

CARDIOVASCULAR SYSTEM

Pathology Practical 1

Prepared by:

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

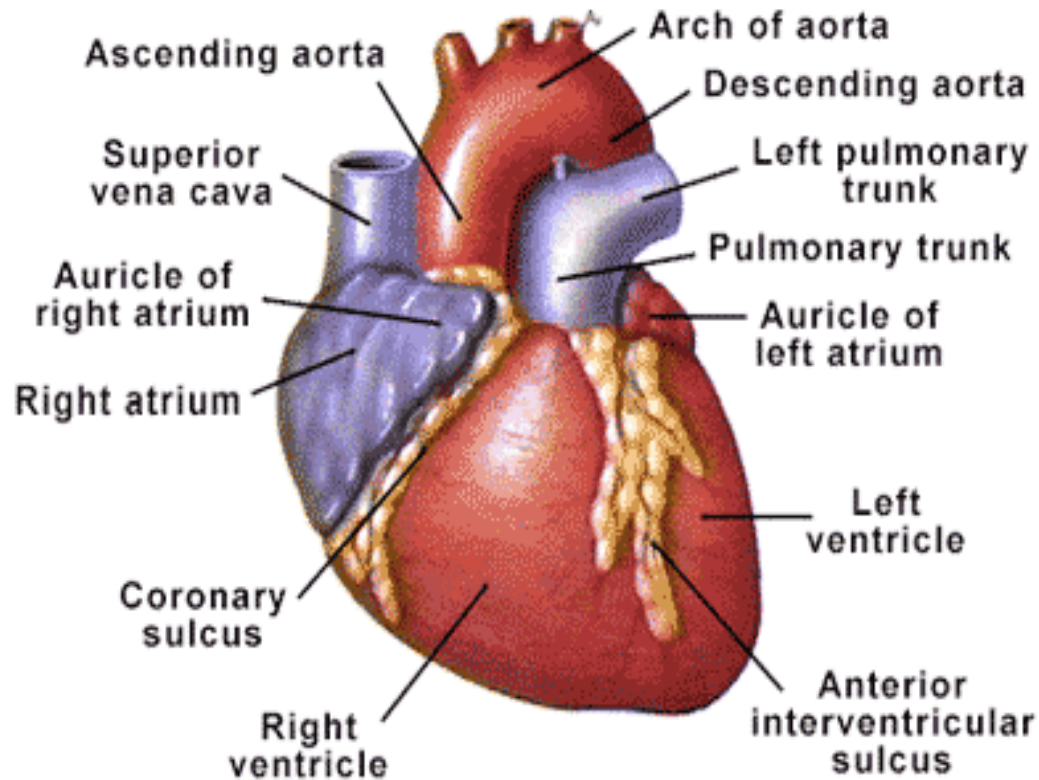
NORMAL ANATOMY AND HISTOLOGY

Objectives:

At the end of this P1 practical session of the cardiovascular block, the medical students will be able to:

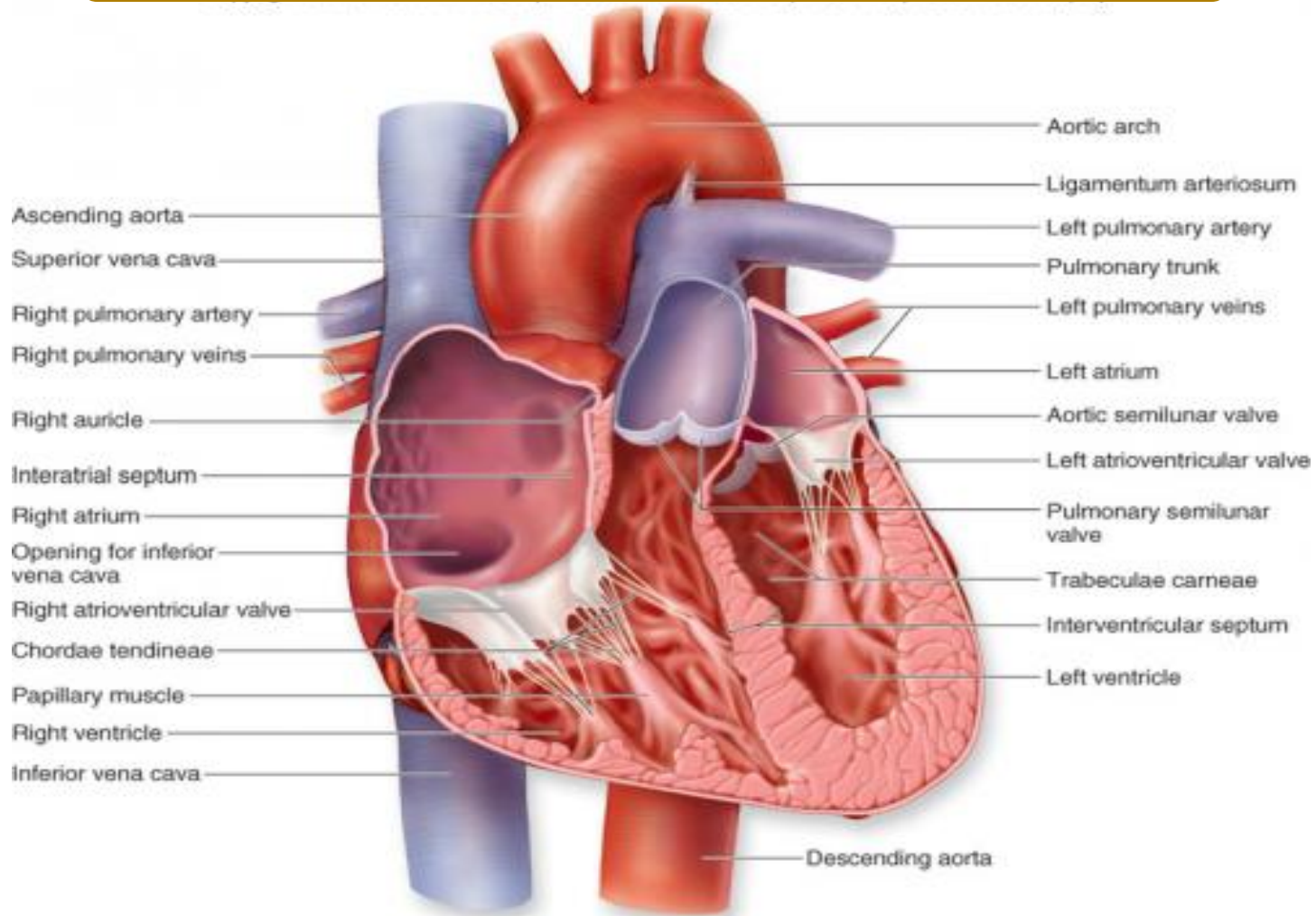
- Identify the morphologic **histopathological** features of:
 - Acute rheumatic myocarditis
 - Acute rheumatic valvulitis
 - Chronic rheumatic valvular heart disease
 - Aortic stenosis
 - Atheroma of aorta
 - Coronary atherosclerosis
 - Atheroma histology
 - Abdominal aortic aneurysm
 - Myocardial infarction

Anatomy of the Heart



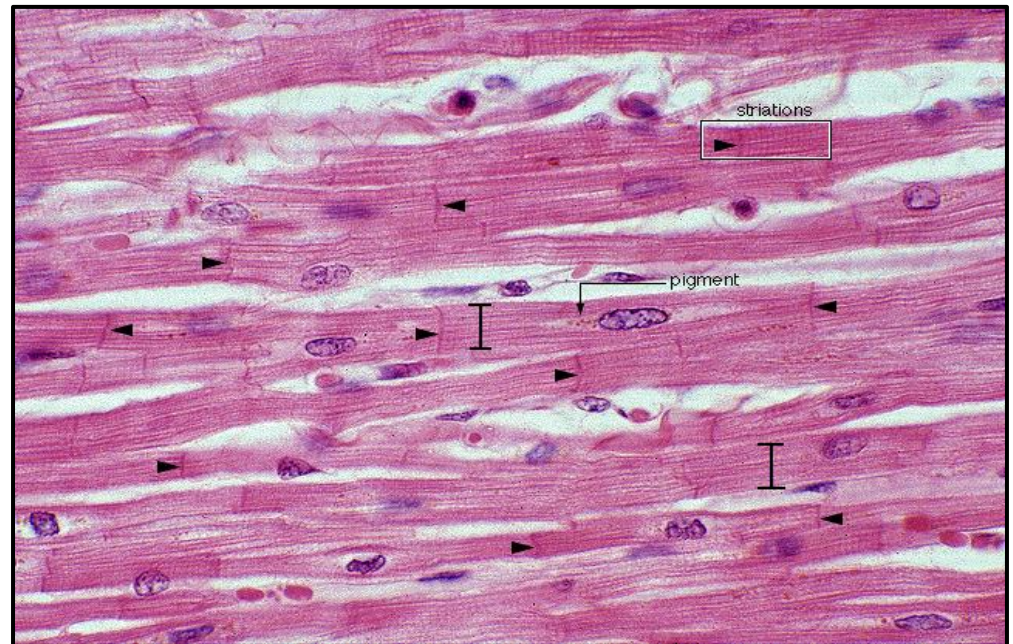
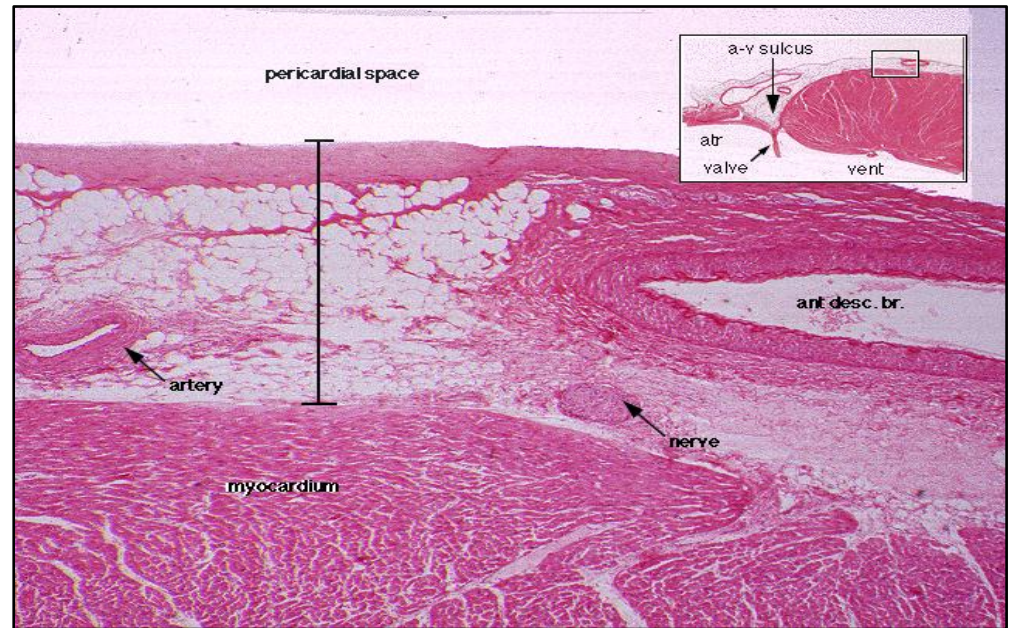
- The heart serves as a **mechanical pump** to supply the entire body with blood, both providing nutrients and removing waste products.
- The great vessels exit the base of the heart.
- Blood flow: body → sup & inf vena cava → right atrium → right ventricle → lungs → left atrium → left ventricle → Aorta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

Anatomy of the Heart – inside view



Histology of the Heart

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

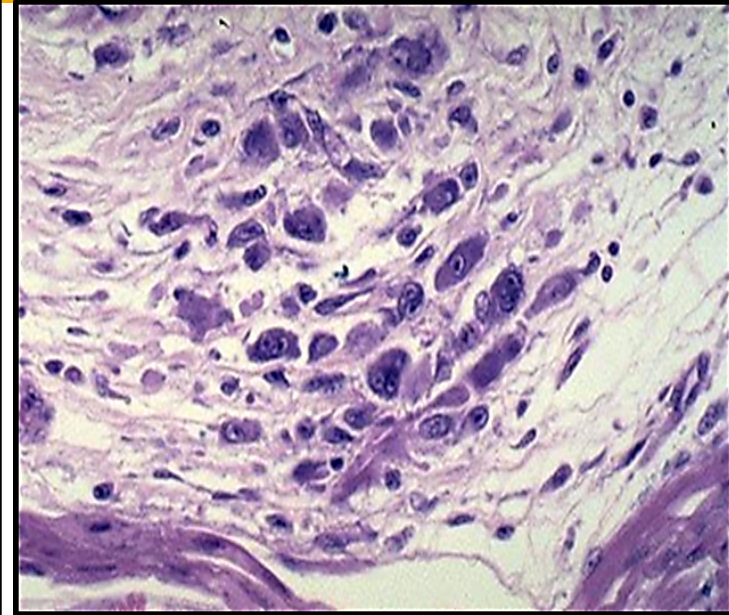
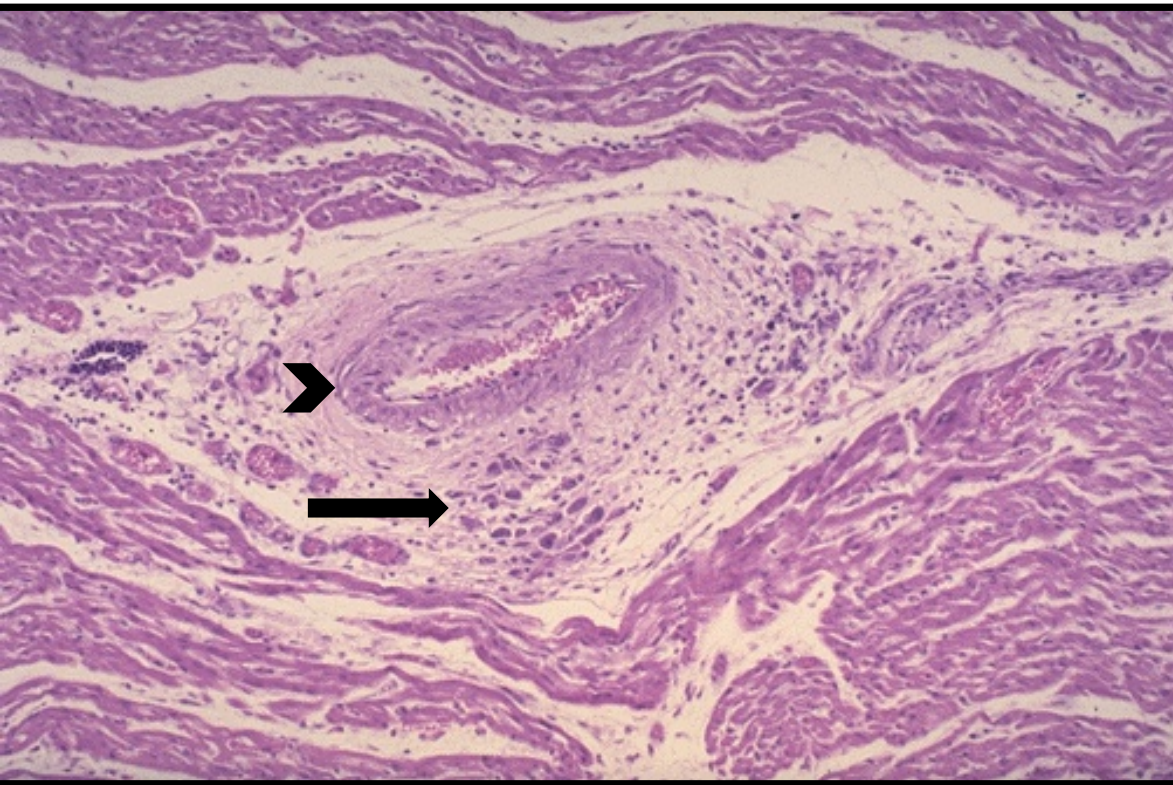


