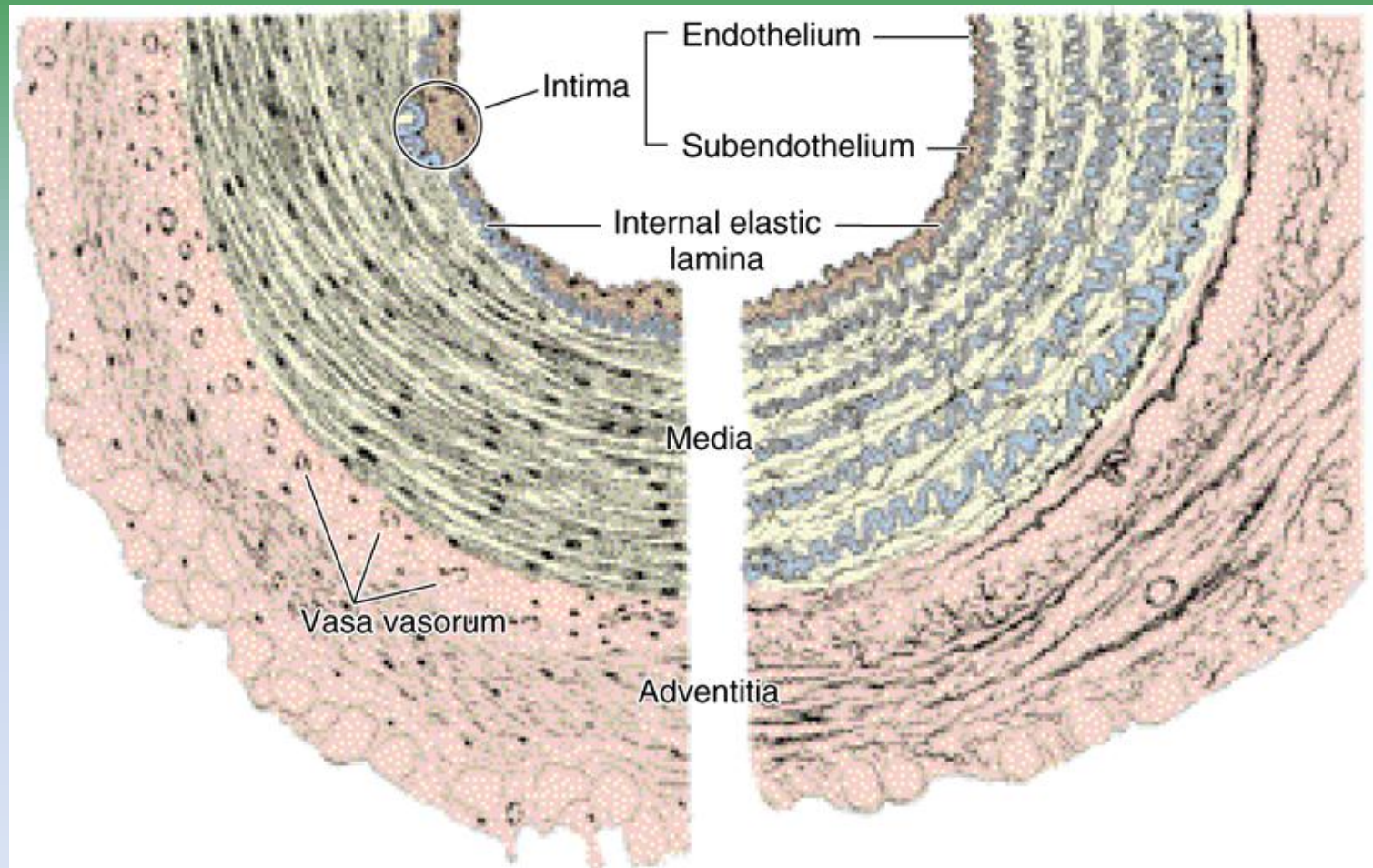


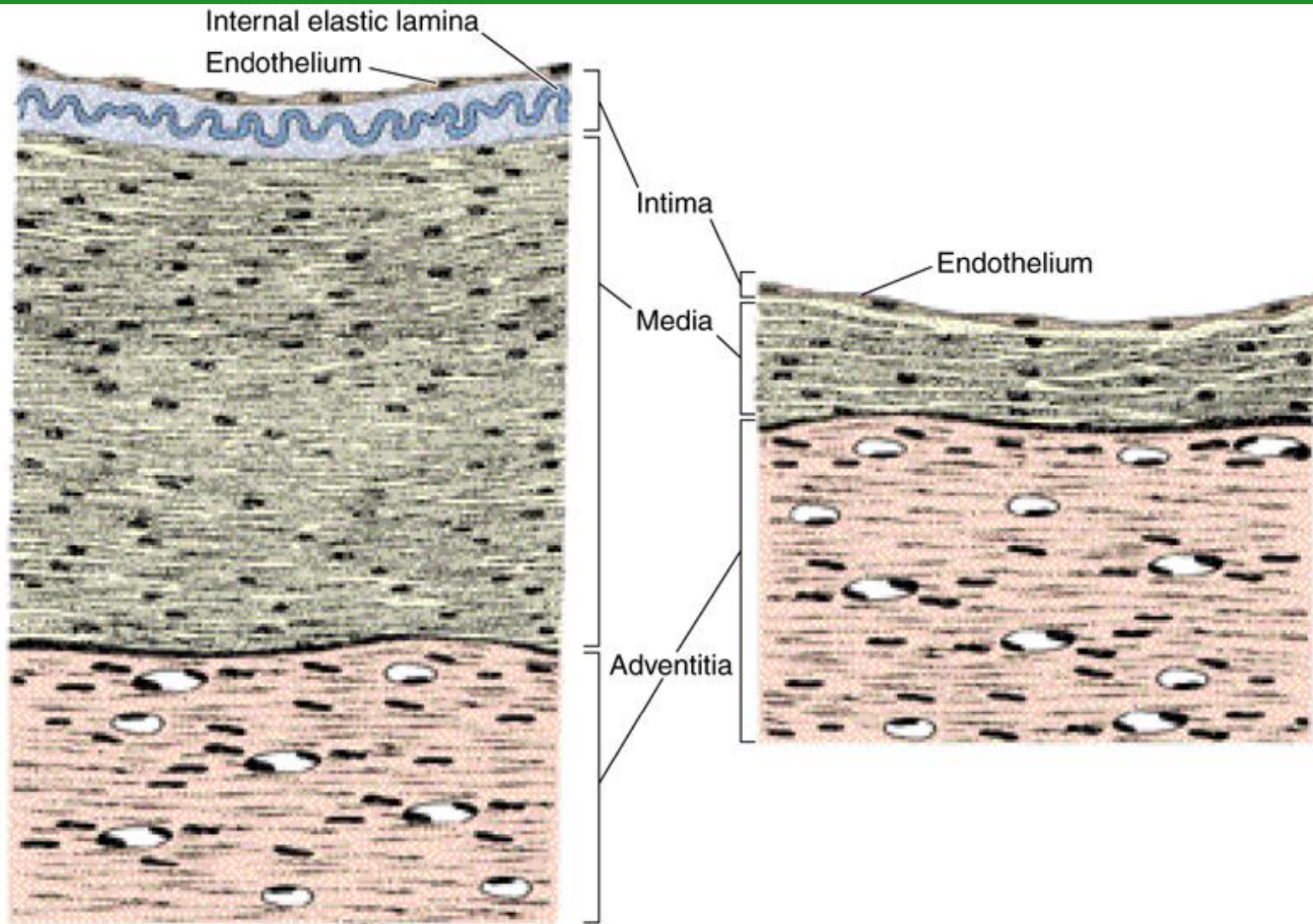
# Disturbances in the blood flow

*Produced by: Assistant Professor Dr. Ala'a Hassan Mirza Hussain*

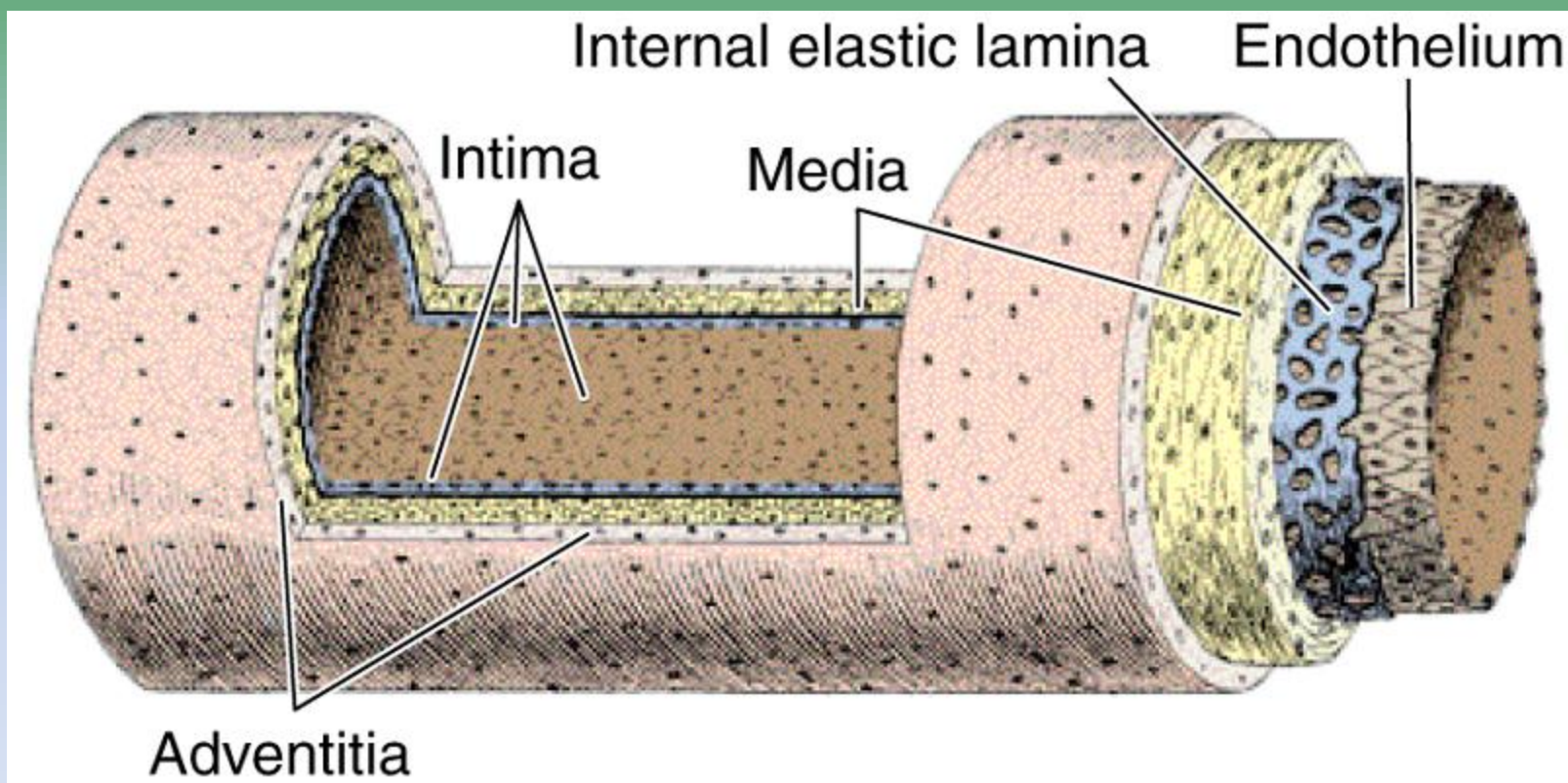
Pathology of the arterial system affects body function through impaired blood flow

# Structure of blood vessels









# Atherosclerosis

- Is a type of hardening of arteries characterized by the formation of fibrofatty lesion in the intimal lining of the large and medium sized arteries such as aorta and its branches, the coronary arteries and large vessels that supply the brain

- Atherosclerosis begins as an insidious process and manifestations of the disease not become evident for 20-30 years or longer

# Mechanism of development

- 1. Endothelial cell injury due to:  
Initiating factor for development of atherosclerosis.
  - a) immune system
  - b). Hypertension
