PATHOLOGY TEAM

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Ischemic Heart Disease (IHD)

- When myocardial perfusion can't meet demand
- Usually caused by decreased coronary artery blood flow ("coronary artery disease")
- Ischemic heart disease is mostly due to coronary artery atherosclerosis
- Less frequently it is due to vasospasm and vasculitis
- A group of closely related syndromes caused by an imbalance between the myocardial oxygen demand and blood supply. Four syndromes:

1. Angina pectoris (chest pain).
2. Acute myocardial infarction.
3. Sudden cardiac death.
4. Chronic ischemic heart disease with congestive heart failure.

Ischemic Heart Disease: Epidemiology-(Coronary Atherosclerosis)

- Peak incidence: 60y for males and 70y for females.
- Men are more affected than women until the ninth decade.
- Contributing factors are that of atherosclerosis: Hypertension, Diabetes mellitus, Smoking, High levels of LDL, Genetic factors (direct or indirect),Lack of exercise and etc.

Pathogenesis of Ischemic Heart Disease

1) **Role of Critical stenosis or obstruction:** (>=75% of the lumen of one or more coronary arteries by atherosclerotic plaque).

2) **Role of Acute Plaque Change**: There is disruption of previously only partially stenosing plaques with rupture or ulceration, exposing the thrombogenic subendothelial basement membrane to blood. There is resultant hemorrhage into the atheroma, expanding its volume.

It can cause the myocardial ischemia in unstable angina, acute MI, and sudden cardiac death. Abrupt plaque change can be followed by thrombosis .

3) **Role of Coronary Thrombus:** thrombus superimposed on a disrupted but previously only partially stenotic plaque converts it to a total occlusion. This can lead to acute transmural MI.

When the extent of luminal obstruction by thrombosis is incomplete it usually leads to unstable angina, acute subendocardial infarction, or sudden cardiac death.

Thrombus in coronary artery can also embolize.

4) **Role of Vasoconstriction:** Vasoconstriction reduces lumen size and can therefore potentiate plaque disruption.

5) **Role of Inflammation:** Inflammatory processes play important roles at all stages of atherosclerosis.

Angina Pectoris: Angina pectoris is a type of IHD characterized by paroxysmal and usually recurrent attacks of substernal or precordial chest discomfort (variously described as constricting, crushing,squeezing, choking, or knifelike). May radiate down the left arm or to the left jaw *(referred pain)* .

It is due to inadequate perfusion and is caused by transient (15 seconds to 15 minutes) myocardial ischemia that falls short of inducing the cellular necrosis that defines infarction i.e. duration and severity is not sufficient for infarction

There are three overlapping patterns of angina pectoris:

1. Stable or typical angina
2. Prinzmetal or variant angina
3. Unstable or crescendo angina

Stable angina/ typical angina pectoris:

- The most common form of angina, caused by atherosclerotic disease with usually ≥75% narrowing of lumen i.e. (critical stenosis) fixed chronic stable stenosis.
- This significant reduction of coronary perfusion makes the heart vulnerable to further ischemia whenever there is increased demand, such as that produced by physical activity, emotional excitement, or any other cause of increased cardiac workload.
- Episodic chest pain associated with exertion or some other form of stress.
- Is usually relieved by rest (thereby decreasing demand) or nitroglycerin, a strong vasodilator.

Unstable or crescendo angina:

- Unstable
- Pain occurs with progressively increasing frequency, is precipitated with progressively less exertion, even at rest, and tends to be of more prolonged duration.
- It is induced by disruption or rupture of an atherosclerotic plaque with superimposed partial thrombosis.
- Unstable angina is often the precursor of subsequent acute MI. Thus this referred to as preinfarction angina.

Note :

*** Stable and non-stable is important in the exam .**
*** Crescendo mean the pain increase gradually .**

Prinzmetal variant angina:

- is an uncommon pattern of episodic angina that occurs at rest and is due to coronary artery spasm. Prinzmetal angina generally responds promptly to vasodilators, such as nitroglycerin and calcium channel blockers.

- Not related to atherosclerotic disease

- The etiology is not clear.

Angina Pectoris: Summary

- Intermittent Chest Pain Caused By Transient, Reversible Ischemia
- Typical (Stable) Angina
- Pain On Exertion
- Fixed Narrowing Of Coronary Artery
- Unstable (Pre-Infarction) Angina
- Increasing Pain With Less Exertion
- Plaque Disruption And Thrombosis
- Prinzmetal (Variant) Angina
- Pain At Rest
- Coronary Artery Spasm Of Unknown Etiology

Myocardial Infarction

Definition: MI, also known as "heart attack," is the death of cardiac muscle resulting from ischemia. Risks are the same as those of coronary atherosclerosis.

Pathogenesis of MI: Most common cause is thrombosis on a preexisting disrupted atherosclerotic plaque. In the typical case of MI, the following sequence of events can be proposed:

- The initial event is a sudden change in the structure of an atheromatous plaque, that is, disruption as intraplaque hemorrhage, ulceration, or rupture.
- Exposure of the thrombogenic subendothelial basement membrane and necrotic plaque contents resulting in thrombus formation.

- Frequently within minutes, the thrombus evolves to completely occlude the lumen of the coronary vessel.

Common location of MI (In right dominent coronary artery heart,90% of population)
Location may come as a MCQ !

