

# Ischemic Heart Diseases Stable Angina Pectoris

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# Definition



Ischemic heart disease, also referred to as coronary artery disease, signs, or complications from an inadequate supply of blood to the myocardium



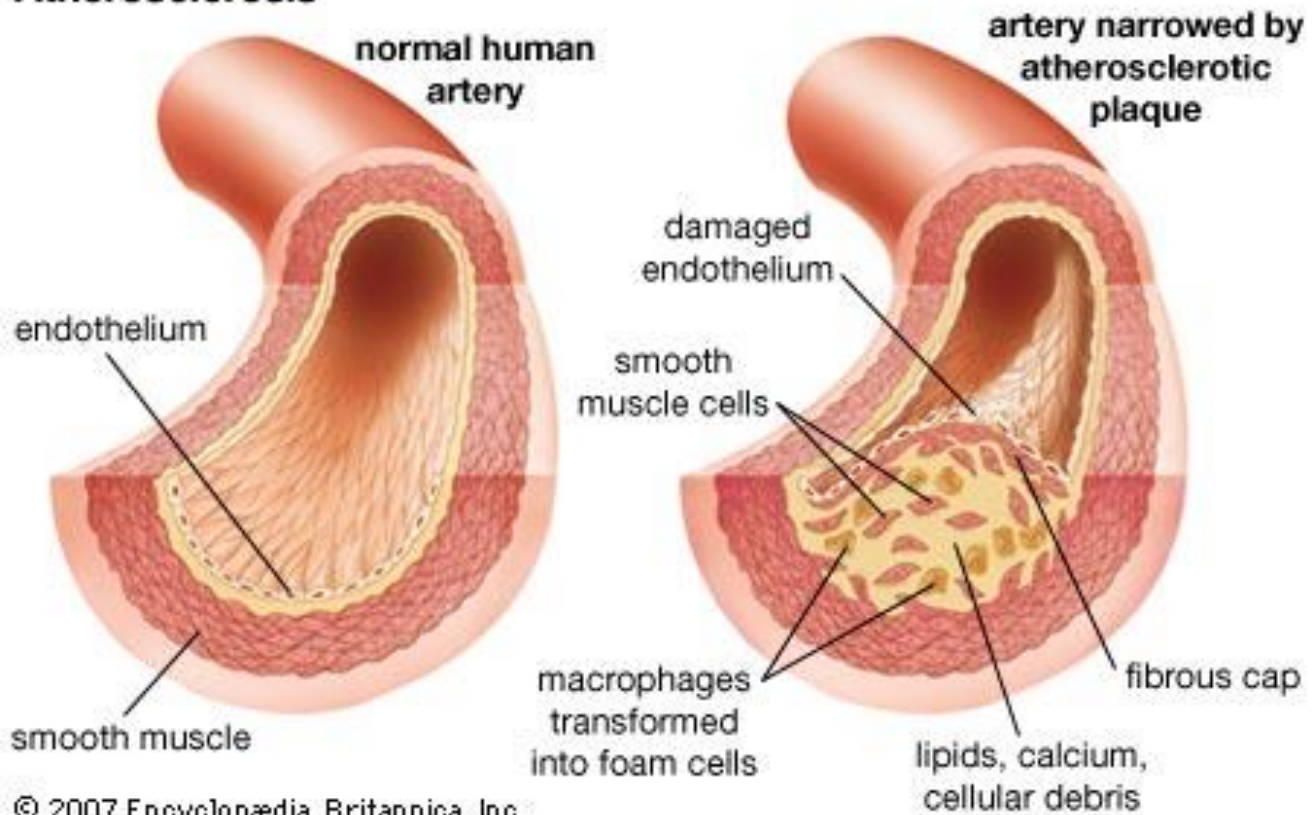
# Etiology

- [Atherosclerosis](#) is the most common cause of epicardial coronary artery stenosis
- Patients with a fixed coronary atherosclerotic lesion of at least 50% show myocardial ischemia during physical activity or stress
- Fixed atherosclerotic lesions of at least 90% almost completely abolish the flow reserve patients with these lesions may experience angina at rest

