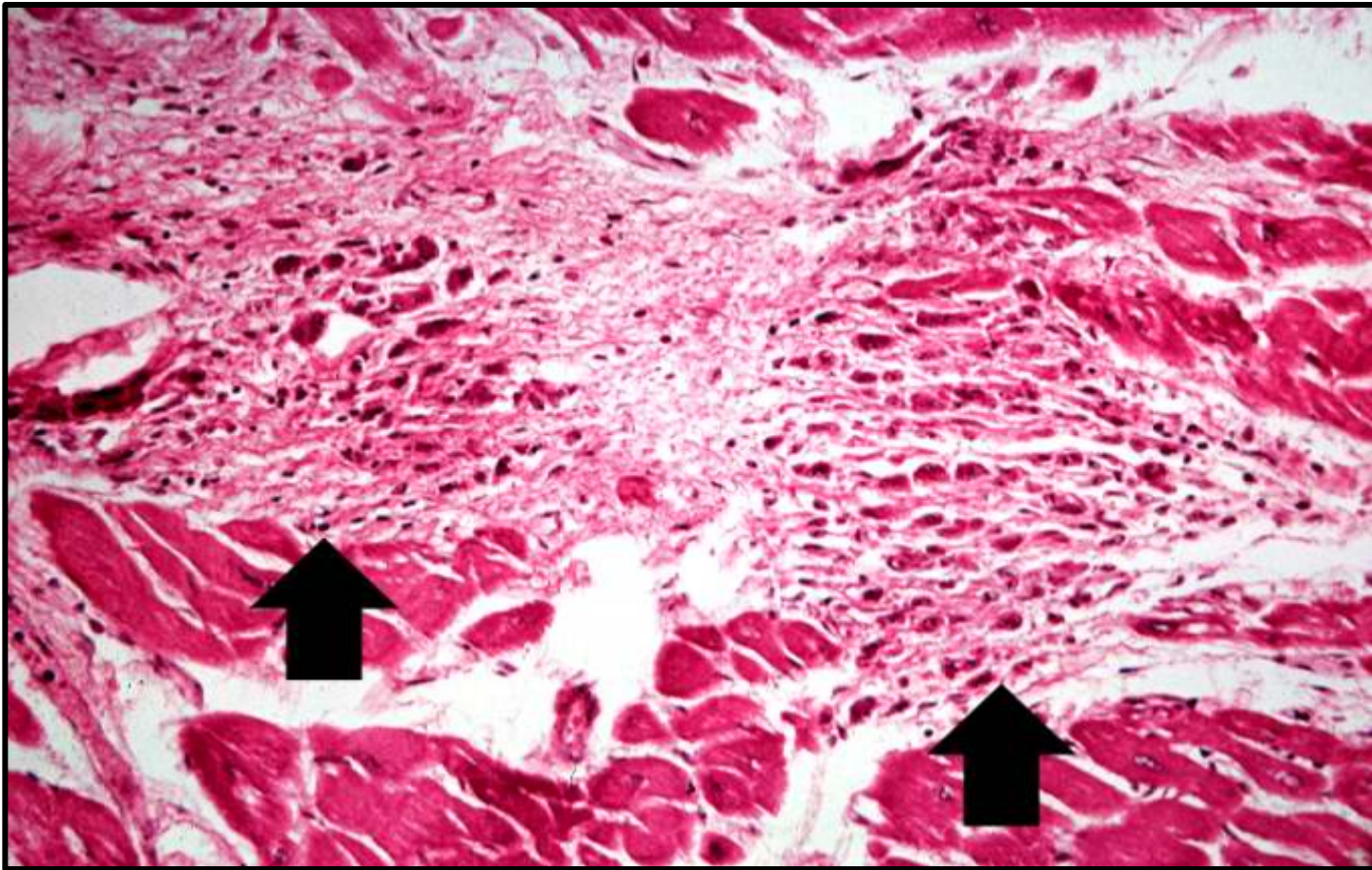


- Myocardial lesion?
- Cells?

An **Aschoff nodule** at high magnification.

