STEMI GUIDELINES 2013
Background

By

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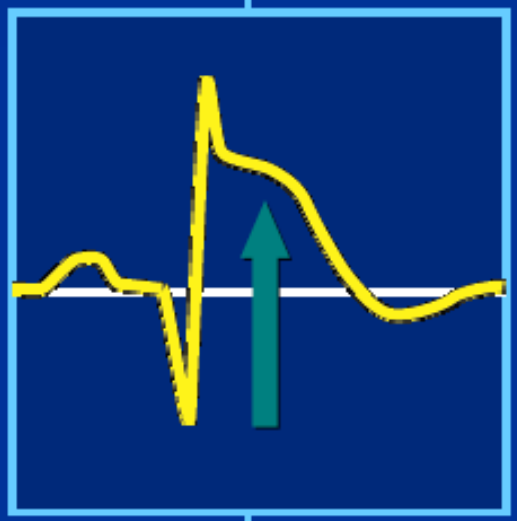
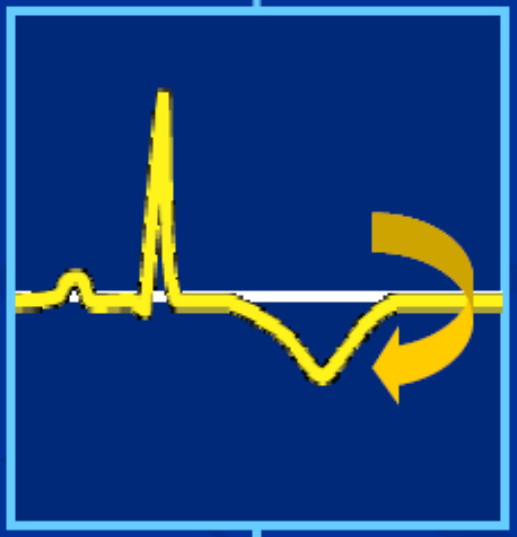
ACS: Scope of the Problem

~ 2.0 MM patients admitted
to CCU or telemetry annually





600,000
STEMI*

1.3 Million
NSTE ACS*

* STEMI = ST-segment elevation myocardial infarction; NSTE ACS = non-ST-segment elevation acute coronary syndromes.

2002 SMG Medicare Database.

Agenda

- Definitions
- Classifications
- Epidemiology
- Risk stratification
- What is new?

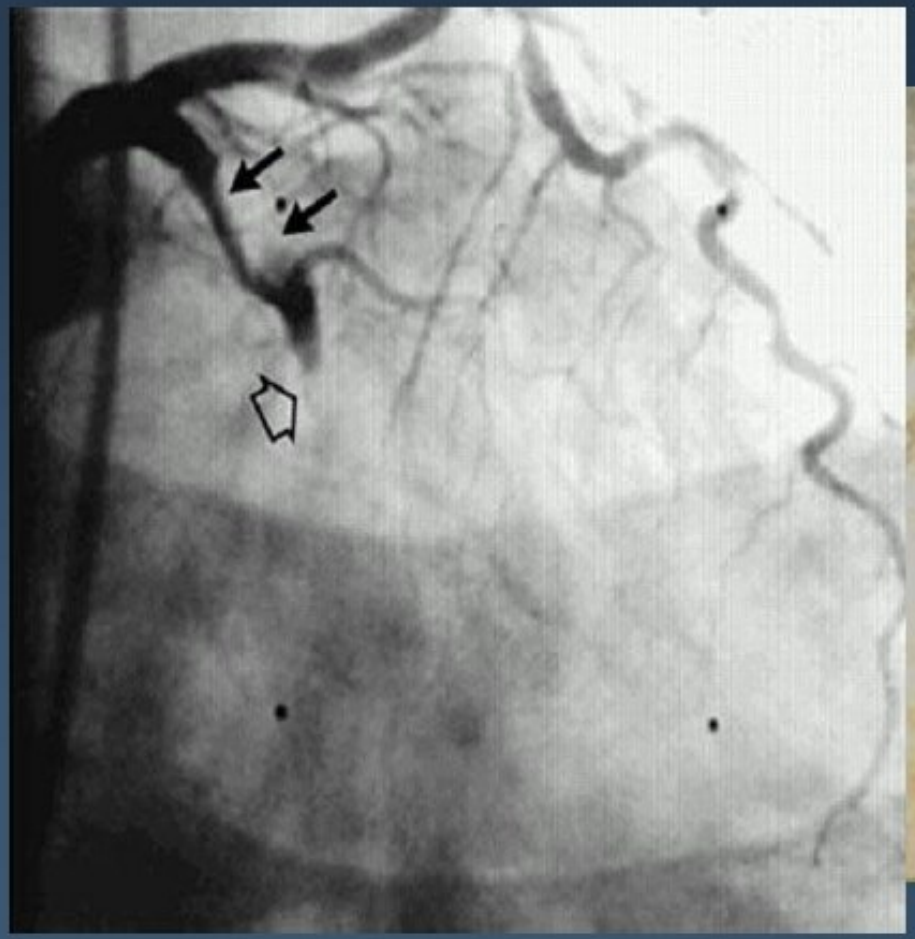
What is MI?