# Atherosclerosis



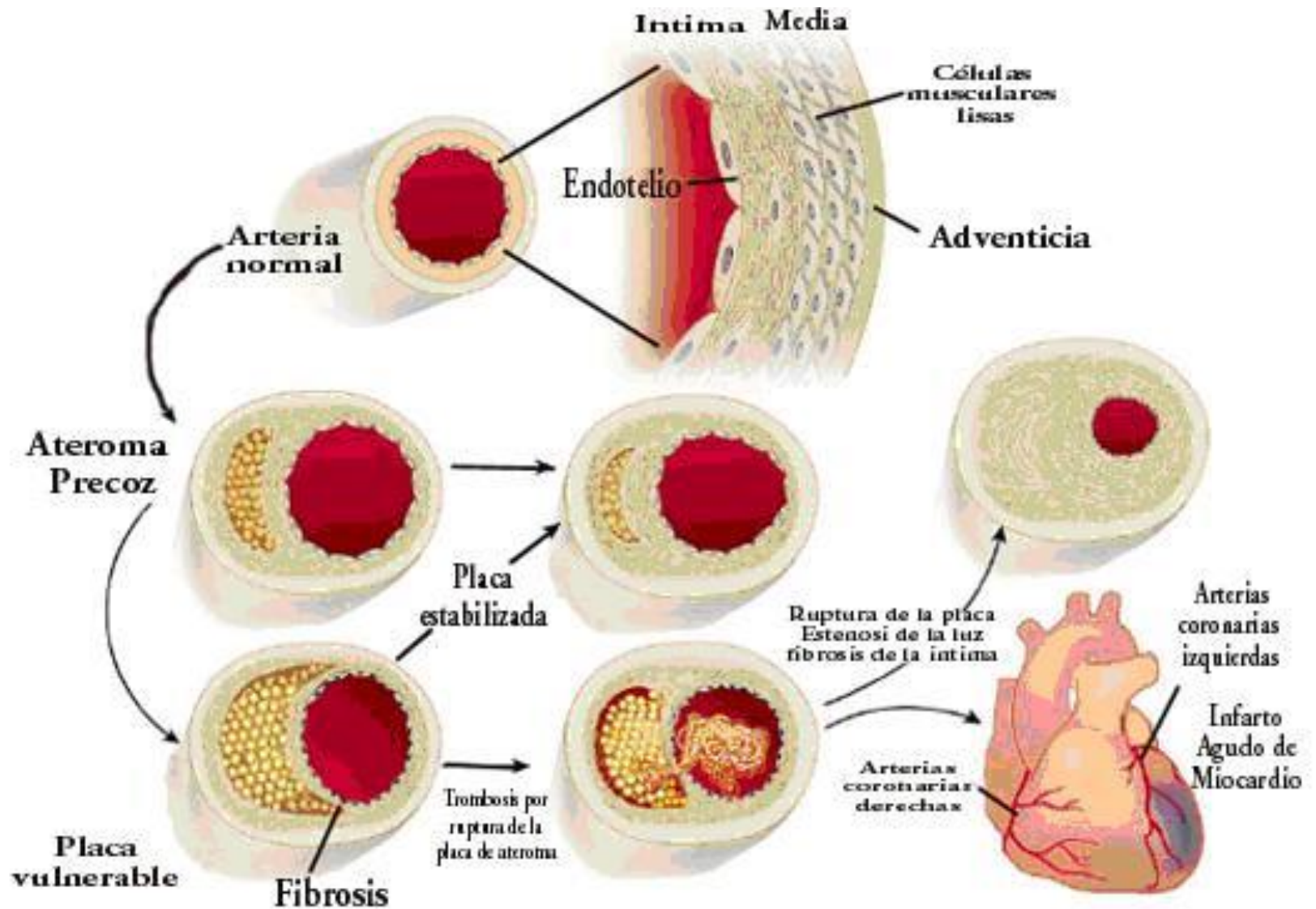
## Atherosclerosis



# The phases in atherosclerosis

- **Fatty streaks** — The first phase in atherosclerosis histologically presents as focal thickening of the intima with an increase in smooth muscle cells and extracellular matrix
- **Fibrous plaque** — The fibrous plaque evolves from the fatty streak via accumulation of connective tissue with an increased number of smooth muscle cells filled with lipids
- **Advanced lesions** develop a microvasculature from both the luminal and medial aspects, and often contain a necrotic lipid rich core