  - c). High blood cholesterol
  - d). Product associated with smoking

- 2. Migration of the inflammatory cells (macrophage) to bind endothelial cells then migrate to the endothelial cells to localize in the intima.
- 3. Platelets, cholesterol and other blood component are accumulated and stimulate abnormal proliferation of smooth muscle cells and connective tissue with vessel wall.



Endothelium  
Intima  
Media  
Adventitia

Chronic  
Endothelial "injury":  
Hyperlipidemia  
Hypertension  
Smoking  
Homocysteine  
Hemodynamic factors  
Inflammation  
Infectious  
Immune reactions

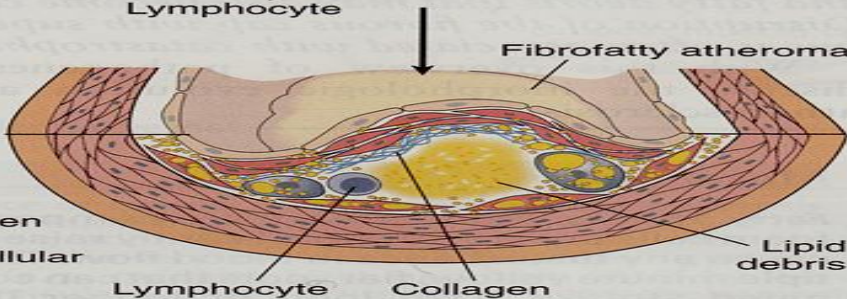
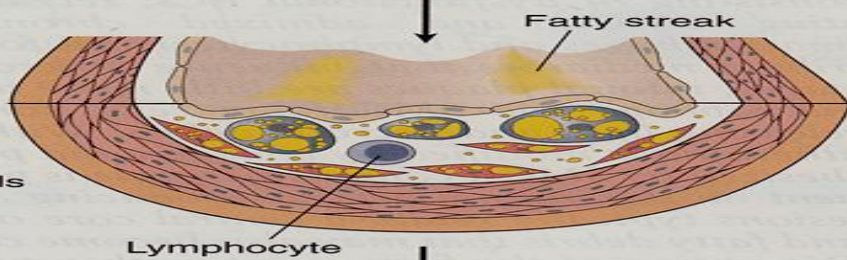
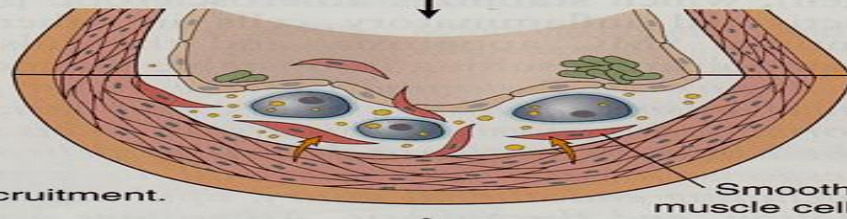
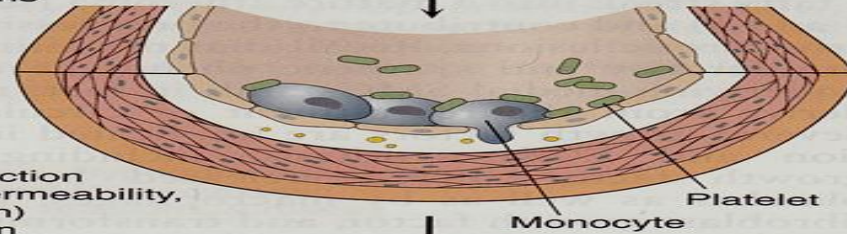
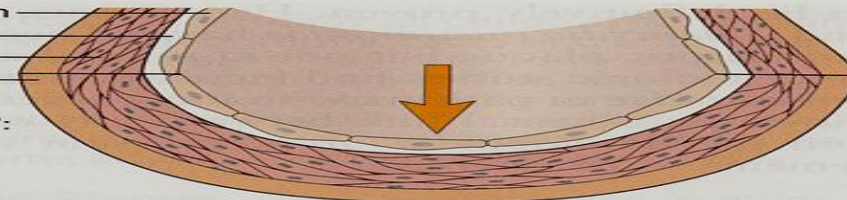
Response to injury

Endothelial dysfunction  
(e.g., increased permeability,  
leukocyte adhesion)  
Leukocyte adhesion  
and migration.