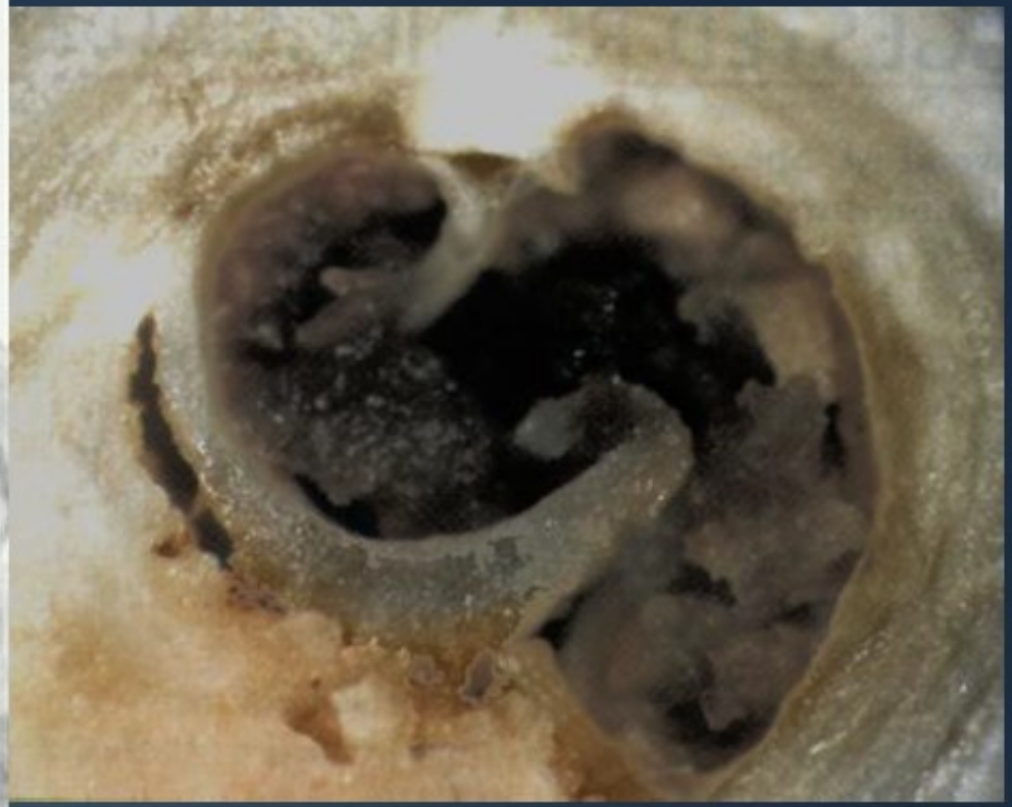
- **Myocardial infarction is the death of part of the heart muscle due to its sudden loss of blood supply.**
- **Death of the heart muscle often causes chest pain and electrical instability of the heart muscle tissue.**
- **Approximately one million Americans suffer a heart attack annually.**
- **Approximately 90% to 95% of heart attack victims who reach the hospital survive.**

ACC/AHA 2013 Definition

- **STEMI is a clinical syndrome defined by characteristic symptoms of myocardial ischemia in association with persistent electrocardiographic (ECG) ST elevation and subsequent release of biomarkers of myocardial necrosis.**

