Summary of

Acute Myocardial Infarction

NEJM 376;21 May 25, 2017. Jeffrey L. Anderson, M.D

DEFINITION AND TYPES

- Acute myocardial infarction is an event of myocardial necrosis caused by an unstable ischemic syndrome. In practice, the disorder is diagnosed and assessed on the basis of clinical evaluation, the electrocardiogram (ECG), biochemical testing, invasive and noninvasive imaging, and pathological evaluation.
- Acute myocardial infarction is classified on the basis of the presence or absence of ST-segment elevation on the ECG and is further classified into six types:
    - infarction due to coronary atherothrombosis (type 1)
    - infarction due to a supply–demand mismatch that is not the result of acute atherothrombosis (type 2)
    - infarction causing sudden death without the opportunity for biomarker or ECG confirmation (type 3)
    - infarction related to a percutaneous coronary intervention (PCI) (type 4a),
    - infarction related to thrombosis of a coronary stent (type 4b)
    - and infarction related to coronary-artery bypass grafting (CABG) (type 5).

PATHOBIOLOGIC FEATURES AND RISK FACTORS

- The usual initiating mechanism for acute myocardial infarction is rupture or erosion of a vulnerable, lipid-laden, atherosclerotic coronary plaque, resulting in exposure of circulating blood to highly thrombogenic core and matrix materials in the plaque.
- In the current era of potent lipid-lowering therapy, the proportion of cases in which erosion is the underlying cause is increasing as compared with the proportion of cases in which rupture is the underlying cause.
- A totally occluding thrombus typically leads to STEMI.
- Partial occlusion, or occlusion in the presence of collateral circulation, results in non-STEMI or unstable angina (i.e., an acute coronary syndrome without ST-segment elevation).
- The occurrence of acute myocardial infarction in the absence of critical epicardial coronary disease is increasingly recognized (accounting for approximately 10% of cases of acute myocardial infarction).

EMERGENCY DEPARTMENT AND EARLY INPATIENT CARE

- **Current evidence does not support oxygen supplementation for ACS unless oxygen saturation is <90%, respiratory distress or other risk factors for hypoxemia.**
- Sublingual NTG indicated for relief of ischemic discomfort, followed by IV NTG for ongoing discomfort, CHF or uncontrolled HTN.
- Beta-blockers favored in first 24 hours, oral administration is fine unless the patient has unrelieved hypertension. Avoid in patients with cardiogenic shock.
- Initiation of statins (Lipitor 80mg QD) regardless of baseline LDL.
- ACE inhibitor within 24 hours in the absence of a contraindication.

TREATMENT OF STEMI

- PCI recommended over fibrinolytics unless PCI is delayed by more than 120 minutes.
- when PCI is delayed by more than 120 minutes, fibrinolytic therapy should be given if it is not contraindicated, followed by routine consideration of transfer in the following 3 to 24 hours to a PCI-capable facility.

Table 1. Six Initial Assessment and Management Decisions Pertaining to Patients Presenting with Chest Pain and a Possible Acute Coronary Syndrome.*

1. Triage to an acute coronary syndrome pathway (STEMI, non-STEMI, possible or probable unstable angina, or nonischemic disorder) on the basis of the history, examination, ECG, and cardiac troponin test result.
2. Assess risk of cardiovascular death or recurrent ischemia (high, intermediate, or low risk) on the basis of clinical features, ECG, and troponin testing; an integrated risk score (e.g., TIMI or GRACE score) can be used.
3. Initiate general care: limit activity; administer aspirin, nitroglycerin, and a statin; consider administration of oxygen, beta-blocker, or morphine.
4. Choose invasive or noninvasive (ischemia-guided) initial strategy; the choice of early invasive management is based on risk and patient's preferences.
5. Select a second antiplatelet agent to add to aspirin ($P2Y_{12}$ inhibitor or glycoprotein IIb/IIIa inhibitor), with selection based on thrombotic risk, timing of invasive strategy, likelihood of need for surgical revascularization, and risk of bleeding.
6. Choose an anticoagulant agent (unfractionated heparin, low-molecular-weight heparin, fondaparinux, or bivalirudin) according to the initial management strategy (invasive or noninvasive) and risk of bleeding.†

* ECG denotes electrocardiogram, GRACE Global Registry of Acute Coronary Events, STEMI ST-segment elevation acute myocardial infarction, and TIMI Thrombolysis in Myocardial Infarction.
† Fondaparinux is not approved for the treatment of acute coronary syndromes in the United States.

