

# Acute Coronary Syndromes

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## Objectives

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- Epidemiology of acute coronary syndromes
- Clinical Presentation
- Management
- Complications
- Cases

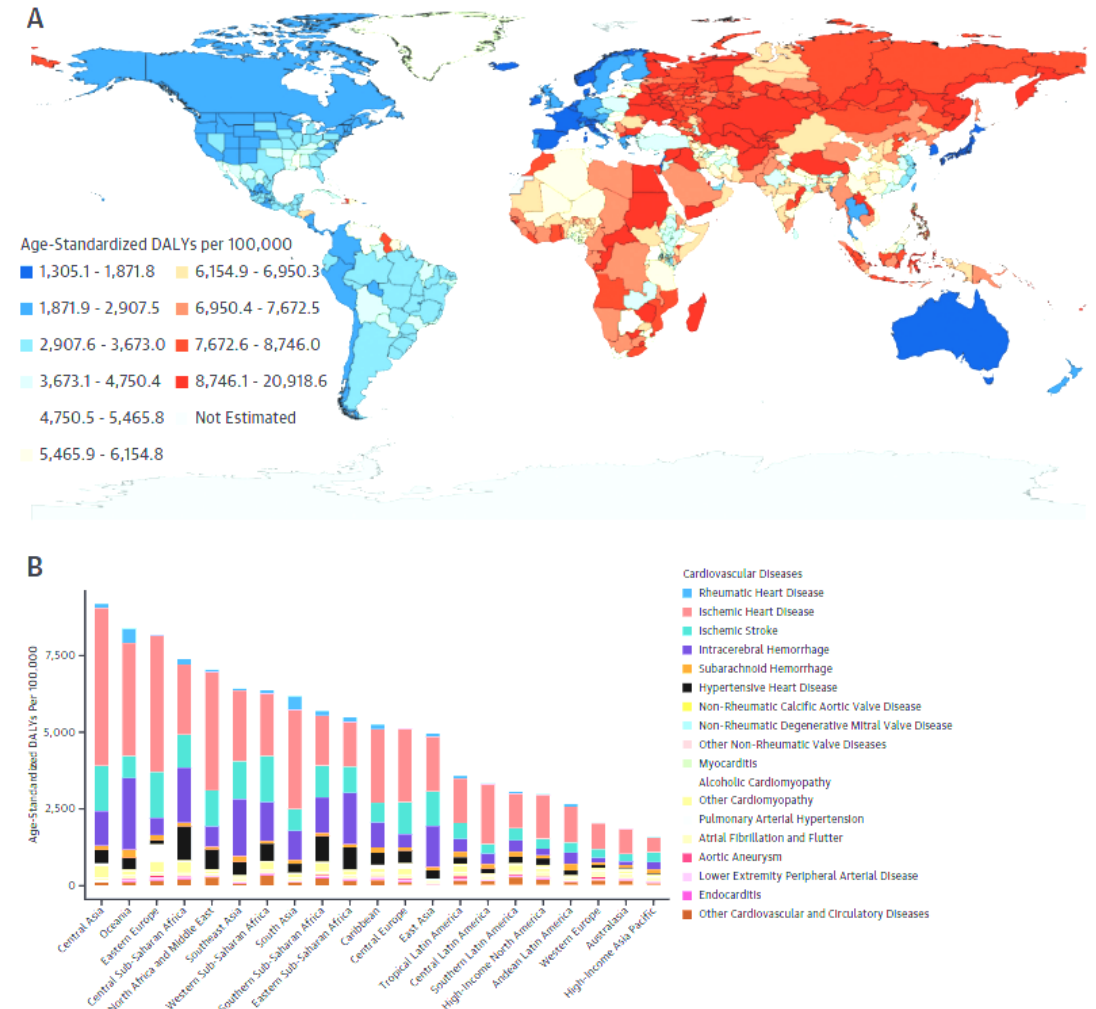
# Global Burden of Ischemic Heart Disease

**TABLE 1 Global Ranking of Cardiovascular Deaths by Cause**

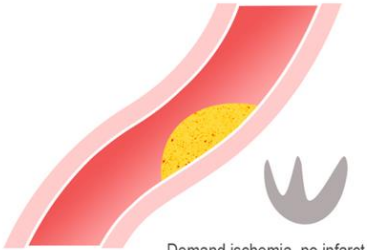

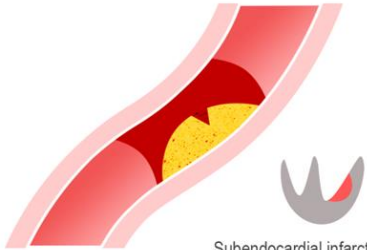
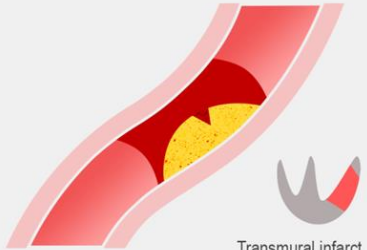