Macrophage  
recruitment,  
Smooth muscle recruitment.

Macrophages and  
smooth muscle cells  
uptake lipid

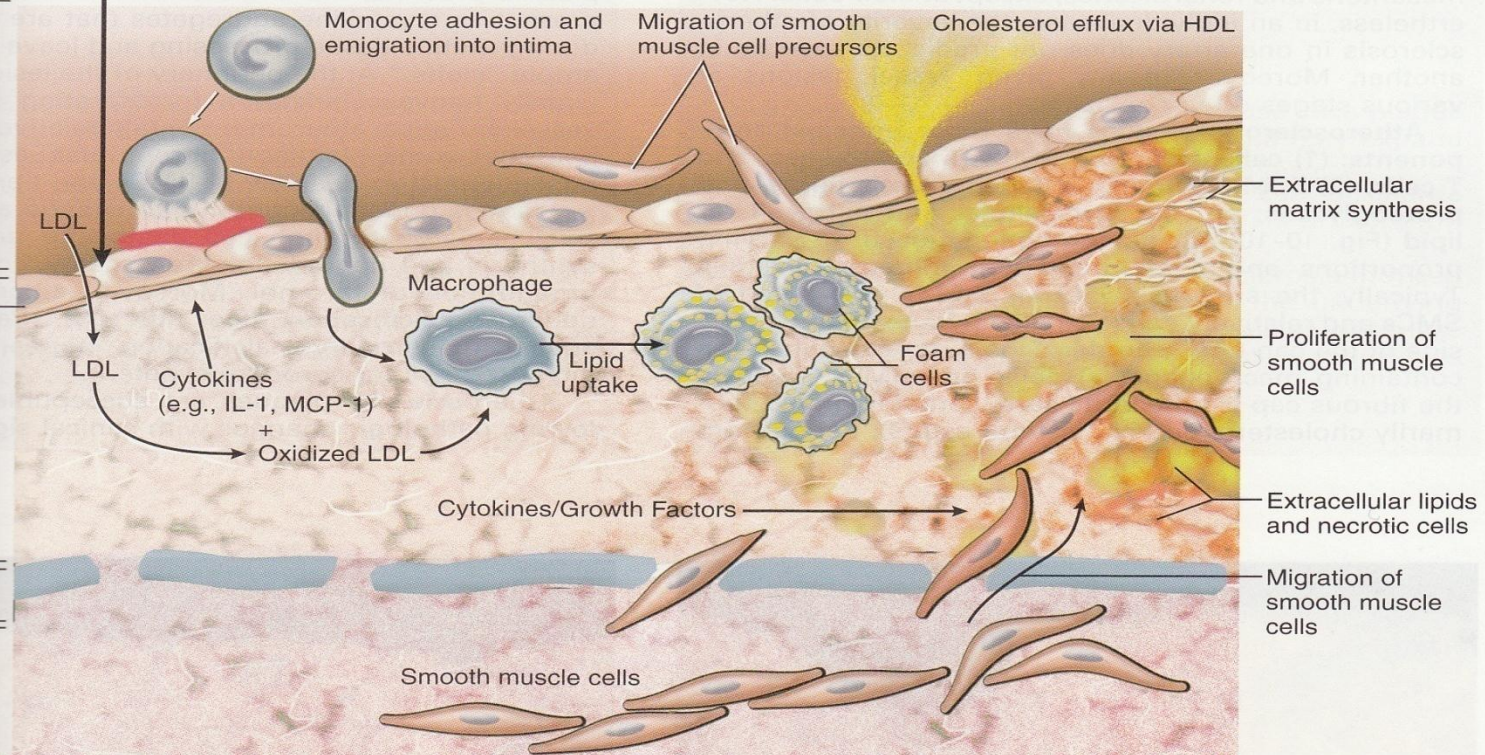
Smooth muscle  
proliferation, collagen  
and other ECM  
deposition, extracellular





Hyperlipidemia, Hypertension,  
Smoking, Toxins, Hemodynamic  
Factors, Immune reactions, Viruses