PRACTICAL 1



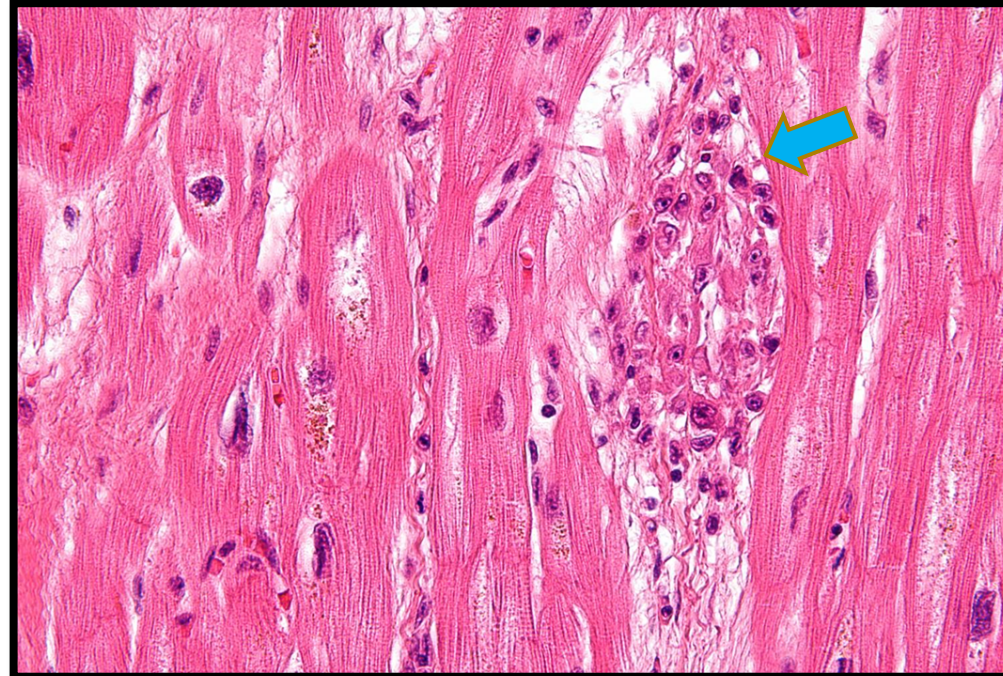
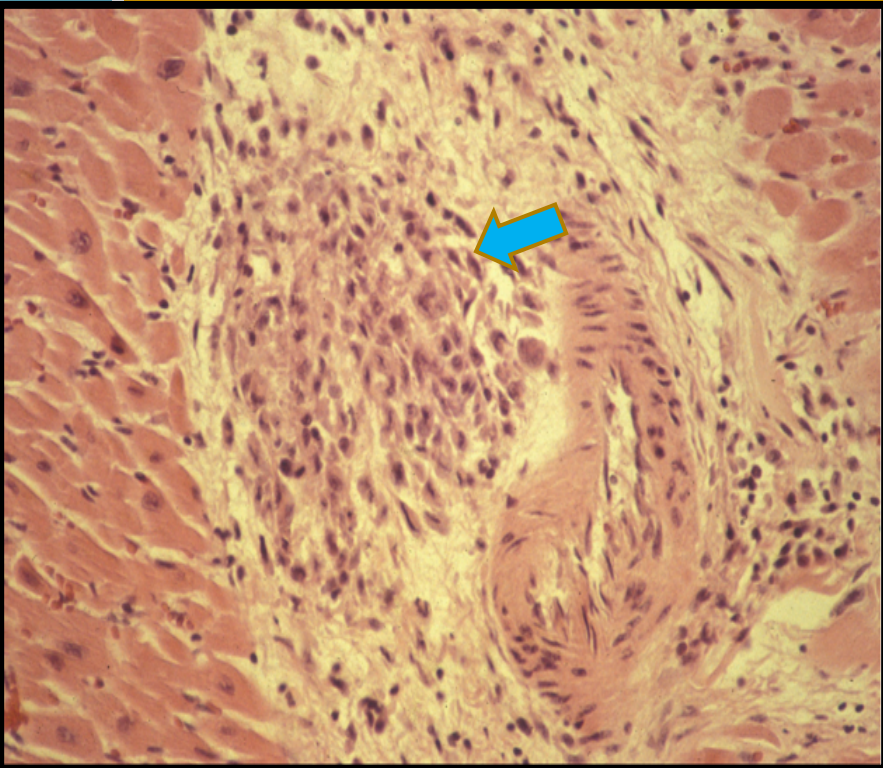
Acute rheumatic myocarditis

Acute Rheumatic Carditis - HPF



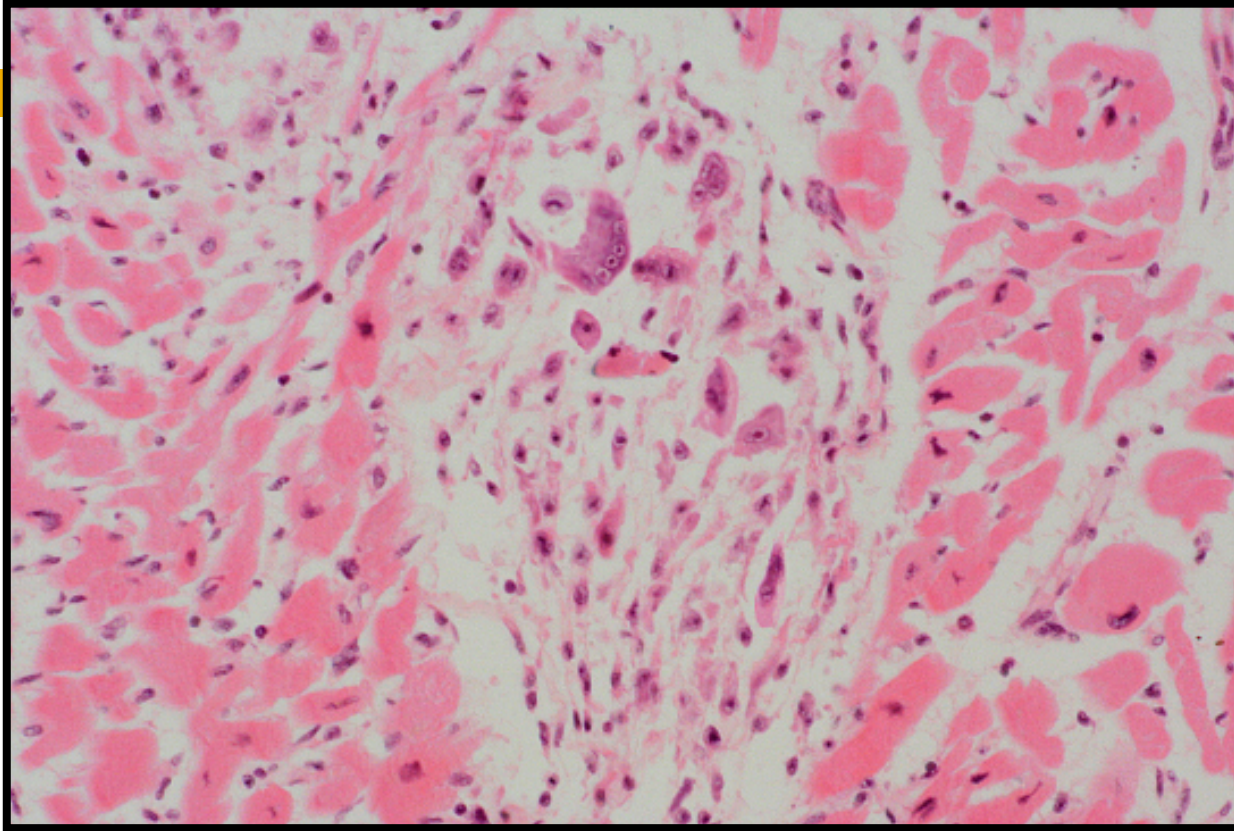
An Aschoff nodule/body (arrow) *seen* in the myocardium. They are usually seen near a blood vessel (arrowhead). It consists of a tiny focus of necrosis, few lymphocytes, macrophages and few giant cells called Aschoff giant cells.

RHEUMATIC MYOCARDIITIS (ASHOFF NODULE)



Aschoff nodule consists of a focus of necrosis, few lymphocytes, macrophages and few small giant cells with one or several nuclei (***Aschoff giant cell***). Aschoff nodules are usually seen near a blood vessel

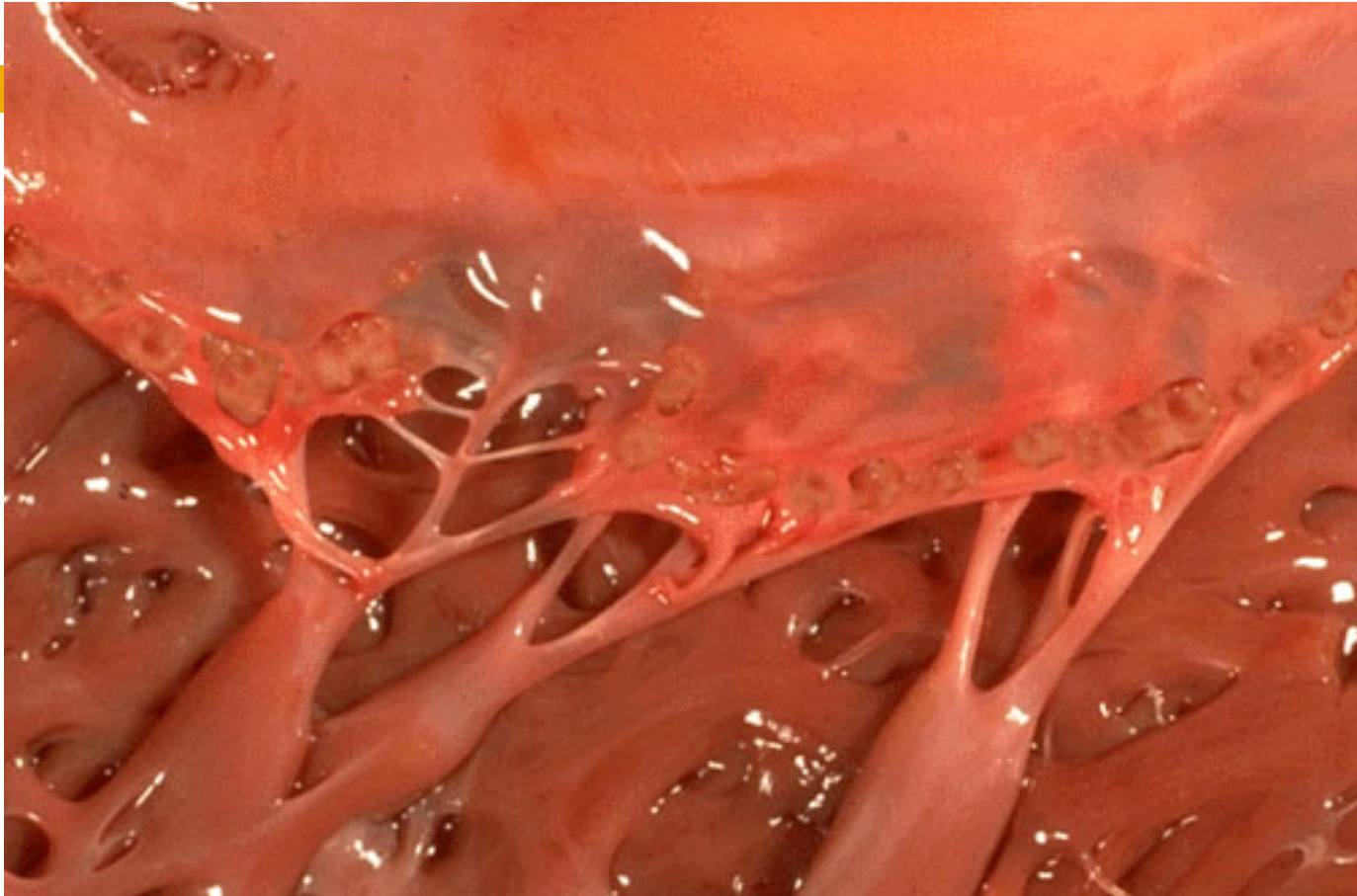
Acute Rheumatic Carditis - HPF



Acute rheumatic fever is an autoimmune process that can follow pharyngeal infection with Group A beta hemolytic Streptococcus. Microscopically, acute rheumatic myocarditis shows granulomatous inflammation called "Aschoff nodules" with giant cells called Aschoff giant cell.

Acute rheumatic valvulitis of the mitral valve

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

Mitral Valvulitis seen in Acute Rheumatic heart disease - Gross



Picture shows large vegetations/hemorrhage along the free margins of the mitral valve in acute rheumatic valvulitis of the mitral valve.

Acute Rheumatic Mitral Valvulitis - Gross



Close-up view of an opened-out rheumatic mitral valve showing vegetations growing of the valve surface. These cases can progress to chronic rheumatic heart disease with rigid and fibrosed and stenosed mitral valve → mitral stenosis.