# PATHWAY OF ATHEROSCLEROSIS



# Nonatherosclerotic Causes

## **Fixed**

- Congenital anomalies
- Myocardial bridges
- Vasculitides
- Aortic dissection
- Granulomas
- Tumors
- Scarring from trauma,
- radiation

## **Transient**

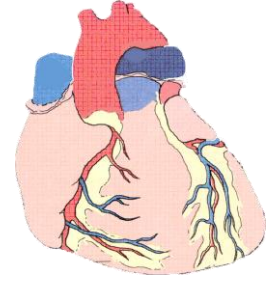
Vasospasm  
Embolus  
Thrombus in situ

# Coronary flow reserve (CFR)

- The ability of the coronary arteries to increase blood flow in response to increased cardiac metabolic demand
- The maximal coronary blood flow after full dilation of the coronary arteries is roughly **4-6 times the resting coronary** blood flow
- CFR depends on at least 3 factors: large and small coronary artery resistance, extravascular (ie, myocardial and interstitial) resistance, and blood composition



# Pathophysiology



- Myocardial ischemia is the result of an imbalance between myocardial oxygen supply and demand
- This causes myocardial cells to switch from aerobic to anaerobic metabolism, with a progressive impairment of metabolic, mechanical, and electrical functions
- Angina pectoris is caused by chemical and mechanical stimulation of sensory afferent nerve endings in the coronary vessels and myocardium

# Pathophysiology

- Studies have shown that adenosine may be the main chemical mediator of anginal pain
- During ischemia, ATP is degraded to adenosine, which, after diffusion to the extracellular space,
- Adenosine induces angina mainly by stimulating the A1 receptors in cardiac afferent nerve endings

# Classification

## Coronary Artery Diseases

- Acute coronary syndrome
- Chronic coronary syndrome

# Classification

- Stable angina pectoris (chronic angina)
- Silent myocardial ischaemia (chronic)
- Unstable angina (acute)
- Myocardial infarction (acute ischaemic heart)
- Sudden cardiac death

## **Stable angina pectoris: synonyms**

- chronic stable angina
- angina pectoris
- effort angina
- angina of effort

# Angina pectoris - the major criteria of pain

- **The character:** pain is a deep visceral pressure or squeezing sensation
- **Localization** : always has some substernal component
- **Radiation:** from the thorax to the jaw, neck, or arm
- **Precipitated:** by exertion, emotional upset
- **Duration:** transient, lasting between 2 - 30 min
- **Pain relief** : after rest, or s/l Nitroglycerine

# **The Canadian Cardiovascular Society classification of angina severity**

- Class I - Angina only during strenuous or prolonged physical activity
- Class II - Slight limitation, with angina only during vigorous physical activity
- Class III - Symptoms with everyday living activities, ie, moderate limitation
- Class IV - Inability to perform any activity without angina or angina at rest, ie, severe limitation

# Atypical symptoms of angina pectoris

- **Dyspnea** may be the patient's only symptom during myocardial ischemia, or it may overshadow the chest pain in the patient's mind
- Ventricular **tachyarrhythmias** manifesting as palpitations or even frank syncope
- Transient **pulmonary edema**



# Factors that Can Aggravate Myocardial Ischemia

## Increased myocardial oxygen demand

- Tachycardia
- Hypertension
- Thyrotoxicosis
- Heart failure
- Valvular heart disease
- Catecholamine analogues (eg, bronchodilators, tricyclic antidepressants)