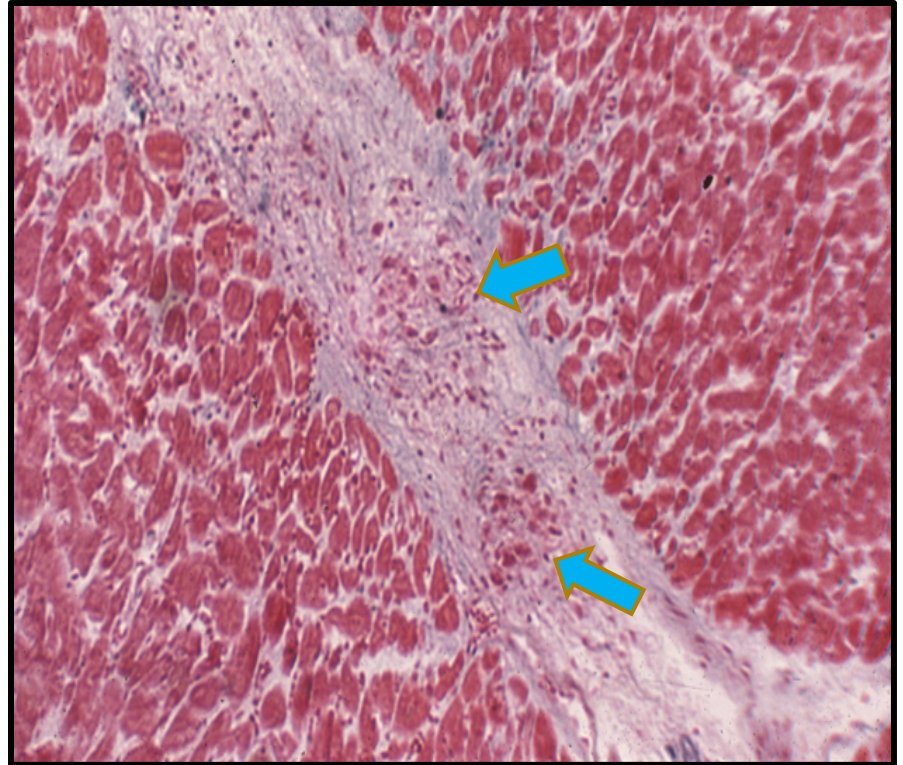
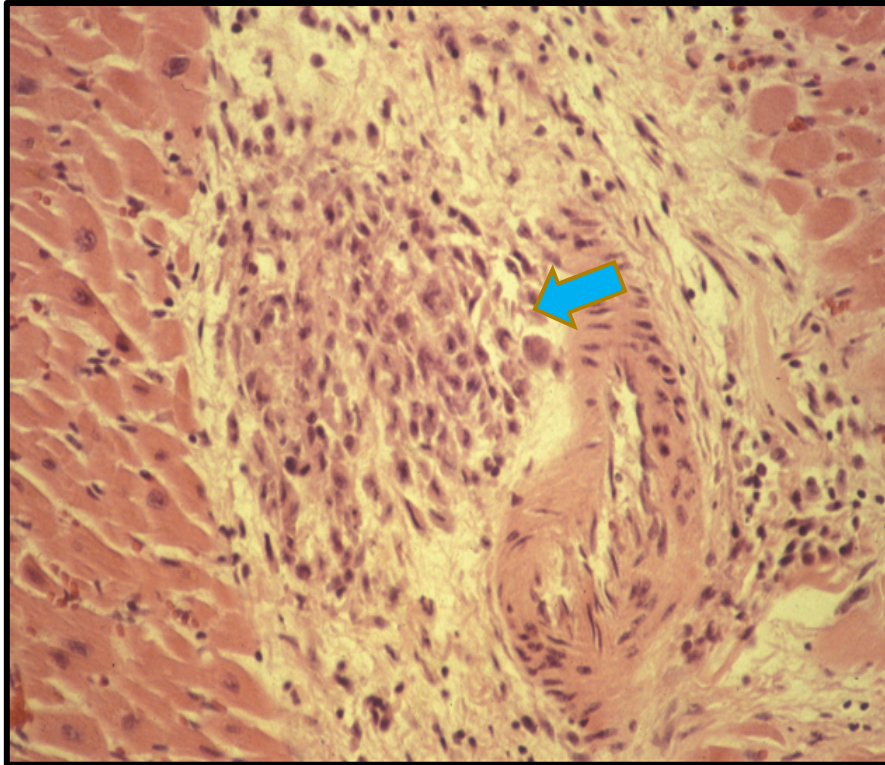
It affects mainly the **left** side of the heart and in particular the posterior wall of the left atrium. The most characteristic component is the **Aschoff giant cell**. Several appear here as large cells with two or more nuclei that have prominent nucleoli.

Acute Rheumatic Carditis - HPF



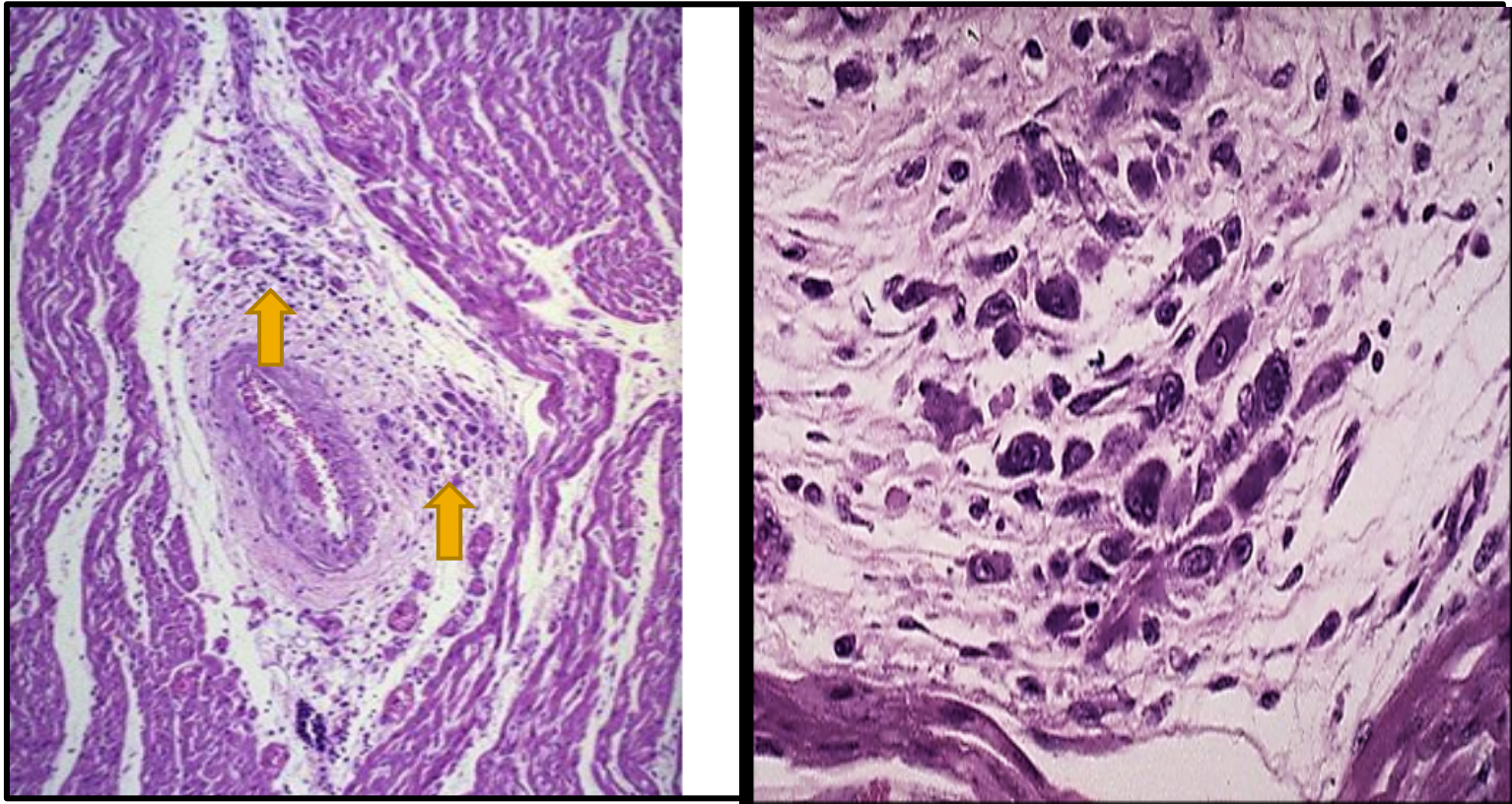
Microscopically, acute rheumatic carditis is marked by a peculiar form of granulomatous inflammation with so-called "Aschoff nodules" seen best in myocardium,

