Lecture 3
Ischemic Heart Diseases (IHD)

- http://youtu.be/afYCN3Upy_w acute coronary syndrome
- http://youtu.be/Bnoo5insrUQ aneurysm

OBJECTIVES

- **Be able to discuss pathology and complications of ischemic heart diseases with special emphasis on myocardial infarction.**
- **Know how lifestyle modifications can reduce the risk of ischemic heart disease.**
- **Macroscopic and microscopic changes in myocardial infarction.**
- **Biochemical markers of myocardial infarction.**
- **Complications of myocardial infarction: immediate and late.**

Ischemic Heart Diseases (IHD)

OR

Coronary artery disease (CAD)

Definition: A group of related syndromes resulting from myocardial *ischemia* (An imbalance between cardiac blood supply and myocardial oxygen demand).

Causes of Ischemic Heart Disease:

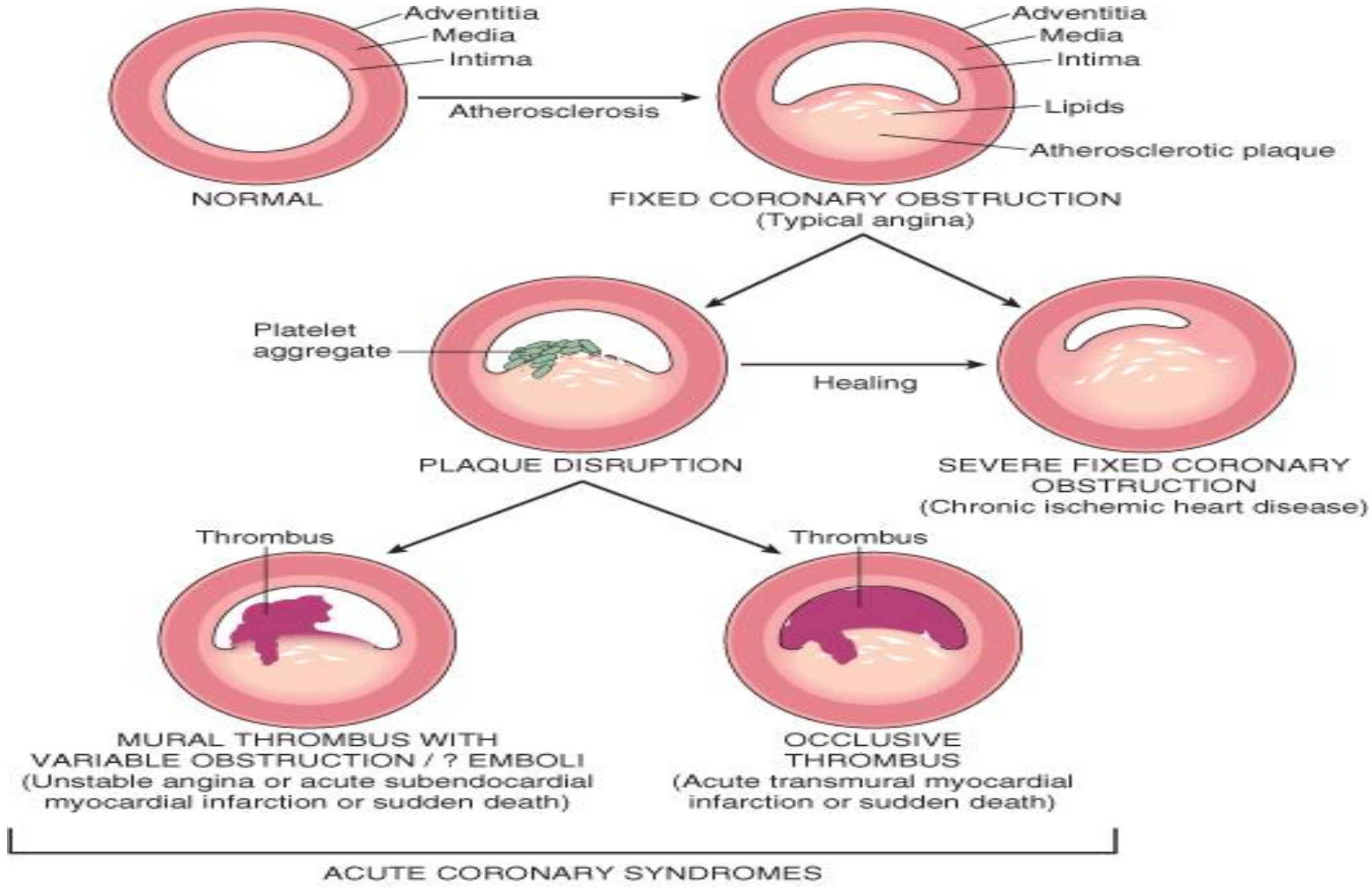
- Coronary artery atherosclerosis **(Major causes)**
- Less frequency Vasospasm and Vasculitis

