

ACC/AHA Practice Guidelines

1999 Update: ACC/AHA Guidelines for the Management of Patients With Acute Myocardial Infarction: Executive Summary and Recommendations

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction)

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The American College of Cardiology/American Heart Association (ACC/AHA) Guidelines for the Management of Patients With Acute Myocardial Infarction have been reviewed over the past 2.5 years since their initial publication in the *Journal of the American College of Cardiology* (1996;28:1328–1428) to ensure their continued relevancy. The guidelines have been updated to include the most significant advances that have occurred in the management of patients with acute myocardial infarction (AMI) during that time frame. This update was developed to keep the guidelines current without republishing the entire document. This effort represents a new procedure of the ACC/AHA Task Force on

Practice Guidelines. These guidelines will be reviewed and updated as necessary until it is deemed appropriate to revise and republish the entire document.

The guidelines, incorporating the update, are available on the Web sites of both the American College of Cardiology (www.acc.org) and the American Heart Association (www.americanheart.org). In the Web site version, deleted text is indicated by ~~strikeout~~, and new/revise text is presented as double-underlined type. Reprints of the original document with the revised sections appended are available from both organizations (see information below).

“1999 Update: ACC/AHA Guidelines for the Management of Patients With Acute Myocardial Infarction: Executive Summary and Recommendations: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction)” was approved by the American College of Cardiology Board of Trustees in June 1999 and by the American Heart Association Science Advisory and Coordinating Committee in July 1999.

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This document is available on the World Wide Web sites of the American College of Cardiology (www.acc.org) and the American Heart Association (www.americanheart.org). A single reprint of the executive summary and recommendations is available by calling 800-242-8721 (US only) or writing the American Heart Association, Public Information, 7272 Greenville Ave, Dallas, TX 75231-4596. Ask for reprint No. 71-0169. To obtain a reprint of the complete guidelines update published in the September 1999 issue of the *Journal of the American College of Cardiology*, ask for reprint No. 71-0170. To purchase additional reprints (specify version and reprint number): up to 999 copies, call 800-611-6083 (US only) or fax 413-665-2671; 1000 or more copies, call 214-706-1466, fax 214-691-6342, or e-mail pubauth@heart.org. To make photocopies for personal or educational use, call the Copyright Clearance Center, 978-750-8400.

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Recommendations

The following is a listing of the recommendations made by the ACC/AHA Task Force on Practice Guidelines in the ACC/AHA Task Force Report "ACC/AHA Guidelines for the Management of Patients With Acute Myocardial Infarction." More detailed information regarding the evidence and the rationale for these recommendations can be found in the full text of the guidelines themselves, which appears in the November 1996 and September 1999 (update) issues of the *Journal of the American College of Cardiology*.

Explanation of Classes

As in previous guidelines, the American College of Cardiology and the American Heart Association have used the following classification system in which indications for a diagnostic procedure, a particular therapy, or intervention are designated as:

Class I: Conditions for which there is evidence for and/or general agreement that a given procedure or treatment is beneficial, useful, and effective.

Class II: Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment.

Class IIa: Weight of evidence/opinion is in favor of usefulness/efficacy.

Class IIb: Usefulness/efficacy is less well established by evidence/opinion.

Class III: Conditions for which there is evidence and/or general agreement that a procedure/treatment is not useful/effective and in some cases may be harmful.

Prehospital Issues

Class I

1. Availability of 911 access.
2. Availability of an emergency medical services (EMS) system staffed by persons trained to treat cardiac arrest with defibrillation if indicated and to triage patients with ischemic-type chest discomfort.

Class IIa

1. Availability of a first-responder defibrillation program in a tiered response system.
2. Healthcare providers educate patients/families about signs and symptoms of AMI, accessing EMS, and medications.

Class IIb

1. Twelve-lead telemetry.
2. Prehospital thrombolysis in special circumstances (eg, transport time greater than 90 minutes).

Initial Recognition and Management in the Emergency Department

Class I

1. Emergency department (ED) AMI protocol that yields a targeted clinical examination and a 12-lead electrocardiogram (ECG) within 10 minutes and a door-to-needle time that is less than 30 minutes.