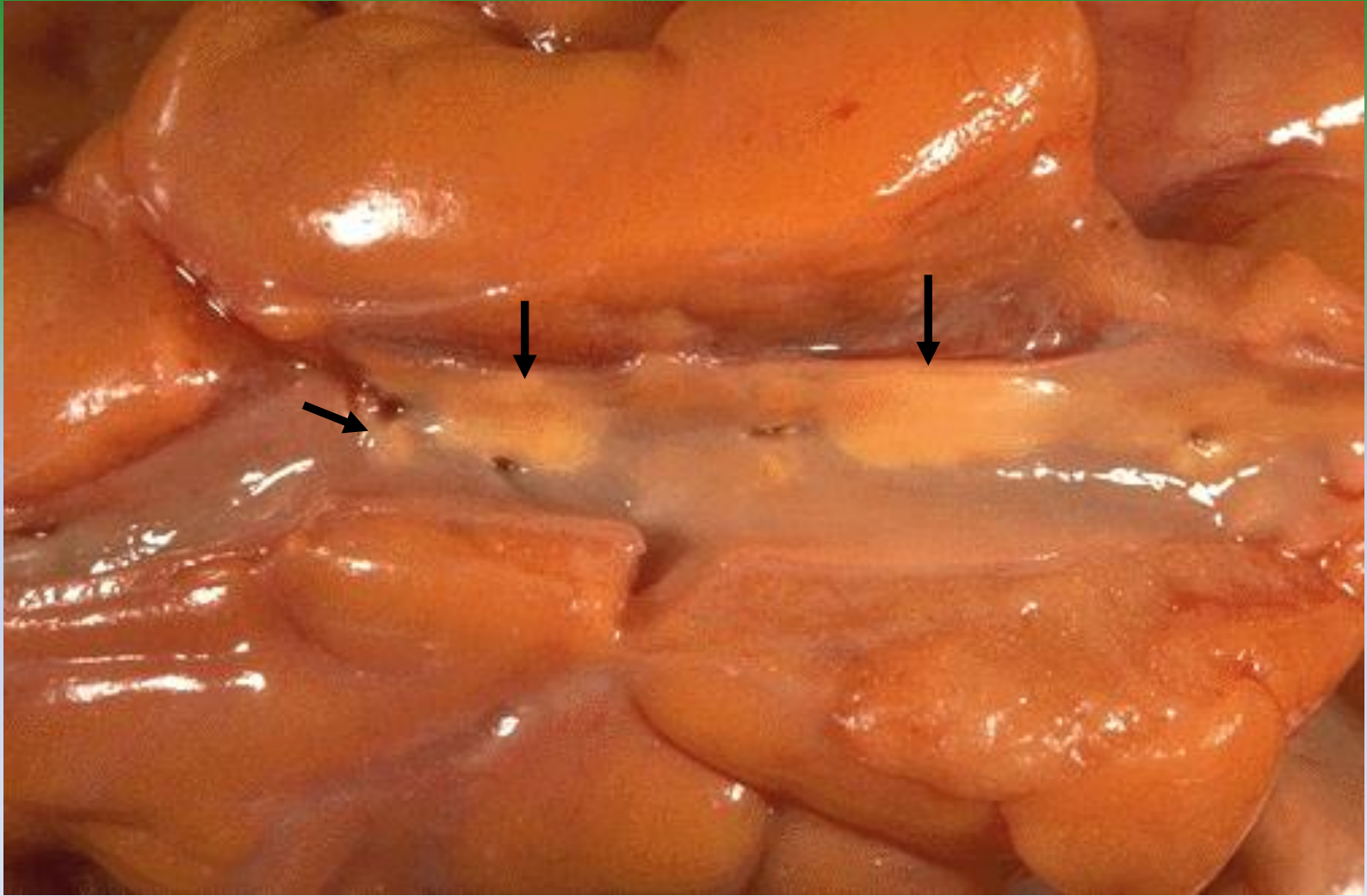
### Endothelial Injury/Dysfunction



# Clinical Manifestations

- These depend on the vessels involved and the extend of vessel obstruction.
- In large vessels, such as aorta the important complications are those of thrombus and weakness of the vessel wall.
- In medium sized arteries, such as coronary and cerebral arteries ischemia and infarction due to vessel occlusion are more common.