Clinical presentation of IHD may include one or more of the following cardiac syndrome:

1- Angina pectoris
2- Myocardial infarction (MI)
3- Chronic IHD with CHF
4- Sudden cardiac death (SCD)

* Weight loss, quit smoking, aerobic exercises, decrease stress, and avoiding the consumption of unsaturated fats, can reduce risk of IHD

Note: Estrogen protects women against IHD, so the men are more affected than women


Adventitia
Media
Intima
Atherosclerosis
Adventitia
Media
Intima
Lipids
Atherosclerotic plaque
NORMAL
FIXED CORONARY OBSTRUCTION
(Typical angina)
Platelet
aggregate
Healing
PLAQUE DISRUPTION
SEVERE FIXED CORONARY
OBSTRUCTION
(Chronic ischemic heart disease)
Thrombus
Thrombus
MURAL THROMBUS WITH
VARIABLE OBSTRUCTION / ? EMBOLI
(Unstable angina or acute subendocardial
myocardial infarction or sudden death)
OCCLUSIVE
THROMBUS
(Acute transmural myocardial
infarction or sudden death)
ACUTE CORONARY SYNDROMES

1- Angina pectoris

Definition: An intermittent chest pain caused by transient, reversible myocardial ischemia, the pain Can radiate down the left arm or to the left jaw.

Types:

Stable angina (typical angina)	- Occurring after certain levels of exertion. - Due to atherosclerotic disease with (**critical stenosis**) fixed chronic stable stenosis. - Is usually relived by rest , thereby decreasing demand , nitroglycerin or a strong vasodilator.
Unstable angina (crescendo angina)	- Often is harbinger of MI. - Occurring with less exertion or even at rest with more prolonged duration. - Associated with plaque disruption triggering by (Platelet aggregation, Vasoconstriction, Formation of mural thrombus).
Variant angina (Prinzmetal angina)	- Occurs **at rest,** and caused by **coronary artery spasm**. **(the aetiology is not clear)** - **Not related to atherosclerosis .** - Responds promptly to vasodilators, such as (nitroglycerin and Ca channel blockers).

2- Myocardial infarction (Heart attack)

Definition: Necrosis of heart muscle resulting from ischemia, usually results from acute thrombosis that follow plaque disruption.

Risk factors of MI :

Are the same of atherosclerosis

Types:

1- Transmural	Myocardial necrosis involves the entire ventricular wall.
2- Subendocardial	Inner 1/3 of ventricular wall

Note

Ischemia to myocardium rapidly (20 – 30 minutes) leads to loss of function and causes necrosis after 20 to 40 minutes and become irreversible.

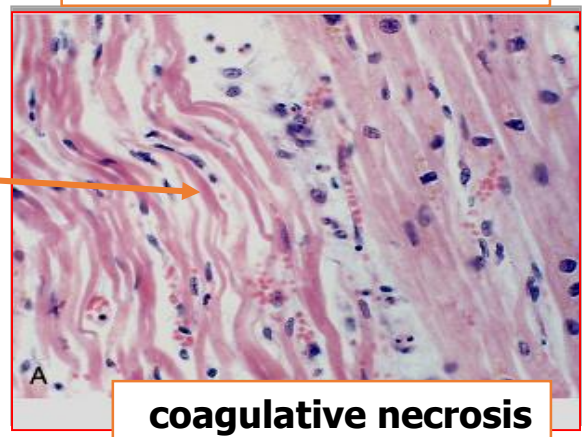
*50% of MI involve the left anterior descending (LAD) artery.

The next most common site for MI is the right coronary artery (RCA), followed by the left circumflex (LCX).