AMI: Pathophysiology

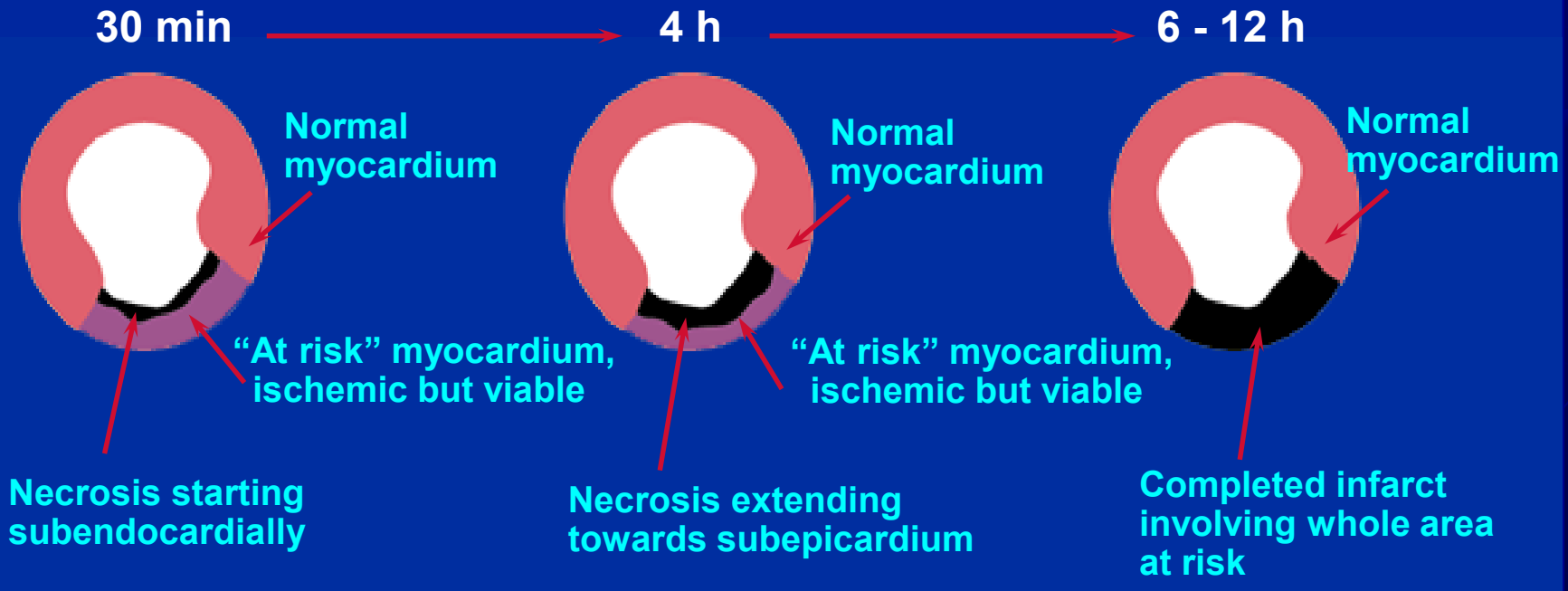




Ruptured plaque with occlusive thrombus

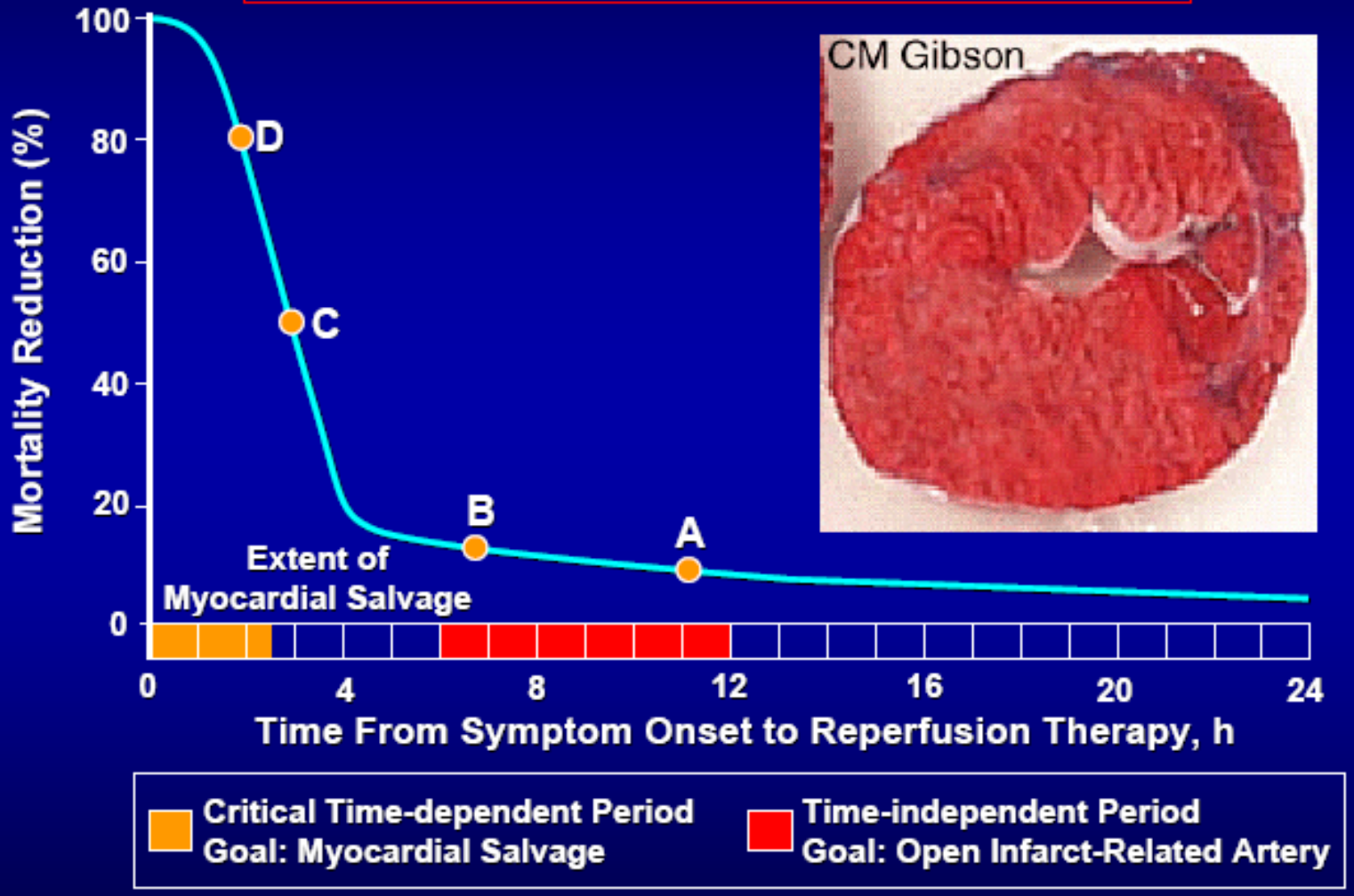
Coronary Artery Occlusion: The Evolution of Infarction

Progression of myocardial necrosis with time since occlusion



Adapted from Saltissi S, Mushahwar SS. Postgrad Med J. 1995;71:534-541, with permission.

1. Time is Myocardium
2. Infarct Size is Outcome



Gersh BJ, et al. *JAMA* 2005;293:979.

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EXPERT CONSENSUS DOCUMENT

Third Universal Definition of Myocardial Infarction

Kristian Thygesen
Joseph S. Alpert
Allan S. Jaffe
Maarten L. Simoons
Bernard R. Chaitman and
Harvey D. White: the Writing Group on behalf of the Joint ESC/ACCF/AHA/WHF Task Force for the Universal Definition of Myocardial Infarction

Historical perspectives

- Old WHO definition
- Year 2000 1st global task force definition that consider any necrosis induced by ischemia as MI
- 2007 2nd global task force definition that was accepted by WHO, ACCF, ESC., WHF.
- 2012 3rd universal definition that include new biomarkers and imaging and adds more classifications

Needs and value

- Accurate diagnosis of AMI and arrangement of therapeutic strategy
- More accurate diagnosis in clinical and epidemiological studies
- Medico-legal aspects
- Insurance and compensations