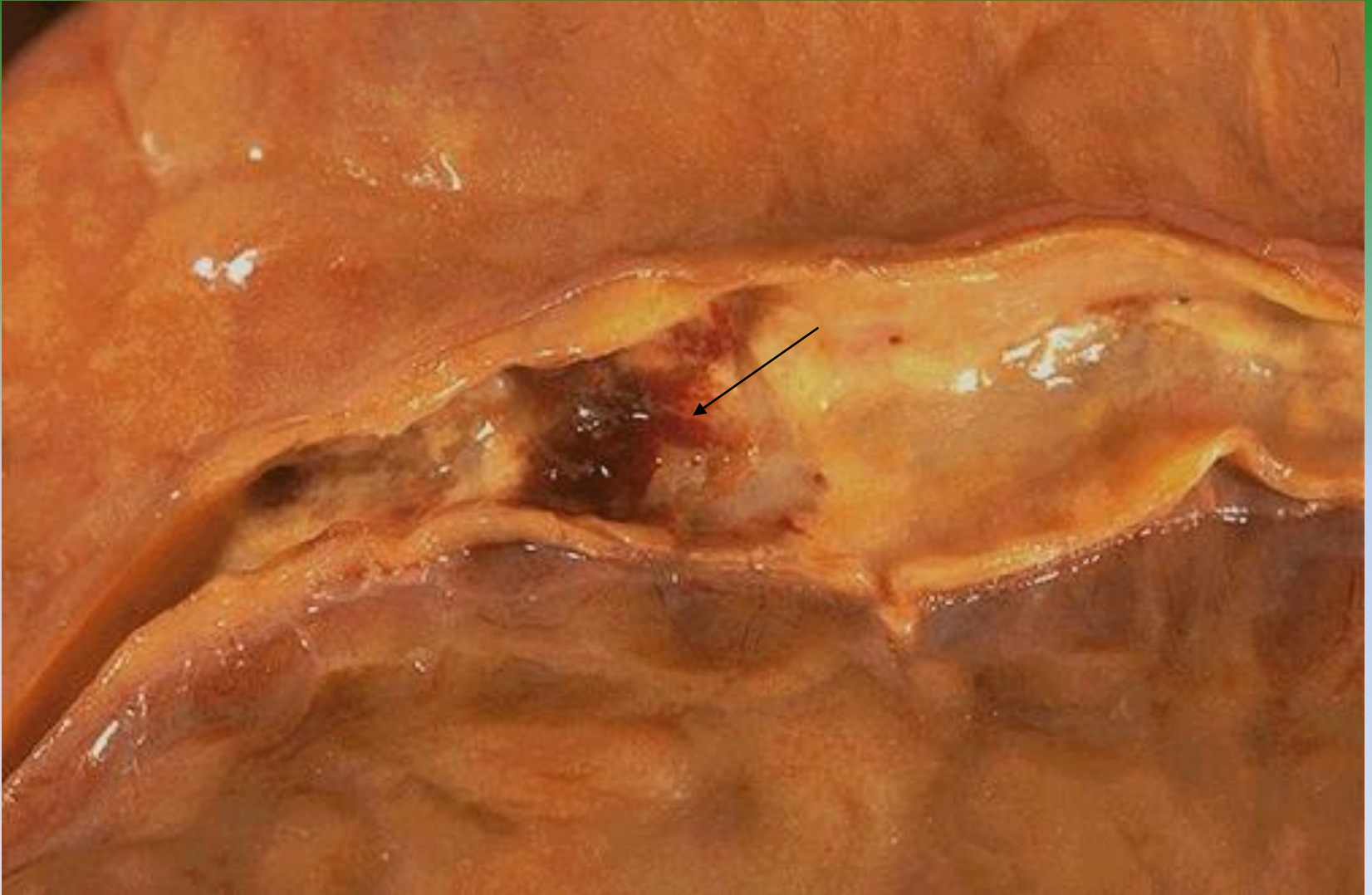
## Mild degree of coronary atherosclerosis



A coronary artery has been opened longitudinally. The coronary extends from left to right across the middle of the picture and is surrounded by epicardial fat. This coronary shows only mild atherosclerosis, with only an occasional yellow-tan lipid plaques (arrows) and no narrowing.



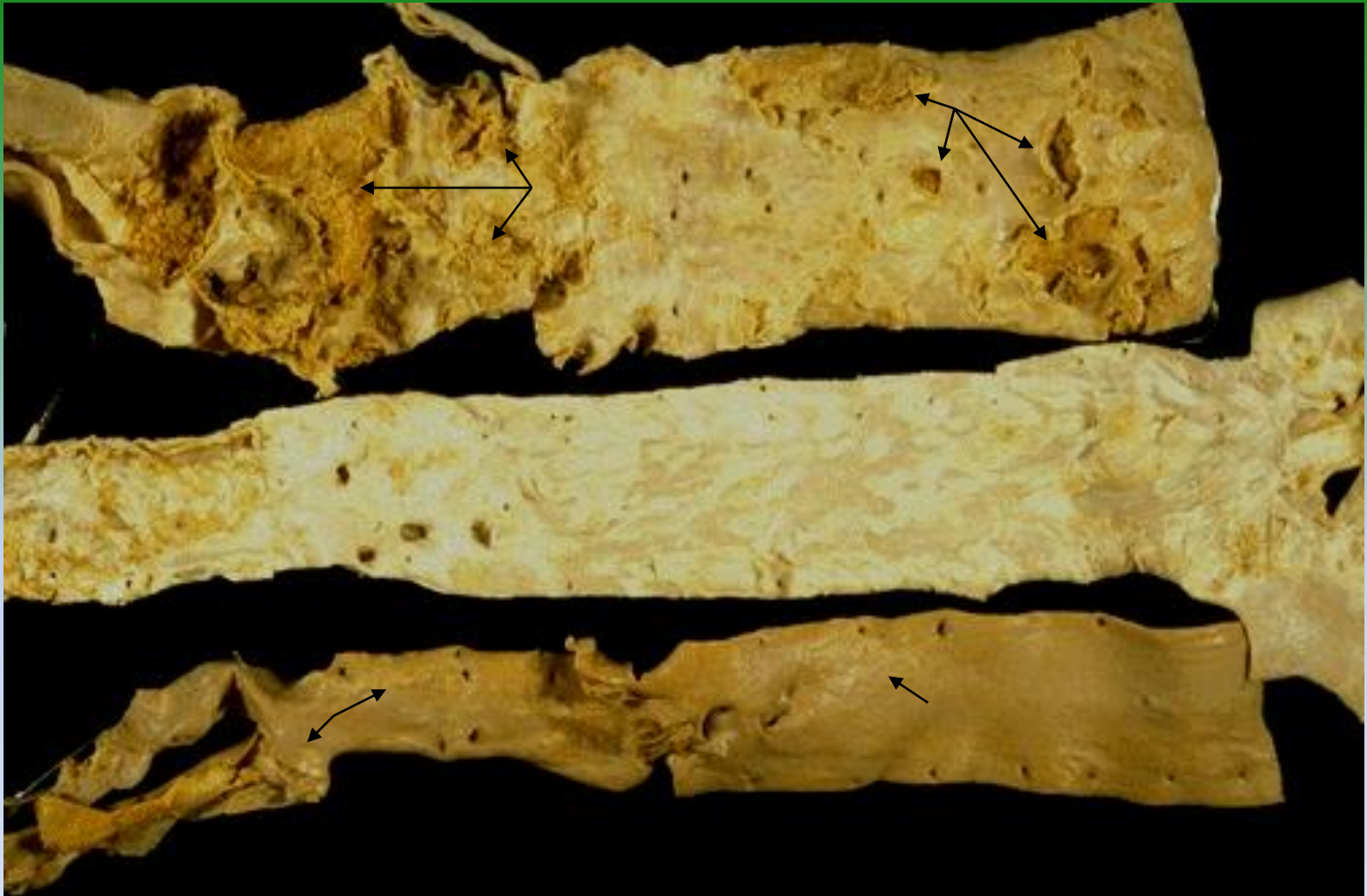
## Coronary atherosclerosis: plaque hemorrhage