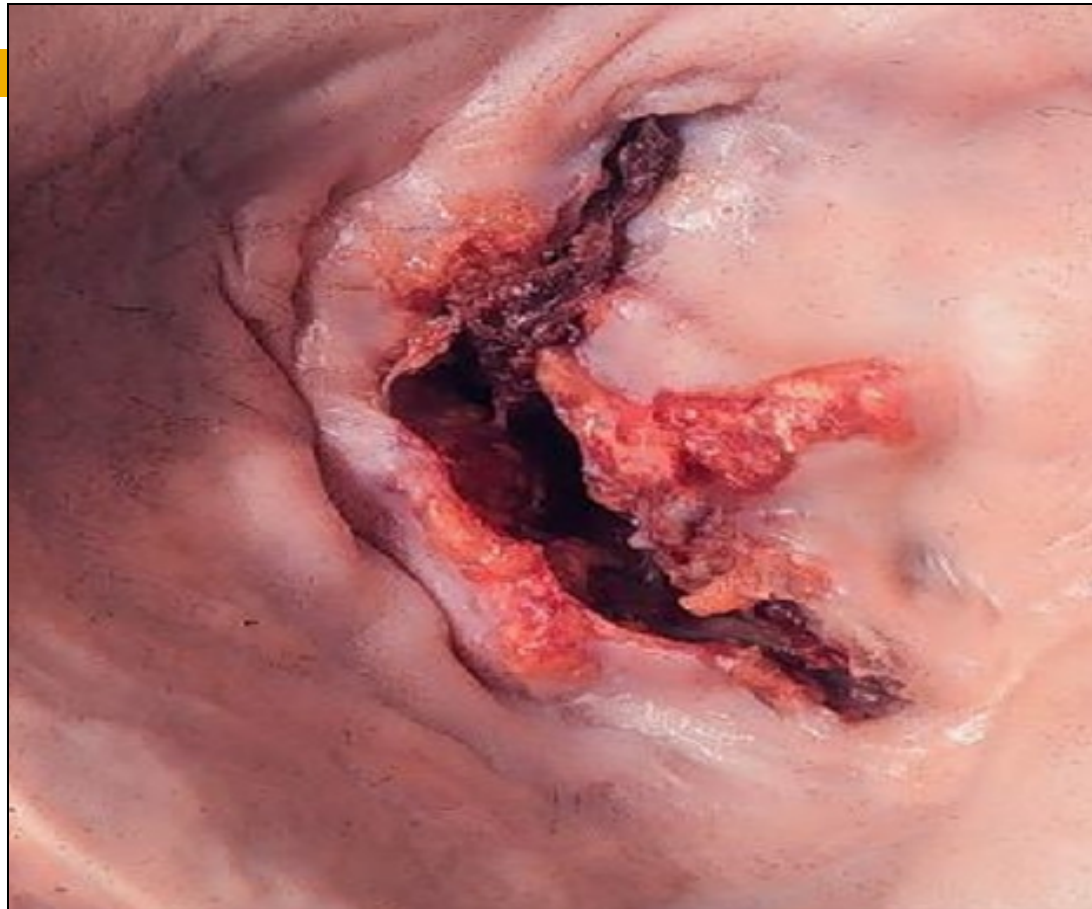
Mitral stenosis (chronic rheumatic valvular heart disease)

Chronic Rheumatic Heart disease: Mitral Stenosis - Gross



In with rheumatic heart disease mitral valve is most often affected, followed by mitral and aortic together. The vegetations on the mitral of acute rheumatic valvulitis undergo organization and the inflamed cusps heal by fibrosis. This results in stenotic mitral valve with "fish mouth" / "button hole" deformity. This picture shows stenotic mitral valve seen from above in the left atrium due to chronic rheumatic scarring. The mitral valve shows fusion of commissures, thickening and calcification of the cusps.

Chronic Rheumatic Heart disease: Mitral Stenosis - Gross

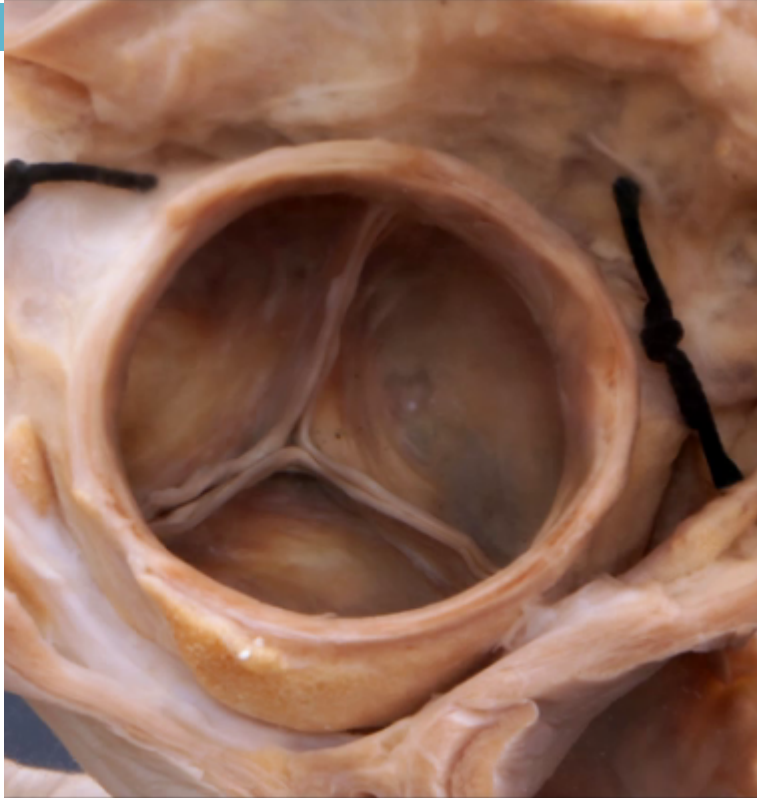


Stenotic mitral valve seen from left atrium (Fish-Mouth) showing fusion of commissures, thickening and calcification of the cusps, The vegetations undergo organization and the inflamed cusps heal by fibrosis.

AORTIC STENOSIS



Aortic stenosis - Gross



Picture shows a normal aortic valve and a stenotic aortic valve

Aortic stenosis: Aorta show thickened, fused calcified aortic valve leaflets

Causes of Aortic stenosis: rheumatic heart disease, calcification of aortic valve in old age

ATHEROMA OF THE AORTA

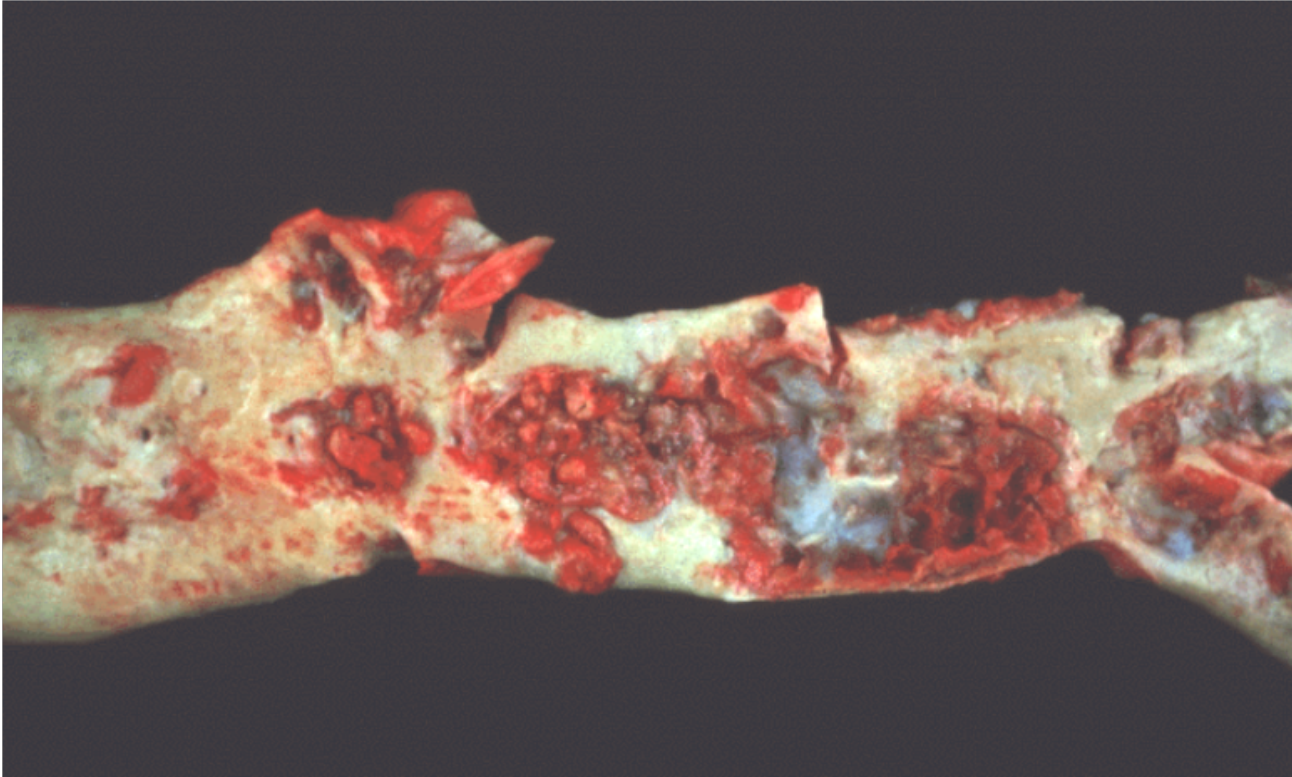
- An **atheroma** is an accumulation and swelling in artery walls made up of (mostly) macrophage cells, or debris, and containing lipids (cholesterol and fatty acids), calcium and a variable amount of fibrous connective tissue.
- The four major risk factors are hyperlipidemia, hypertension, cigarette smoking and diabetes .

Atheroma of the Aorta - Gross



Atherosclerosis of aorta gross pathology shows extensive ulceration in the plaques

Atheroma of the Aorta - Gross



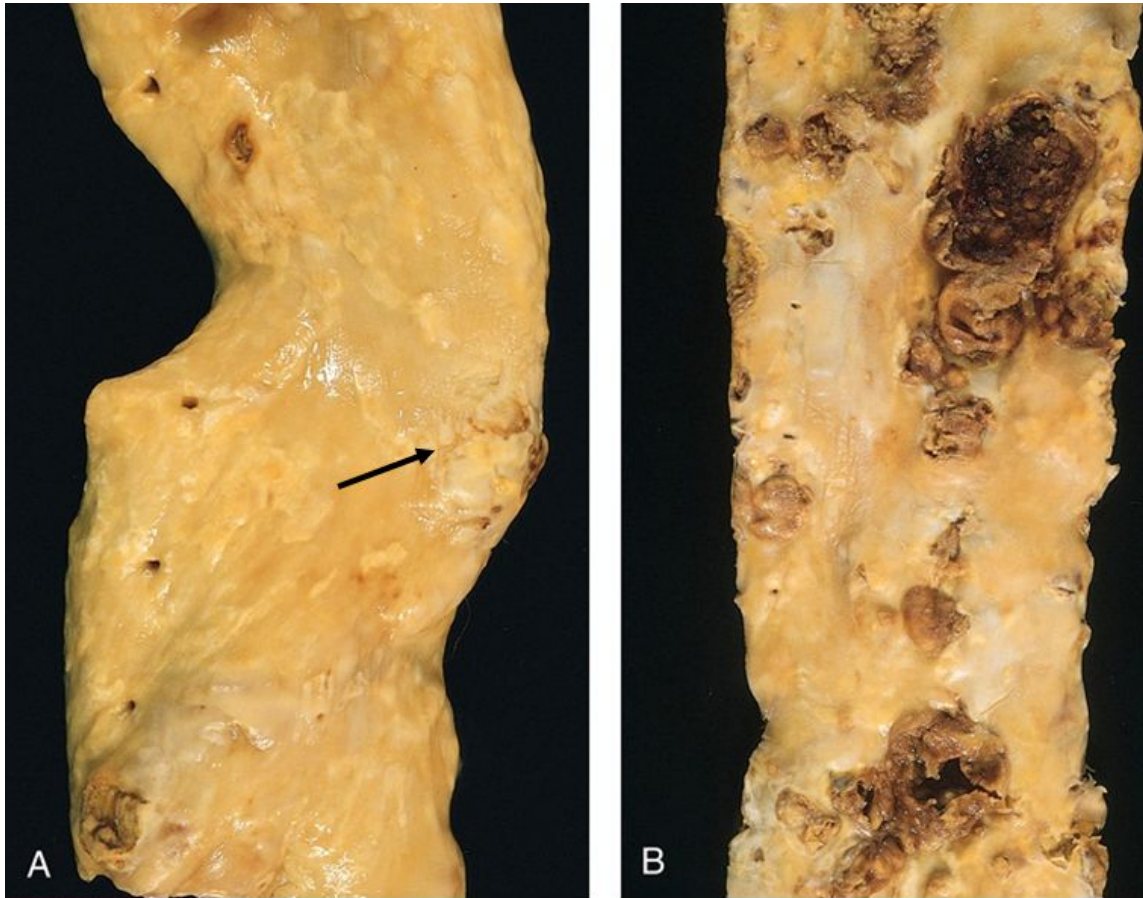
Severe atherosclerosis of the aorta : the atheromatous plaques have undergone ulceration along with formation of overlying mural thrombus. Complications are thrombosis , hemorrhage , calcifications and aneurysmal dilatation with the distal ischemic events .

Atheroma of the Aorta - Gross



Severe atherosclerosis of the aorta : the atheromatous plaques have undergone ulceration along with formation of overlying mural thrombus. Complications are thrombosis , hemorrhage , calcifications and aneurysmal dilatation with the distal ischemic events .