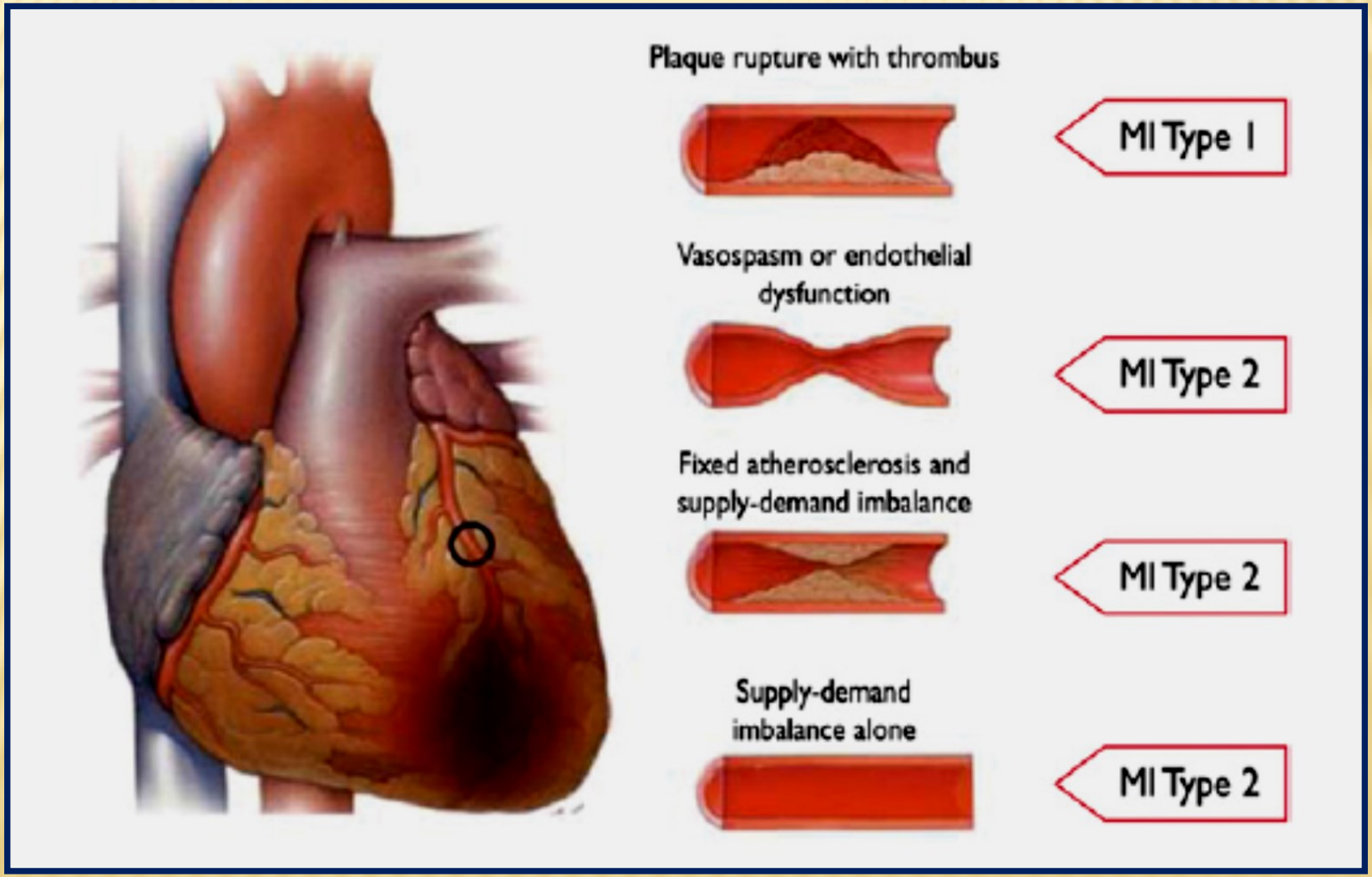
Universal Classifications of MI

- Type 1: **Spontaneous myocardial infarction**
  - Spontaneous myocardial infarction related to atherosclerotic plaque rupture, ulceration, Assuring, erosion, or dissection with resulting intraluminal thrombus in one or more of the coronary arteries leading to decreased myocardial blood flow or distal platelet emboli with ensuing myocyte necrosis. The patient may have underlying severe CAD but on occasion non-obstructive or no CAD.
- Type 2: **Myocardial infarction secondary to an ischemic imbalance**
  - In instances of myocardial injury with necrosis where a condition other than CAD contributes to an imbalance between myocardial oxygen supply and/or demand, e.g. coronary endothelial dysfunction, coronary artery spasm, coronary embolism, tachy-/brady-arrhythmias, anemia, respiratory failure, hypotension, and hypertension with or without LVH.
- Type 3: **Myocardial infarction resulting in death when biomarker values are unavailable**
  - Cardiac death with symptoms suggestive of myocardial ischemia and presumed new ischemic ECG changes or new LBBB, but death occurring before blood samples could be obtained, before cardiac biomarker could rise, or in rare cases cardiac biomarkers were not collected.

Universal Classifications of MI

- **Type 4a: Myocardial infarction related to percutaneous coronary intervention (PCI)**
  - **Myocardial infarction associated with PCI is arbitrarily defined by elevation of cTn values 5 x 99th percentile URL in patients with normal baseline values (99th percentile URL) or a rise of cTn values 20% if the baseline values are elevated and are stable or falling. In addition, either (i) symptoms suggestive of myocardial ischemia, or (ii) new ischemic ECG changes or new LBBB, or (iii) angiographic loss of patency of a major coronary artery or a side branch or persistent slow- or no-flow or embolization, or (iv) imaging demonstration of new loss of viable myocardium or new regional wall motion abnormality are required.**
- **Type 4b: Myocardial infarction related to stent thrombosis**
  - **Myocardial infarction associated with stent thrombosis is detected by coronary angiography or autopsy in the setting of myocardial ischemia and with a rise and/ or fall of cardiac biomarkers values with at least one value above the 99th percentile URL.**
- **Type 5: Myocardial infarction related to coronary artery bypass grafting (CABG)**
  - **Myocardial infarction associated with CABG is arbitrarily defined by elevation of cardiac biomarker values 10 x 99th percentile URL in patients with normal baseline cTn values (99th percentile URL). In addition, either (i) new pathological Q waves or new LBBB, or (ii) angiographic documented new graft or new native coronary artery occlusion, or (iii) imaging evidence of new loss of viable myocardium or new regional wall motion abnormality.**