- **Left anterior descending(40-50%):** it supplies the anterior left ventricle, apex and anterior two thirds of interventricular septum.
- **Right coronary artery(30-40%):** it supplies the posterior wall of the left ventricle, posterior one third of interventricular septum.
- **Left circumflex (about 20%)**: it supplies the lateral wall of left ventricle.
- Myocardial necrosis begins within 20-30 minutes, mostly starting at the subendocardial region (less perfused, high intramural pressure).
- Infarct reaches its full size within 3-6 hrs., during this period, lysis of the thrombus by streptokinase or tissue plasminogen activator, may limit the size of the infarct.
- Irreversible cell injury: 20-40 min

The precise location, size, and specific morphologic features of an acute myocardial infarct depend on:

1. The location, severity, and rate of development of coronary atherosclerotic obstructions
2. The size of the area suplied by the obstructed vessels
3. The duration of the occlusion
4. The oxygen needs of the myocardium at risk
5. The extent of collateral blood vessels
6. Other factors, such as blood vessel spasm, alterations in blood pressure, heart rate, and cardiac rhythm.
7. In addition reperfusion may limit the size of the infarct.

MI types:

Transmural : Full thickness (>50% of the wall)

Subendocardial : Inner 1/3 of myocardium

Myocardial Infarction, Morphology:

Coagulative necrosis and inflammation, formation of granulation tissue, organization of the necrotic tissue to form a fibrous scar.

Microscopic changes	Gross changes	Time
None	None	0-4h
Coagulation necrosis	Mottling	4-12h
More coagulation necrosis; neutrophils come in	Mottling	12-24h
Neutrophils die, macrophages come to eat dead cells	Yellow infarct center	1-7 d
Granulation tissue	Yellow center, red borders	1-2 w
Collagen	Scar	2-8 w

Note :

The table is important especially the morphological time

Myocardial Infarction: Clinical Features

1. Pain: Severe crushing substernal chest pain, which may radiate to the neck, jaw, epigastrum, shoulder or left arm. Pain lasts for hours to days and is not relieved by nitroglycerin. Absent in 20-30% of patients (diabetics, hypertensive, elderly).
2. Pulse is rapid and weak.
3. Diaphoresis.
4. Dyspnea.
5. Cardiogenic shock in massive MI(>40%of lt. ventricle).
6. ECG shows typical findings of ischemia.

Laboratory Evaluation

❖ Troponins: best marker, TnT, TnI (more specific).

- TnI and TnT are not normally detectable in the circulation
- After acute MI both troponins become detectable after 2 to 4 hours, peaks at 48 hours. Their levels remain elevated for 7 to 10 days

❖ CK-MB is the second best marker:

- It begins to rise within 2 to 4 hours of MI, peaks at 24 to 48 hours and returns to normal within approximately 72 hours

❖ Lactate dehydrogenase (LD)… LD1.

- Rise 24 hrs, peaks 72 hrs, persists 72 hrs.

Myocardial Infarction: Outcomes or complications

❖ No complications in 10-20%.
❖ 80-90% experience one or more of the following complications:

a. Cardiac arrhythmia (75-90%). Many patients have conduction disturbances and myocardial irritability following MI, which undoubtedly are responsible for many of the sudden deaths. Sudden coronary death can occur due to ventricular arrhythmia.

b. Left ventricular failure with mild to severe pulmonary edema (60%).

c. Cardiogenic shock (10%).

d. Myocardial rupture:Rupture of free wall, septum, papillary muscle (leading to papillary muscle dysfunction)

e. Thromboembolism (15-49%). the combination of a local myocardial abnormality in contractility (causing stasis) with endocardial damage (causing a thrombogenic surface) can foster mural thrombosis and, potentially, thromboembolism

f. Pericarditis

g. Infarct extension and expansion

h. Ventricular aneurysm.

i. External rupture of the infarct with associated bleeding into the pericardial space (hemopericardium).

j. Progressive late heart failure in the form of chronic IHD.

Note :
Compelcation is important .

Myocardial Infarction (MI), summary: Necrosis of heart muscle caused by ischemia and most due to acute coronary artery thrombosis

a. sudden plaque disruption
b. platelets adhere
c. coagulation cascade activated
d. thrombus occludes lumen within minutes
e. irreversible injury/cell death in 20-40 minutes
Prompt reperfusion can salvage myocardium

Clinical Features

- Severe, crushing chest pain ± radiation
- Not relieved by nitroglycerin, rest
- Sweating, nausea, dyspnea
- Sometimes no symptoms

Laboratory Evaluation

- Troponins increase within 2-4 hours, remain elevated for a week.
- CK-MB increases within 2-4 hours, returns to normal within 72 hours.

Complications

- Contractile Dysfunction
- Arrhythmias
- Rupture
- Chronic Progressive Heart Failure

Prognosis

- Depends on remaining function and perfusion
- Overall 1 year mortality: 30%
- 3-4% mortality per year thereafter

Chronic Ischeamic Heart Disease: Progressive heart failure due to ischemic injury, either from prior infarction(s) (most common) OR chronic low-grade ischemia

Sudden cardiac death: Unexpected death from cardiac causes either without symptoms or within 1 to 24 hours of symptom onset.Results from a fatal arrhythmia, most commonly in patients with severe coronary artery disease