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
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 ATEROSCLEROSIS
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 or 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
Sress 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)
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
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.