Myocardial Infarction

Myocardial infarction (MI) is defined as a clinical (or pathologic) event caused by myocardial ischemia in which there is evidence of myocardial injury or necrosis. The diagnosis is evident when there is a rise and/or fall of cardiac biomarkers, along with supportive evidence in the form of typical symptoms, ECG changes consistent with MI, or imaging evidence of new loss of viable myocardium or new regional wall motion abnormality (Reeder & Kennedy, 2025).

Types of MI (Reeder & Kennedy, 2025)
The criteria used to define MI differ somewhat depending upon the particular clinical circumstance of the patient. The two most common types of MI are:

- Type 1 – MI caused by acute atherothrombotic coronary artery disease and usually precipitated by atherosclerotic plaque disruption (rupture or erosion).
- Type 2 – MI caused by a mismatch between oxygen supply and demand. This includes several potential mechanisms including coronary dissection, vasospasm, emboli, microvascular dysfunction, as well as increases in demand with or without underlying coronary artery disease.

Classification of Acute Coronary Syndrome (ACS) (Reeder & Kennedy, 2022)

ACS is classified based on the presence or absence of ST segment elevation. There are three major classifications of ACS:

- **Unstable Angina (UA)**
  Clinical symptoms suggestive of ACS with the absence of persistent ST elevation and no elevation in cardiac biomarkers (troponin) [which are elevated with myocardial tissue damage]; with or without electrocardiogram (ECG) changes indicative of ischemia. ECG changes are generally transient. Diagnosis may be made by clinical history alone.

- **Non-ST Segment Elevation Acute Coronary Syndrome (NSTE-ACS): Non-ST Segment Elevation Myocardial Infarction (NSTEMI)**
  Clinical symptoms suggestive of ACS with elevated cardiac biomarkers (troponin); with or without ECG changes indicative of cardiac ischemia.
  Note: ECG changes suggestive of cardiac ischemia include ST depression, transient ST elevation or prominent T wave inversions.

- **ST-Segment Elevation Myocardial Infarction (STEMI)**
  ACS symptoms with elevated cardiac biomarkers (troponin); ECG shows persistent ST elevation or new left bundle branch block (LBBB). These patients should be considered for immediate reperfusion therapy (fibrinolysis or percutaneous coronary intervention [PCI]).

History and Physical Examination (Reeder & Kennedy, 2025)

- Patients with acute MI may present with chest pain or other symptoms of myocardial ischemia
- Chest pain or discomfort is likely the most common symptom of acute MI.
- Ask your patient the characteristics of chest pain: duration, character, similarity to possible previous episodes, provoking factors, alleviating or aggravating factor, and past history of coronary disease risk factors.

  - Classic MI chest pain is chest tightness or pressure, in the substernal area, with radiation to the left arm or jaw.
  - Women, diabetic patients, or in older individuals usually have an atypical presentation.
- Associated symptoms include shortness of breath, diaphoresis, weakness, and anxiety.
- The physical examination should include auscultation of the heart and lungs, measurement of blood pressure in both arms, checking the presence of all major pulses, and assessment for heart failure or circulatory compromise, which are associated with a high early mortality.

Laboratory Testing

- Cardiac Troponin (gold standard): levels rise within hours of a heart attack and remain elevated for days, indicating heart muscle death.
- Electrocardiogram (ECG) test to map heart's electrical activity for immediate signs of damage.
- B-Type Natriuretic Peptide (BNP): used to help diagnose heart failure, often accompanying heart attacks. It's a hormone released when the ventricles are stretched (e.g., from fluid overload).
- Complete blood count and basic metabolic panel:assess for infection, anemia, kidney/electrolyte issues, and glucose levels, important for overall picture and risk.

Goals of Therapy (Reeder, Awtry & Mahler, 2022) and Management Strategies

RECOMMENDATIONS FOR ALL MI (REGARDLESS OF CLASSIFICATION)	
Goals	**Management**
Early identification	• ECG should be performed within 10 minutes upon arrival to emergency department if not obtained by Emergency Medical System (EMS) prearrival. • If initial ECG is not diagnostic and patient remains symptomatic, repeat ECG every 15-30 minutes to detect ischemic changes.
Acute triage	• Assess responsiveness, airway, breathing, and circulation. • Look for evidence of systemic hypoperfusion (hypotension; tachycardia; impaired cognition; cool, clammy, pale skin); cardiogenic shock requires aggressive management. • Left heart failure with hypoxia (dyspnea, hypoxia, pulmonary edema, and/or impending respiratory compromise) requires aggressive oxygenation, airway stabilization, diuretic therapy and afterload reduction. • Treat ventricular arrhythmias immediately due to effect on cardiac output and exacerbation of myocardial ischemia.
Initial therapy	• Continuous cardiac monitoring with emergency resuscitation equipment nearby. • Administer oxygen to patients with arterial saturation less than 90%, patients in respiratory distress including those with heart failure, or those with other high-risk factors for hypoxia. *Note: Supplemental oxygen shows no benefit to patients with oxygen saturation greater than or equal to 90%.* • Establish intravenous (IV) access. • Obtain serial cardiac troponin I or T levels at presentation and 2-3 hours after symptom onset.