This is coronary atherosclerosis with the complication of hemorrhage into atheromatous plaque (arrow). Such hemorrhage acutely may narrow the arterial lumen.

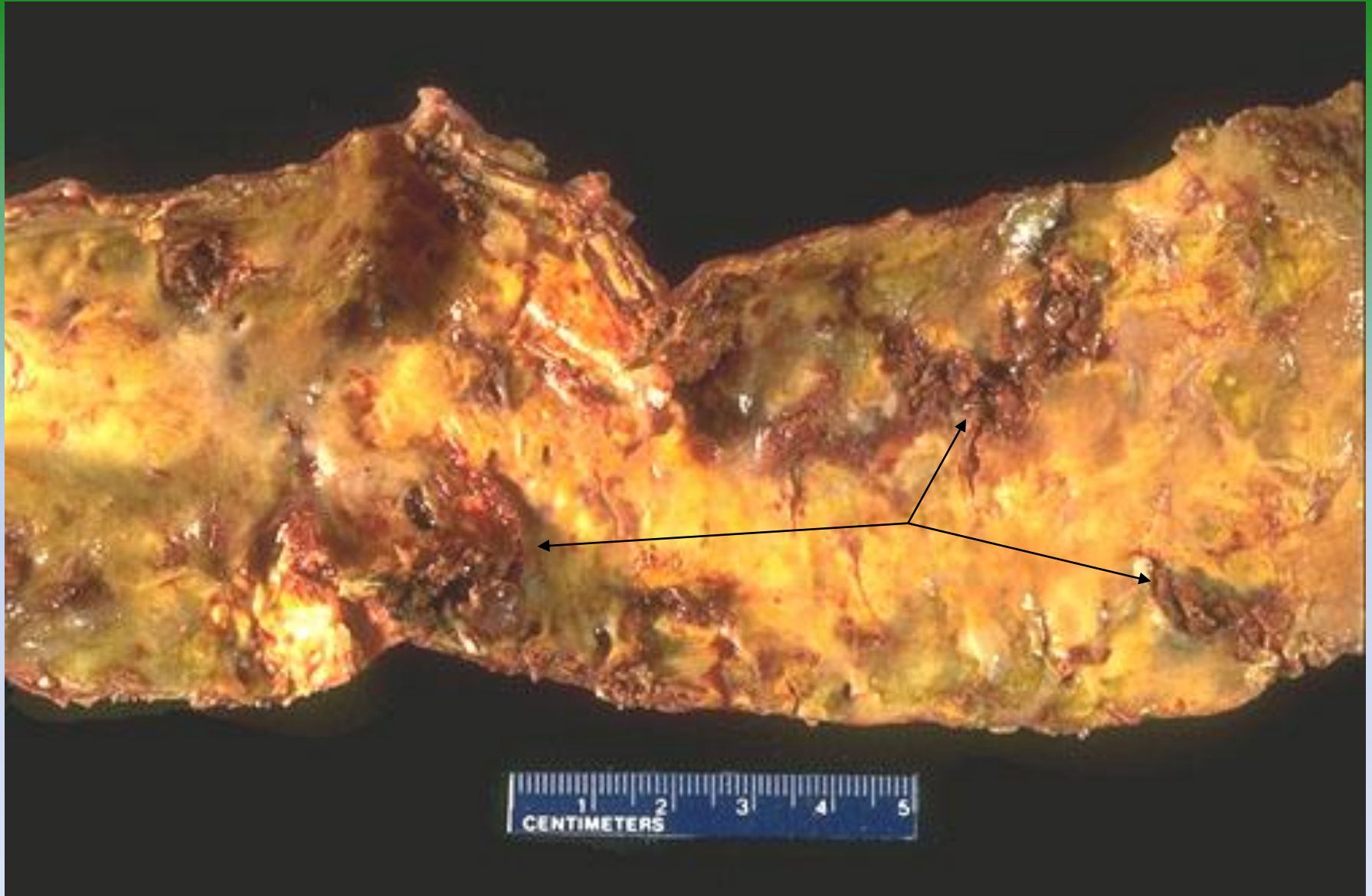


## Atherosclerosis aorta



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

## Atherosclerosis aorta: ulcerations with superadded thrombosis

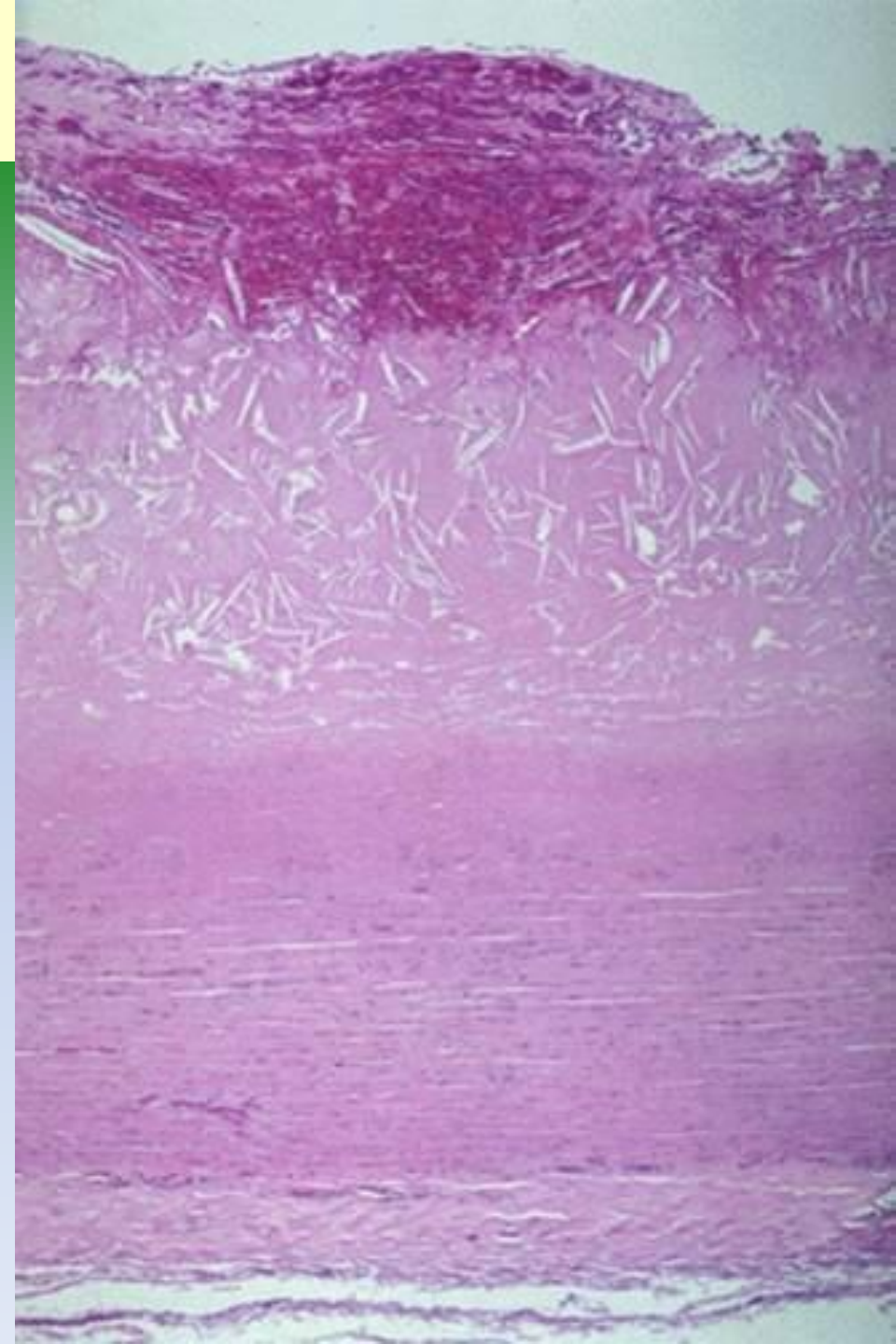


This is severe atherosclerosis of the aorta in which the atheromatous plaques have undergone ulceration along with formation of overlying mural thrombus (arrows).



**Aorta: atheromatous plaque with hemorrhage.  
(HE) low power**

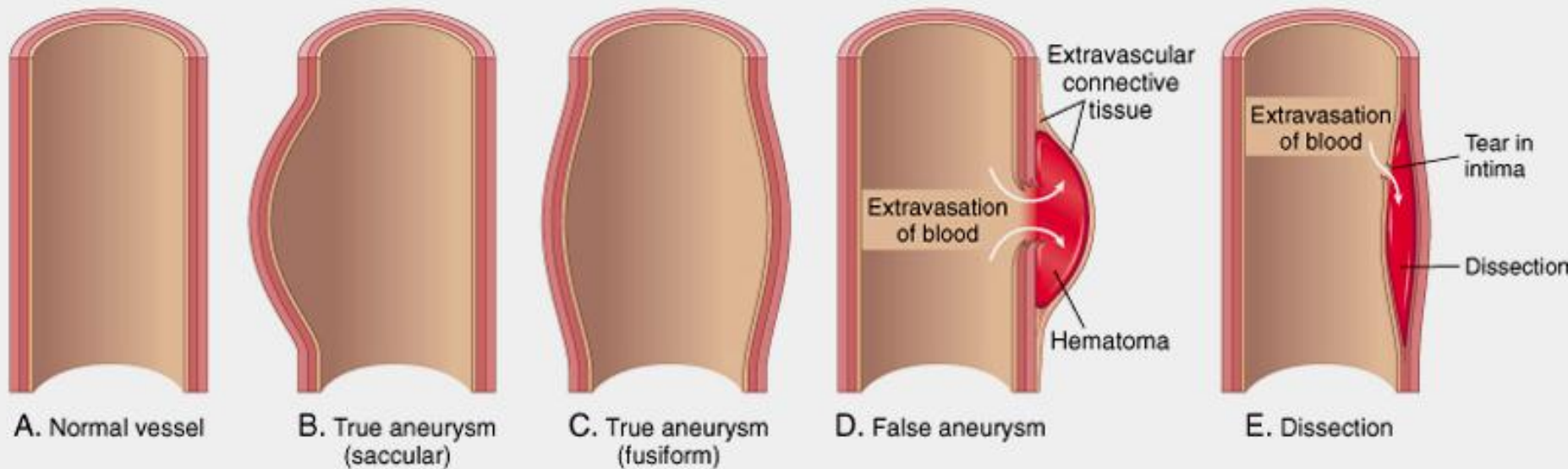
This microscopic cross section of the aorta shows a large luminal atheroma. Cholesterol clefts are numerous in this atheroma. The surface shows intraplaque hemorrhage.



# Aneurysm

- Is abnormal localized vessel dilation caused by weakness of tunica media of blood vessel's wall.
- Causes of arterial wall weakness:
  - Congenital defect
  - Infections
  - Trauma
  - Atherosclerosis.

# Morphological types of aneurysms



A. Normal vessel. B, True aneurysm, saccular type. The wall focally bulges outward and may be attenuated but is otherwise intact. C, True aneurysm, fusiform type. There is circumferential dilation of the vessel, without rupture. D, False aneurysm. The wall is ruptured, and there is a collection of blood (hematoma) that is bounded externally by adherent extravascular tissues. E, Dissection. Blood has entered (dissected) the wall of the vessel and separated the layers. Although this is shown as occurring through a tear in the lumen, dissections can also occur by rupture of the vessels of the vaso vasorum within the media.



# Aortic aneurysms

- May involve any part of aorta:
- Ascending aorta
- Descending aorta
- Aortic arch
- Thoracic-abdominal aorta.