## Reduced myocardial oxygen supply

- Anemia
- Carbon monoxide poisoning
- Hypotension
- Tachycardia

# Physical Examination

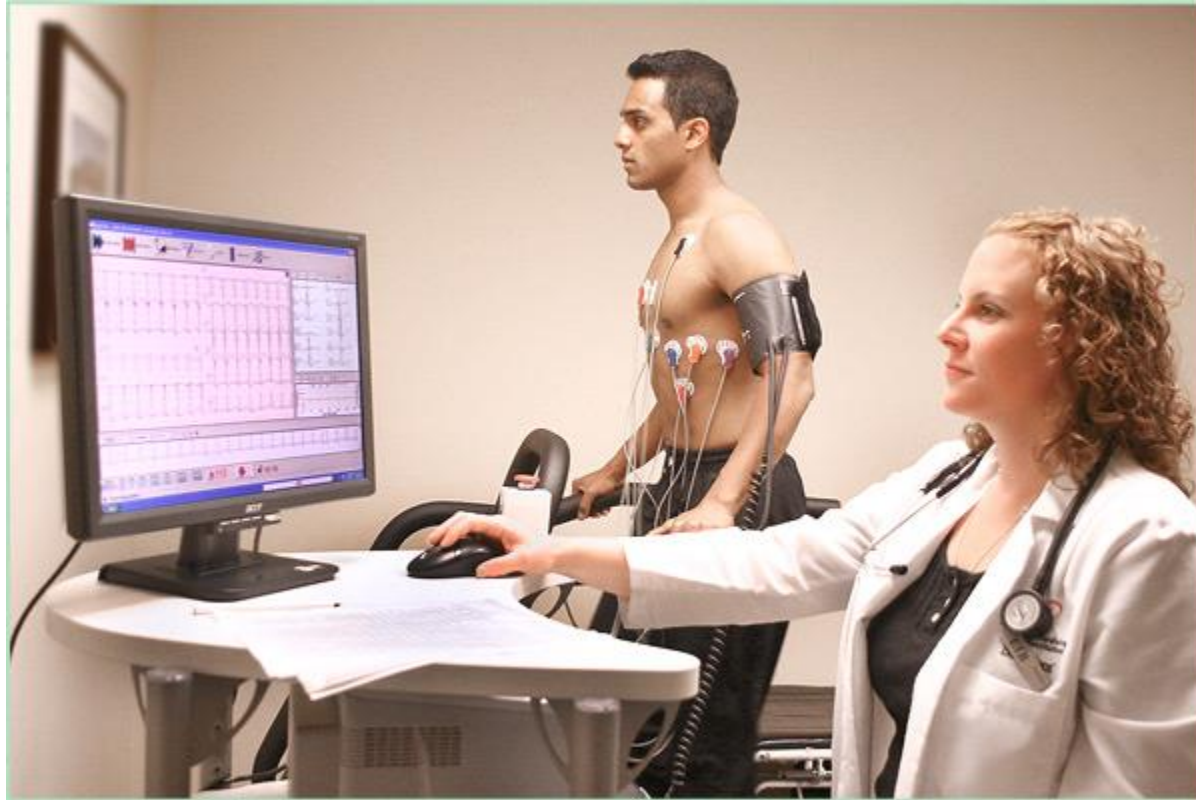
- is often not helpful in the diagnosis of chronic ischemic heart disease
- many patients with chronic ischemic heart disease have no physical findings related to the disease, or if they do, the findings are not specific for coronary artery disease

# Laboratory findings

- To detect anemia a complete blood count is useful
- Thyroid function tests are also important  
hypothyroidism can lead to atherosclerosis
- High sensitivity C-reactive protein (CRP)-  
values greater than 3 mg/L predict coronary  
events
- Brain natriuretic peptide (BNP) levels in  
patients with coronary artery disease - can  
predict mortality

# Diagnostic Studies: Stress Tests

- the most popular is **treadmill exercise**
- walking requires higher levels of myocardial oxygen demand than do many other forms of exercise
- an inexpensive treadmill device, which makes evaluating the patient easy and cost-effective



# **Bicycling is an alternative form of exercise**

- Patient may become fatigued on the bicycle before myocardial ischemia is induced, resulting in lower diagnostic yields
- On the other hand, bicycle exercise can be performed in the supine position, which facilitates some myocardial ischemia detection methods such as echocardiography