RHEUMATIC MYOCARDIITIS (ASHOFF NODULE)



Aschoff nodule consists of a focus of fibrinoid necrosis, few lymphocytes, macrophages and few small giant cells with one or several nuclei (***Aschoff giant cell***).

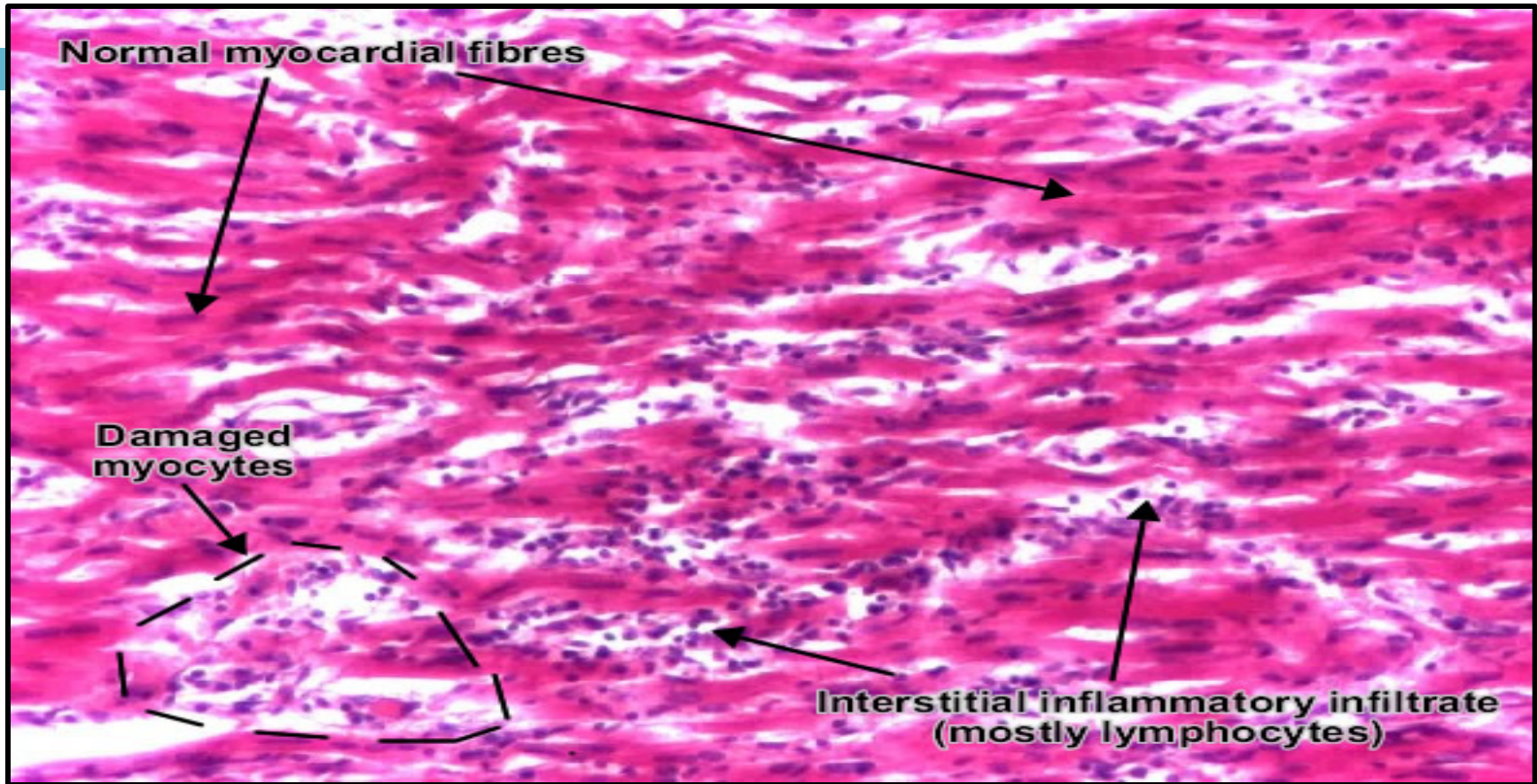
RHEUMATIC MYOCARDIITIS (ASHOFF NODULE)



Aschoff bodies in the intermuscular fibrous septa. They are oval in shape and seen in relation to blood vessels.