Rank	Cause of Death	Number of Deaths in 2021 (95% UI)	Number of DALYs (95% UI)
1	Ischemic heart disease	9,440,000 (8,820,000-9,960,000)	185,000,000 (175,000,000-196,000,000)
2	Ischemic stroke	3,870,000 (3,550,000-4,170,000)	70,200,000 (64,500,000-76,800,000)
3	Intracerebral hemorrhage	3,460,000 (3,210,000-3,750,000)	78,600,000 (73,300,000-84,600,000)
4	Hypertensive heart disease	1,410,000 (1,170,000-1,560,000)	24,900,000 (20,900,000-27,200,000)
5	Rheumatic heart disease	391,000 (340,000-454,000)	13,400,000 (11,600,000-15,400,000)
6	Atrial fibrillation and flutter	366,000 (313,000-396,000)	8,200,000 (6,830,000-9,940,000)
7	Subarachnoid hemorrhage	365,000 (329,000-411,000)	10,400,000 (9,370,000-11,800,000)
8	Other cardiomyopathy	320,000 (289,000-348,000)	8,450,000 (7,800,000-9,170,000)
9	Other cardiovascular diseases	232,000 (212,000-252,000)	10,100,000 (8,500,000-11,900,000)
10	Aortic aneurysm	160,000 (144,000-170,000)	3,040,000 (2,820,000-3,210,000)
11	Nonrheumatic calcific aortic valve disease	151,000 (127,000-164,000)	2,140,000 (1,950,000-2,370,000)
12	Endocarditis	81,100 (74,400-90,400)	2,040,000 (1,880,000-2,270,000)
13	Lower extremity peripheral arterial disease	71,200 (61,400-76,300)	1,520,000 (1,230,000-2,010,000)
14	Alcoholic cardiomyopathy	66,000 (55,600-74,200)	2,190,000 (1,850,000-2,460,000)
15	Nonrheumatic degenerative mitral valve disease	38,600 (33,900-43,100)	924,000 (827,000-1,070,000)
16	Myocarditis	33,600 (27,100-38,000)	962,000 (810,000-1,090,000)
17	Pulmonary arterial hypertension	23,300 (20,000-26,000)	640,000 (565,000-726,000)
18	Other nonrheumatic valve diseases	2,120 (1,580-2,690)	51,500 (37,100-66,200)

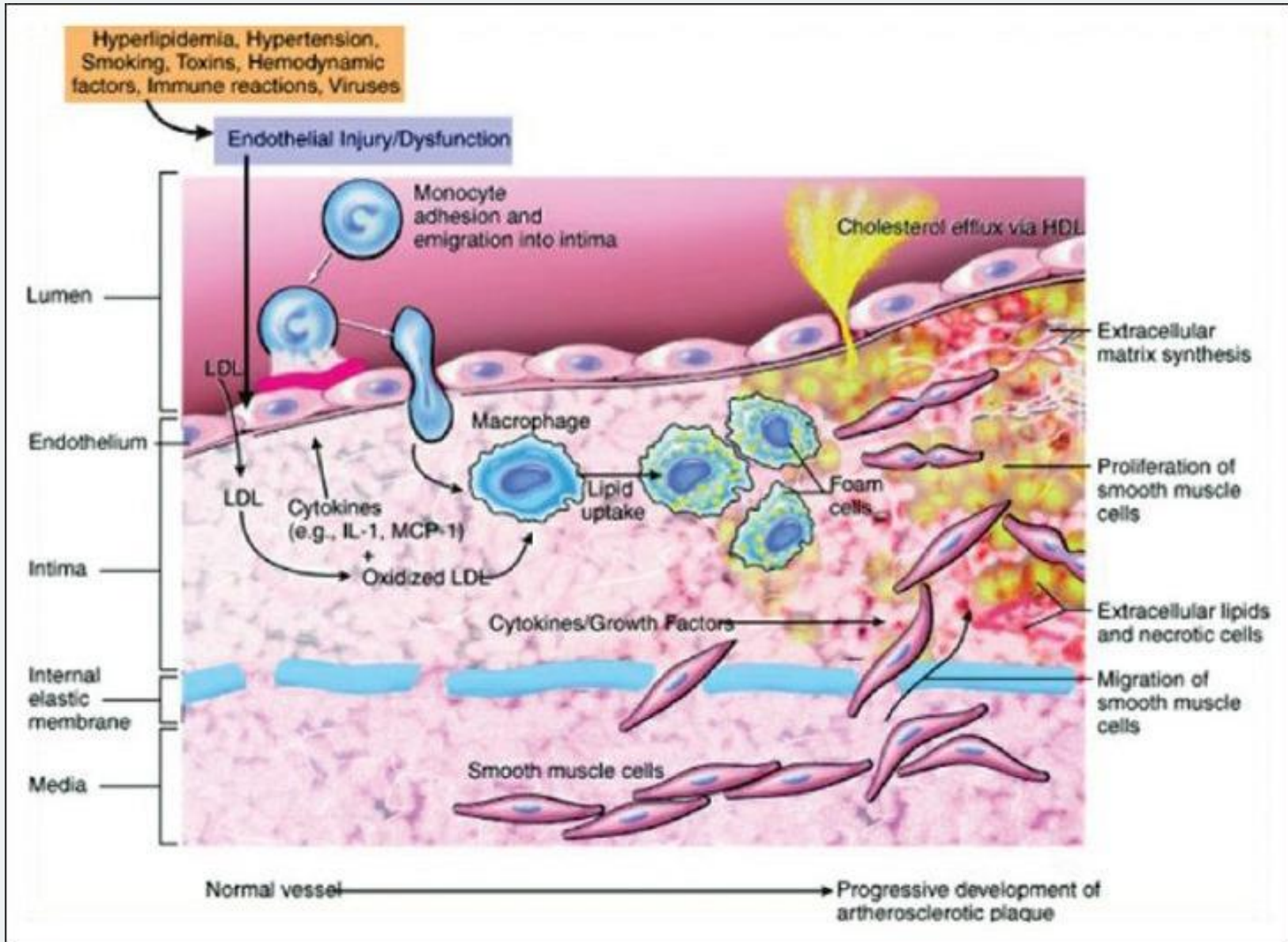
DALY = disability-adjusted life year; UI = uncertainty interval.

