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Acute Coronary Syndrome

★ Objectives:

1. Know the major risk factors for atherosclerosis.
2. Understand the pathophysiology of atherosclerosis.
3. Know the classification of acute coronary syndrome.
4. General approach to assessing an ischemic chest pain.
5. General approach to the diagnostic work up of ACS.
6. Know the universal definition of myocardial infarction.
7. General lines of management of ACS, with emphasis on reperfusion. therapy of STEMI including the indication of administering fibrinolytic therapy, and knowing the absolute contraindication for its use.
8. General understanding of the immediate and late complications of STEMI.

★ Resources used for this lecture:

Slides, Kaplan CK, Davidson's, Master the boards, Step-up and Pretest Medicine.

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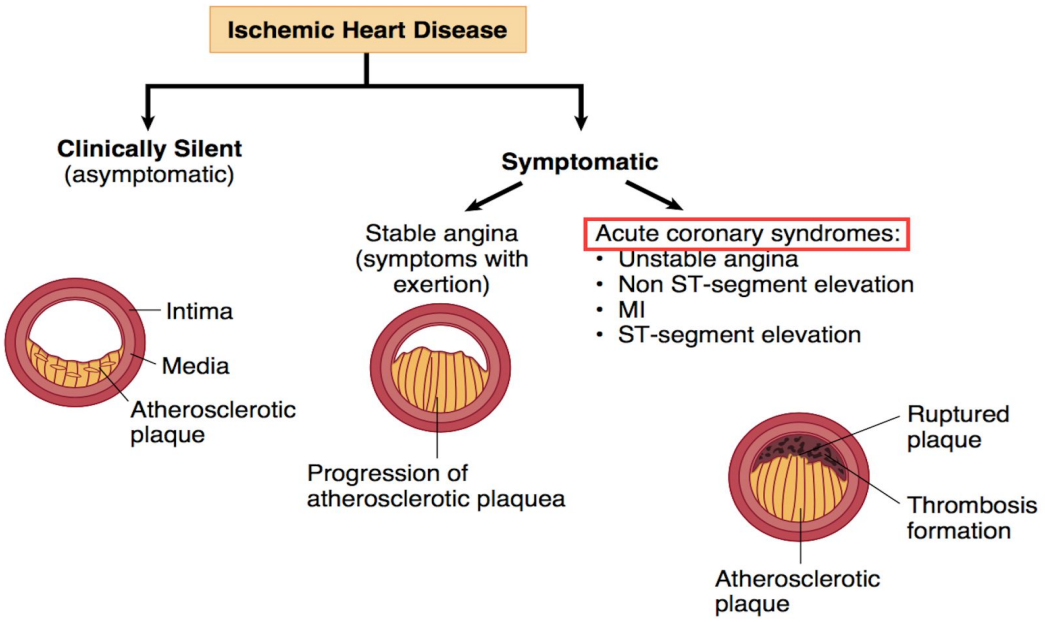
Introduction:

Ischemic heart disease (IHD), also known as *coronary heart disease*, refers to an imbalance in coronary oxygen demand and supply resulting from insufficient blood flow. In nearly all cases, the reduction in blood flow is caused by coronary **atherosclerosis,** in some rare conditions are it could be due to **non-athersclerotic lesions** (eg coronary artery embolism, coronary artery spasm, coronary arteritis, and coronary artery dissection).



Acute coronary syndrome: Refers to a spectrum of clinical presentations ranging from those for ST-segment elevation myocardial infarction (STEMI) to presentations found in non–ST-segment elevation myocardial infarction (NSTEMI) or in unstable angina.

Myocardial ischemia *VS* **Myocardial infarction:**

Myocardial Ischemia occurs when the blood supply to a tissue is inadequate to meet the tissue's metabolic demands this mainly the case of anginas and early, while *Myocardial Infarction* which is necrosis of myocardium as result of no perfusion of blood and this due in most of cases thrombosis (rupture of atheroma plaque).

Atherosclerosis

As said earlier atherosclerosis accounts for nearly all cases of IHDs, which is a progressive inflammatory disorder of the arterial wall that is characterized by focal lipid rich deposits of atheroma that remain clinically silent until -either-:

1. Large enough to **occlude** vessel completely.
2. Ulceration of the lesion results in **thrombosis**.
3. Distal **embolization**.