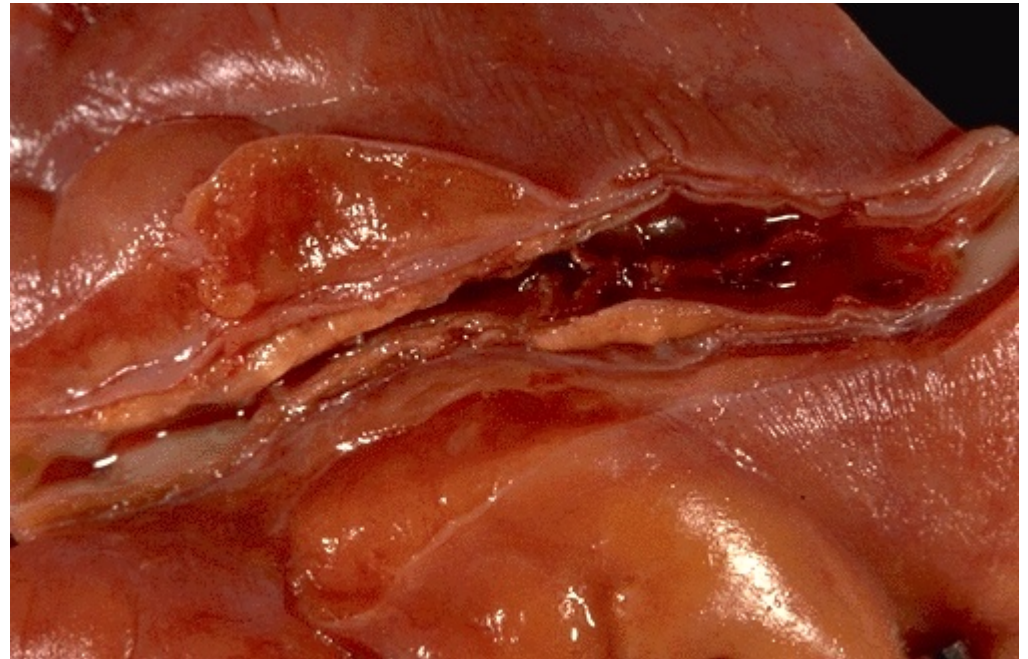
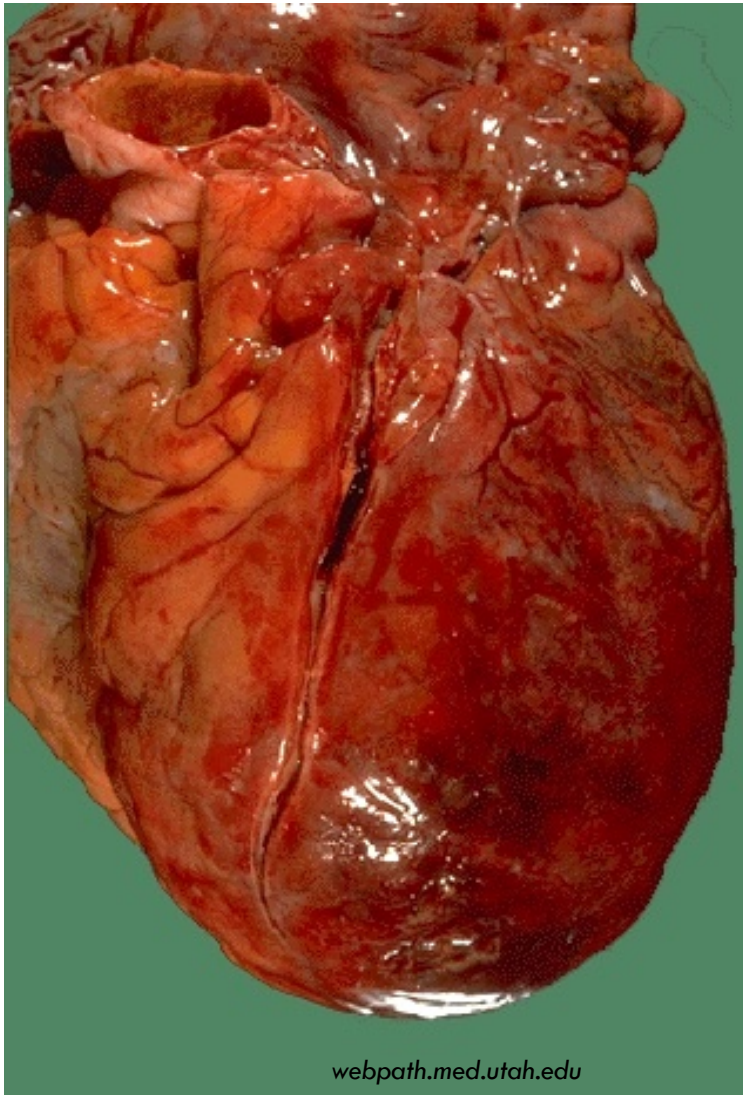
Atheroma of the Aorta - Gross



These 2 aortas demonstrate mild and severe atherosclerosis. “A” shows mild atherosclerosis few scattered atheromatous lipid plaques. “B” shows many more larger plaques with disruption and ulceration in the plaques.

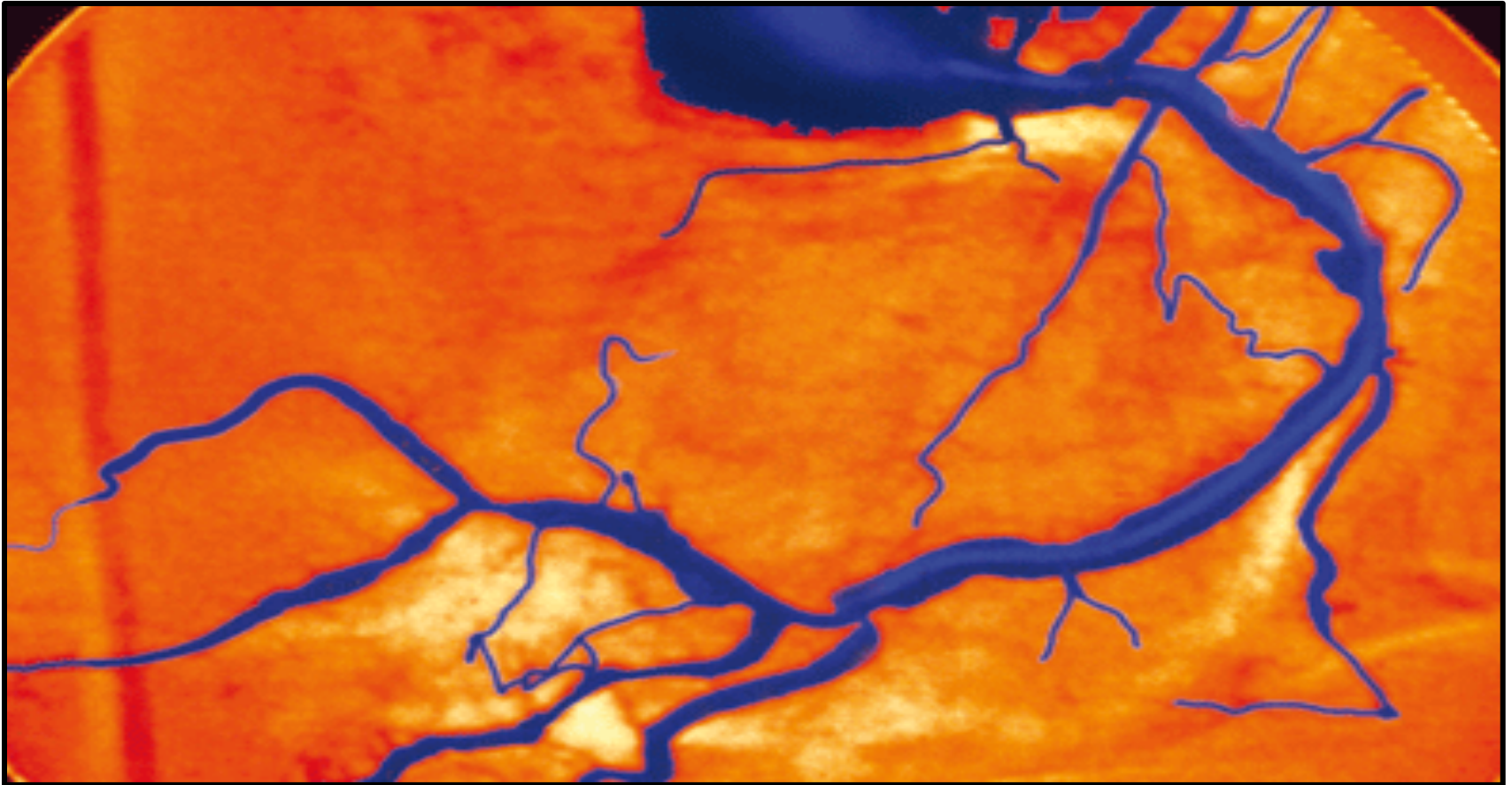
CORONARY ATHEROSCLEROSIS

Coronary Atherosclerosis - Gross



The surface of the heart demonstrates an opened interventricular left anterior descending coronary artery. Within the lumen of the coronary, there is a dark red recent coronary thrombosis. The hemorrhagic area seen at the lower right of the thrombus is the area of myocardial infarction. At high magnification, the dark red thrombus is apparent in the lumen of the coronary. The yellow tan plaques of atheroma narrow this coronary significantly, and the thrombus occludes it completely.

Coronary Atherosclerosis - Gross

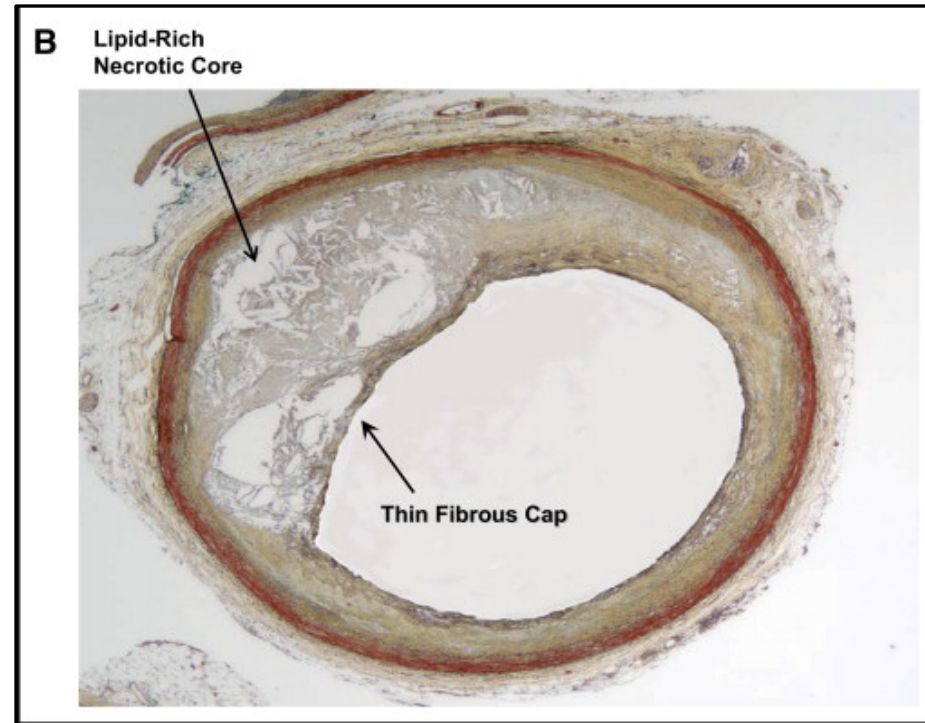
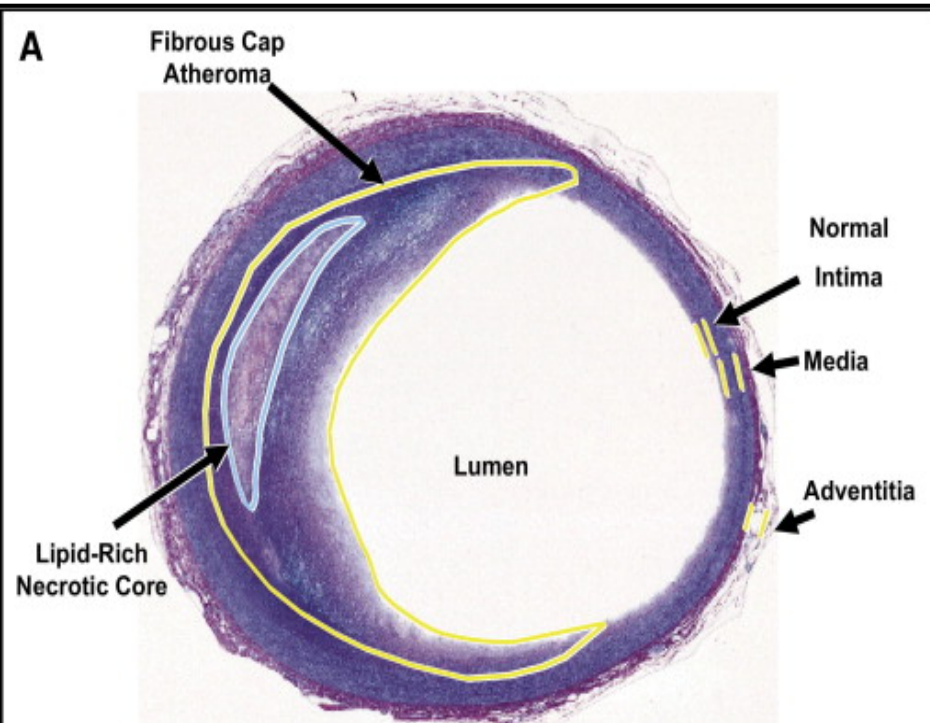


Coronary atherosclerosis. Coloured angiogram (X- ray) showing atherosclerosis in a coronary artery. The atherosclerosis is seen as the pinching in the blue- coloured artery at bottom centre