Each consists of a focus of fibrinoid necrosis, few lymphocytes, macrophages and few small giant cells with one or several nuclei (Aschoff giant cell).

Acute viral myocarditis - MPF



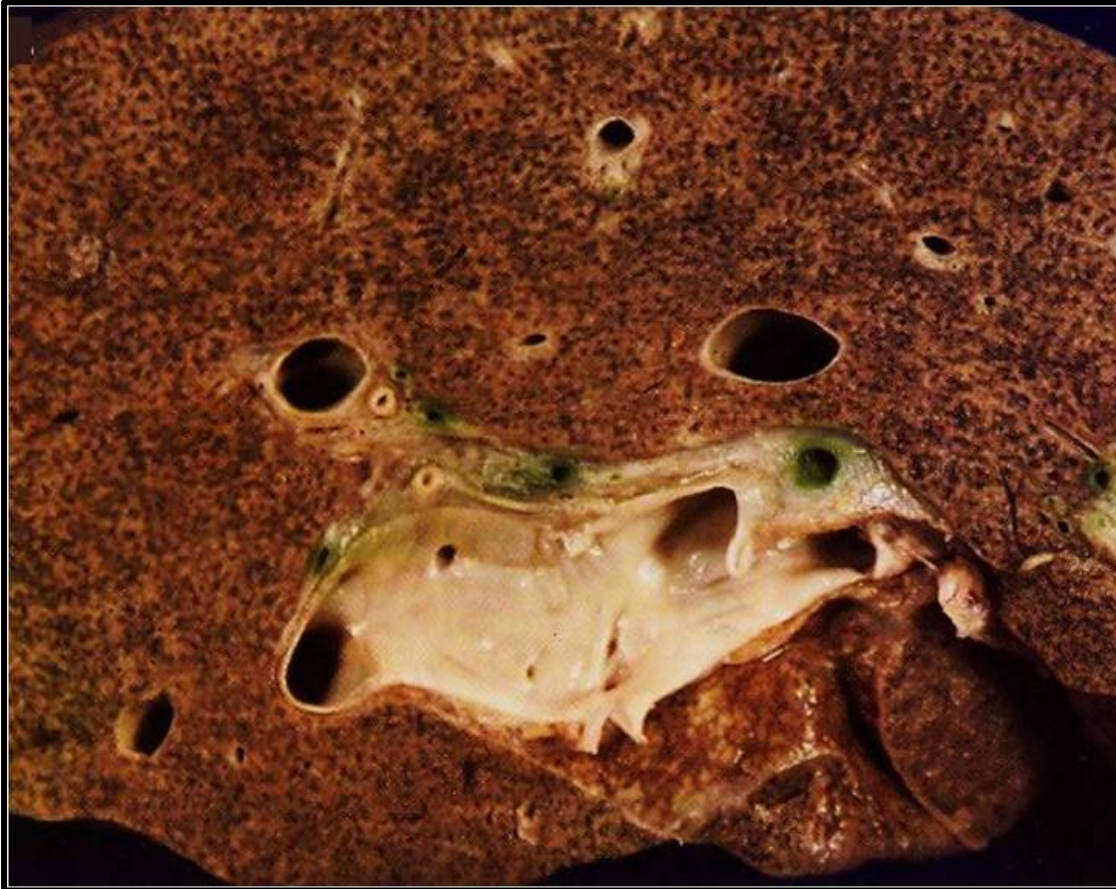
Myocarditis is an inflammation of the myocardium. Acute viral myocarditis is produced most often by Coxsackie B virus and echoviruses. Myocardial interstitium presents an abundant edema and inflammatory infiltrate, mainly with lymphocytes and macrophages.