Pathophysiology:

★ **Early atherosclerosis:**

Fatty streaks occur at altered endothelial (eg: bifurcations) ⇒ Monocyte migration into intima ⇒ Take up oxLDL ⇒ Becomes foam cells ⇒ Extracellular lipid pools appears ⇒ Smooth muscle cells migrates from media into intima ⇒ Stablizes the athersoclerotic lesion by forming a cap. If this succeeded = Stable atherosclerotic plaque will remain asymptomatic until it becomes one of the 3 fates mentioned earlier.

★ **Advanced atherosclerosis:**

In established atherosclerotic plaque ⇒ Mediates inflammation ⇒ Plaque becomes active and unstable ⇒ Complicated by ulceration and thrombosis ⇒ Cytokines released by macrophages ⇒ Thinning the fibrous cap ⇒ Making the plaque vulnerable to mechanical stress ⇒ Erosion, fissure or rupture ⇒ Expose its contents to blood ⇒ Triggers platelets ⇒ Extend into the atheromatous plaque and the arterial lumen ⇒ This type of event may cause partial/complete obstruction or distal embolization ⇒ Resulting in infarction or ischemia of affected organ (eg: CLI, MI, stroke).

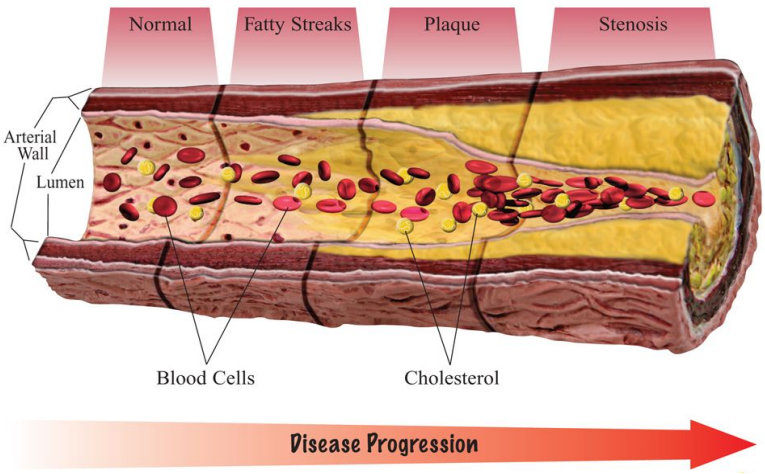
★ **Arterial remodeling:** Events happen to arterial wall (media) induced by atherosclerosis.

✓ Negative remodeling: Arterial segments slowly constrict making the lumen narrower.

✓ Positive remodeling: Other segments may gradually enlarge making the lumen wider.

Risk factors: "arranged from major to minor"