ATHEROMA HISTOLOGY



Coronary atherosclerosis - LPF

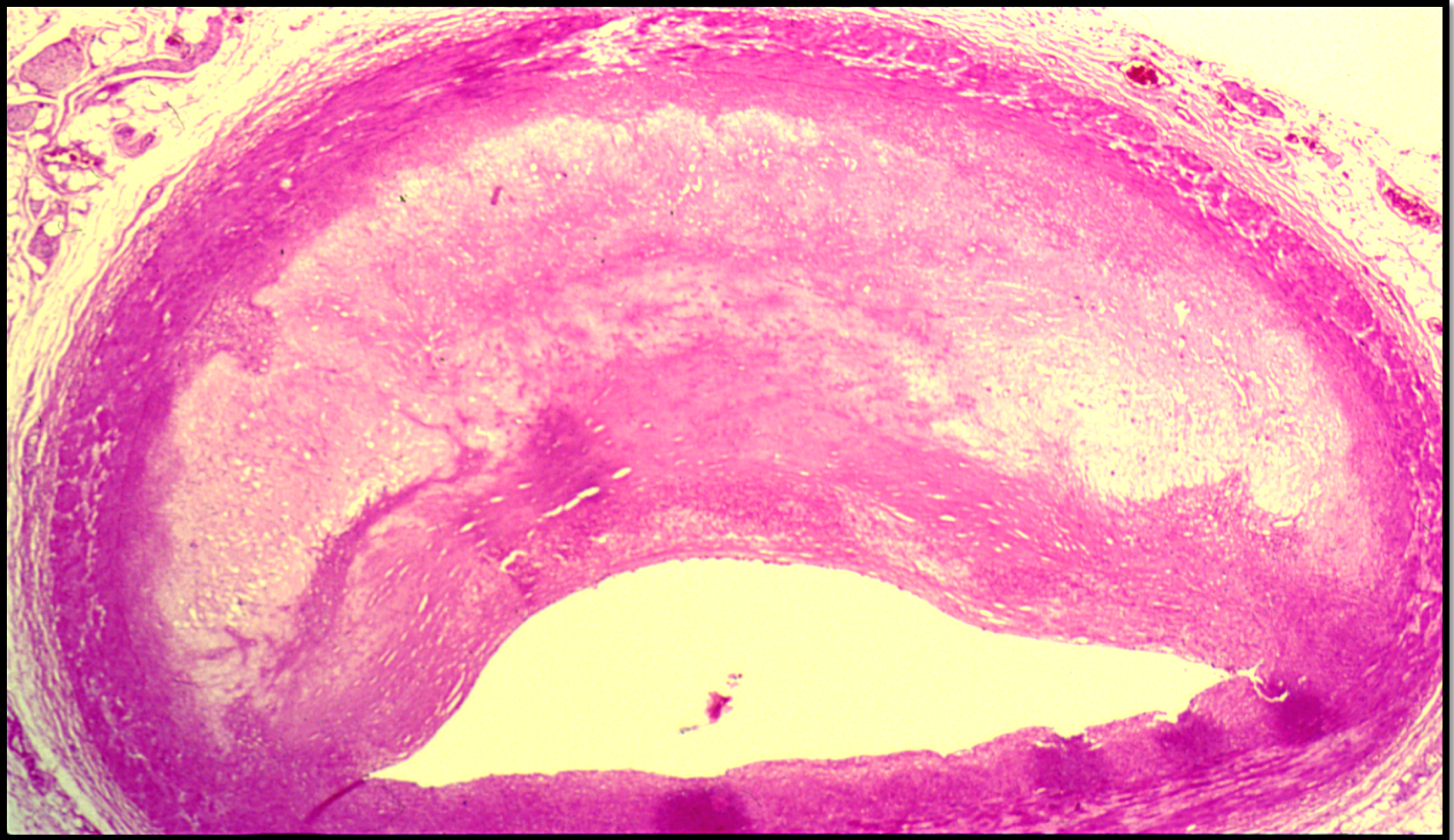


<https://doi.org/10.1016/j.amjmed.2008.10.013>

The American Journal of Medicine, Vol 122, No 1A, January 2009

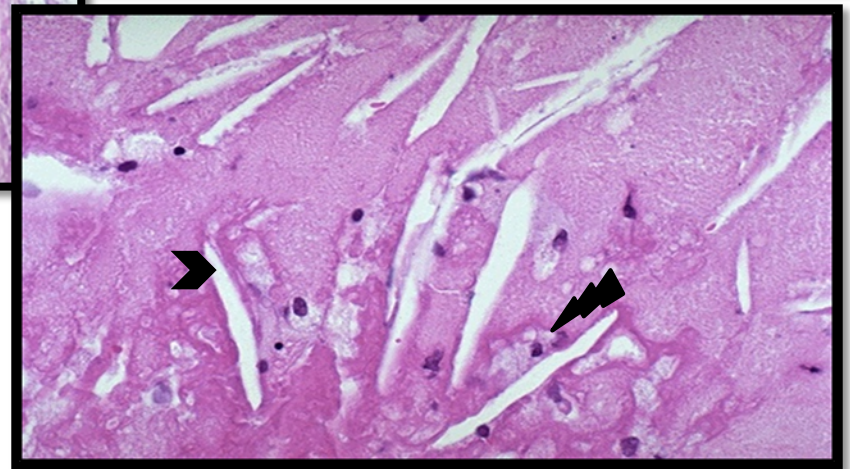
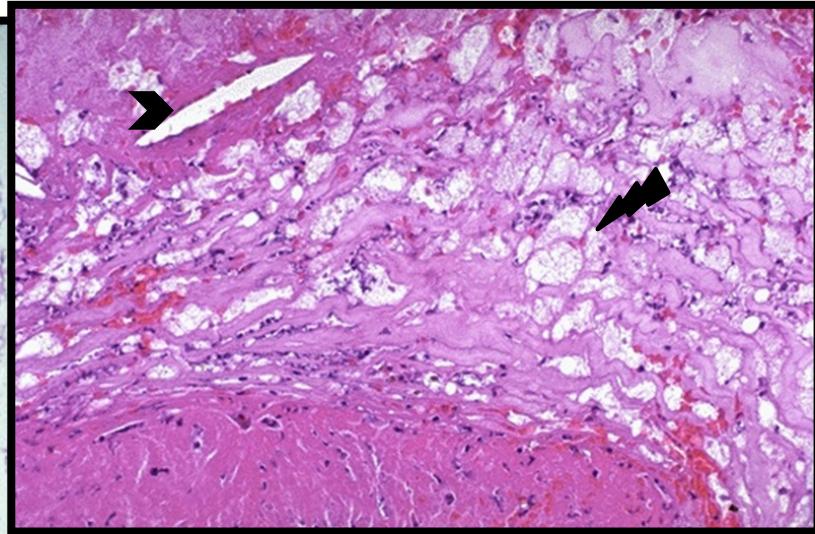
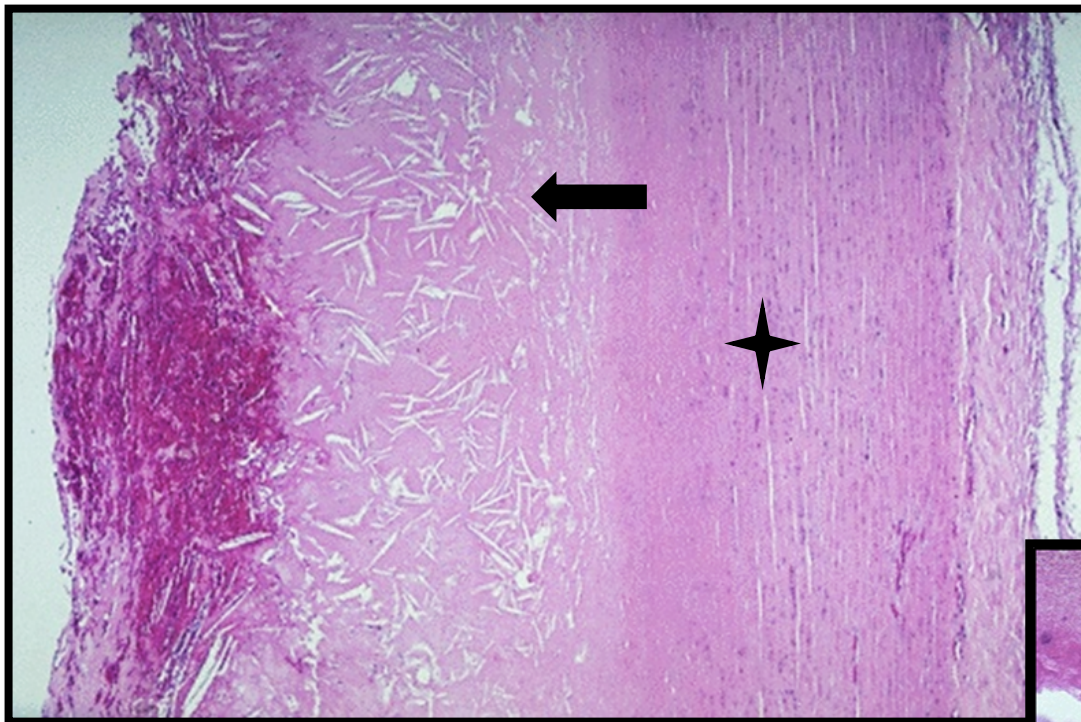
Coronary artery with atherosclerosis (fibro-lipid or fibro-fatty plaque). The atheromatous fibro-fatty plaque is characterized by the accumulation of lipids in the intima of the arteries, narrowing the lumen. Beneath the endothelium it has a "fibrous cap" covering the atheromatous "core" of the plaque,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

Coronary atherosclerosis - MPF



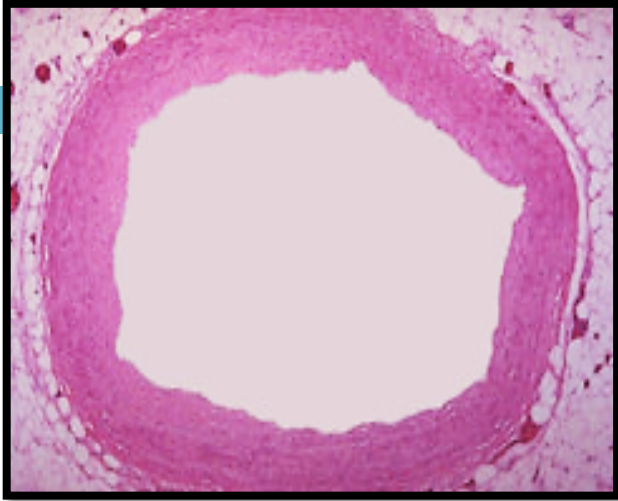
**Severe coronary atherosclerosis with 70% narrowing
of the lumen**

Atheroma

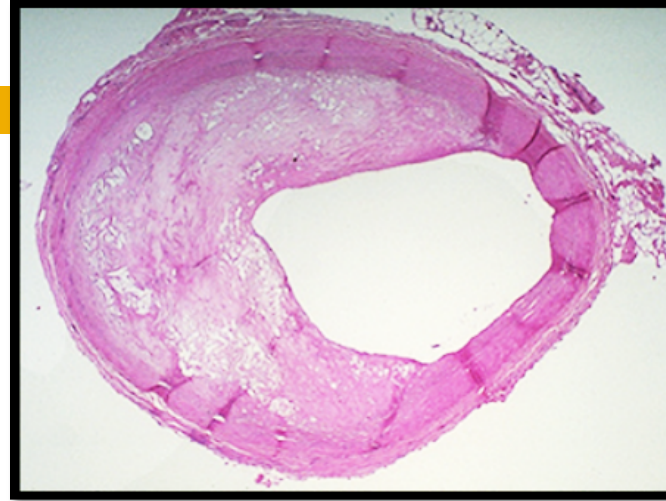


This microscopic cross section of aorta shows the wall of the aorta (star) and an atheroma (arrow). The atheroma shows numerous cholesterol clefts are numerous, surface ulceration and hemorrhage. The higher magnification pictures show cholesterol clefts (arrow head) and foam cells (lightning arrow).

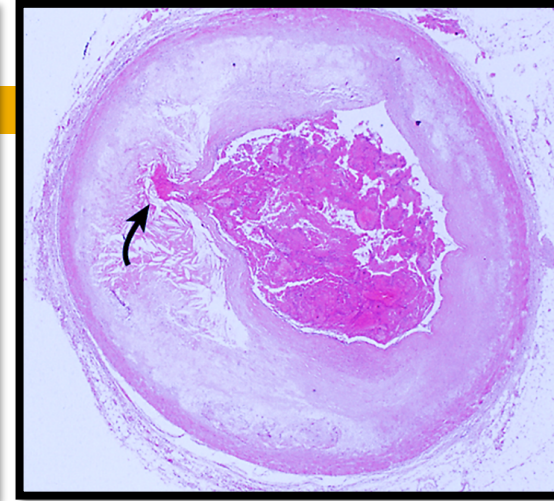
Coronary atherosclerosis



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

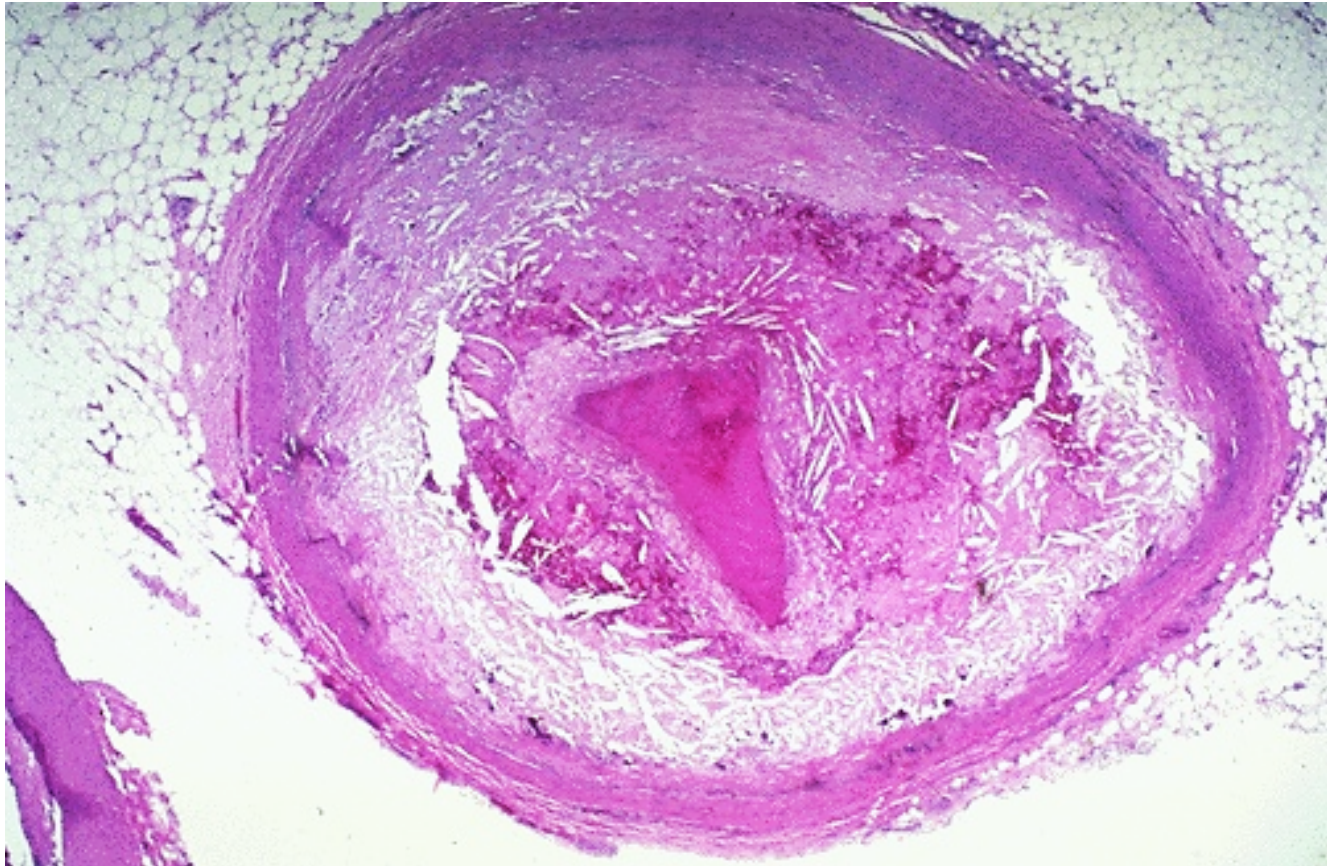


Coronary atherosclerosis. The coronary artery is narrowed by 50%.