HEART FAILURE

Right Sided Heart Failure

*Chronic venous congestion
of the liver*

NUTMEG LIVER – Cut surface



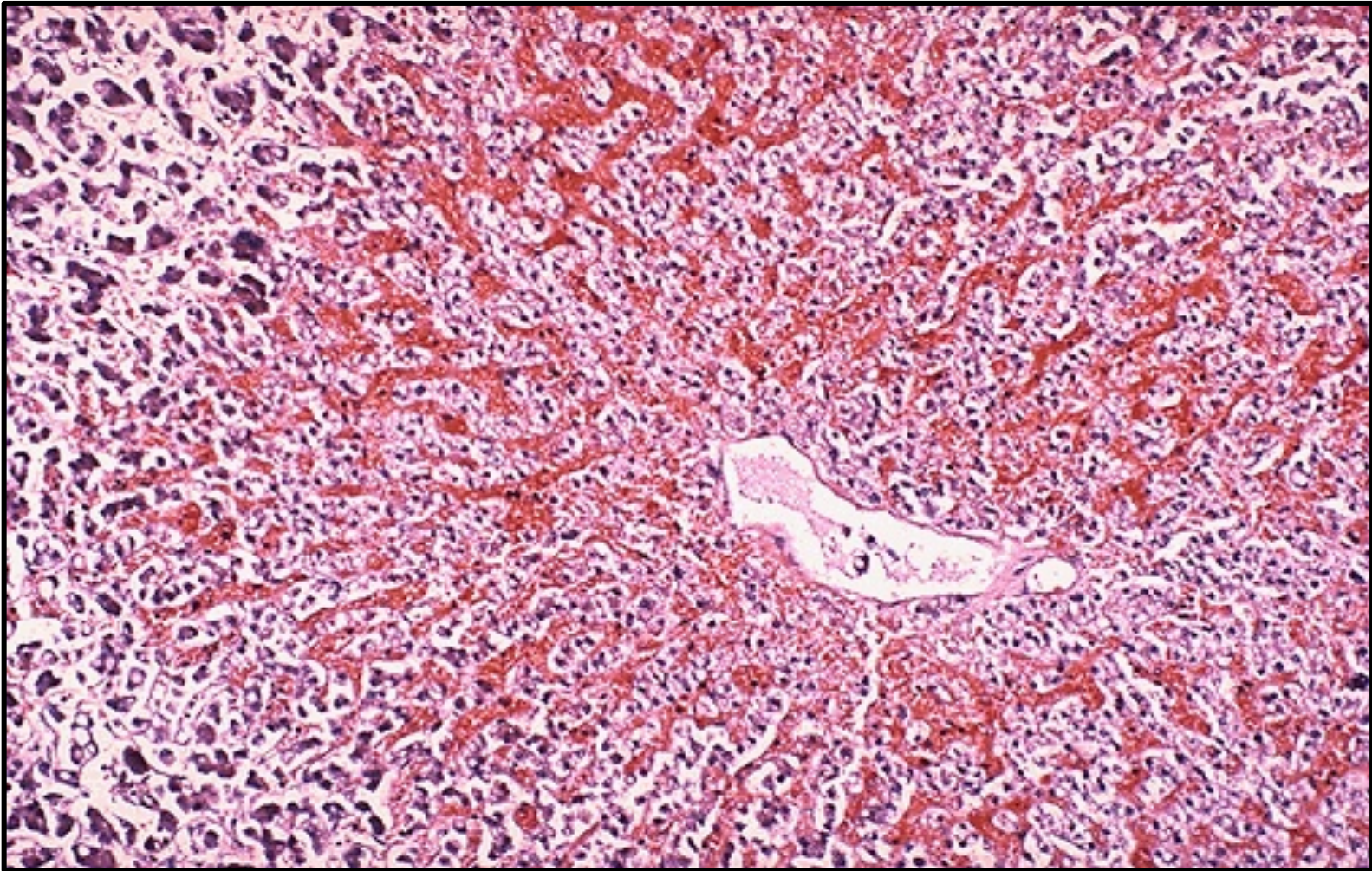
Section of liver showing alternating pale and dark areas with a *nutmeg* like appearance possibly due to passive congestion secondary to right sided heart failure.

NUTMEG LIVER – Cut surface



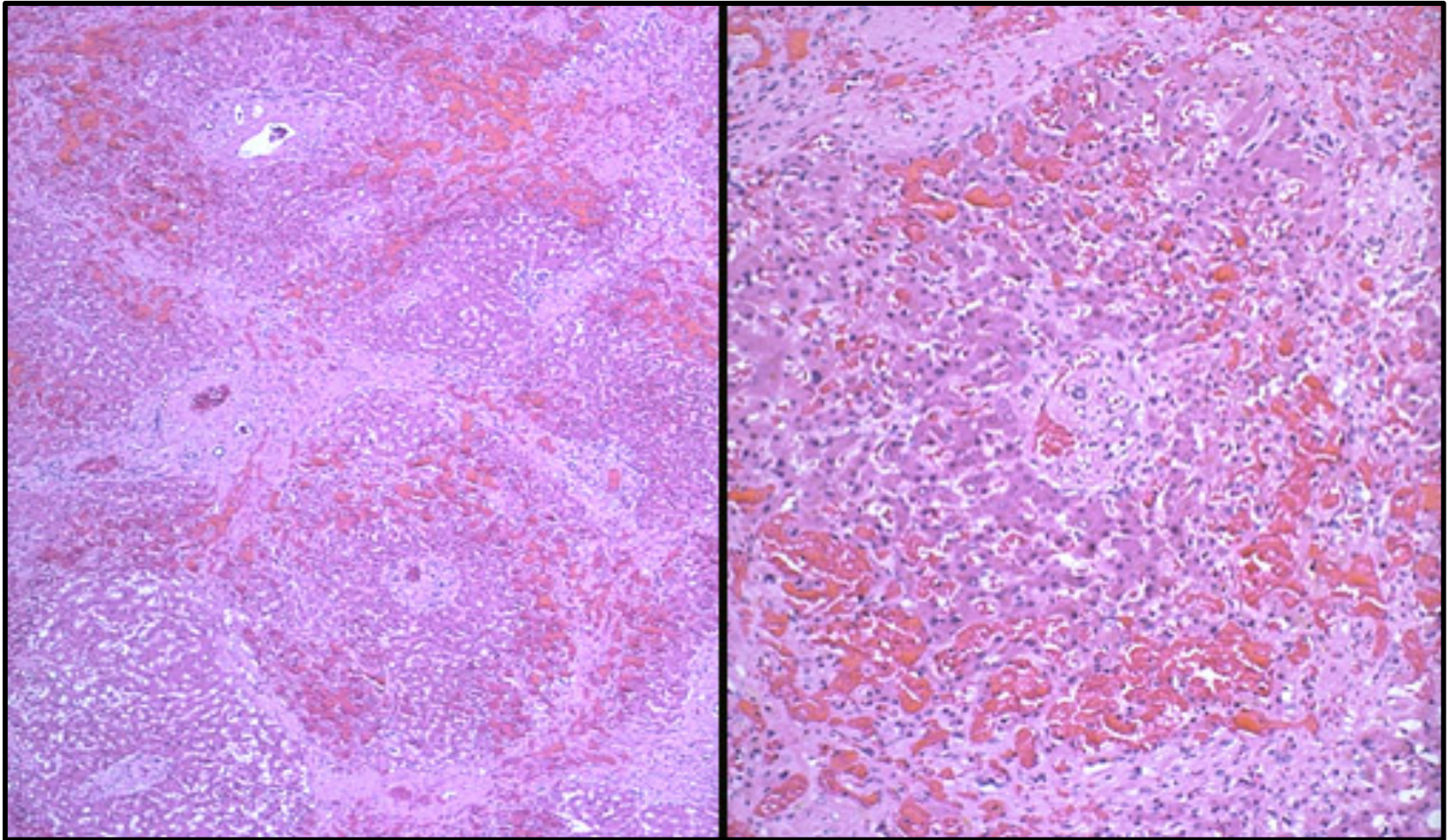
The hepatic parenchyma contains a faintly nodular pattern and nutmeg staining due to chronic passive congestion due to Right sided heart failure.