**CENTRAL ILLUSTRATION Global Burden of Cardiovascular Diseases and Risks**



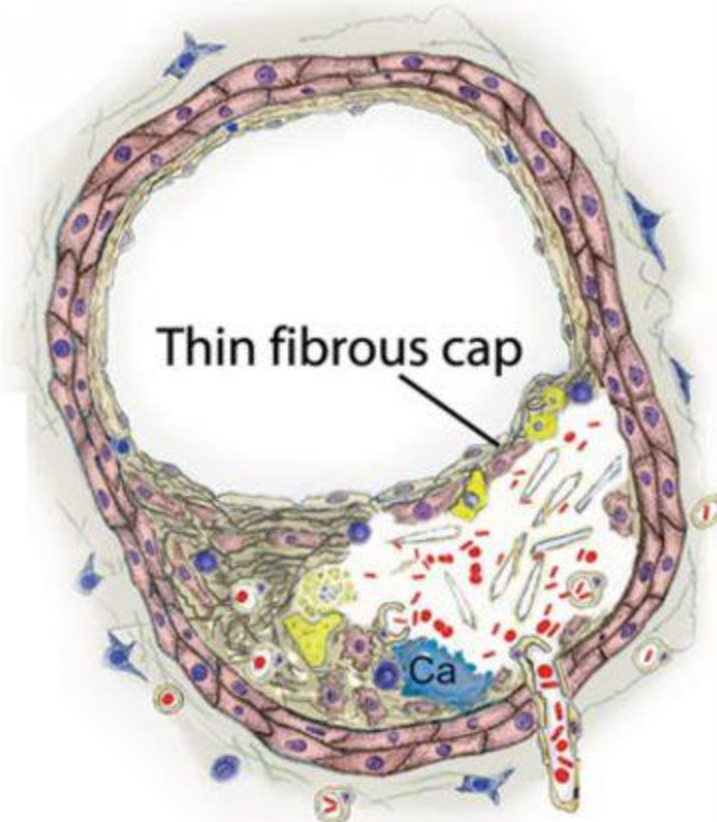
# Acute Coronary Syndrome

ACUTE CORONARY SYNDROME	1 STABLE ANGINA	2 UNSTABLE ANGINA	3 NSTEMI	4 STEMI
	<p>Angina pain develops when there is increased demand in the setting of a stable atherosclerotic plaque. The vessel is unable to dilate enough to allow adequate blood flow to meet the myocardial demand.</p>  <p>Demand ischemia, no infarct</p>	<p>The plaque ruptures and a thrombus forms around the ruptured plaque, causing partial occlusion of the vessel. Angina pain occurs at rest or progresses rapidly over a short period of time.</p>  <p>Supply ischemia, no infarct</p>	<p>During an NSTEMI, the plaque rupture and thrombus formation causes partial occlusion to the vessel that results in injury and infarct to the subendocardial myocardium.</p>  <p>Subendocardial infarct</p>	<p>A STEMI is characterized by complete occlusion of the blood vessel lumen, resulting in transmural injury and infarct to the myocardium, which is reflected by ECG changes and a rise in troponins.</p>  <p>Transmural infarct</p>
ECG	 <p>Normal</p>	 <p>Normal, Inverted T waves, or ST depression</p>	 <p>Normal, Inverted T waves, or ST depression</p>	 <p>Hyperacute T waves or ST elevation</p>
TROPONINS	Normal	Normal	Elevated	Elevated