Routine Measures

1. Supplemental oxygen, intravenous access, and continuous electrocardiographic monitoring should be established in all patients with acute ischemic-type chest discomfort.
2. An ECG should be obtained and interpreted within 10 minutes of arrival in the ED in all patients with suspected acute ischemic-type chest discomfort.

Oxygen

Class I

1. Overt pulmonary congestion.
2. Arterial oxygen desaturation (SaO₂ less than 90%).

Class IIa

1. Routine administration to all patients with uncomplicated myocardial infarction (MI) during the first 2 to 3 hours.

Class IIb

1. Routine administration of supplemental oxygen to patients with uncomplicated MI beyond 3 to 6 hours.

Intravenous Nitroglycerin**Class I**

1. For the first 24 to 48 hours in patients with AMI and congestive heart failure (CHF), large anterior infarction, persistent ischemia, or hypertension.
2. Continued use (beyond 48 hours) in patients with recurrent angina or persistent pulmonary congestion.

Class IIa

None.

Class IIb

1. For the first 24 to 48 hours in all patients with AMI who do not have hypotension, bradycardia, or tachycardia.
2. Continued use (beyond 48 hours)* in patients with a large or complicated infarction.

Class III

1. Patients with systolic blood pressure less than 90 mm Hg or severe bradycardia (less than 50 bpm).

Aspirin**Class I**

1. A dose of 160 to 325 mg should be given on day 1 of AMI and continued indefinitely on a daily basis.

JACC page no.	CIRC page no.	Original Recommendation (1996)	Revised Recommendation (1999)
1344	2344	Aspirin <i>Class IIb</i> 1. Other antiplatelet agents such as dipyridamole or ticlopidine may be substituted if true aspirin allergy is present.	Aspirin <i>Class IIb</i> 1. Other antiplatelet agents such as dipyridamole, ticlopidine, or clopidogrel may be substituted if true aspirin allergy is present or if the patient is unresponsive to aspirin.

Atropine**Class I**

1. Sinus bradycardia with evidence of low cardiac output and peripheral hypoperfusion or frequent premature ventricular complexes at onset of symptoms of AMI.
2. Acute inferior infarction with type I second- or third-degree atrioventricular (AV) block associated with symptoms of hypotension, ischemic discomfort, or ventricular arrhythmias.
3. Sustained bradycardia and hypotension after administration of nitroglycerin.
4. For nausea and vomiting associated with administration of morphine.
5. Ventricular asystole.

Class IIa

1. Symptomatic patients with inferior infarction and type I second- or third-degree heart block at the level of the AV node (ie, with narrow QRS complex or with known existing bundle-branch block [BBB]).

Class IIb

1. Administration concomitant with (before or after) administration of morphine in the presence of sinus bradycardia.
2. Asymptomatic patients with inferior infarction and type I second-degree heart block or third-degree heart block at the level of the AV node.
3. Second- or third-degree AV block of uncertain mechanism when pacing is not available.

Class III

1. Sinus bradycardia greater than 40 bpm without signs or symptoms of hypoperfusion or frequent premature ventricular contractions.
2. Type II AV block and third-degree AV block and third-degree AV block with new wide QRS complex presumed due to AMI.

Thrombolysis**Class I**

1. ST elevation (greater than 0.1 mV, two or more contiguous leads),[†] time to therapy 12 hours or less,[‡] age less than 75 years.
2. BBB (obscuring ST-segment analysis) and history suggesting AMI.

* Oral or topical preparations may be substituted.

[†] Repeat ECGs recommended during medical observation in clinical settings when initial ECG is nondiagnostic of ST elevation.[‡] Time of symptom onset is defined as beginning of continuous persistent discomfort that brought the patient to the hospital.

Class IIa

1. ST elevation,* age 75 years or older.

Class IIb

1. ST elevation,† time to therapy greater than 12 to 24 hours.*
2. Blood pressure on presentation greater than 180 mm Hg systolic and/or greater than 110 mm Hg diastolic associated with high-risk MI.