Chronic Congestion of the Liver - LPF



The central portion of liver lobules shows congestion and dilatation of central veins and blood sinusoids, with atrophy and necrosis of liver cells.

Chronic Congestion of the Liver - LPF

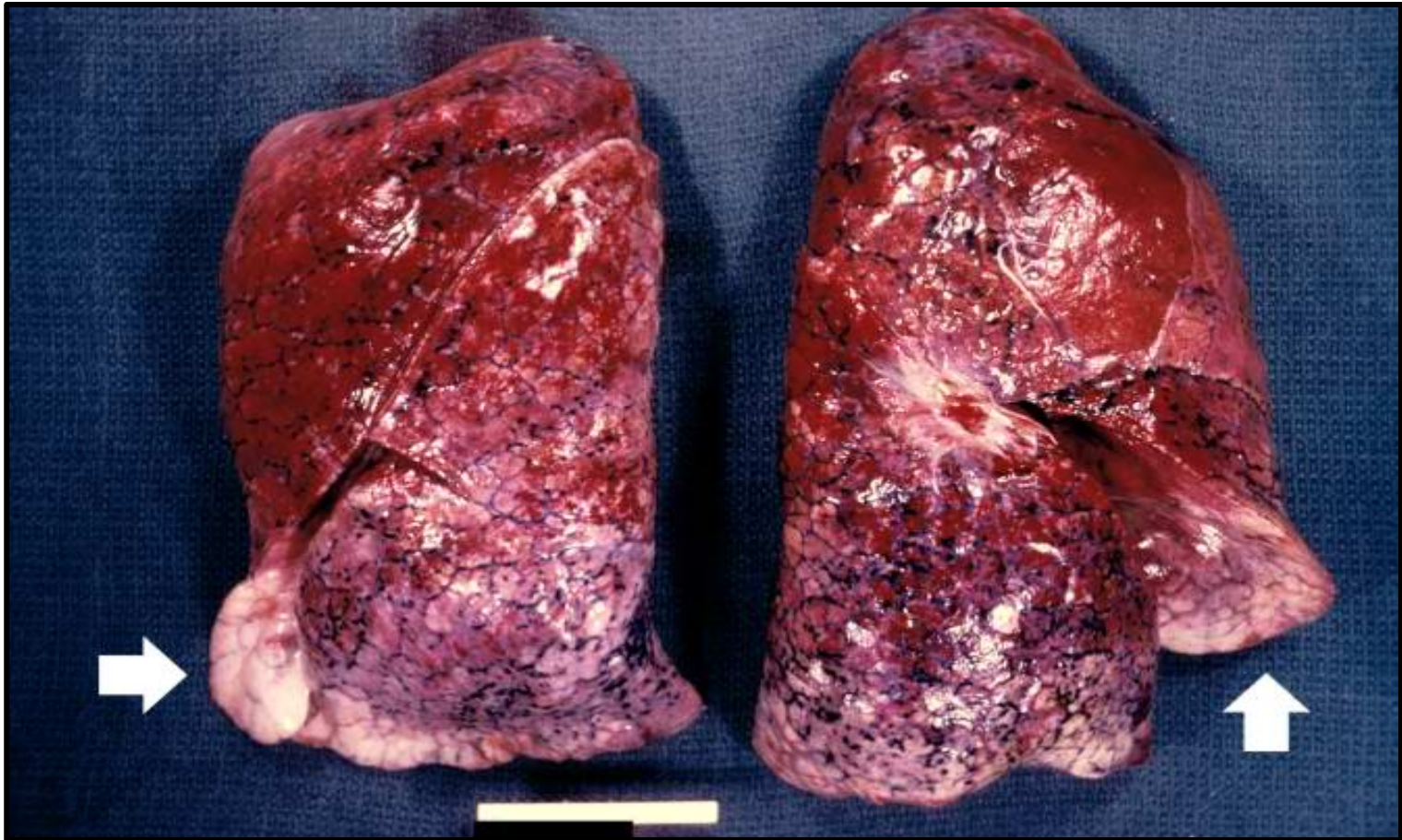


Central veins dilated and congested , necrotic hepatocytes , kupffer cells and steatosis