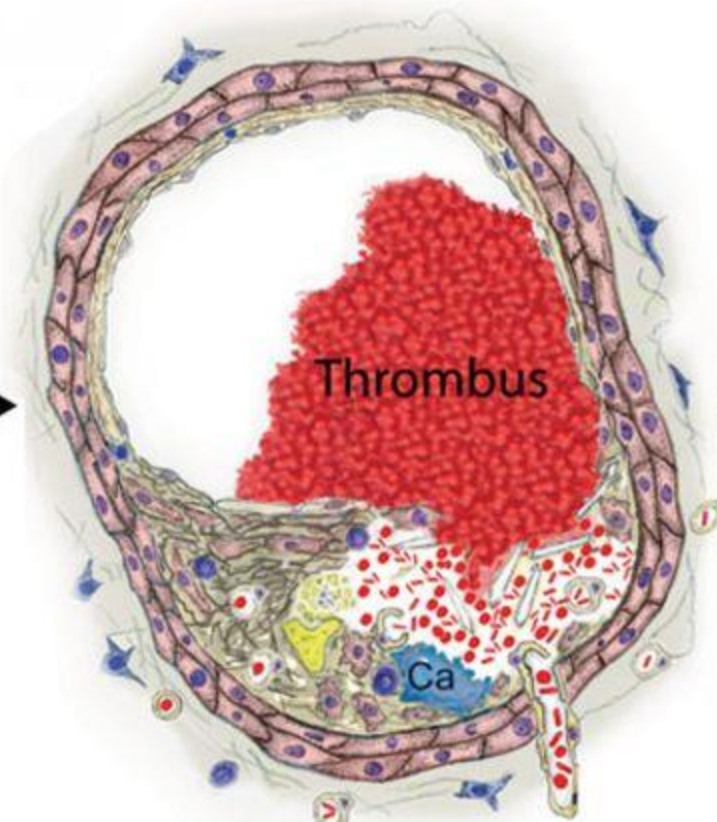


Rafieian-Kopaei M, Setorki M, Doudi M, Baradaran A, Nasri H. Atherosclerosis: process, indicators, risk factors and new hopes. *Int J Prev Med.* 2014 Aug;5(8):927-46. PMID: 25489440; PMCID: PMC4258672

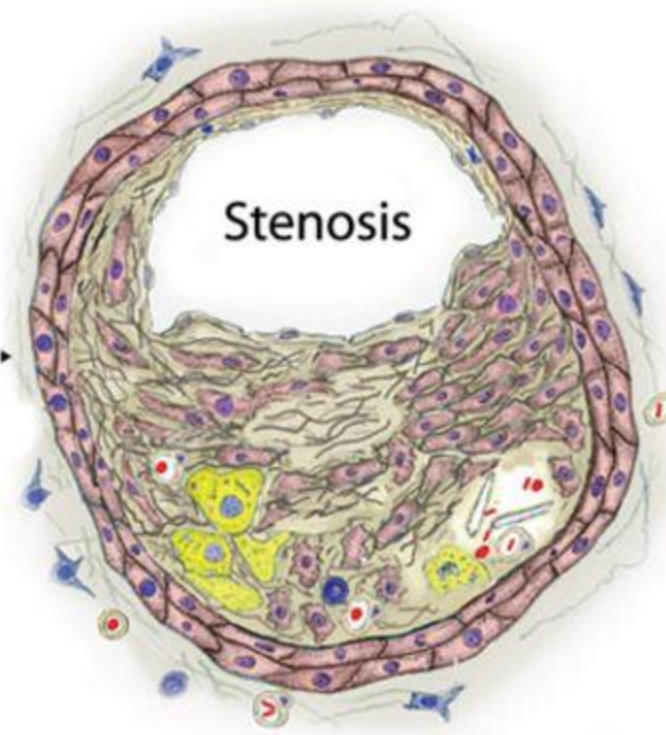




Thin-cap fibroatheroma



Ruptured plaque



Healed plaque



## Presentation

# Initial Evaluation

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- Two goals
  - Diagnose the pathology
  - Assess the severity
  - Ensure no contraindications to therapies
  
- Time is Muscle!