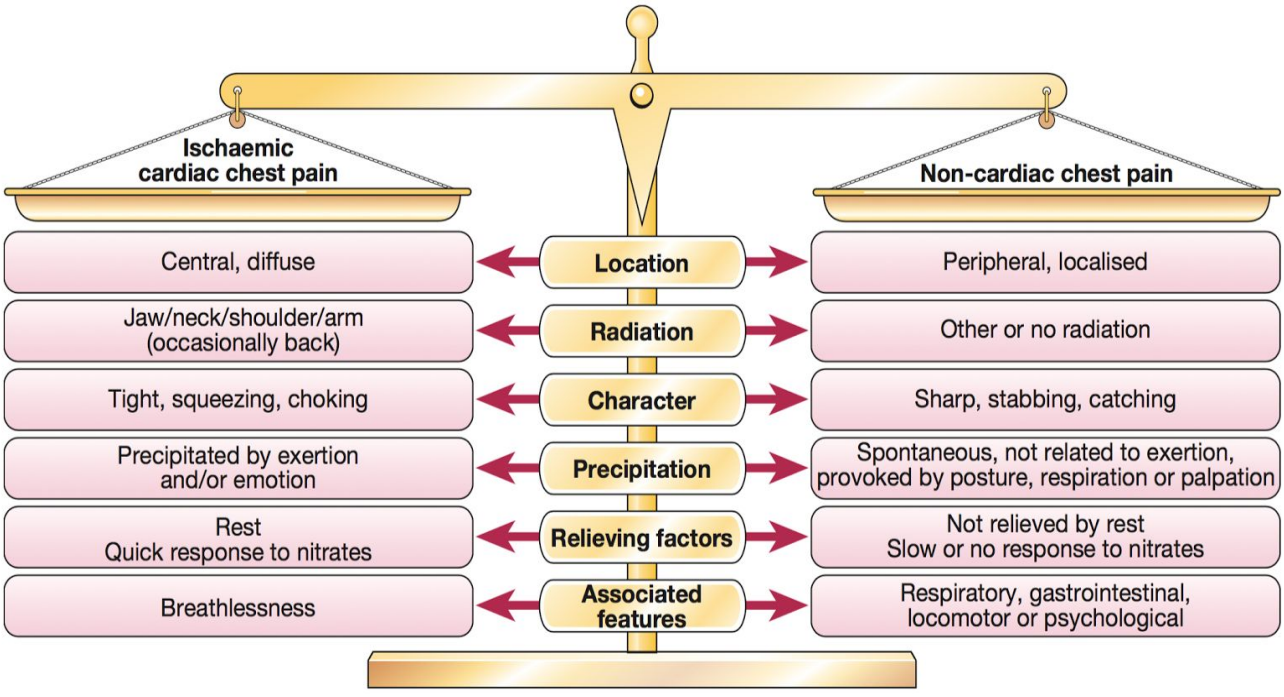
1. Hypercholesterolemia
2. Smoking.
3. Hypertension.
4. Physical inactivity.
5. Diabetes mellitus.
6. Age and male sex[1].
7. Family history.
8. Obesity.
9. Haemostatic factors [2].
10. *Excess* alcohol consumption.



[1] Sex difference disappears after the menopause.
[2] Platelet activation, plasma fibrinogen concentration and antiphospholipids antibodies.

Ischemic Chest Pain:

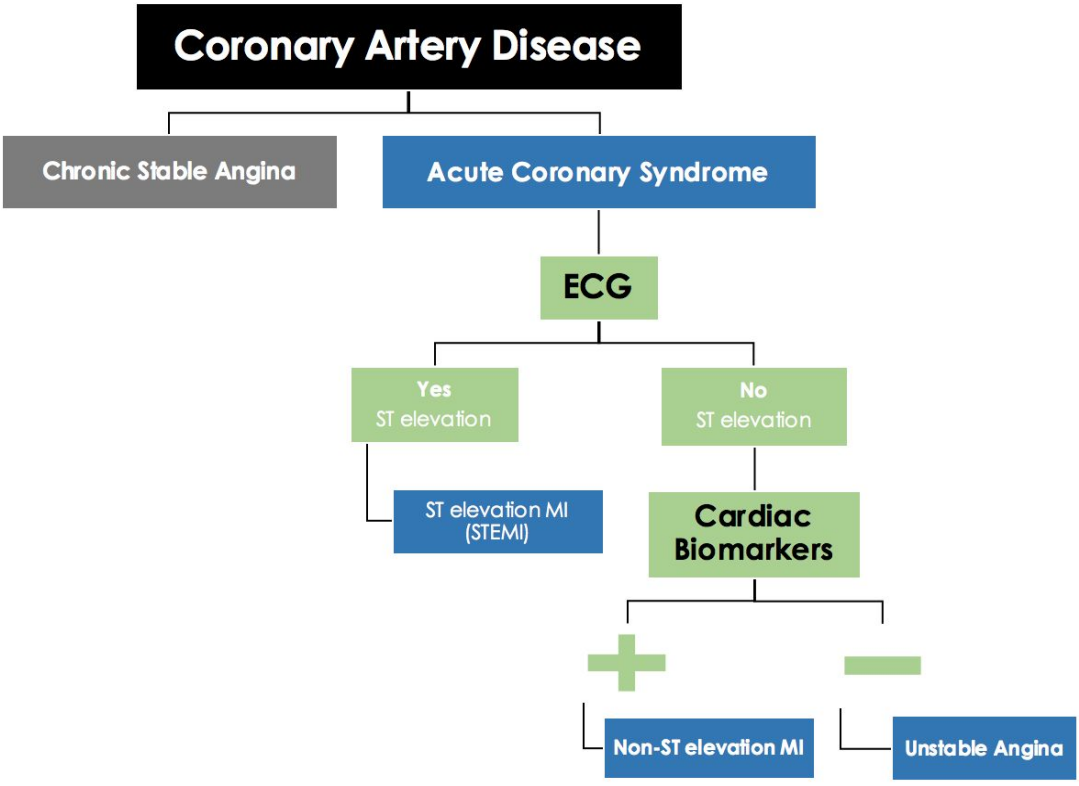
Characteristics of ischemic pain	
Duration	**Stable angina:** >2 to <10 min **ACS** >10 to 30 min *If seconds or hours or days **not** ischemic!!
Provoking factors	Physical activity,cold,emotional stress
Relieving factors	Rest
Location	Substernal
Quality	Squeezing ,tightness, heaviness, pressure, burning, aching, dull, sore *Not: Sharp,pins,stabbing,knifelike
Radiation	Neck,lower jaw & teeth,arms,shoulders
Associated symptoms	SOB, nausea, diaphoresis, dizziness, lightheadedness, fatigue.