Left Sided Heart Failure

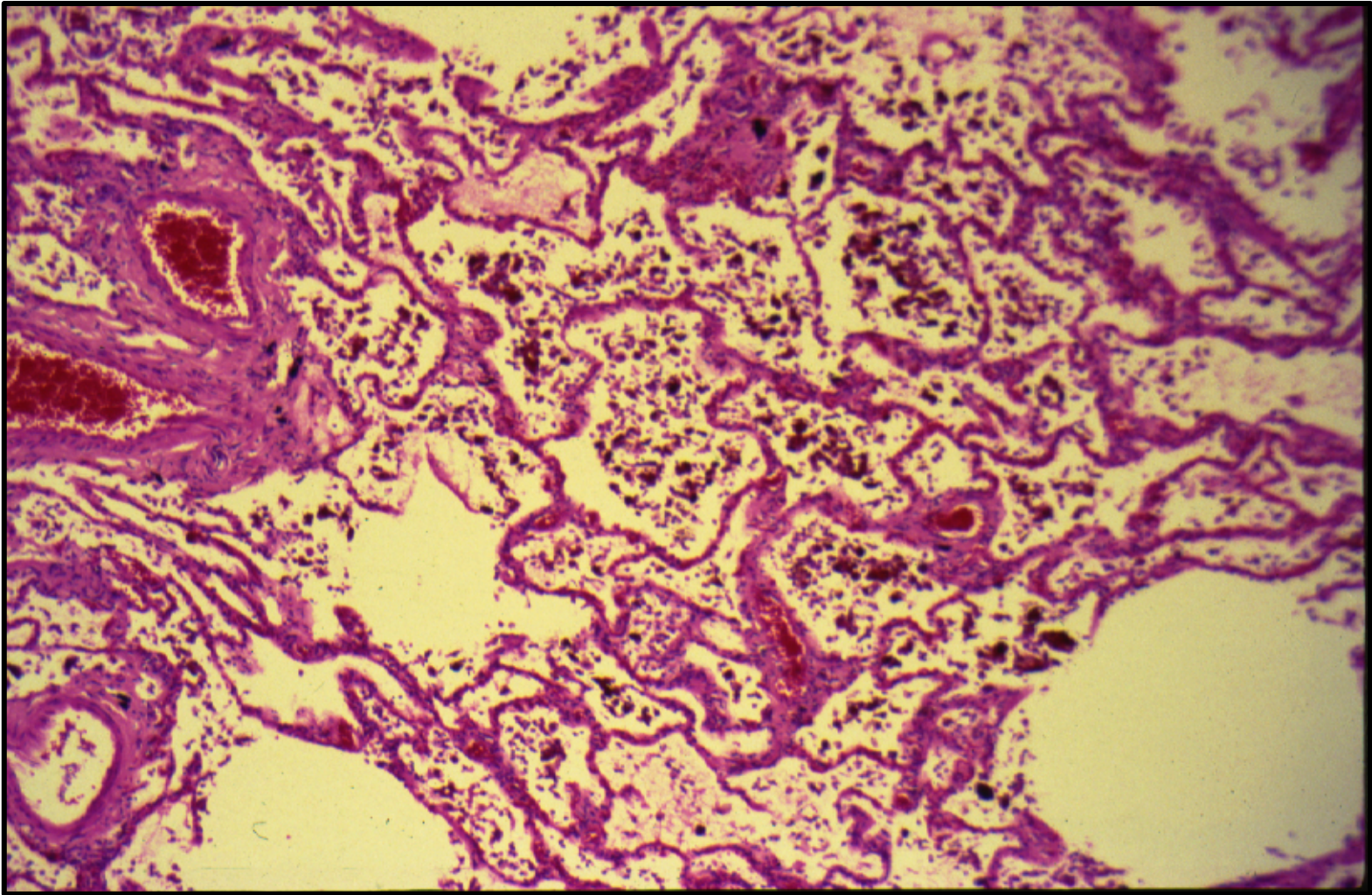
*Chronic venous congestion
of the lung*

Chronic venous congestion of the lung - Gross



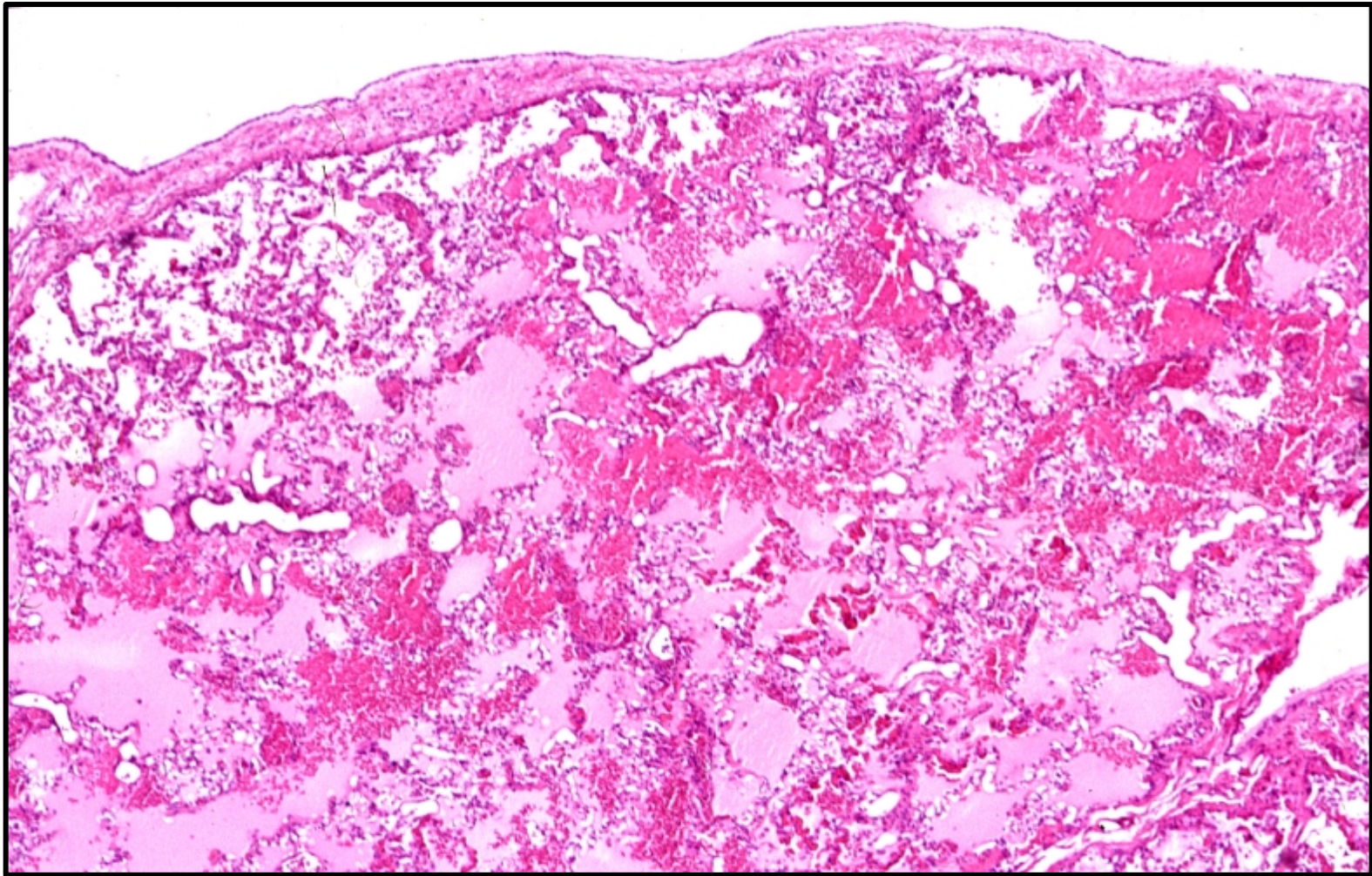
This is a gross photograph of lungs that are distended and red. The *reddish* coloration of the tissue is due to congestion. Some normal pink lung tissue is seen at the edges of the lungs (arrows).