Morphology: Microscopic feature

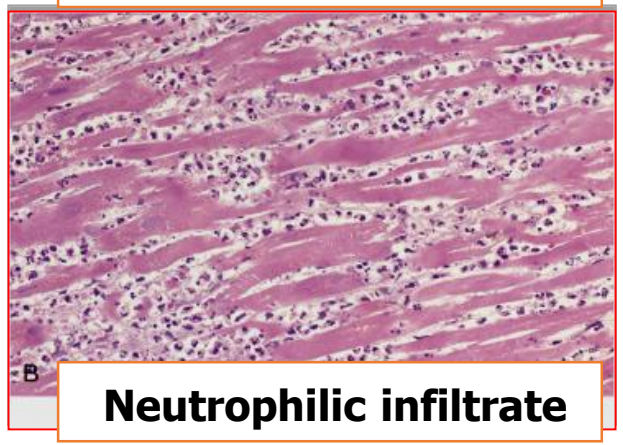
One-day-old infarct

wavy fibers



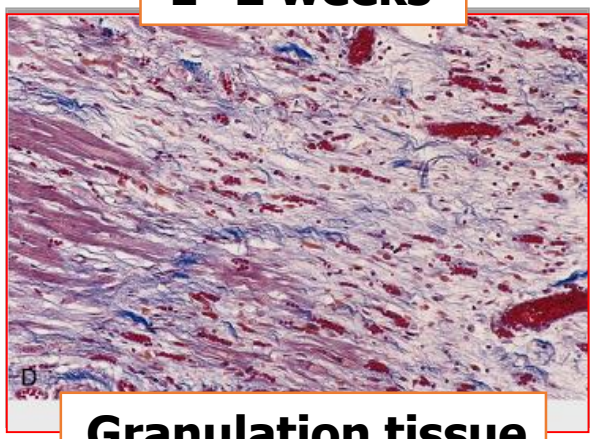
coagulative necrosis

Up to 3 days duration



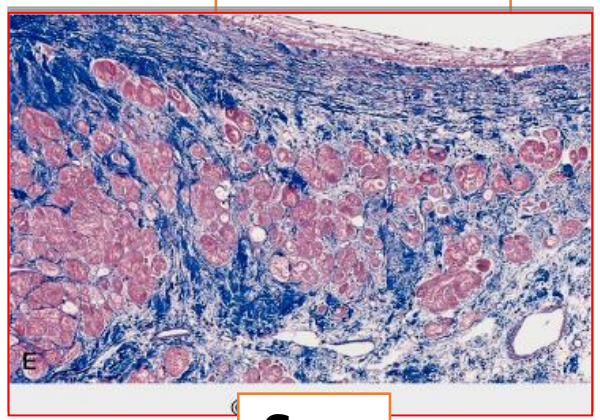
Neutrophilic infiltrate

1 -2 weeks



Granulation tissue

>3 weeks



Scar

*MI less than 12h old usually are not grossly apparent

Morphologic Changes in Myocardial Infarction

- Coagulative necrosis and inflammation.
- Formation of granulation tissue.
- Organization of the necrotic tissue to form a fibrous scar.

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

Clinical presentation of MI

1. Severe, crushing substernal chest **pain** or discomfort that can radiate to the neck, jaw, epigastrium, or left arm.

2. Diaphoresis

(Excessive sweating)

3.Nausea

4.Dyspnea

5.Can be silent (DM, old age)

6.ECG changes:

- ✓ Q waves (indicating transmural infarcts).
- ✓ ST-segment abnormalities.
- ✓ T-wave inversion.
- ✓ Arrhythmias.

Laboratory investigations:

- ✓ Cardiac troponins T and I (TnT, TnI).
- ✓ Creatine kinase (CK, and more specifically the myocardial-specific isoform CK-MB).
- ✓ Lactate dehydrogenase.

"Troponins and CK-MB have high specificity and sensitivity for myocardial damage"

	Troponins	CK-MB
Notes:	✓ The best marker for MI. ✓ TnI and TnT are not normally detectable in the circulation.	✓ 2nd best marker of MI.
Become detectable:	after 2 to 4 hours.	within 2 to 4 hours of MI.
Peak at:	48 hours.	24 to 48 hours.
Duration:	Their levels remain elevated for 7 to 10 days.	Returns to normal within approximately 72 hours.

Complications of MI:

At least 80% will suffer:

- ✓ Cardiogenic shock (> 40% infarct of L.V).
- ✓ Congestive heart failure (CHF).
- ✓ Arrhythmia.
- ✓ Rupture of ventricle, free wall, septum, or papillary muscle
- ✓ left ventricular failure.
- ✓ Aneurysm formation.
- ✓ Mural thrombus, potentially source of emboli.
- ✓ Pericarditis.
- ✓ Thromboembolism
- ✓ External rupture of the infarct with associated bleeding into the pericardial space **(hemopericardium).**

MI death and complications rates:

- 80-90% will develop complications.
- 10% of the rest will die within a month.
- 25% die, presumably due to arrhythmia.
- Overall 30% die in the 1st year and then 10% per year.