Acute coronary thrombosis superimposed on an atherosclerotic plaque with focal disruption of the fibrous cap, triggering a myocardial infarction

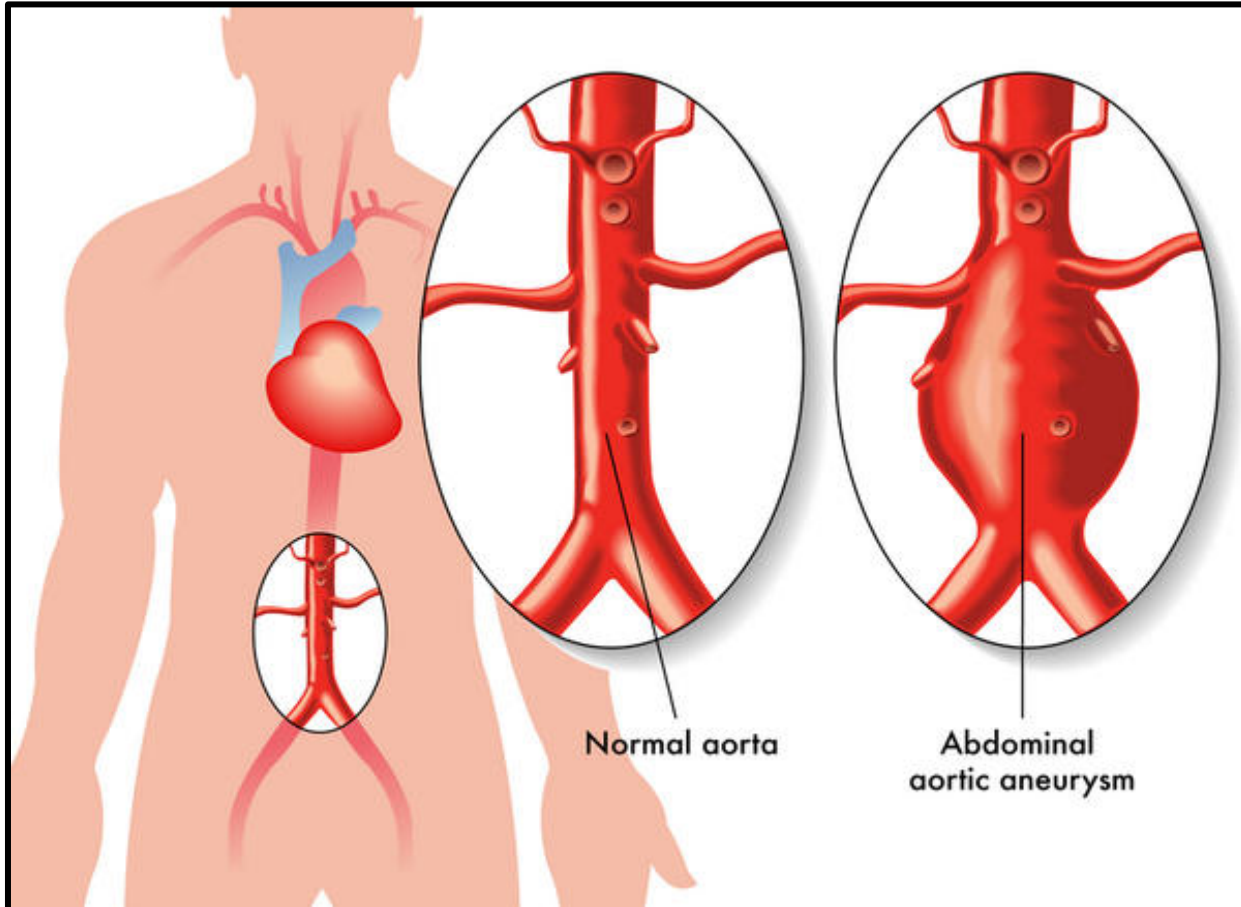
Atheroma



Artery showing atheroma with a totally occlusive thrombus → infarction in the organ being supplied by this artery.

ANEURYSM OF ABDOMINAL AORTA

Abdominal Aortic Aneurysm

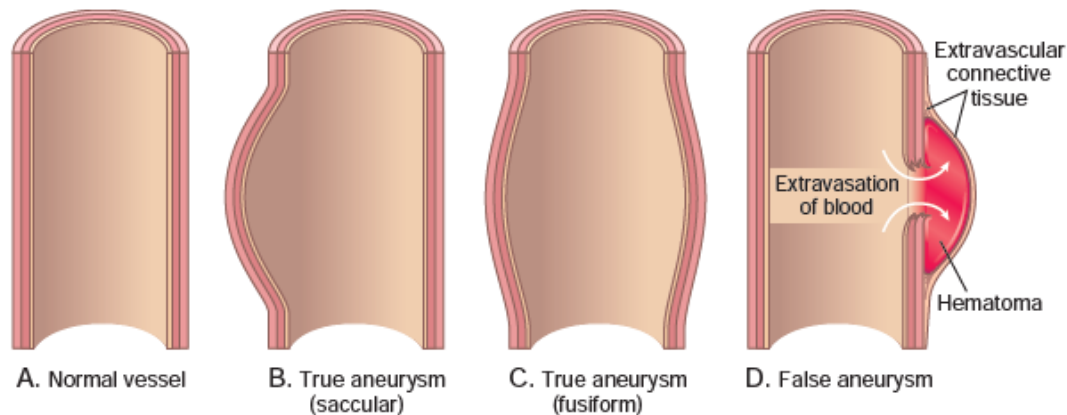


Normal aorta

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)

- Is 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

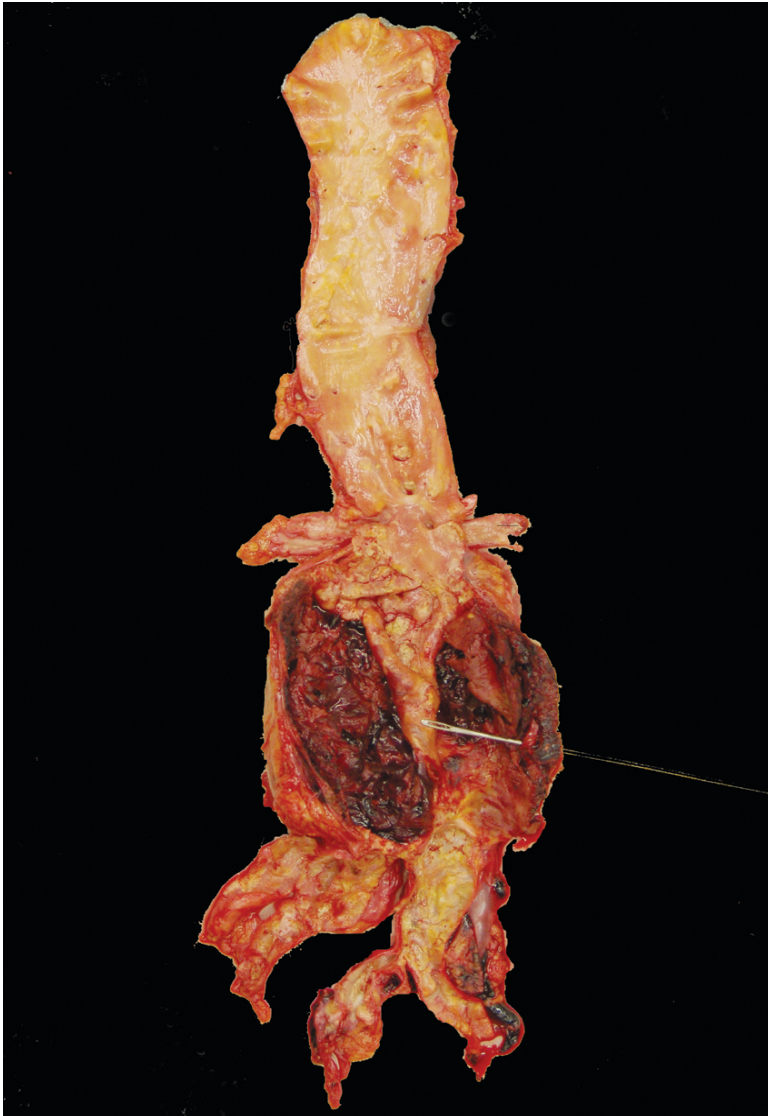
The most likely causes of aneurysms are atherosclerosis , mycotic, syphilitic and congenital

Abdominal Aortic Aneurysm



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

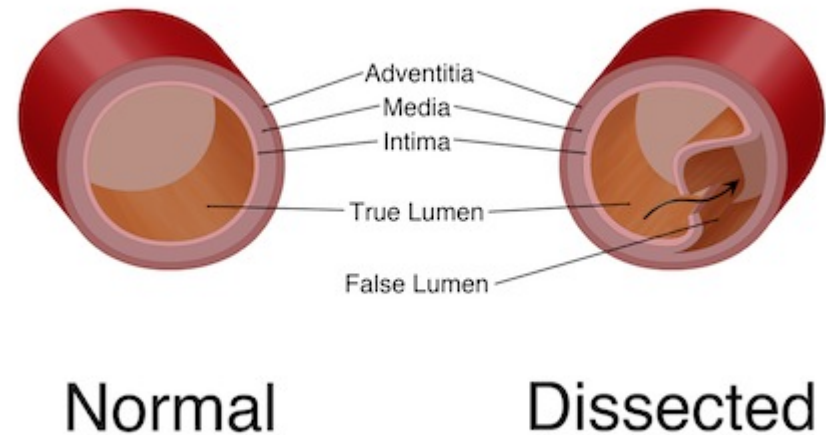
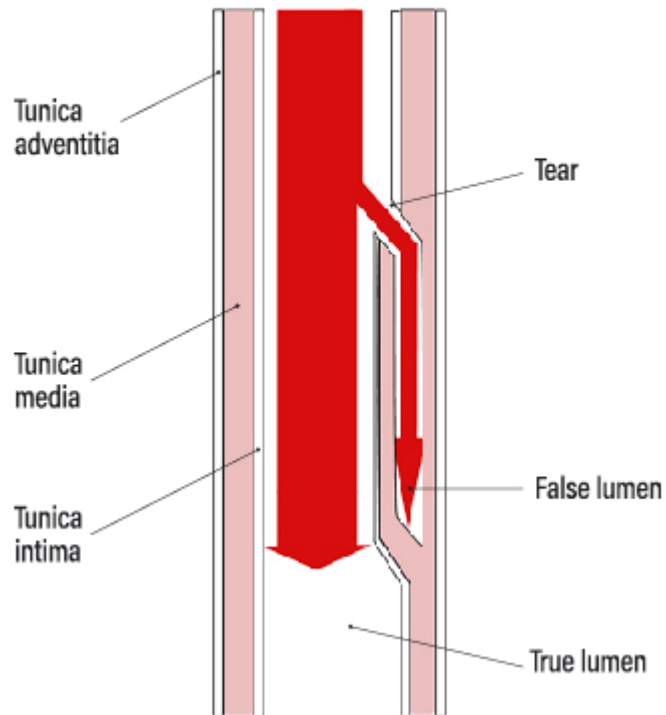
Abdominal Aortic Aneurysm



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

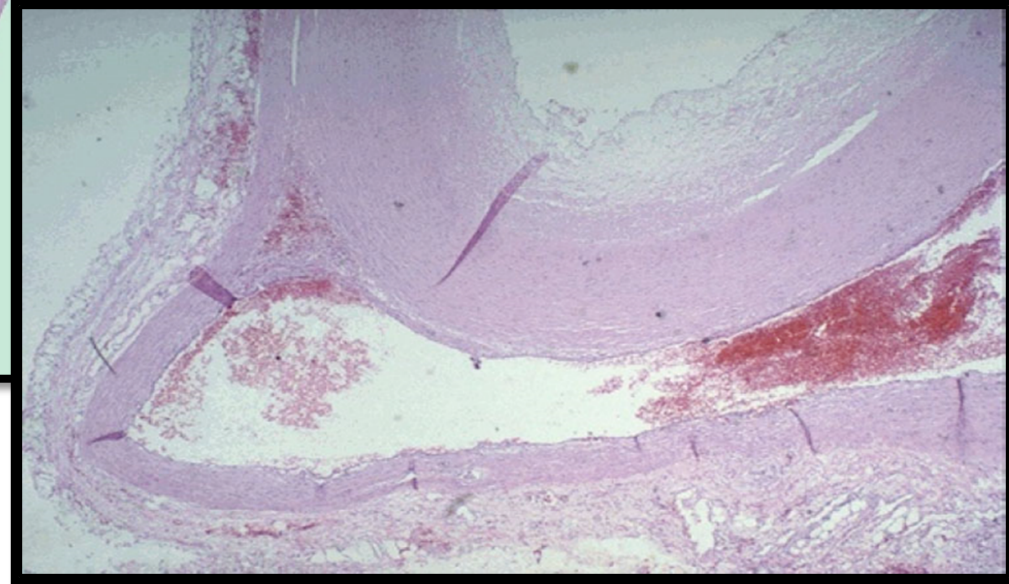
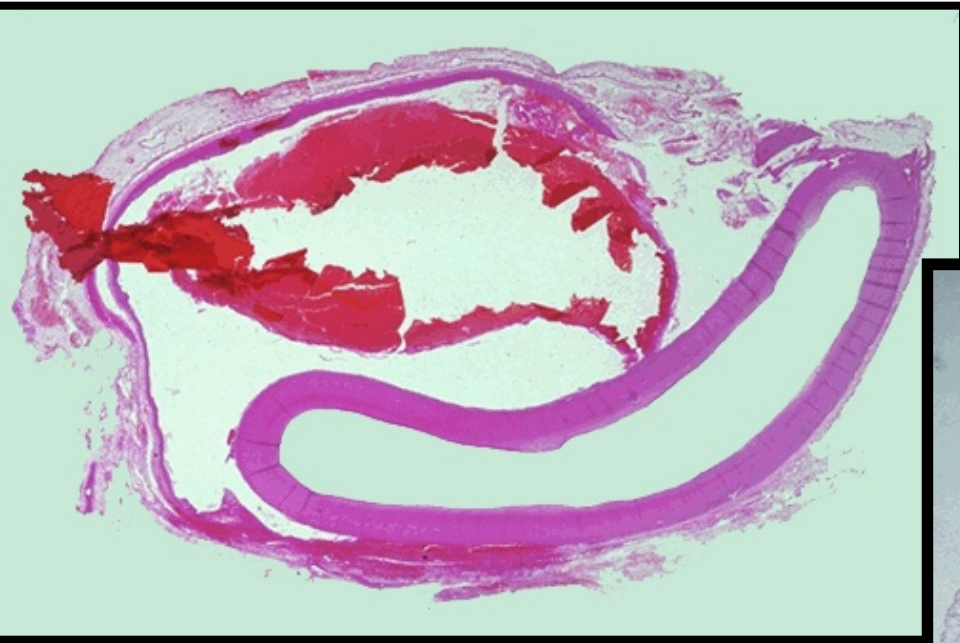
The patient had suddenly developed severe abdominal pain, shocked and collapsed

Dissecting aortic aneurysm



In aortic dissection there is a tear in the wall of the aorta and the blood enters into the wall through the defect, thereby dissecting the wall of the aorta. An aortic dissection is an extreme emergency and can lead to death in a matter of minutes. The blood can dissect up or down the aorta.