Other Causes of Chest Pain: important in OSCE

If the case describes	Most likely diagnosis
Chest wall tenderness	Costochondritis
Radiation to back, unequal blood pressure between arms	Aortic dissection
Pain worsen when lying flat,better when sitting younger (<40)	Pericarditis (Respond to NSAID)
Epigastric discomfort and pain better when eating	Duodenal Ulcer
Bad taste, cough and hoarseness	GERD (most common non-cardiac)
Cough and sputum hemoptysis	Pneumonia
Sudden onset SOB and tachycardia hypoxia	Pulmonary embolism
Sharp pleuritic pain and tracheal deviation	Pneumothorax

Classification: Simply CAD and ACS can be classified and distinguished as the following:



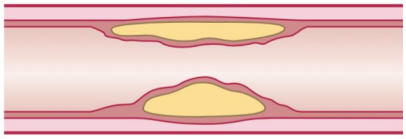
Prinzmetal Angina

Vasospasm usually accompanied by fixed atherosclerosis but can also occur in normal arteries.

ECG : ST elevation / Normal in angiography.

Treatment : Calcium channel blockers, Nitrate and Risk factors modification.

Stable angina:



★ **History:** Chest pain described as heavens, pressure or burning after *exertion* or emotional *stress*. Relieved by rest or Nitrates.

★ **Investigation:**

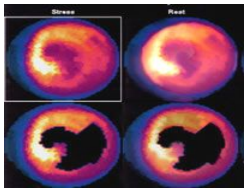
A. Rest ECG normal. *Best initial test for all forms of chest pain.

B. Stress test (by exercise/ chemical[3]) divide into:

	Stress ECG	Stress Echocardiogram	Stress Nuclear Isotopes (stress myocardial perfusion imaging)
Indication	Detection of Ischemia. (ideal initial test if able to exercise and normal resting ECG.)	Detection of Ischemia when Stress ECG can't read it.	Detection of Ischemia when Stress ECG can't read it (most accurate stress test but has many side effect & expensive).
Result	ST depression	(abnormal movement of wall of heart) Akinesis , dyskinesis or hypokinesis	Decrease the uptake of thallium[4] by myocardial cells (important to know areas of ischemia is reversible).

C. Catheterization with angiography (See figure 18.15 page 9) for prognosis and diagnosis when the stress test is positive (ST depression, wall motion abnormality or decreased uptake of thalli) most accurate test in CAD.

★ **Management :**



■ **Risk factors modification:**

(Smoking cessation, controlling HTN, DM, hyperlipidemia and obesity, diet and exercise)

■ **Medical:**

(Aspirin "reduces morbidity & mortality", Beta-blockers, Nitrates, ±[5] Calcium channel blocker)

■ **Revascularization:** are preferred with high risk patients.

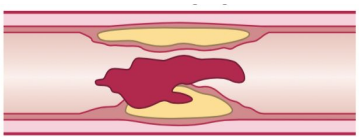
1- *Percutaneous coronary intervention PCI (angioplasty)*: when Two or one vessels occluded.