# Seven Deadly Causes of Chest Pain

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- Acute coronary syndromes
- Tension Pneumothorax
- Cardiac Tamponade
- Aortic Dissection
- Esophageal Rupture, Boerhaave Syndrome
- Pulmonary Embolism
- Pneumonia

# Initial Evaluation

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- HPI
  - Symptoms
  - Onset
  - Duration
  - Alleviating and Aggravating factors
  - Associated Symptoms
  - Radiation
- Medical History
  - CV history, strokes, bleeding history?
- Medications
  - Anticoagulants, PDE-5 inhibitors

# Initial Evaluation Cont.

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- Physical Exam
  - Vital Signs: Stable or Unstable
  - Signs of Heart Failure or cardiogenic shock?
  - Equal Pulses?
  - Bilateral breath sounds
- Labs
  - Troponin
  - CK-MB
  - AST, ALT
  - Creatinine, Hgb, Platelets
- EKG
  - ST elevation?
  - Signs of ischemia?
- Chest Xray
  - Widened mediastinum?
  - Pulmonary edema
  - Pneumonia



## Management

# Acute Coronary Syndromes

- STEMI
  - Primary PCI within 90 minutes
  - If not at a PCI capable hospital, able to transfer to a near PCI center for PCI within 120 minutes
  - If not able to receive PCI within 120 minutes, give thrombolytics within 30 minutes
- NSTEMI, Unstable Angina
  - Invasive Management
    - Aspirin
    - +/- P2Y12 Inhibitor
    - Heparin
  - Non-Invasive Management
    - Aspirin
    - P2Y12 Inhibitor
    - Heparin



# Perform immediate electrocardiogram (ECG) when acute coronary syndromes (ACS) are suspected

ST-segment elevation is present on ECG

**ST-segment elevation myocardial infarction (STEMI)<sup>a</sup> diagnosed**

Treat with antiplatelet and anticoagulant therapy

Catheterization laboratory available within 2 h

YES

NO

Treat with fibrinolytics

- Alteplase, reteplase, or tenecteplase
- Streptokinase (if cost is a consideration)

Transfer to percutaneous coronary intervention (PCI) facility within 24 h

Perform coronary angiography to assess presence of obstruction

Myocardial infarction with nonobstructive coronary arteries diagnosed

Medical therapy and risk factor control only, no coronary revascularization

ST-segment elevation is not present on ECG

**Non-ST-segment elevation ACS (NSTEMI-ACS) diagnosed**

Treat with antiplatelet and anticoagulant therapy

Elevated high-sensitivity troponin levels present within 3 h

YES

NO

**NSTEMI<sup>b</sup> diagnosed**

**Unstable angina<sup>b</sup> diagnosed**

High-risk features present (heart failure, ECG changes,<sup>c</sup> ongoing chest discomfort, or hemodynamic instability)

YES

NO

Medical therapy and risk factor control

Noninvasive evaluation (eg, computed tomography angiography or stress testing)

Significantly abnormal results present

YES

NO

Continue medical therapy and risk factor control

Obstruction not present

Obstruction present

Treat with PCI

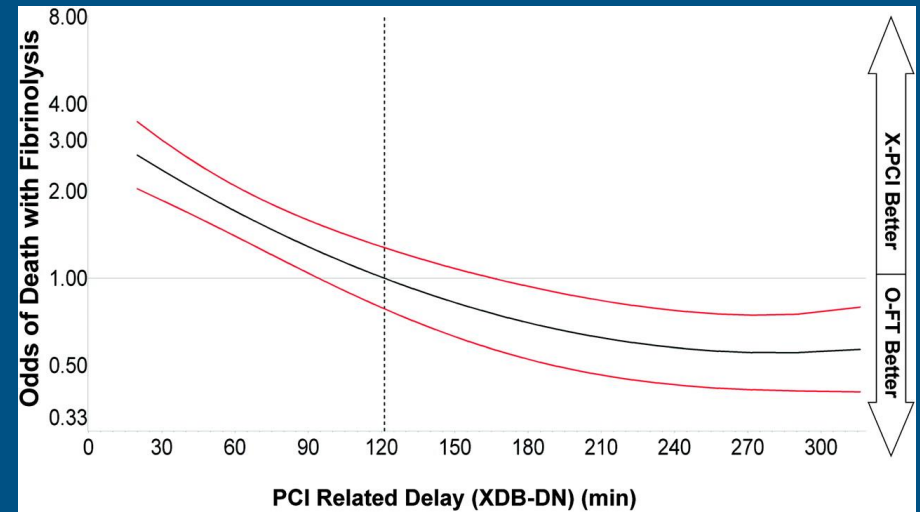
STEMI – within 2 h if catheterization laboratory is available (within 24 h if transfer to outside facility is necessary)

NSTEMI-ACS – within 24-48 h if appropriate for coronary anatomy, otherwise proceed with medical therapy or coronary artery bypass graft surgery

Bhatt, D. L., et al. (2022). "Diagnosis and Treatment of Acute Coronary Syndromes: A Review." *Jama* 327(7): 662-675

# Pharmaco-invasive Strategies

- Ideally
  - Primary PCI
  - Early lytics + Transfer to PCI capable center
    - Rescue PCI (~50% do not have resolution with lytics)
    - Routine Angiography and PCI (2 to 24 hours later)
    - Facilitated PCI- contraindicated



Pinto, D. S., et al. (2011). "Benefit of Transferring ST-Segment-Elevation Myocardial Infarction Patients for Percutaneous Coronary Intervention Compared With Administration of Onsite Fibrinolytic Declines as Delays Increase." *Circulation* 124(23): 2512-2521.