Class III

1. ST elevation,† time to therapy greater than 24 hours,* ischemic pain resolved.
2. ST-segment depression only.

Primary Percutaneous Transluminal Coronary Angioplasty (PTCA)

JACC page no.	CIRC page no.	Original Recommendation (1996)	Revised Recommendation (1999)
1348-49	2345	<p>Primary PTCA</p> <p><i>Class I</i></p> <ol style="list-style-type: none"> 1. As an alternative to thrombolytic therapy only if performed in a <i>timely fashion by individuals skilled in the procedure*</i> and <i>supported by experienced personnel in high-volume centers.†</i> <p>*Individuals who perform >75 PTCA procedures per year. †Centers that perform >200 PTCA procedures per year.</p> <p><i>Class IIa</i></p> <ol style="list-style-type: none"> 1. As a reperfusion strategy in patients who are candidates for reperfusion but who have a <i>risk of bleeding</i> contraindication to thrombolytic therapy. 2. Patients in cardiogenic shock. <p><i>Class IIb</i></p> <ol style="list-style-type: none"> 1. As a reperfusion strategy in patients who fail to qualify for thrombolytic therapy for reasons other than a risk of bleeding contraindication. <p><i>Class III</i></p> <p>None.</p>	<p>Primary PTCA</p> <p><i>Class I</i></p> <ol style="list-style-type: none"> 1. As an alternative to thrombolytic therapy in patients with AMI and ST-segment elevation or new or presumed new left BBB (LBBB) who can undergo angioplasty of the infarct-related artery within 12 hours of onset of symptoms or beyond 12 hours if ischemic symptoms persist, if performed in a <i>timely fashion* by persons skilled in the procedure†</i> and <i>supported by experienced personnel in an appropriate laboratory environment.‡</i> <p>*Performance standard: balloon inflation within 90 (±30) minutes of admission. †Individuals who perform >75 PTCA procedures per year. ‡Centers that perform >200 PTCA procedures per year and have cardiac surgical capability.</p> <ol style="list-style-type: none"> 2. In patients who are within 36 hours of an acute ST-elevation/Q-wave or new LBBB MI who develop cardiogenic shock, are <75 years old, and in whom revascularization can be performed within 18 hours of onset of shock. <p><i>Class IIa</i></p> <ol style="list-style-type: none"> 1. As a reperfusion strategy in candidates for reperfusion who have a contraindication to thrombolytic therapy. <p><i>Class IIb</i></p> <ol style="list-style-type: none"> 1. In patients with AMI who do not present with ST elevation but who have reduced (less than TIMI grade 2) flow of the infarct-related artery and when angioplasty can be performed within 12 hours of onset of symptoms. <p><i>Class III</i></p> <p>This category applies to patients with AMI who</p> <ol style="list-style-type: none"> 1. Undergo elective angioplasty of a non-infarct-related artery at the time of AMI 2. Are beyond 12 hours after onset of symptoms and have no evidence of myocardial ischemia 3. Have received fibrinolytic therapy and have no symptoms of myocardial ischemia 4. Are eligible for thrombolysis and are undergoing primary angioplasty performed by a low-volume operator in a laboratory without surgical capability

* Time of symptom onset is defined as beginning of continuous persistent discomfort that brought the patient to the hospital.
† Repeat ECGs recommended during medical observation in clinical settings when initial ECG is nondiagnostic of ST elevation.

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Early Coronary Angiography in the ST-Segment Elevation or BBB Cohort Not Undergoing Primary PTCA

Class I

None.

Class IIa

1. Patients with cardiogenic shock or persistent hemodynamic instability.

Class IIb

1. Patients with evolving large or anterior infarcts treated with thrombolytic agents in whom it is believed that the artery is not patent and adjuvant PTCA is planned.

Class III

1. Routine use of angiography and subsequent PTCA within 24 hours of administration of thrombolytic agents.

Emergency or Urgent Coronary Artery Bypass Graft (CABG) Surgery

Class I

1. Failed angioplasty with persistent pain or hemodynamic instability in patients with coronary anatomy suitable for surgery.
2. AMI with persistent or recurrent ischemia refractory to medical therapy in patients with coronary anatomy suitable for surgery who are not candidates for catheter intervention.
3. At the time of surgical repair of postinfarction ventricular septal defect (VSD) or mitral valve insufficiency.