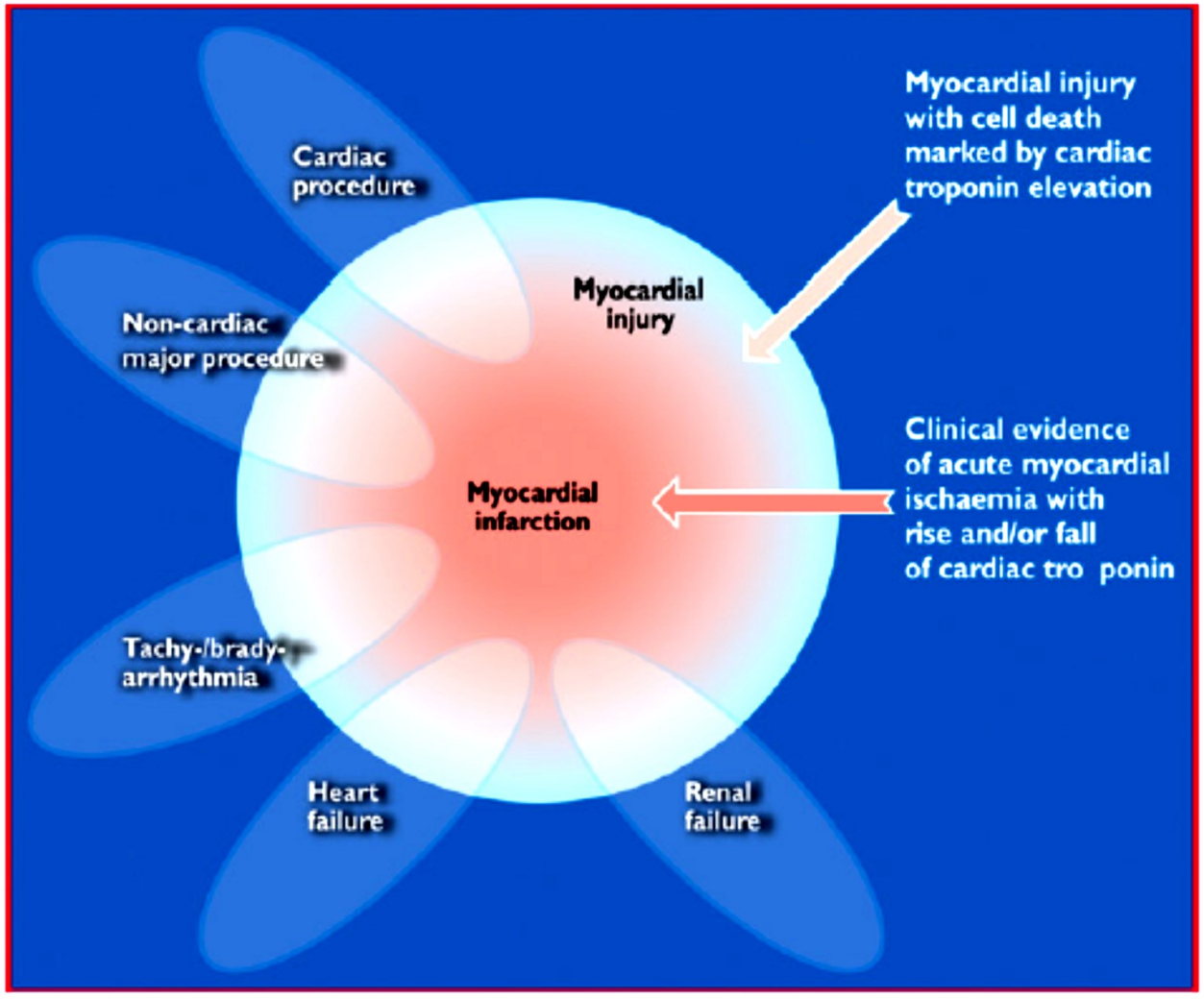
DD of type 1&2


Plaque rupture with thrombus
MI Type 1
Vasospasm or endothelial dysfunction
MI Type 2
Fixed atherosclerosis and supply-demand imbalance
MI Type 2
Supply-demand imbalance alone
MI Type 2

Value of biomarkers

- hs cTn and CKMB are the most important biomarkers of myocardial necrosis
- Acute elevation and serial changes are more diagnostic than chronic elevation
- Other cardiac and noncardiac causes of high cTn must be taken in consideration
- Other older biomarkers have no place in the new definition

Overlap of causes of mypcardial injury and AMI



Causes of elevation of cTn

- **Injury related to primary myocardial ischemia**
  - **Plaque rupture**
  - **Intraluminal coronary artery thrombus formation**
- **Injury related to supply/demand imbalance of myocardial ischemia**
  - **Tachy-/brady-arrhythmias**
  - **Aortic dissection or severe aortic valve disease**
  - **Hypertrophic cardiomyopathy**
  - **Cardiogenic, hypovolemic, or septic shock**
  - **Severe respiratory failure**
  - **Severe anemia**
  - **Hypertension with or without LVH**
  - **Coronary spasm**
  - **Coronary embolism or vasculitis**
  - **Coronary endothelial dysfunction without significant CAD**