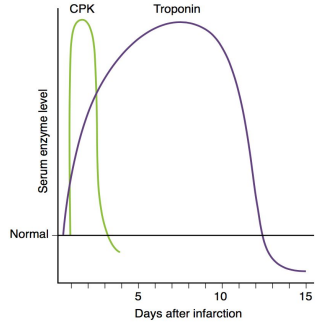
2- Coronary Artery Bypass Graft: when 3 vessels occluded OR 2 vessels w/diabetes OR Left main artery.

There's a lot of controversy but "Risk factors modifications and Aspirin is indicated in ALL patients" other treatment options depend on patient overall risks!

[3]When patient can't tolerate exercise we do chemical-induced stress by IV adenosine, dipyridamole, dobutamine.
[4]Thallium similar structure to calcium
[5] Ca channel blockers are considered secondary treatment when B-blocker and/ or nitrates are not fully effective

Unstable Angina & NSTEMI *oxygen demand unchanged but supply is decreased.





★ **History:** Severe and worsening chest pain as heavens , pressure or crushing and usua*lly at rest last more than 10 minutes.*

★ **Investigation:**

A. Rest ECG shows ST deviation and T wave abnormality.

B. Cardiac Marker (CK-MB[6] , Troponins[7]):

+ve will indicate NSTMI / -ve indicate unstable angina.

C. Stress test : (Positive as above)

D. Catheterization with angiography based on result the patient undergo PCI or CABG

★ **Management:**

-Acute treatment:

1- General/Initial	2- Medical	3- Invasive
Hospitalization	*Aspirin*	Coronary angiography & Cardiac catheterization/Revascularization
Nitrates	*Clopidogrel OR Prasugrel OR Ticagr*elor	Percutaneous Coronary Intervention (PCI)
Oxygen supplement "To improve oxygen supply"	*Beta-blockers* *(Atenolol OR Metoprolol)*	90% of patients improve with medical regimen and don't need invasive management. Only if ischemia persist after 48 hours, then proceed directly to invasive procedures.
Morphine	Glycoprotein IIb/IIIa inhibitors *(Abciximab OR Tirofiban)*	
Replace deficient electrolytes	*Heparin OR Enoxaparin* "Anti-coagulant > prevent progression of thrombus (decrease mortality)"	

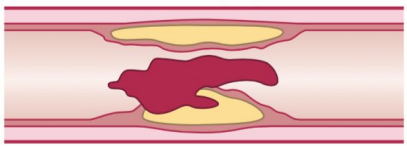
-After acute treatment:

1. Continue Aspirin, Beta blockers and Nitrates.
2. Reduce risk factors: (Smoking cessation, weight loss and control DM, HTN and hyperlipidemia)

After confirming with biomarkers what type is it start giving medication: First most important is to give: 1- Aspirin 2- Heparin 3- Beta blocker 4-Statin These are most important cause they have clear effect on mortality rate, also give 5- Oxygen 6- Nitrates 7- Morphine.

[6] Most helpful in detecting reinfarction given quicker return to baseline than Troponins.
[7] Most important enzyme test to order.

STEMI



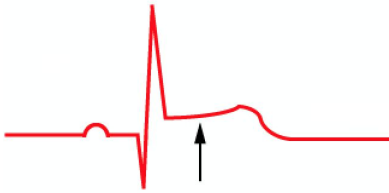
★ **History:** severe substernal chest pain described as heavens, pressure or crushing.

★ **Investigation:**

A. ECG: shows:

✓ ST elevation appear immediately and disappear after 24 hours

✓ Q wave appeared after 24 hours and may not disappear



Note : if the only Q wave is present on ECG this means the patient has history of M

✓ T wave inversion appear after 6 hours and disappear after months

B. Cardiac Marker:

+ve (CK-MB remain elevated for 36 to 48 , troponin I and T remain elevated for week or more)