Medication	Pharmacokinetics	Administration Instructions	Rate of TIMI II-III flow	Notes	Intracranial Hemorrhage
Tenecteplase	½ life: 20-24 mins Hepatic Clearance	Weight based single bolus over 5 to 10 seconds	85%	Most fibrin specific Single IV dose Quickest administration Half dose for age >75	1%
Alteplase	½ life: 5 mins Hepatic Clearance	(1) 15 mg bolus then (2) (2) 0.75 mg/kg infusion for 30 mins then (3) (3) 0.5 mg/kg infusion for 60 mins 90 min total regimen	81%	Complex and time-consuming regimen	0.7-1.0%
Reteplase	½ life: 13-15 mins Renal/ GI clearance	Standard IV bolus: Two 10 unit boluses infused over two mins 30 mins apart	84%	Standard dose, quick administration	0.9%
Streptokinase	½ life: 11-17 mins Renal clearance	1.5 million units over 30 to 60 mins	60-68%	Most affordable Inferior outcomes Hypotension common	0.5%

# Treatment

Medications	Patient Population	Dose	Timing	Contraindications
Aspirin	All patients	325 mg chew then 81 mg daily	Immediately	Aspirin allergy
P2Y12 Inhibitor	All patients	Clopidogrel 600 mg loading vs Ticagrelor 180 mg loading dose	Early*	Active bleed
Heparin	All patients	IV bolus + infusion*	Immediately	Active bleed
Beta blockers	All patients not in shock	Depends on formulation	Early	Shock, heart failure, heart block
Statins	All patients	Atorvastatin 40 or 80 Rosuvastatin 20 or 40	Prior to discharge	Active liver disease, Rhabdomyolysis
ACE- inhibitors	LV dysfunction or DM	Depends on formulation	Prior to discharge	Angioedema
Mineralocorticoid Receptor Antagonist	LV dysfunction	Spironolactone or Eplerenone	Prior to discharge	Hyperkalemia, CrCl <30

## Complications

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- Heart Failure
- Cardiogenic Shock
- Arrhythmias particularly VT/VF
- Mechanical Complications
  - Ventricular Septal Defect
  - Free wall rupture
  - Papillary muscle rupture
- Pericardial effusion (Dressler's Syndrome)





 **Cases**



## Case 1

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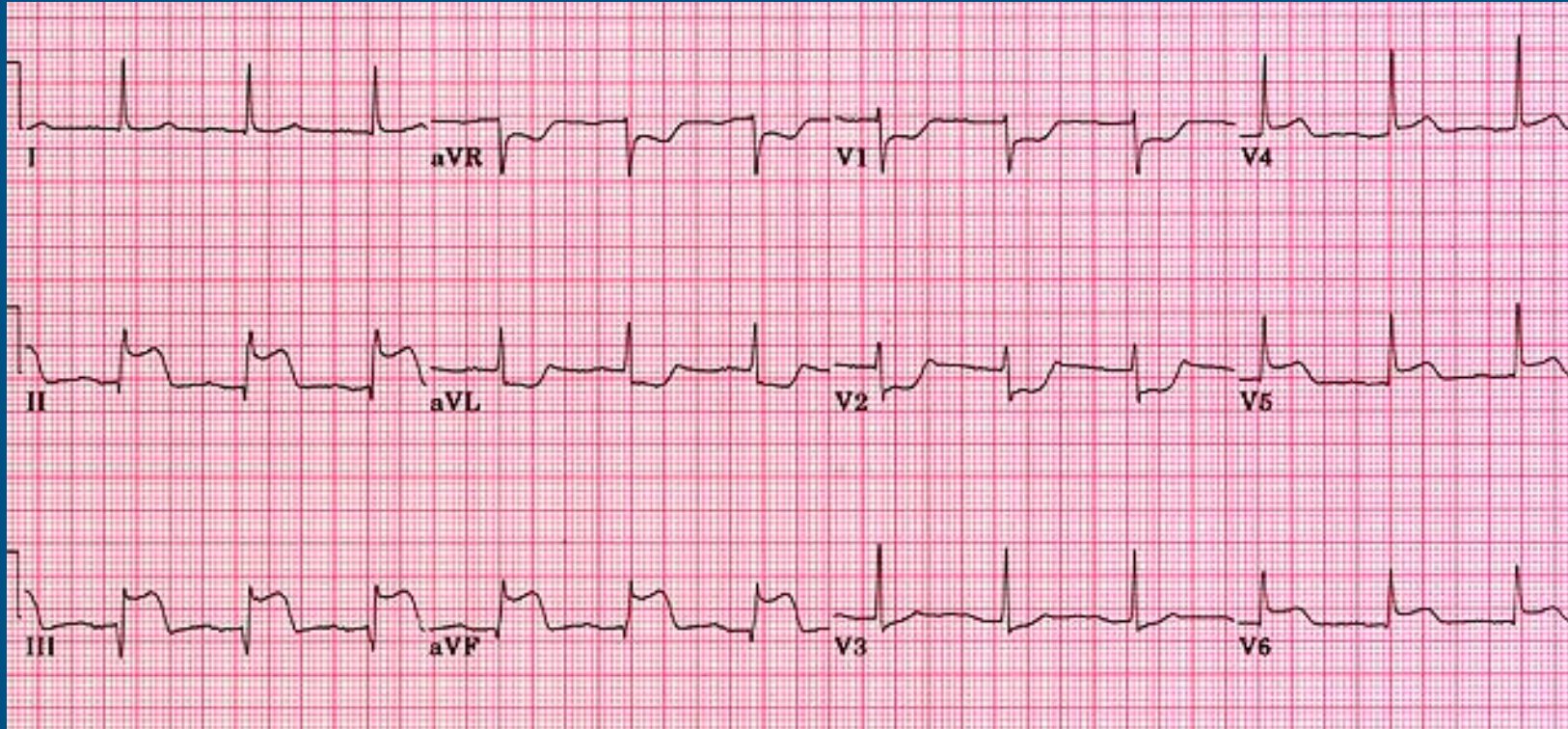
- 57 year old female with severe chest pain that started 45 minutes ago