# Pharmacologic stress testing - patients who cannot perform leg exercises

- patients who cannot perform leg exercises
- synthetic catecholamine **dobutamine**, that mimic exercise is preferred for wall motion imaging
- vasodilator drugs, such as **dipyridamole** and **adenosine**, that, by producing profound vasodilatation, increase heart rate and stroke volume, thereby raising myocardial oxygen demand is preferred for myocardial perfusion imaging

## **Stress test: ECG**

- horizontal or down-sloping ST segment depression, achieving at least 0.1 mV at 80 ms beyond the J point (junction of the QRS and the ST segment)
- This criterion provides the highest values of sensitivity and specificity
- accuracy is highest when ECG changes are in the lateral precordial leads (V4, V5, V6) instead of the inferior leads (II, III, aVF)



**Prior to exercise  
on stationary bike  
(86 bpm)**



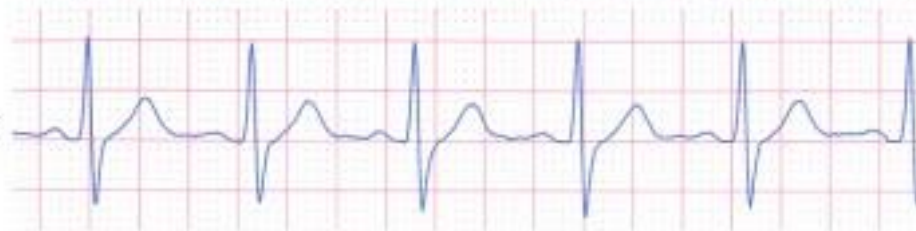
**During exercise  
(133 bpm)**



**1 minute post  
exercise (111 bpm)**



**1 hr 16 min post  
exercise (87 bpm)**



# Echocardiography

- an ideal detection system for wall motion abnormalities because it can examine the left ventricle from several imaging planes, maximizing the ability to detect subtle changes in wall motion
- When images are suboptimal (< 5% of cases), intravenous contrast agents can be given to fill the left ventricular cavity and improve endocardial definition

# CORONARY ANGIOGRAPHY

- is the standard for evaluating the anatomy of the coronary artery tree
- It is best at evaluating the large epicardial coronary vessels that are most frequently diseased in coronary atherosclerosis
- Experimental studies suggest that lesions that reduce the lumen of the coronary artery by 70% or more in area (50% in diameter) significantly limit flow, especially during periods of increased myocardial oxygen demand
- If such lesions are detected, they are considered compatible with symptoms or other signs of myocardial ischemia

# Magnetic resonance imaging (MRI)

- can also be used to assess left ventricular wall motion during pharmacologic stress testing, but there is relatively little experience with this technique

# Myocardial Perfusion Scanning

- method detects differences in regional myocardial perfusion rather than ischemia per se
- there is a high correlation between abnormal regional perfusion scans and the presence of significant coronary artery occlusive lesions

# Myocardial Perfusion Scanning

- treadmill exercise is the preferred stress modality for myocardial perfusion imaging
- pharmacologically induced stress with dipyridamole or adenosine produces nearly as good results and is an acceptable alternative in the patient who cannot exercise

# Target of treatment

- increasing supply or reducing demand—or both
- Heart rate is a major determinant of myocardial oxygen demand
- most coronary blood flow occurs during diastole, the longer the diastole, the greater the coronary blood flow

# **Non pharmacological treatment: risk reduction measures**

- smoking cessation
- physical activity
- weight loss
- control of hypertension
- control of glycaemia
- management of stress



# Aspirin

- all individuals diagnosed with stable angina
- low dose anti-platelet therapy
- aspirin 75-150 mg daily
- unless contraindicated

# Beta Blockers

- first line therapy for the relief of symptoms in stable angina pectoris
- work by improving coronary flow
- contraindicated in bradycardia, a history of asthma or bronchospasm, severe hypotension, severe peripheral arterial disease and uncontrolled heart failure

# Statins

- lipid lowering effect
- reduced mortality, subsequent myocardial infarction, coronary revascularisation and stroke

# **Additional pharmacologic treatment**

- Nitrates
- Calcium Channel Blockers
- Potassium Channel Activators
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# Nitrates