★ **Management:**

1- General/Initial	2- Medical	3- Reperfusion "WITHIN 12 hours (window period)"
Hospitalization Cardiac monitor (CCU)	*Aspirin* "Anti-platelets > Reduces coronary reocclusion (Reduces mortality)"	*Percutaneous Coronary Intervention (PCI)*[8] (Improve short/long-term outcomes)
Nitrates (Nitroglycerine) "Coronary vasodilators > Open artery"	*Beta-blockers (Atenolol OR Metoprolol)* "Block sympathetic stimulation > Reduces cardiac demand (Reduces mortality)"	*Thrombolysis* (Alteplase or Streptokinase or tPA[9]) (Greater benefit in anterior infarctions)
Oxygen supplement "To improve oxygen supply"	*ACE inhibitors (Enalapril OR Lisinopril)* "Anti-hypertensive (Reduces mortality)"	*Coronary Artery Bypass Grafting (CABG)* Only if complications OR Failure of PCI Benefits include low rates of events-free survival and reintervention-free survival.
Morphine	*Statins* "Anti-hyperlipidemic > Lower cholesterol and stabilizes plaque (Reduce risk of further events)"	
	Clopidogrel "Anti-platelets (In pts undergo PCI)"	
	Heparin	

Don't wait to do biomarker tests, give Aspirin or Clopidogrel (if there is allergy to aspirin) Then decide PCI or tPA ?

[8] When PCI is delayed or not available, reperfusion with thrombolytic therapy should occur
"If you're hungry, BAD food NOW better than GOOD food 3 HOURS LATER"

[9] Tissue-type plasminogen activator

Thrombolytics (tPA) VS Angioplasty (PCI)	
Absolute contraindications to **thrombolytic**: ● Major bleeding into the bowl (Melena) or brain. ● Recent surgery (last 2 weeks) ● Severe hypertension (above 180/110) ● Nonhemorrhagic Stroke within last 6 months. ■ The standard of care is to be performed within 30 mins of patient arrival in the ER**. (Door to needle time)**	**PCI** (Best done at first 6 hours) ● It's more beneficial In mortality & survival. ● Less hemorrhagic complication. **Complications:** - Rupture of coronary artery on inflation of balloon - Restenosis (thrombosis) of vessel after angioplasty is done. - Hematoma at site of entry (Femoral A.) ■ The standard of care is to be performed within 90 mins of patient arrival in the ER**.. (Door to balloon time)**

-When discharge consider "ABCDE": Aspirin and Antianginal Beta blockers and Blood pressure, Cholesterol and Cigarettes, Diet and Diabetes, Education and Exercise).

★ Complication:

1. **Arrhythmia such** as atrial fibrillation , ventricular fibrillation , ventricular tachycardia , premature beats , sinus tachycardia or sinus bradycardia.

Note: ventricular fibrillation is the most common cause of death in MI patient.

2. **Conduction Abnormality** such as 1st , 2nd and 3rd degree block.

Note : The most common cause of conduction defect from sinoatrial node to atrioventricular node is IHD.

3. **Pump failure (CHF)** *Most common cause in hospital mortality.
4. **Recurrent infarction** re-elevation of CK-MB and repat ST elevation after 24 hours.
5. **Mechanical problem** such as rupture of papillary muscles that lead to mitral valve regurgitation (murmur), septal rupture or free wall rupture, ventricular pseudoaneurysm or ventricular aneurysm.
6. **Aneurysm/Thromboembolic** after MI the weakness area lead mural thrombi or deep venous thrombosis.
7. **Pericarditis** due to the **dressler syndrome** (infarct heart release foreign antigen into pericardium which get attacked by antibody)

Mnemonic to remember MI complications: "DARTH VADER"

Death, **A**rrhythmias, **R**upture (free ventricular wall, septum or papillary muscles), **T**amponade, **H**eart failure, **V**alve disease, **A**neurysm of ventricule, **D**ressler's syndrome, **E**mbolism (mural thrombus), **R**ecurrence / mitral **R**egurgitation.