Chronic venous congestion of the lung - LPF



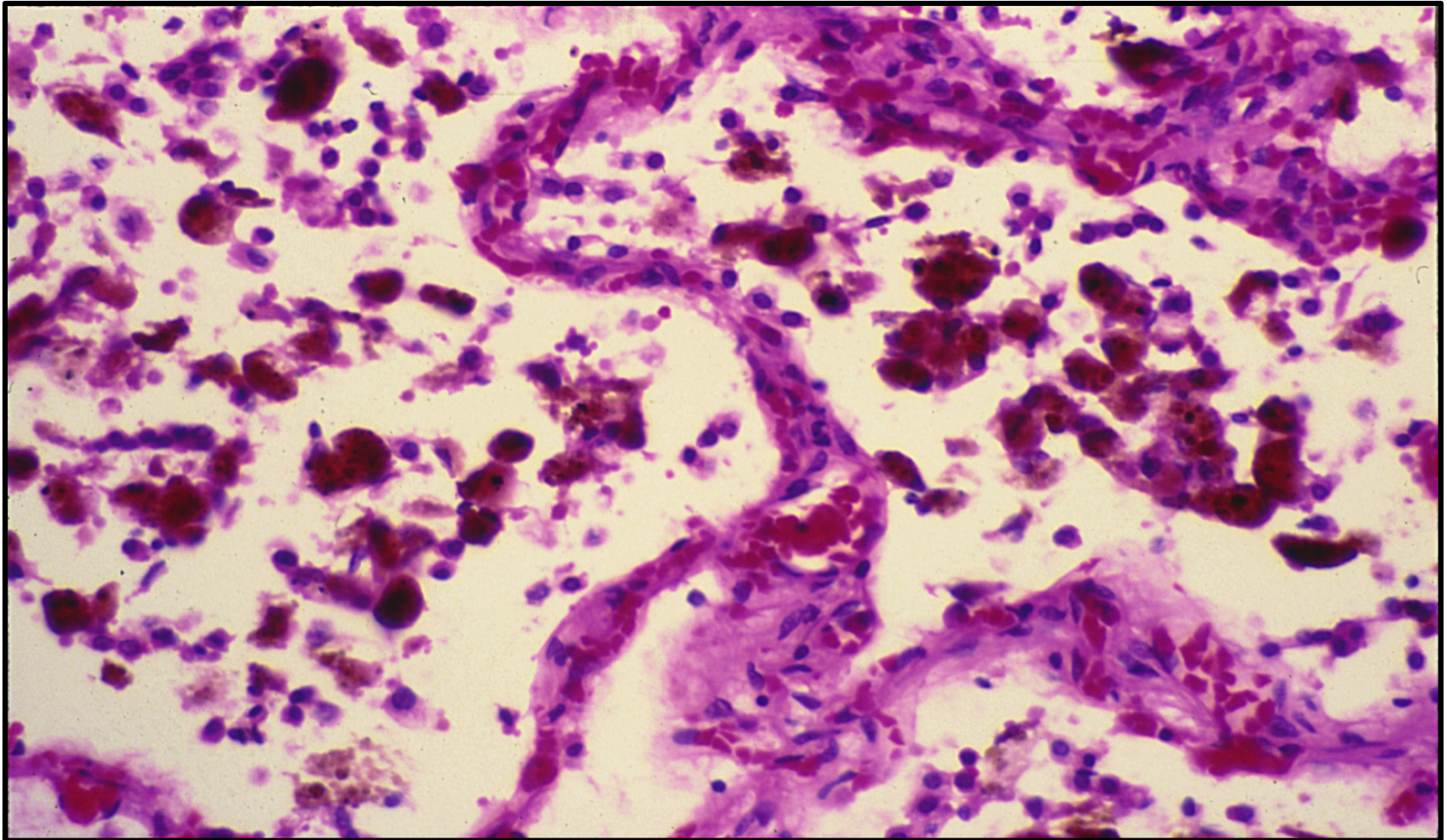
The alveolar walls are thickened by dilated and engorged capillaries.

Chronic venous congestion of the lung - LPF



Lung, pulmonary edema in patient with congestive heart failure due to heart transplant rejection

Chronic venous congestion of the lung - HPF



The alveoli contain fluid, red blood cells and large alveolar macrophages (heart failure cells), which are filled with hemosiderin pigment derived from red cells breakdown.