Causes of elevation of cTn

- **Injury not related to myocardial ischemia**
  - **Cardiac contusion, surgery, ablation, pacing, or defibrillator shocks**
  - **Rhabdomyolysis with cardiac involvement**
  - **Myocarditis**
  - **Cardiotoxic agents, e.g. anthracyclines, herceptin**
- **Multifactorial or indeterminate myocardial injury**
  - **Heart failure**
  - **Stress (Takotsubo) cardiomyopathy**
  - **Severe pulmonary embolism or pulmonary hypertension**
  - **Sepsis and critically ill patients**
  - **Renal failure**
  - **Severe acute neurological diseases, e.g. stroke, subarachnoid hemorrhage**
  - **Infiltrative diseases, e.g. amyloidosis, sarcoidosis**
  - **Strenuous exercise**

ECG

- ECG Manifestations of Acute Myocardial Ischemia (in Absence of LVH and LBBB)
  - ST elevation
    - New ST elevation at the J point in two contiguous leads with the cut-points:
    - 0.1 mV in all leads other than leads V2–V3 where the following cut
    - points apply: 0.2 mV in men 40 years; 0.25 mV in men 40 years,
    - or 0.15 mV in women.
  - ST depression and T wave changes
    - New horizontal or down-sloping ST depression 0.05 mV in two contiguous leads and/or T inversion 0.1 mV in two contiguous leads with prominent R wave or R/S ratio 1.

ECG

- ECG Changes Associated With Prior Myocardial Infarction
  - Any Q wave in leads V2–V3 0.02 sec or QS complex in leads V2 and Vr
  - Q wave 0.03 sec and 0.1 mV deep or QS complex in leads 1, II, aVL, aVF or V4–V6 in any two leads of a contiguous lead grouping (1, aVL; V1–V6; II, III, aVF).a R wave 0.04 sec in V1–V2 and R/S 1 with a concordant positive T wave in absence of conduction defect.

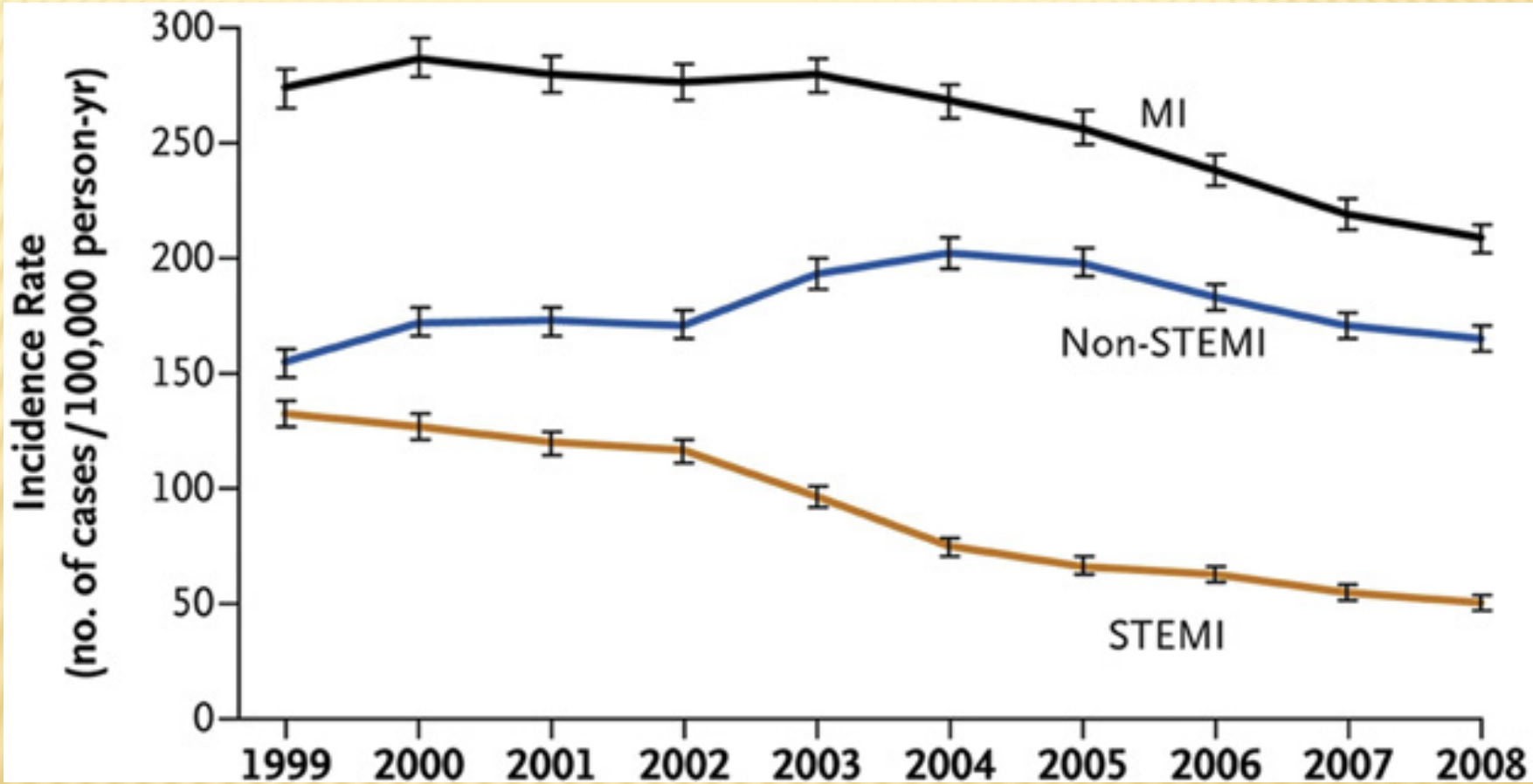
COMMON ECG PITFALLS IN DIAGNOSING MYOCARDIAL INFARCTION

- **False positives**
  - Early repolarization
  - LBBB
  - Pre-excitation
  - J point elevation syndromes, e.g. Brugada syndrome
  - Peri-/myocarditis
  - Pulmonary embolism
  - Subarachnoid hemorrhage
  - Cardiomyopathy
- **False negatives**
  - Prior MI with Q-waves and/or persistent ST elevation
  - Right ventricular pacing
  - LBBB
  - Metabolic disturbances such as hyperkalemia
  - Lead transposition
  - Cholecystitis
  - Persistent juvenile pattern
  - Malposition of precordial ECG electrodes
  - Tricyclic antidepressants or phenothiazines