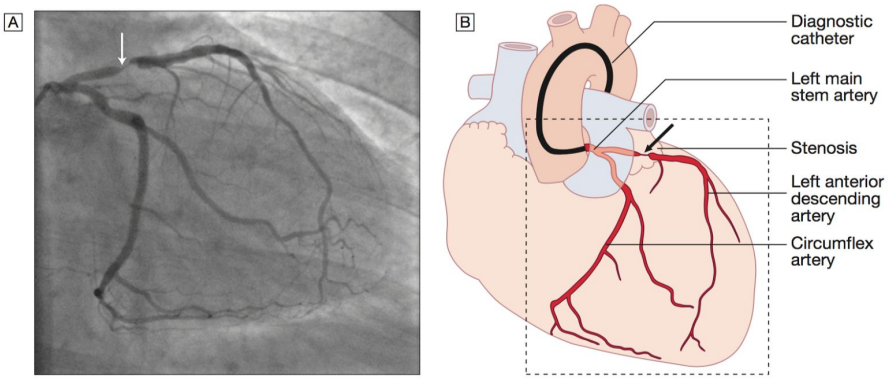
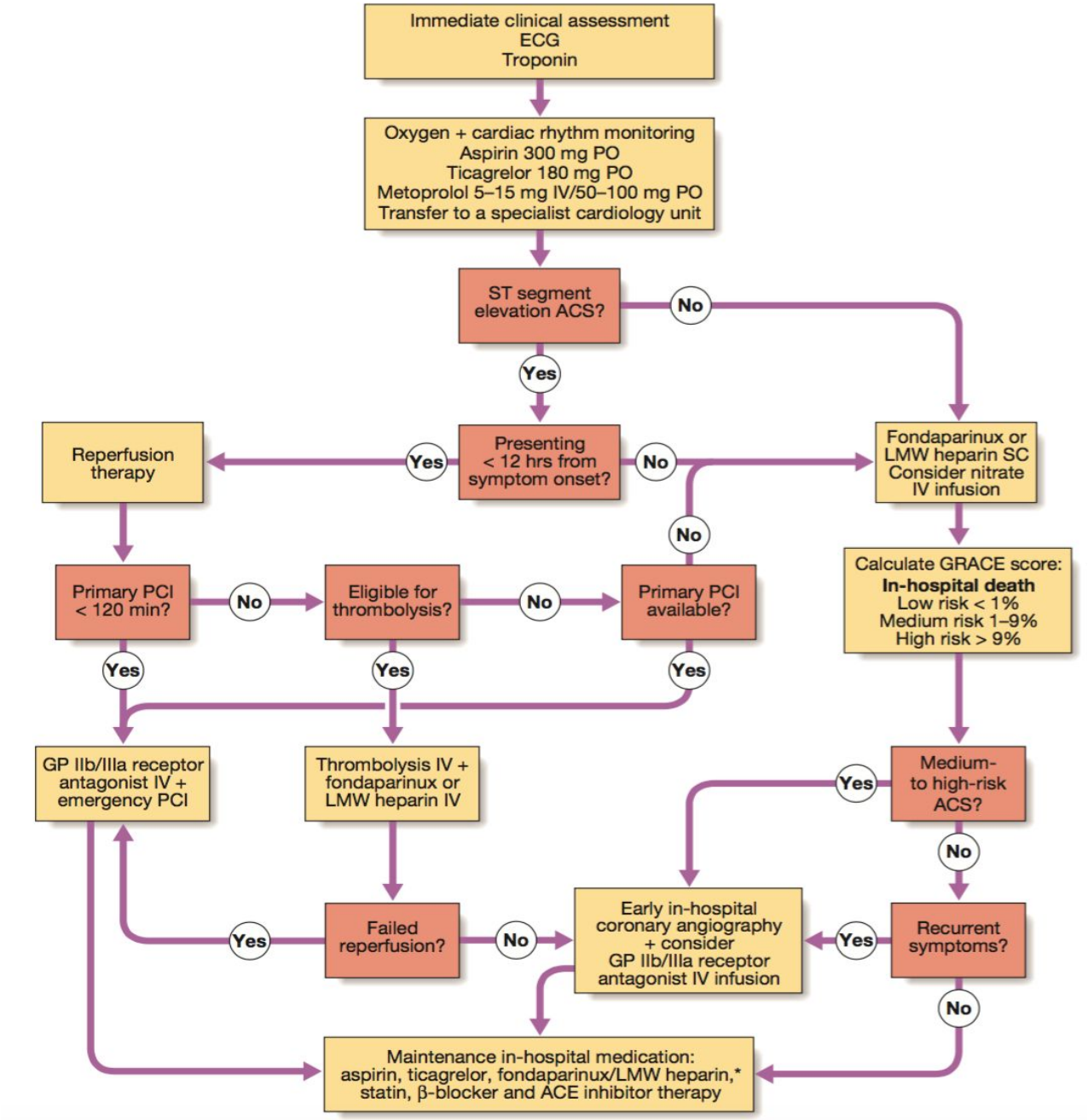


Fig. 18.15 The left anterior descending and circumflex coronary arteries with a stenosis in the left anterior descending vessel. [A] Coronary artery angiogram. [B] Schematic of the vessels and branches.