	• Obtain basic electrolyte panel, kidney function tests, complete blood count with platelets, and coagulation panel if patient is on warfarin therapy or has liver disease.
Relief of ischemic pain	• Administer sublingual nitroglycerin (NTG) every 5 minutes up to 3 times for continuing ischemic pain; administer IV NTG for persistent ischemia, heart failure, or hypertension. Contraindicated in patients with one or more of the following: hypotension (SBP less than 90 mm Hg), suspicion/confirmed right ventricular failure, marked bradycardia (HR less than 50 bpm) or tachycardia (HR greater than 100 bpm), known hypertrophic cardiomyopathy, severe aortic stenosis or if phosphodiesterase inhibitor (e.g., Viagra) has been taken within the previous 24 hours.. • IV morphine should be avoided unless patient has an unacceptable level of pain. Initial dose is 2-4 mg, with increments of 2-8 mg at 5- to 15-minute intervals. • Discontinue nonsteroidal anti-inflammatory drugs (NSAIDs), except aspirin, because of increased risk of adverse cardiac events.
Stabilize hemodynamics/ prevent and manage arrhythmias	• Atrial fibrillation and flutter can cause symptomatic hypoperfusion; ventricular tachycardia and fibrillation are life-threatening. • Treat with prophylactic IV β-blocker and maintain serum potassium between 3.5 and less than 4.5 meq/L and serum magnesium above 2.0 meq/L. • Avoid prophylactic lidocaine. • Treat symptomatic bradycardia and heart block with atropine or temporary pacing.
Estimation of risk	• High risk patients require aggressive management. This includes those of advanced age, or those with low blood pressure, tachycardia, heart failure, and an anterior MI. *(See TIMI score below).*
β-Blocker therapy	• Used to prevent recurrent ischemia and life-threatening ventricular arrhythmias. • Start β-blocker (metoprolol or atenolol) in all patients without contraindications within 24 hours; defer in patients that are hemodynamically unstable. • Contraindications are heart failure, low output state, risk for cardiogenic shock, bradycardia, PR interval greater than 0.24 seconds, second- or third- degree heart block without permanent pacemaker, reactive airway disease/active bronchospasm.
Dual antiplatelet therapy	• Aspirin: loading dose-325 mg uncoated aspirin, to be chewed or crushed to allow for rapid absorption; maintenance dose 81mg/day is preferred as there is no benefit to higher doses but there is a higher risk of bleeding with higher daily dosages, especially gastrointestinal bleeding events. Also note, 81 mg/day is the *only* dose option when used concomitantly with ticagrelor. • P2Y12 inhibitors for 12 months, regardless if treated with primary- PCI or ischemia-guided strategy. Loading and maintenance doses are the same for both indications, however prasugrel is an option only in primary PCI, not in ischemia-guided strategy.

	• Clopidogrel: Loading dose 300-600 mg; maintenance dose 75 mg/day • Ticagrelor: Loading dose 180 mg; maintenance 90 mg every 12 hours (must only be given with aspirin 81 mg/day) • Prasugrel (primary PCI only): Loading dose 60 mg; maintenance dose 10 mg/day (contraindicated with history of stroke or TIA, age 75 years or older, and weight less than 60 kg)
Cholesterol therapy (Rosenson, 2020)	• High-intensity statin therapy should be initiated as early as possible; obtain fasting lipid panel within 24 hours. • Atorvastatin 80 mg daily or rosuvastatin 20 or 40 mg daily • LDL goal is 50 mg/dL or less • Add ezetimibe 10 mg daily to high dose statin therapy if LDL not a goal. • Add PCSK9 inhibitor for patient with statin allergy or intolerance or if LDL not a goal with high dose statin therapy and ezetimibe alone.
Long-term management	• Antiplatelet therapy to reduce the risk of recurrent coronary artery thrombosis or, with PCI, coronary artery stent thrombosis • Statin therapy in definitely • Oral anticoagulation in the presence of left ventricular thrombus or chronic atrial fibrillation to prevent embolization • Angiotensin converting enzyme (ACE) inhibitors, especially in STEMI patient, with or without reduced left ventricular function and/or patients with diabetes, hypertension, and chronic kidney disease • β-blockers, if no contraindications

Risk Assessment

- **Early Risk Stratification (UA/NSTEMI):** Identify patients at highest risk for future cardiac events.
  - Presence and extent of ST segment depression
  - Elevated cardiac biomarkers
  - Evidence of hemodynamic instability
  - Persistent chest pain despite appropriate medical therapy
- **Thrombolysis in Myocardial Infarction (TIMI) Risk Score (Antman, Cohen, & Bernink, 2000)**
  - Seven variables at presentation were independently predictive of outcome in patients with unstable angina or an acute non-ST elevation MI (1 = present, 0 = absent)
    - Age 65 years or older
    - Presence of at least 3 risk factors for coronary heart disease (hypertension, diabetes, dyslipidemia, smoking, or positive family history of early MI)
    - Prior coronary stenosis 50% or more
    - Presence of ST segment deviation on admission electrocardiogram
    - At least 2 anginal episodes in prior 24 hours
    - Elevated serum cardiac biomarkers
    - Use of aspirin in prior 7 days (possible marker of more severe coronary disease)
  - TIMI Scoring:
    - Low risk score = 0 to 2
    - Intermediate risk score = 3 to 4
    - High risk score = 5 to 7

Patient Education

- The primary care provider and nurse practitioner should educate the patient on the benefits of a healthy diet, the importance of controlling blood pressure and diabetes, exercising regularly, discontinuing smoking, maintaining healthy body weight, and remaining compliant with medications.
- The pharmacist should educate the patient on types of medication used to treat ischemic heart disease, their benefits, and potential adverse effects.
- Smoking cessation is the most cost-effective secondary measure to prevent MI. Smoking has a pro-thrombotic effect, which has a strong association with atherosclerosis and myocardial infarction.
- Diet, alcohol, and weight control*:* A diet low in saturated fat with a focus on whole grain products, vegetables, fruits, and the fish is considered cardioprotective. The target level for bodyweight is body mass index of 20 to 25 kg/m2 and waist circumference of less than 94 cm for males and less than 80 cm for females.

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