Special definitions

- Silent MI ECG path Q or imaging evidence of myocardial scar
- Perioperative MI occur between 24-72 h after surgery usually of type 2 and serial HS c Tn is needed for its diagnosis as pain may be absent
- MI in ICU has the worst prognosis may be type 2 or direct injury by toxins or catecholamines sometimes type1
- Recurrent MI if occurs after 28 days of incident MI
- Re-infarction is considered if occurs < 28 day of incident or recurrent MI

ACS incidence rates in USA 1998-2008



STEMI in women

- About 30%
- Atypical and late presentation
- Long D2B time
- Long D2needle time
- Less use of aspirin and B-Blockers
- More incidence of bleeding

Other demographic data

- 13,3% non-white
- 23% diabetics
- Diabetics have higher short and long term mortality
- Hypoglycemia and hyperglycemia are associated with higher mortality
- Elderly patient and those with CKD have less use of guideline documented therapy

Risk stratfication

- TIMI Risk score
- GRACE Risk score

TIMI RISK SCORE FOR UA/NSTEMI: 7 INDEPENDENT PREDICTORS

- Aged ≥65 years
- ≥3 CAD risk factors
- Prior CAD (stenosis >50%)
- Aspirin in last 7 days
- ≥2 anginal events in ≤24 hours
- ST deviation
- Elevated cardiac markers (CK-MB or troponin)

TIMI, thrombosis in myocardial infarction; UA, unstable angina; NSTEMI, non–ST-segment elevation myocardial infarction; CAD, coronary artery disease.

Antman EM, et al. JAMA. 2000;284:835-842.

TIMI Risk Score For UA/NSTEMI

- Age ≥65 years
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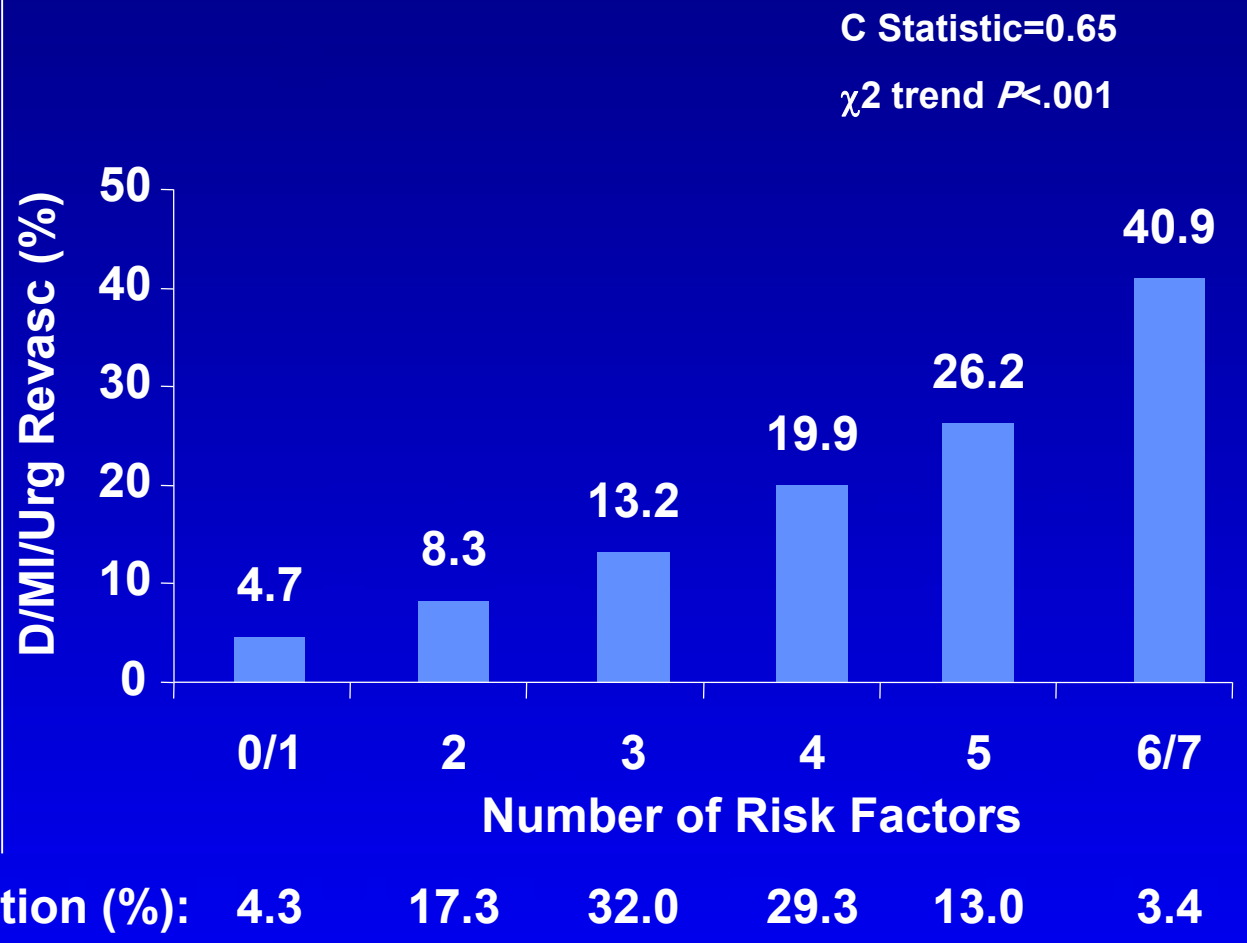