Summary of Treatment for Acute Coronary Syndrome (ACS)



MCQs

1/ A 48-year-old woman comes to the office with chest pain that has been occurring over the last several weeks. The pain is not reliably related to exertion. She is comfortable now. The location of the pain is retrosternal. The pain is sometimes associated with nausea. There is no shortness of breath and the pain does not radiate beyond the chest. She has no past medical history. What is the most likely diagnosis?

A. Gastroesophageal reflux disease (GERD)

B. Unstable angina

C. Pericarditis

D. Prinzmetal angina

2/ A 70-year-old woman comes to the emergency department with crushing substernal chest pain for the last hour. An ECG shows ST segment elevation in V2 to V4. Aspirin has been given to the patient.What is the most appropriate next step in the management of this patient?

A. CK-MB level

B. Thrombolytics

C. Angioplasty

D. Troponin level

3/ A 70-year-old woman comes to the emergency department with crushing substernal chest pain for the last hour. The pain radiates to her left arm and is associated with anxiety, diaphoresis, and nausea. She describes the pain as "sore" and "dull" and clenches her fist in front of her chest. She has a history of hypertension. Which of the following is most likely to be found in this patient?

A. >10 mm Hg decrease in blood pressure on inhalation b. Increase in jugular venous pressure on inhalation

C. Triphasic scratchy sound on auscultation

D. Continuous "machinery" murmur

E. S4 gallop

4/A 60-year-old male patient is receiving aspirin, an angiotensin-converting enzyme inhibitor, nitrates, and a beta-blocker for chronic stable angina. He presents to the ER with an episode of more severe and long-lasting anginal chest pain each day over the past 3 days. His ECG and cardiac enzymes are normal. Which of the following is the best course of action?

A. Admit the patient and add intravenous digoxin.

B. Admit the patient and begin low-molecular-weight heparin.

C. Admit the patient for thrombolytic therapy.

D. Admit the patient for observation with no change in medication.

E. Increase the doses of current medications and follow closely as an outpatient.

5/ You have been asked to evaluate a 42-year-old white male smoker who presented to the emergency department with sudden onset of crushing substernal chest pain, nausea, diaphoresis and shortness of breath. His initial ECG revealed ST segment elevation in the anteroseptal leads. Cardiac enzymes were normal. The patient underwent emergent cardiac catheterization, which revealed only a 25% stenosis of the left anterior descending (LAD) artery. No percutaneous intervention was performed. Which of the following interventions would most likely reduce his risk of similar episodes in the future?

A. Placement of a percutaneous drug-eluting coronary artery stent.

B. Placement of a percutaneous non-drug-eluting coronary artery stent.

C. Beginning therapy with an ACE inhibitor.

D. Beginning therapy with a beta-blocker.

E. Beginning therapy with a calcium-channel blocker.

The answer is e. This patient's presentation and minimal coronary artery disease are most consistent with Prinzmetal variant angina. Prinzmetal angina is caused by severe spasm of an epicardial coronary artery. The area of vasospasm is often near a non-hemodynamically significant atherosclerotic lesion. Patients tend to be smokers and are often younger than patients who present with atherosclerotic coronary artery disease. In this case, the patient's mild LAD stenosis does not explain the degree of ischemia evidenced by the ST segment elevation. Percutaneous intervention has not been shown to be useful in management of Prinzmetal angina, as the culprit is transient vasospasm rather than fixed obstruction. Calcium- channel blockers are the mainstay of therapy to prevent recurrence of spasm. ACE inhibitors and beta-blockers do not prevent acute vasospasm. Of course, the patient should also be counseled to abstain from smoking.

ANSWERS
1- A
2- C
3- E
4- B
5- E