3- Chronic ischemic heart disease

Definition: Progressive heart failure due to ischemic injury, either from:

- ✓ prior infarction (most common).
- ✓ chronic low-grade ischemia.

4- Sudden cardiac death

Definition: Unexpected death from cardiac causes either without symptoms or within 1 to 24 hours of symptom onset.

- results from a lethal arrhythmia without myocyte necrosis.
- most commonly in patients with severe coronary artery disease.

*Acute coronary syndrome: Refers to any group of symptoms attributed to obstruction of the coronary arteries.

It is applied to three catastrophic manifestations of IHD:

- ✓ Unstable angina.
- ✓ Acute MI.
- ✓ Sudden cardiac death.

1- The most common cause of IHD is:

A. vasospasm
B. vasculitis
C. atherosclerosis

2- An imbalance between cardiac blood supply and oxygen demand of cardiac tissues is:

A. Arrhythmia
B. Atherosclerosis
C. Ischemic heart disease

3- Stable angina typically occurs due to atherosclerotic disease with:

A. >= 75 fixed chronic stable stenosis
B. < 75 fixed chronic stable stenosis
C. < 50 fixed chronic stable stenosis

4- Type of necrosis in MI:

A. liquefactive
B. Cuagulative
C. Caseous

5- The other name of ischemic heart disease :

A. Arrhythmia
B. Atherosclerosis
C. Coronary artery disease

Answers:
1-C
2-C
3-A
4-B
5-C

6- Which of the following is the most sensitive blood test to detect acute myocardial infarction?

A. Creatine phosphokinase
B. Cardiac troponins
C. Lactate dehydrogenase

7- When CK-MB returns to its normal level ?

A. within 72 hours

B. within 24 hours

C. within 48 hours

8- Which hormone protects human against IHD:

A. Prolactin

B. Testosterone

C. Estrogen

9- When the troponins become detectable in MI ?

A. after 8 hours

B. after one hours

C. after 2-4 hours

10- VARIANT ANGINA related to atherosclerosis :

A. True

B. False

Answers:
6-B
7-A
8-C
9-C
10-B

11- When does Myocardial Infarction become irreversible:

A. 20-40 sec
B. 20-40 min
C. After 40 min

12- Most site of MI:

A. left circumflex
B. right coronary artery
C. left anterior descending

13- In MI the change in T-wave in ECG is :

A. Disappear
B. Invert
C. Prolong

14- The 2nd best marker of MI:

A. Troponin
B. Lactate dehydrogenase
C. CK-MB

15- Which marker is not normally detectable :

A. Troponin
B. Lactate dehydrogenase
C. CK-MB

Answers:
11- B
12-C
13-B
14-C
15-A

16- VARIANT ANGINA caused by:

A. Coronary artery spasm
B. Vasculitis
C. Atherosclerosis

17- Most of people with MI:

A. Develop complications
B. Sudden death
C. Nothing happen

18- Troponins reach their peak at :

A. 24 hors
B. 72 hours
C. 48 hours

19- The most specific biomarker for diagnosis of acute coronary syndrome

A. Troponin
B. Myoglobin
C. LDH
D. Leucocytosis

20- All of the following are major risk factors of coronary artery disease except

A. Hypercholesterolemia
B. Hypertension
C. Smoking
D. Hyperuricemia

21- Clinical features of myocardial ischemia can be all except

A. Crushing
B. diaphoresis
C. dyspnea
D. Burning

Answers:
16- A
17-A
18-C
19-A
20-D
21-D

1- What are the types of angina ?

Stable, unstable, variant

2- **cardiac syndrome:**

1- Angina pectoris, 2- Myocardial infarction (MI), 3- Chronic IHD with CHF, 4- Sudden cardiac death (SCD)

3- List the complication of MI :

Cardiogenic shock, CHF, arrhythmias, aneurysm, pericarditis, mural thrombus, rupture of ventricle wall or papillary muscles.

4- What are the clinical presentations of MI ?

crushing substernal chest pain, diaphoresis, nausea, dyspnea.

5- How can we reduce risk of IHD?

Weight loss, quit smoking, aerobic exercises, decrease stress, and avoiding unsaturated fats.

6- What are Morphologic Changes in Myocardial Infarction?

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

7- What are ECG changes in MI?

Q waves (indicating transmural infarcts), ST-segment abnormalities, T-wave inversion, Arrhythmias.

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