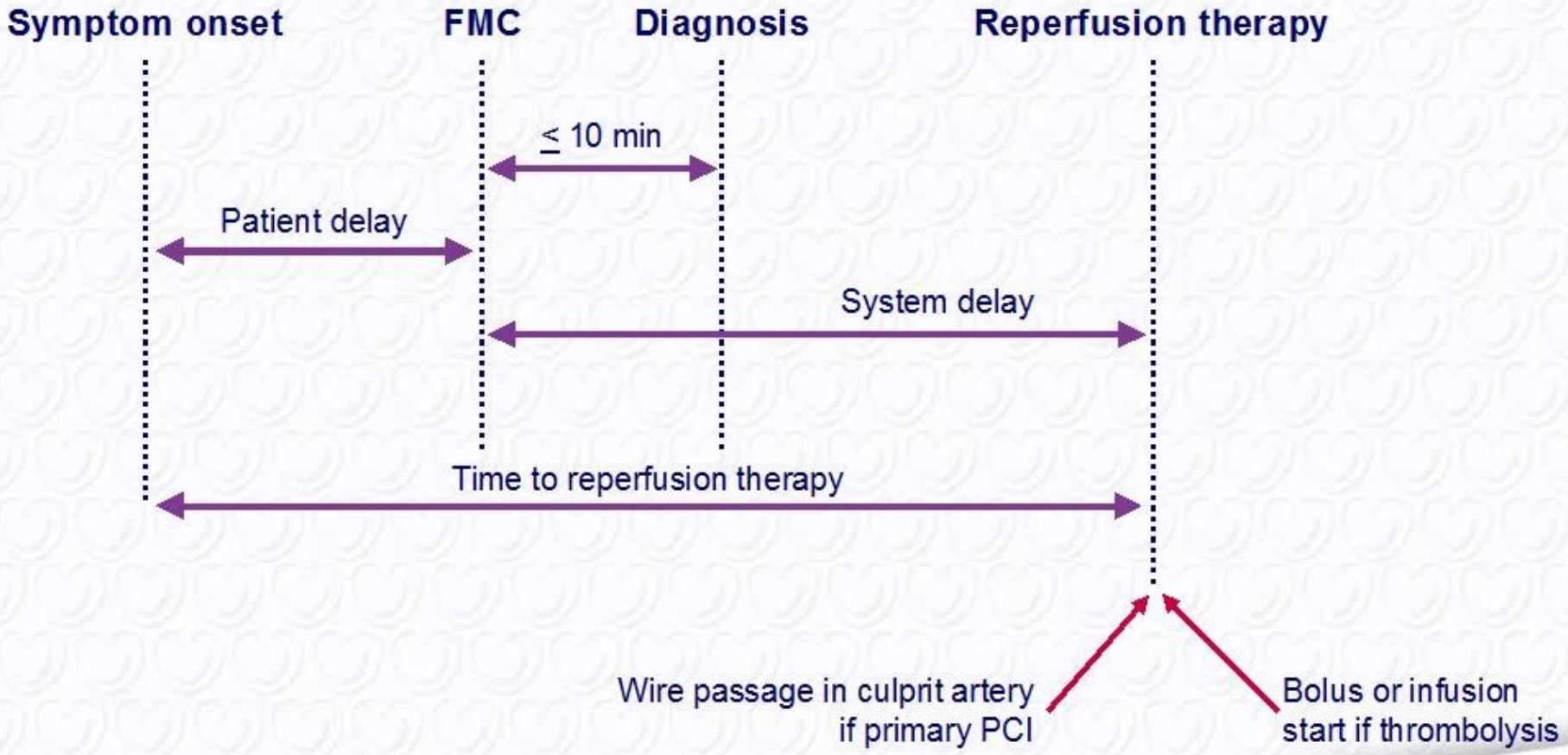
Antman EM, et al. *JAMA.* 2000;284:835-442. (with permission)

GRACE Risk Score

Variable	Odds ratio
Older age	1.7 per 10 y
Killip class	2.0 per class
Systolic BP	1.4 per 20 mm Hg ↑
ST-segment deviation	2.4
Cardiac arrest during presentation	4.3
Serum creatinine level	1.2 per 1-mg/dL ↑
Positive initial cardiac biomarkers	1.6
Heart rate	1.3 per 30-beat/min ↑

The sum of scores is applied to a reference monogram to determine the corresponding all-cause mortality from hospital discharge to 6 months. Eagle KA, et al. *JAMA* 2004;291:2727–33. The GRACE clinical application tool can be found at www.outcomes-umassmed.org/grace. Also see Figure 4 in Anderson JL, et al. *J Am Coll Cardiol* 2007;50:e1–e157.
GRACE = Global Registry of Acute Coronary Events.

Components of delay in STEMI and ideal time intervals for intervention



All delays are related to FMC (first medical contact)

European Heart Journal 2012 - doi:10.1093/eurheartj/ehs215

What is new?

- **Early Diagnosis**
  - Expanded section, atypical presentations.
- **Cardiac Arrest**
  - Expanded section. The role of therapeutic hypothermia and angiography defined.
- **Pre Hospital Logistics of Care**
  - Expanded section, role of pre hospital diagnosis, triage and networks highlighted.
- **Reperfusion strategies**
  - Modified recommended maximal time delays.
- **PCI strategies**
  - Stent recommendations, anti thrombotic therapy.
- **Routine therapies and strategies**
  - Duration of hospital stay, secondary prevention, duration of anti thrombotic therapy, Evaluation of LV function and viability.

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شكرا لحسن إستماعكم
Thank you
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