# Questions

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# EKG



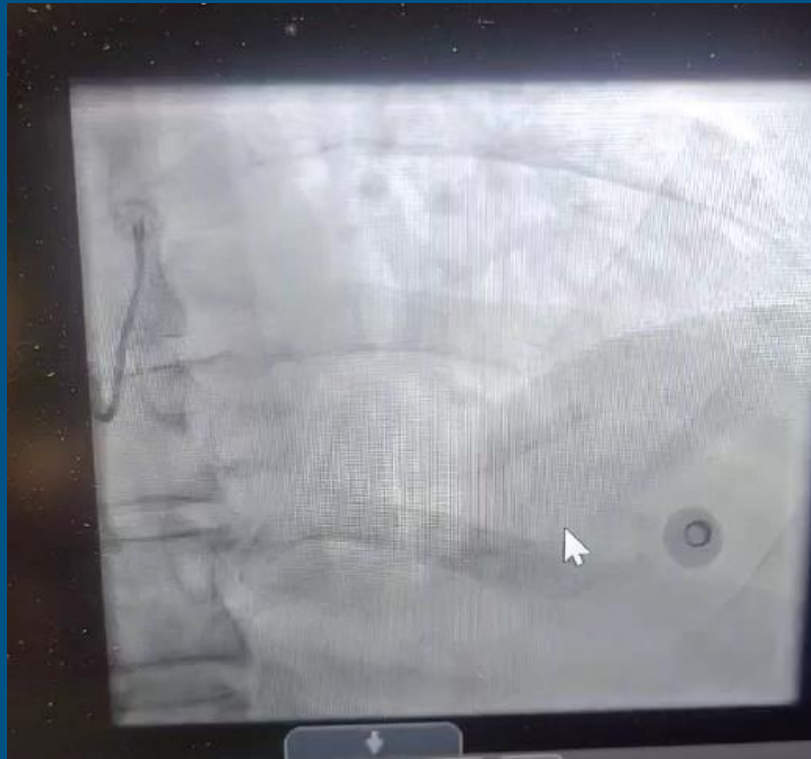
## Setting

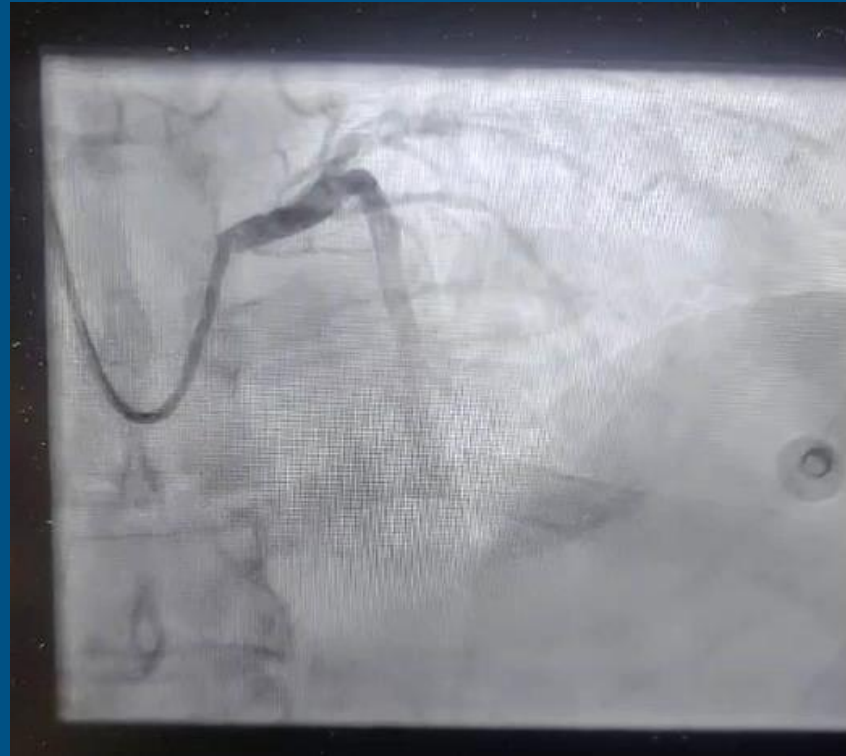
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- Cath lab
- No cath lab but can transfer to one
- No cath lab and can't transfer



## Case 1



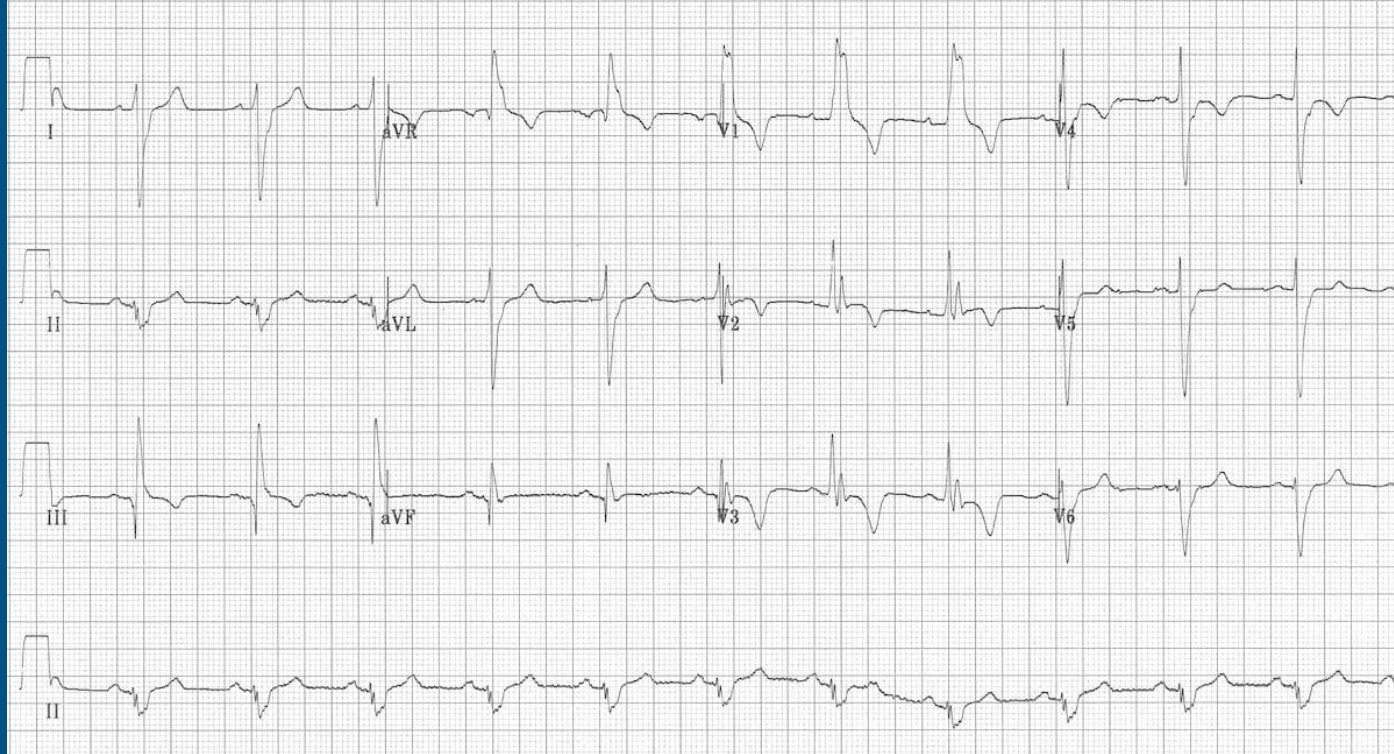


## Case 2

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- 57 year old female with chest pain and shortness of breath for 45 minutes

# EKG



## Different Scenarios

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- NSTEMI
- Pulmonary Embolism
- Aortic Dissection



# Thank You

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