TREATMENT OF ACUTE CORONARY SYNDROMES WITHOUT ST-SEGMENT ELEVATION

- Once a definite or likely diagnosis of an acute coronary syn-drome without ST-segment elevation has been made, the patient is triaged to either an invasive strategy or an ischemia-guided strategy (i.e., an initial medical strategy with angiography re-served for evidence of spontaneous or provoked ischemia).
- An invasive strategy leads to improved outcomes and is favored for the majority of patients; the urgency of angiography (performed with the goal of revascularization) depends on the presence or absence of high-risk features (Table 3).
- If initial medical therapy stabilizes the patient's hemodynamic condition and relieves ischemic discomfort, angiography can proceed within 12 to 24 hours. An even more delayed approach (with angiography performed within 25 to 72 hours) is an option for patients at lower immediate risk.
- In patients whose condition is unstable, urgent PCI is performed, as it is for patients with STEMI.
- An ischemia-guided strategy is chosen for patients at low risk for recurrent ischemia (especially for women at low-risk and others for whom angiography carries excessive risk), for patients at hospitals where interventional services are unavailable, and on the basis of the patient's or physician's preference.
- **Fibrinolytic therapy may be harmful in patients who have an acute coronary syndrome without ST-segment elevation and is therefore contraindicated.**
- At the time of angiography, PCI is the most common intervention, but depending on the coronary anatomy and clinical features, a decision may be made to perform CABG instead of PCI or to forgo an intervention. Nonculprit arteries may be approached with the same cautions as for nonculprit arteries in patients with STEMI.
- Indeed, because the culprit artery may be difficult to identify with certainty in patients who have an acute coronary syndrome without ST-segment elevation, simultaneous multivessel PCI is often performed if the patient is hemodynamically stable.