- reduce preload/venous pooling and afterload/BP, which results in increased coronary perfusion
- Sublingual – aerosol spray has a longer life, whereas tablet can be removed once attack relieved
- Long-acting mononitrates – an oral form of nitrate with good bioavailability

# Calcium Channel Blockers

- Calcium-channel blockers reduce afterload and coronary artery spasm by inducing smooth muscle relaxation
- shown to be as effective as beta blockers in minimising angina symptoms
- The choice of specific drug will be influenced by contraindications, side effects and the presence of comorbidities

# Potassium Channel Activators

- Nicorandil significantly reduces unplanned admissions, morbidity and mortality from coronary heart disease in individuals with angina
- The drug acts by relaxing smooth muscle, causing venous and arterial (including coronary) vasodilatation

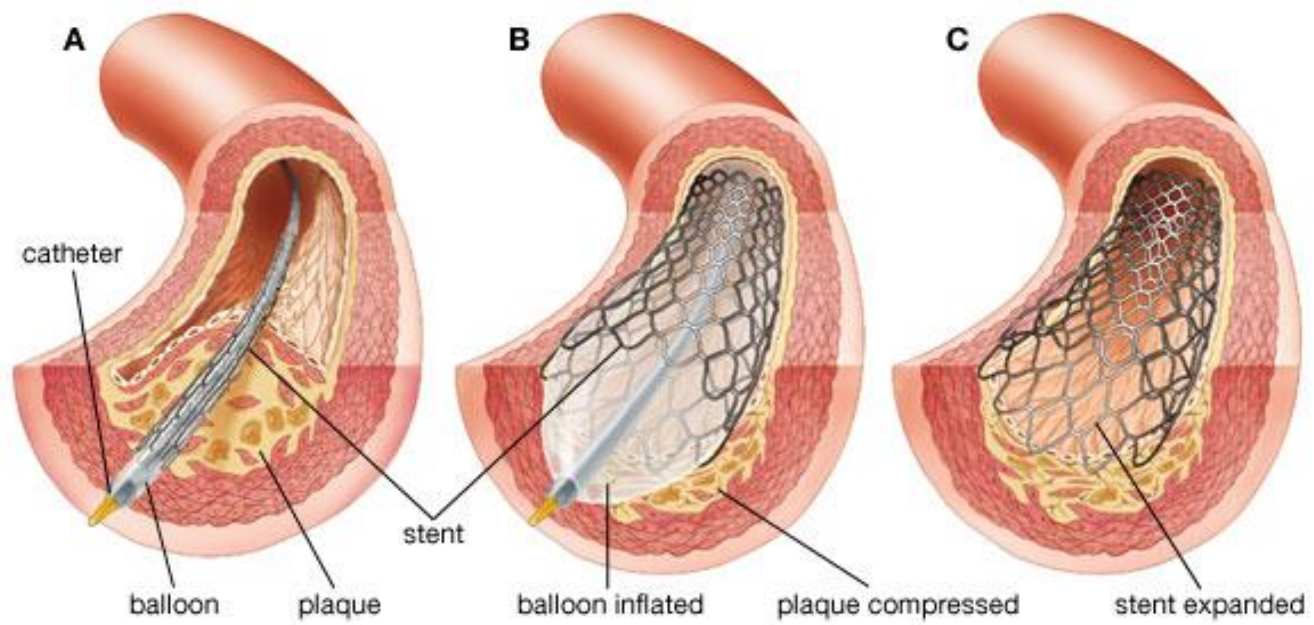
# **Surgical Interventions for Chronic Angina: revascularization**

- Percutaneous Intervention Procedures
- Coronary Artery Bypass Graft



# Indication

- Failure of medications to control the patient's symptoms
- Drug-refractory angina pectoris



# **Microvascular Angina Syndrome X**

- The syndrome that includes angina pectoris, ischemia like ST-segment changes and/or myocardial perfusion defects during stress testing, and angiographically normal coronary arteries is referred to as syndrome X
- Most patients with this syndrome are postmenopausal women, and they usually have an excellent prognosis
- Syndrome X is believed to be caused by microvascular angina