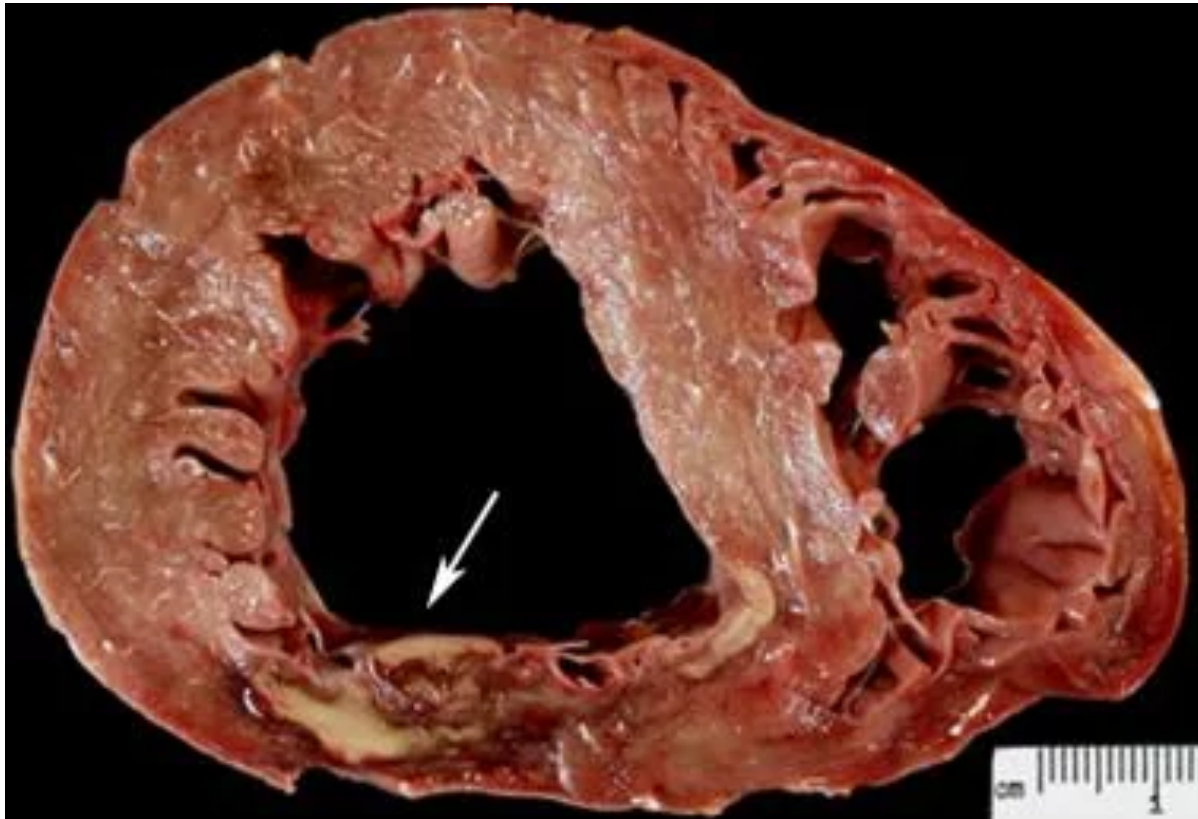
Dissecting aortic aneurysm



This is a microscopic cross section of a dissecting aortic aneurysm showing a red blood clot compressing the aortic lumen. It is usually associated with atherosclerosis, inflammation, and degeneration of the connective tissue of the tunica media of the blood vessel.

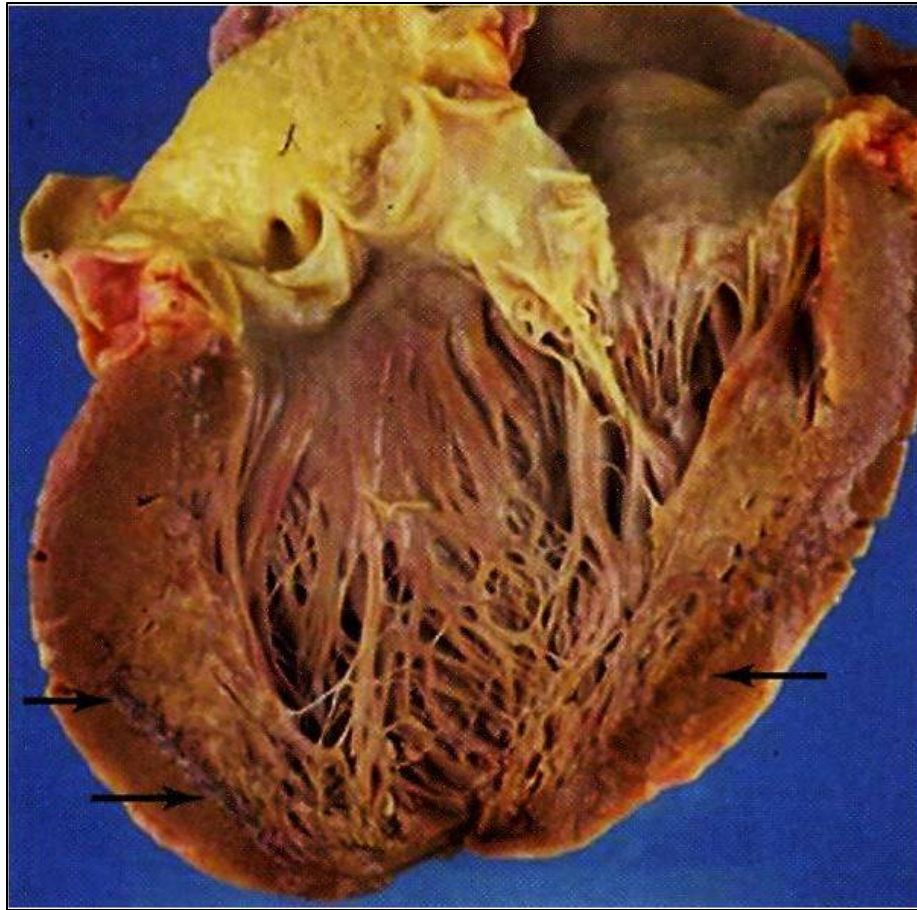
MYOCARDIAL INFARCTION

Myocardial Infarction - CS



This is a cross section through the heart shows the larger left ventricular chamber and the small right ventricle. There is a transmural **myocardial infarction in the wall of the left ventricle (arrow)**. The center is tan with surrounding hyperemia. This infarction is "transmural" because it extends through the full thickness of the ventricular wall

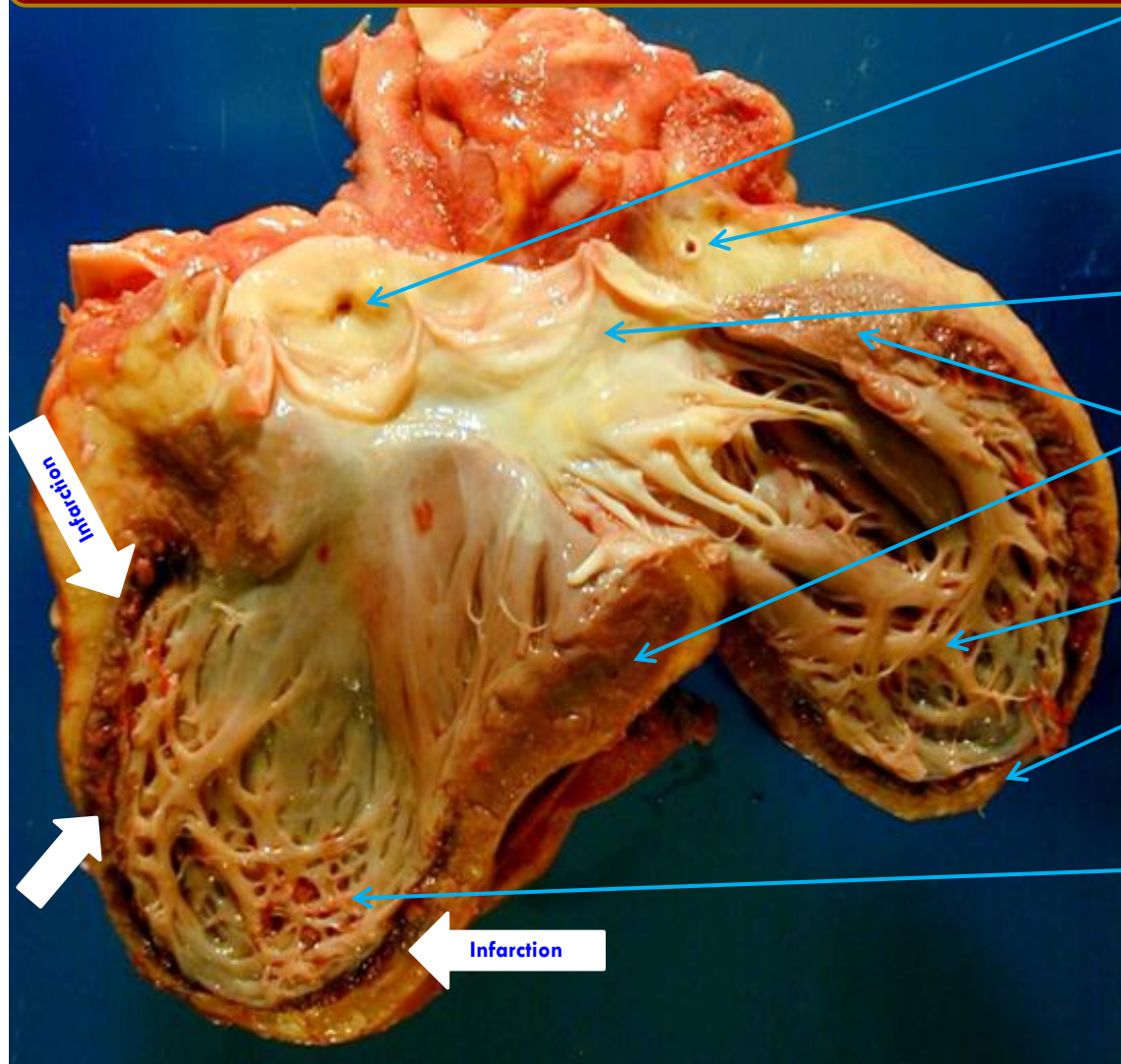
Myocardial Infarction - CS



This is a longitudinal section through the left ventricular chamber show transmural myocardial infarction (arrow) in the wall of the left ventricle and also involving the apex of the heart. The infarct is hyperemic.

Complications of MI: arrhythmias, ventricular aneurysm, rupture of myocardium, cardiac tamponade etc.