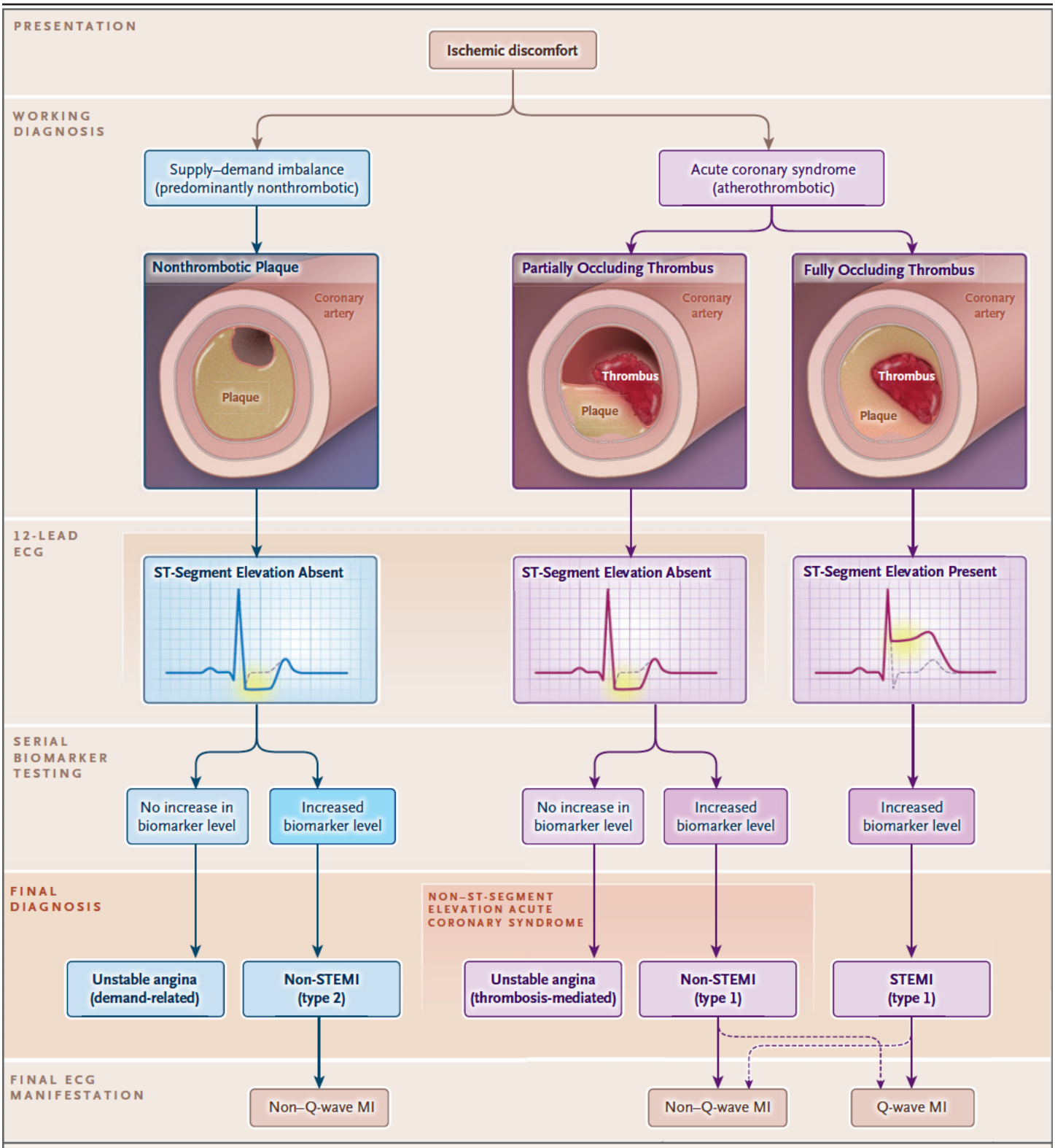

Figure 1. Spectrum of Pathologic and Clinical ST-Segment Elevation Acute Myocardial Infarction (STEMI) and Non-STEMI Acute Coronary Syndromes.

Adapted from Morrow.[10] ECG denotes electrocardiogram, and MI myocardial infarction.

ANTIPLATELET AGENTS

- Non–enteric-coated aspirin, at a dose of 162 to 325 mg, is recommended at the time of the first medical contact for all patients with an acute coro-nary syndrome (ACC–AHA class I recommenda-tion,

evidence level A).8,9 The initial dose is followed by a daily maintenance dose of 81 to 325 mg of aspirin, which is given indefinitely**.**

- In addition to aspirin, an oral P2Y12 inhibitor (clopidogrel, prasugrel, or ticagrelor) is recom-mended for all higher-risk patients.
- For patients with STEMI who are undergoing primary PCI, a loading dose should be given as early as possible or at the time of PCI, followed by a daily maintenance dose for at least 1 year.
- Whereas prasugrel and ticagrelor, which are more potent than clopidogrel, may be preferred with primary PCI, clopidogrel is recommended in association with fibrinolytic therapy and is given after fibrinolytic therapy for a minimum of 14 days and for a maximum of 1 year
- For an acute coronary syndrome with-out ST-segment elevation, clopidogrel or ticagrelor is indicated at the time of presentation for patients treated with either an early invasive strategy or an ischemia-guided strategy

ANTICOAGULANT AGENTS

- Administration of a parenteral anticoagulant agent (i.e., unfractionated heparin, enoxaparin, bivalirudin, or fondaparinux) is recommended for patients who present with an acute coronary syndrome.
- Enoxaparin is somewhat more effective than unfractionated heparin, particularly in patients who are treated with a noninvasive strategy.

COMBINED ORAL ANTICOAGULANT AND ANTIPLATELET THERAPY

- On the basis of limited evidence and expert opinion, current guidelines recommend antiplatelet therapy combined with oral anticoagulant therapy with a vitamin K antagonist in patients with STEMI who have an elevated risk of atrial fibrillation, mechanical heart valves, venous thromboembolism, or hypercoagulable disorders
- The WOEST (What Is the Optimal Antiplatelet and Anticoagulant Therapy in Patients with Oral Anticoagulation and Coronary Stenting) trial, a single-center study involving 563 patients (28% of whom had acute coronary syndromes), showed that an oral anticoagulant plus clopido-grel without aspirin, as compared with an oral anticoagulant plus clopidogrel and aspirin, re-duced the risk of clinical bleeding (hazard ratio, 0.36; 95% CI, 0.26 to 0.50) without an increase in thrombotic events.51

Table 3. Invasive and Ischemia-Guided Intervention Categories in Patients with Non-STEMI Acute Coronary Syndromes.*

Variable	Invasive Intervention†			Ischemia-Guided Intervention
	Immediate	Early	Delayed	
Timing	Within 2 hr	Within 24 hr	Within 25–72 hr	Depends on spontaneous or provoked ischemia
Indications	Refractory angina, new-onset heart failure, new or worsening mitral regurgitation, recurrent angina during maximal medical therapy	High risk (e.g., GRACE score >140), rising troponin level, new ST-segment depression	Intermediate risk (e.g., GRACE score of 109–140, TIMI score of ≥2), ejection fraction <40%, postinfarction angina, diabetes, renal insufficiency, prior CABG, recent PCI (within 6 mo)	Low risk (e.g., TIMI score of 0 or 1); low-risk and troponin-negative women, patient's or physician's preference in absence of high-risk features, unavailability of interventional facilities or expertise

* Data are adapted from Amsterdam et al.[9]
† Invasive interventions are those involving coronary angiography with the intention to perform percutaneous coronary intervention (PCI) or to refer the patient for CABG (coronary-artery bypass grafting), as appropriate.