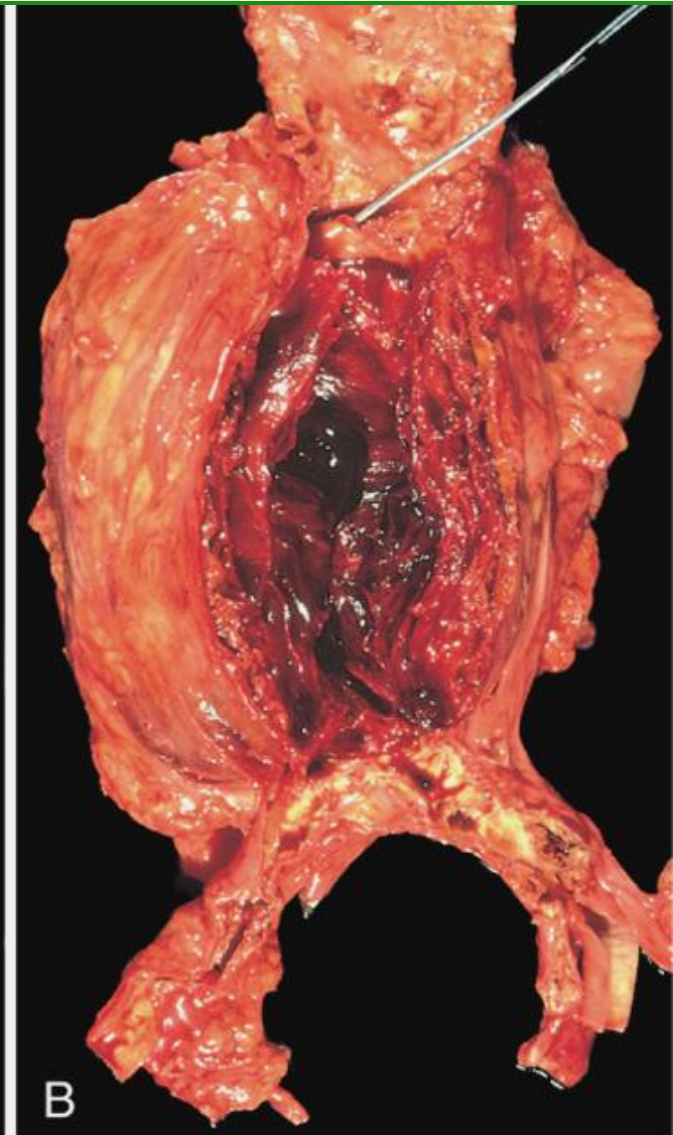
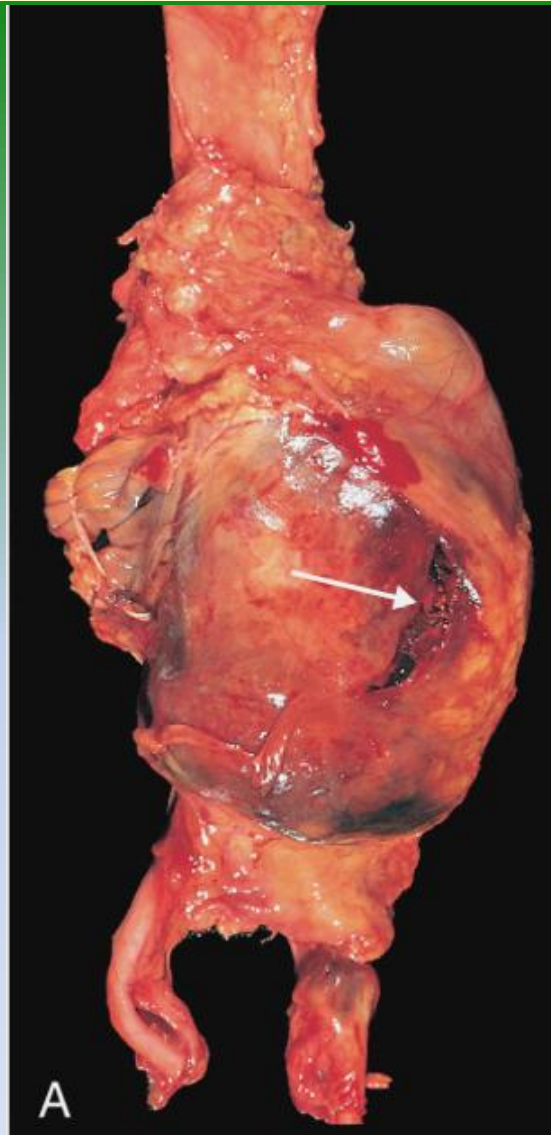
## Atherosclerotic aneurysm of the abdominal aorta

A large "bulge" appears just above the aortic bifurcation. Such aneurysms are prone to rupture when they reach about 6 to 7 cm in size. Most such aneurysms are located below the renal arteries so that surgical resection can be performed with placement of a dacron graft.



## Abdominal aortic aneurysm

A, External view, gross photograph of a large aortic aneurysm that ruptured (arrow). B, Opened view, with the location of the rupture tract indicated by a probe. The wall of the aneurysm is exceedingly thin, and the lumen is filled by a large quantity of layered but largely unorganized thrombus.



# Signs and symptoms

- Depend on the size and location of aneurysm.
- Signs of the thoracic aorta aneurysm:
  1. Substernal back and neck pain.
  2. Dyspnea, cough caused by pressure on the trachea.
  3. Hoarseness may result from pressure on the laryngeal nerve.

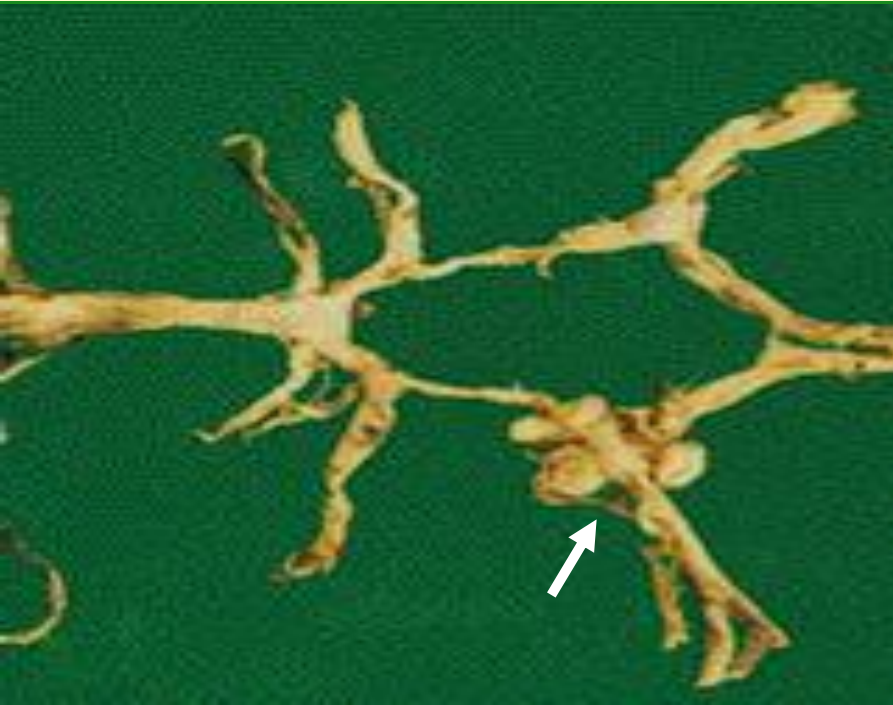
- Difficulty in swallowing because of pressure on the oesophagus.
- Odema of the face and neck due to pressure on the superior vena cava.



# Aneurysm of cerebral arteries

- It is very important because they lead to fatal sub-archnoid hemorrhage.
- The most common cerebral aneurysm is called berry aneurysm.
- The aneurysm results from congenital defect in arterial wall.
- A sudden severe headache is a first indication the onset of subarchnoid hemorrhage and may be followed by coma

## Berry aneurysms



Berry aneurysms are seen arising where the internal carotid bifurcates into middle and anterior cerebral arteries (arrow).



## Ruptured Berry aneurysm with subarachnoid Hge



Blood is present in the sub-arachnoid space over the cerebellum. in this case the aneurysm was arising at the tip of the basilar artery.

- Patient who survive for 3-4 days often manifest a progressive decline in consciousness due to arterial spasm and consequence cerebral ischemia and infarction.