Myocardial Infarction



Right coronary ostium,
patent

Left circumflex artery,
patent

Aortic valve

Residual normal
myocardium

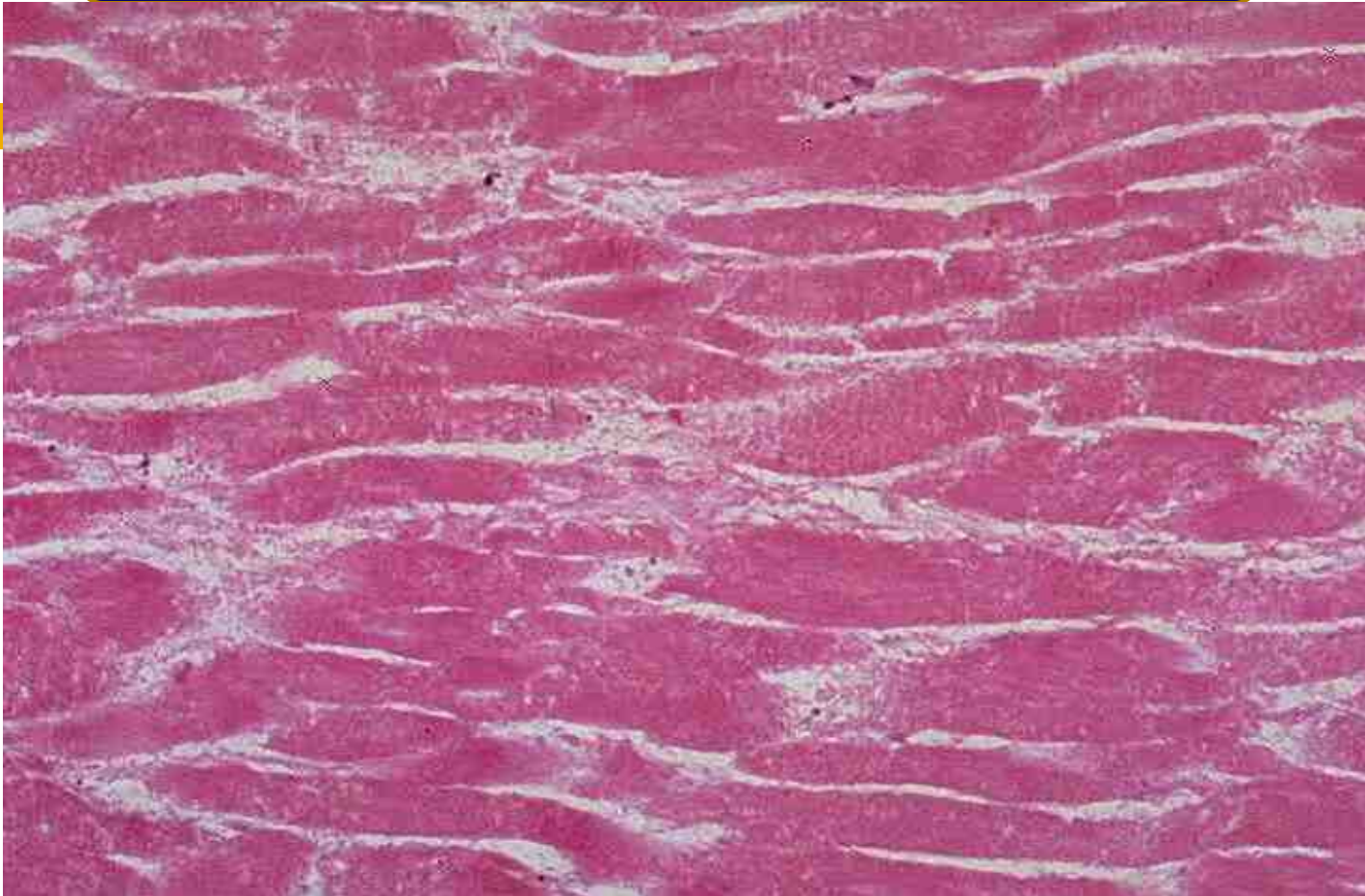
Free wall of left ventricle

Markedly thinned left
ventricular apex

Septal wall

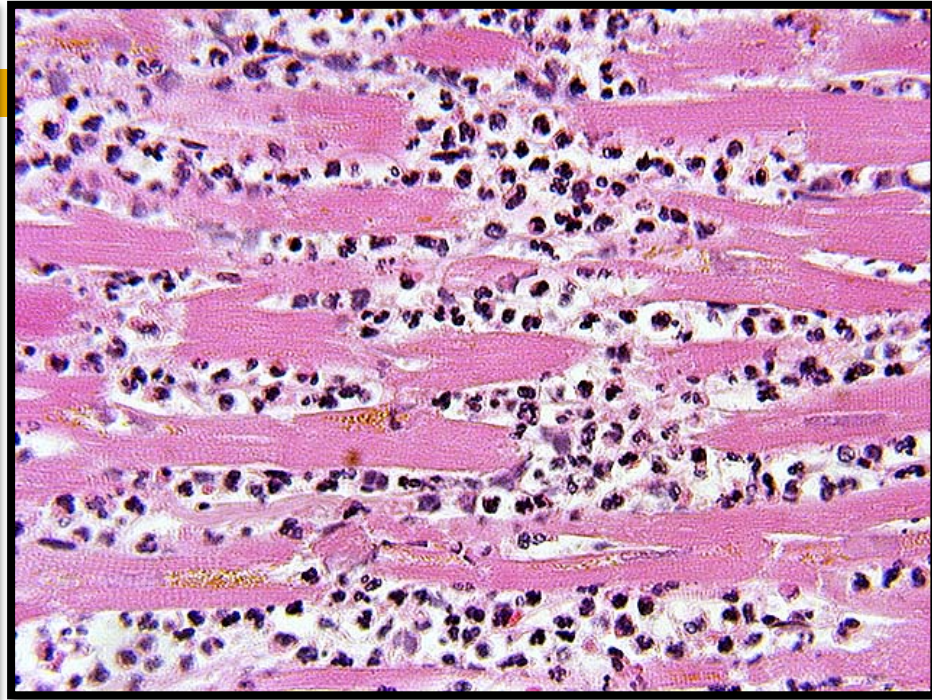
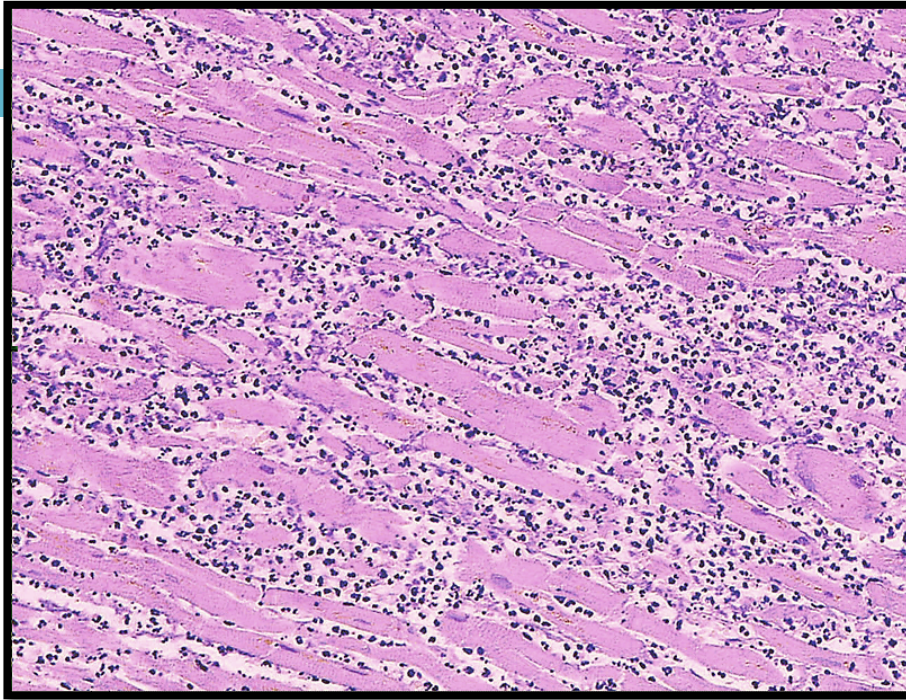
The heart is opened showing the left ventricle. There is a **Massive Transmural Infarction** extending around the entire wall between the white arrows.

Recent Myocardial Infarction



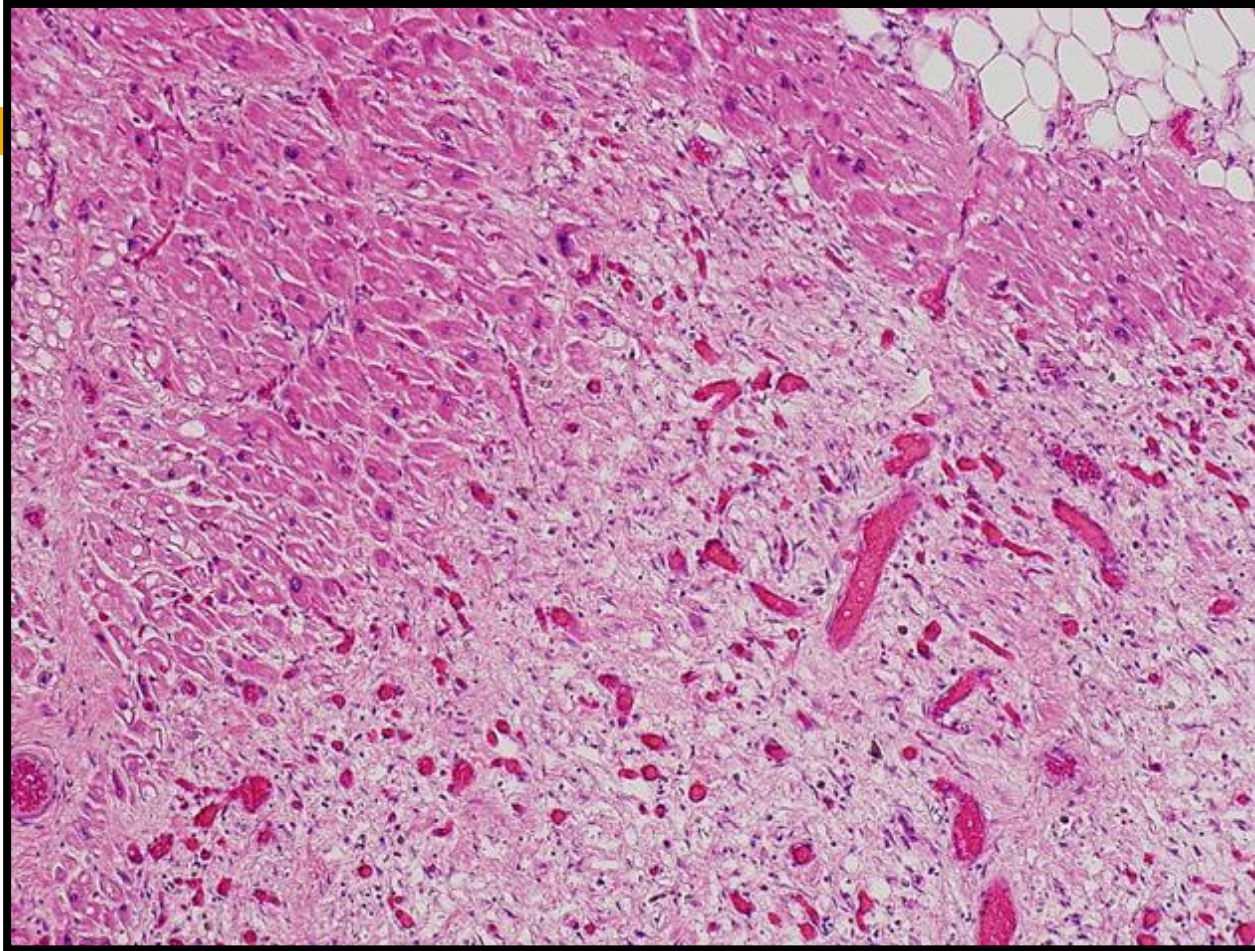
Recent myocardial infarct (day 1): myocardial fibers are still well delineated (ghost outline), with intense eosinophilic (pink) cytoplasm, but lost their cross striations and the nucleus.

Myocardial Infarction



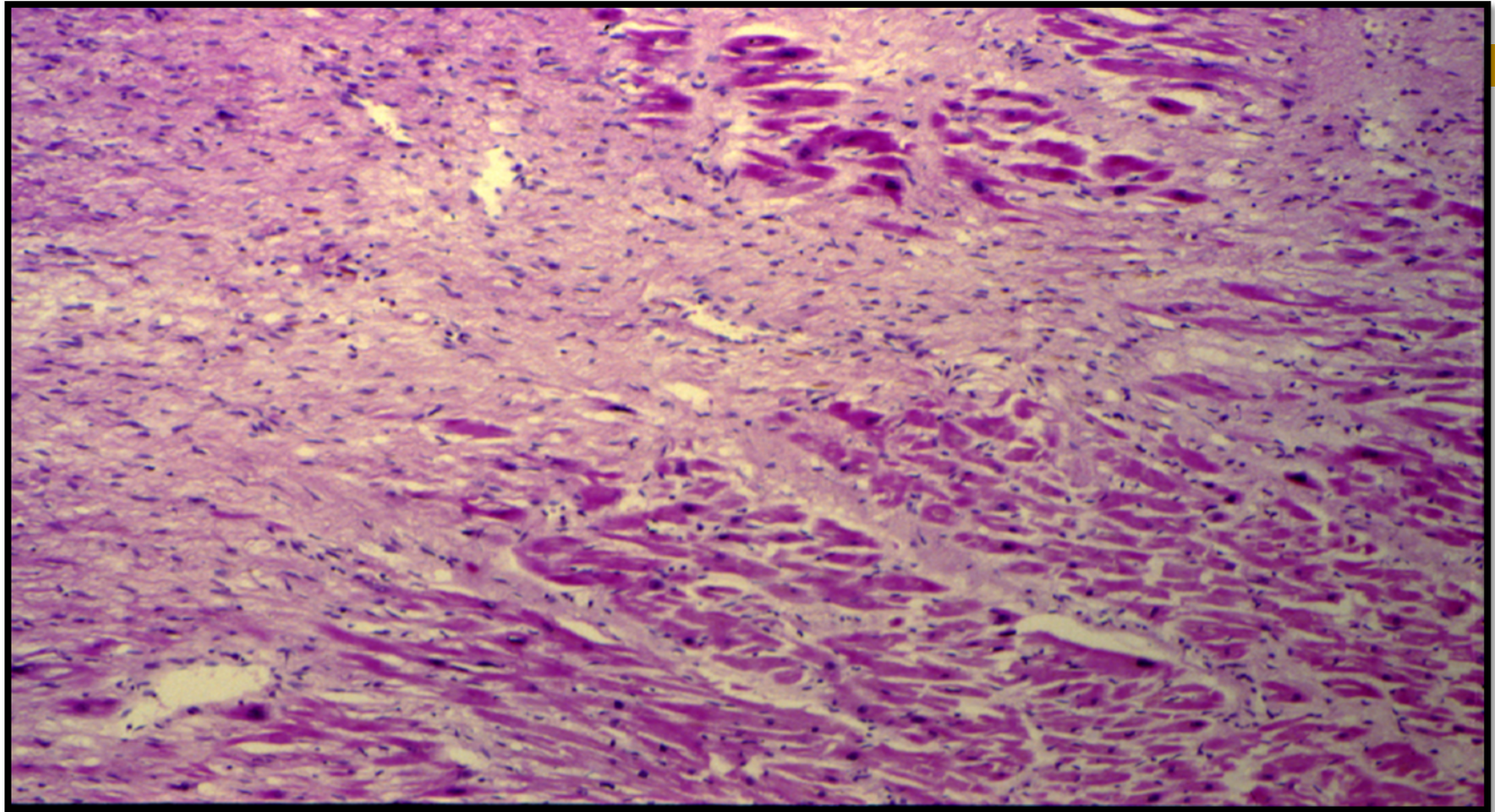
Myocardial infarct (day 3-4) coagulative necrosis of myocardial cells and infiltration by many polymorphnuclear leukocytes (neutrophils).

Myocardial Infarction



Myocardial infarct (week 1 to week 2) shows granulation tissue (new blood vessels, fibroblasts and chronic inflammatory cells)

Myocardial Infarction - HPF



Scar of myocardial infarct (> 8 weeks) shows dense collagenous scar (fibrosis)

Scar of an old Myocardial Infarction



Cross section of the left and right ventricles shows a pale and irregular focal fibrosis in the left ventricular wall with increased thickness . There is a collagenous scar in the wall of the left ventricle extending into the interventricular septum. Also, there is left ventricular hypertrophy.