Class IIa

1. Cardiogenic shock with coronary anatomy suitable for surgery.

Class IIb

1. Failed PTCA and small area of myocardium at risk; hemodynamically stable.

Class III

1. When the expected surgical mortality rate equals or exceeds the mortality rate associated with appropriate medical therapy.

Early Coronary Angiography and/or Interventional Therapy in Non-ST-Segment Elevation Cohort

JACC page no.	CIRC page no.	Original Recommendation (1996)	Revised Recommendation (1999)
1352	2345	<p>Early Coronary Angiography and/or Interventional Therapy</p> <p><i>Class I</i></p> <ol style="list-style-type: none"> 1. Patients with recurrent (stuttering) episodes of spontaneous or induced ischemia or evidence of shock, pulmonary congestion, or left ventricular (LV) dysfunction. <p><i>Class IIa</i></p> <ol style="list-style-type: none"> 1. Patients with persistent ischemic-type discomfort despite medical therapy and an abnormal ECG or ≥ 2 risk factors for coronary artery disease. 2. Patients with chest discomfort, hemodynamic instability, and an abnormal ECG. <p><i>Class IIb</i></p> <ol style="list-style-type: none"> 1. Patients with chest discomfort and an unchanged ECG. 2. Patients with ischemic-type chest discomfort and a normal ECG and >2 risk factors for coronary artery disease. 	<p>Early Coronary Angiography and/or Interventional Therapy</p> <p><i>Class I</i></p> <ol style="list-style-type: none"> 1. Patients with persistent or recurrent (stuttering) episodes of symptomatic ischemia, spontaneous or induced, with or without associated ECG changes. 2. Presence of shock, severe pulmonary congestion, or continuing hypotension. <p><i>Class IIa</i></p> <p>No recommendation.</p> <p><i>Class IIb</i></p> <p>No recommendation.</p>

Glycoprotein IIb/IIIa Inhibitors

JACC page no.	CIRC page no.	Original Recommendation (1996)	Revised Recommendation (1999)
New	New		Glycoprotein IIb/IIIa Inhibitors <i>Class IIa</i> 1. For use in patients experiencing an MI without ST-segment elevation who have some high-risk features and/or refractory ischemia, provided they do not have a major contraindication due to a bleeding risk.

Hospital Management**Early, General Measures****Class I**

1. Selection of ECG monitoring based on infarct location and rhythm.
2. Bed rest with bedside commode privileges for initial 12 hours in hemodynamically stable patients free of ischemic-type chest discomfort.
3. Avoidance of Valsalva.
4. Careful attention to maximum pain relief.

Class IIb

1. Routine use of anxiolytics.

Class III

1. Prolonged bed rest (more than 12 to 24 hours) in stable patients without complications.

Identification and Treatment of the Patient at High Risk**Management of Recurrent Chest Discomfort****Class I**

1. Aspirin for pericarditis.
2. β -Adrenoceptor blockers intravenously, then orally for ischemic-type chest discomfort.
3. (Re)administration of thrombolytic therapy (alteplase) for patients with recurrent ST elevation.
4. Coronary arteriography for ischemic-type chest discomfort recurring after hours to days of initial therapy and associated with objective evidence of ischemia in patients who are candidates for revascularization.

Class IIa

1. Nitroglycerin intravenously for 24 hours, then topically or orally for ischemic-type chest discomfort.

Class IIb

1. Corticosteroids for pericarditis.
2. Indomethacin for pericarditis.

Hemodynamic Monitoring*Balloon Flotation Right-Heart Catheter Monitoring***Class I**

1. Severe or progressive CHF or pulmonary edema.
2. Cardiogenic shock or progressive hypotension.
3. Suspected mechanical complications of acute infarction, ie, VSD, papillary muscle rupture, or pericardial tamponade.

Class IIa

1. Hypotension that does not respond promptly to fluid administration in a patient without pulmonary congestion.

Class III

1. Patients with acute infarction without evidence of cardiac or pulmonary complications.

Intra-arterial Pressure Monitoring

Class I

1. Patients with severe hypotension (systolic arterial pressure less than 80 mm Hg) and/or cardiogenic shock.
2. Patients receiving vasopressor agents.