# False aneurysm

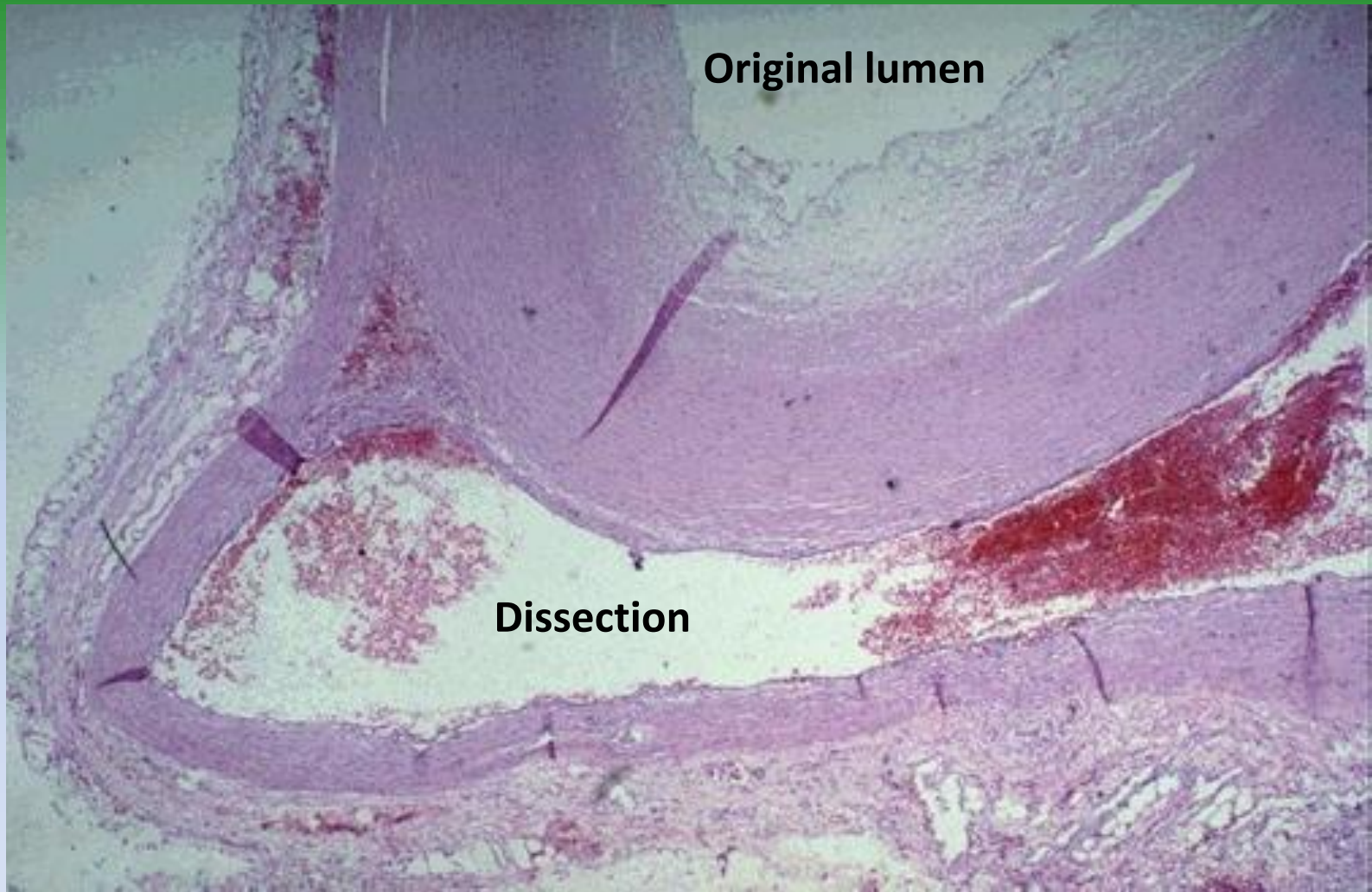
- Dissecting aneurysm represents a localized tear in the inner wall of the artery with formation of an extra-vascular hematoma that causes vessel enlargement.

## Aortic dissection (False aneurysm)



This aorta has been opened longitudinally to reveal an area of fairly limited dissection that is organizing. The red-brown hematoma can be seen in on both sides of the section as it extends around the aorta. The dissection creates a "double lumen" to the aorta. This aorta shows in addition severe atherosclerosis.

## Aortic dissection



The dissection goes into the muscular wall creating an aorta with double lumina.

# Diagnosis

- Arterography
- CT scan
- Ultrasonography
- Magnetic Resonance Imaging (MRI)
- Rteatment : Surgically



# Hypertension

- Means elevation in in systolic and/ or diastolic blood pressure.
- Hypertension is commonly divided into:
  - Primary (essential) hypertension
  - Secondary hypertension.

- **Essential hypertension:** is applied to 95% of cases in which no cause for hypertension can be identified.
- **Secondary hypertension:** in this type of hypertension the elevation of blood pressure results from some other disorder such as kidney disease.

# Essential Hypertension

- Is characterized by chronic elevation in blood pressure that occurs without evidence of other disease.
- Risk factors of essential hypertension:
  - Family history
  - Race
  - Lifestyle risk factors (high salt intake, obesity, excess alcohol consumption).
  - Metabolic disturbances.
  - Age related.

# Essential hypertension

- Essential is a symptomatic disorder, when symptoms do occur, they are usually related to the long term effect of hypertension on other organ system such as, kidney, heart , eyes and blood vessels.
- Hypertension is a major risk factor for atherosclerosis; it predisposes to all major atherosclerotic cardiovascular disorders, including coronary heart disease, heart failure, stroke and peripheral artery disease



# In heart

- An increase in blood pressure increase the work load after left ventricle by increasing the pressure against which the heart must pump as it ejects blood into the systemic circulation.
- As the workload of the heart increases it left ventricular wall hypertrophies to compensate for the increased pressure work.
- Left ventricular hypertrophy is a major risk for: 1. coronary heart disease, 2. cardiac dysrrhythmias, 3. congestive heart failure, 4. sudden death.

Hypertension left ventricular hypertrophy  
regresses with treatment.

- Dementia and cognitive impairment occur more commonly in persons with hypertension.
- Systolic hypertension is a major risk factor for ischemia stroke and intra cerebral hemorrhage.

# Treatment

- Diuretic
- B- adrenergic blocker
- Angiotensin converting enzyme inhibitors
- Angiotensin II receptor blockers
- Calcium channel blocking agents

# Alteration in cardiac function

- Heart problems that affect people in all age are  
:
  1. Disorders of the pericardium
  2. Coronary artery diseases
  3. Cardiomyopathies
  4. Valvular heart diseases
  5. Congenital heart diseases



# Disorders of the pericardium

- Disorders of the pericardium are:
  1. Inflammation of pericardium (pericarditis).
  2. Pericardial effusion.

# Causes of pericarditis

- Infection
- Uremia
- Rheumatic fever
- Myocardial infarction

# Signs:

- Chest pain
- ECG
- Friction

# Pericardial effusion

- Means presence of an exudate in the pericardial cavity. It can increase intracardiac pressure, compress the heart and interfere with venous return to the heart.

# Causes of pericardial effusion

- Inflammation
- Kidney diseases
- Heart failure



# Coronary artery diseases

- This type of heart disease caused by impaired coronary blood flow.

Diseases of coronary vessels can lead to:

Angina, myocardial infarction, heart failure, sudden death.

# Angina pectoris

- Angina pectoris is a symptomatic paroxysmal pain associated transient myocardial ischemia.
- The duration of angina last for 5 minuts

# Causes of angina

- Coronary atherosclerosis
- Spasm of coronary artery (the mechanisms are unknown but it may result from hyperactive sympathetic nervous system)

# Diagnosis methods

- History
- ECG
- Exercise stress testing (the presence of chest pain, severe shortness of breath, dysrhythmias, and decrease in blood pressure.
- If one or more of these symptoms appear the test is stopped.
- Cardiac catheterization.

# Treatment

- Non pharmacological methods
- Pharmacological methods which include:
  - Relief angina pain
  - Vasodilatation
  - $\beta$  blocker
  - anti coagulant



# Myocardial infarction

- Myocardial infarction refers to the ischemic death of myocardial tissue associated with impair blood flow sufficient to produce lethal cell injury.
- An infarct may involve the endocardium, myocardium , pericardium or a combination of these.

# Signs and symptoms

- Severe pain sometime described as being suffocating.
- The pain usually substernal radiating to left arm, neck or jaw.
- The pain in myocardial infarction is prolonged (unlike in angina).
- Nausea, vomiting
- Fever develop within 24 hours and last 3-7 days
- The level of myoglobin (an oxygen carrying protein that normally present in the cardiac muscle) elevation.

# Shock

- Is the clinical emergency state caused by circulatory disturbances of acute fall in cardiac out put.

# Causes and types

1. Reduction in blood volume (hypovolemic shock), caused by sever hemorrhage extensive vascular exudation, sever vomiting and diarrhea.
2. Acute cardiac shock (cardiogenic shock).
3. Sever infection is associated with bacteraemia and septicemia causing septic shock.