Class IIa

1. Patients receiving intravenous sodium nitroprusside or other potent vasodilators.

Class IIb

1. Hemodynamically stable patients receiving intravenous nitroglycerin for myocardial ischemia.
2. Patients receiving intravenous inotropic agents.

Class III

1. Patients with acute infarction who are hemodynamically stable.

Intra-aortic Balloon Counterpulsation

Class I

1. Cardiogenic shock not quickly reversed with pharmacological therapy as a stabilizing measure for angiography and prompt revascularization.
2. Acute mitral regurgitation or VSD complicating MI as a stabilizing therapy for angiography and repair/revascularization.
3. Recurrent intractable ventricular arrhythmias with hemodynamic instability.
4. Refractory post-MI angina as a bridge to angiography and revascularization.

Class IIa

1. Signs of hemodynamic instability, poor LV function, or persistent ischemia in patients with large areas of myocardium at risk.

Class IIb

1. In patients with successful PTCA after failed thrombolysis or those with three-vessel coronary disease to prevent reocclusion.
2. In patients known to have large areas of myocardium at risk with or without active ischemia.

Rhythm Disturbances

Atrial Fibrillation

Class I

1. Electrical cardioversion for patients with severe hemodynamic compromise or intractable ischemia.
2. Rapid digitalization to slow a rapid ventricular response and improve LV function.
3. Intravenous β -adrenoceptor blockers to slow a rapid ventricular response in patients without clinical LV dysfunction, bronchospastic disease, or AV block.
4. Heparin should be given.

Class IIa

1. Either diltiazem or verapamil intravenously to slow a rapid ventricular response if β -adrenoceptor blocking agents are contraindicated or ineffective.

Ventricular Tachycardia/Ventricular Fibrillation

Class I

1. Ventricular fibrillation (VF) should be treated with an unsynchronized electric shock with an initial energy of 200 J; if unsuccessful, a second shock of 200 to 300 J should be given, and, if necessary, a third shock of 360 J.
2. Sustained (more than 30 seconds or causing hemodynamic collapse) polymorphic ventricular tachycardia (VT) should be treated with an unsynchronized electric shock using an initial energy of 200 J; if unsuccessful, a second shock of 200 to 300 J should be given, and, if necessary, a third shock of 360 J.
3. Episodes of sustained monomorphic VT associated with angina, pulmonary edema, or hypotension (blood pressure less than 90 mm Hg) should be treated with a synchronized electric shock of 100 J initial energy. Increasing energies may be used if not initially successful.

4. Sustained monomorphic VT not associated with angina, pulmonary edema, or hypotension (blood pressure less than 90 mm Hg) should be treated with one of the following regimens:

- a. Lidocaine: bolus 1.0 to 1.5 mg/kg. Supplemental boluses of 0.5 to 0.75 mg/kg every 5 to 10 minutes to a maximum of 3 mg/kg total loading dose may be given as needed. Loading is followed by infusion of 2 to 4 mg/min (30 to 50 μ g/kg per minute).
- b. Procainamide: 20 to 30 mg/min loading infusion, up to 12 to 17 mg/kg. This may be followed by an infusion of 1 to 4 mg/min.
- c. Amiodarone: 150 mg infused over 10 minutes followed by a constant infusion of 1.0 mg/min for 6 hours and then a maintenance infusion of 0.5 mg/min.
- d. Synchronized electrical cardioversion starting at 50 J (brief anesthesia is necessary).

Class IIa

1. Infusions of antiarrhythmic drugs may be used after an episode of VT/VF but should be discontinued after 6 to 24 hours and the need for further arrhythmia management assessed.
2. Electrolyte and acid-base disturbances should be corrected to prevent recurrent episodes of VF when an initial episode of VF has been treated.

Class IIb

1. Drug-refractory polymorphic VT should be managed by aggressive attempts to reduce myocardial ischemia, including therapies such as β -adrenoceptor blockade, intra-aortic balloon pumping, and emergency PTCA/CABG surgery. Amiodarone, 150 mg infused over 10 minutes followed by a constant infusion of 1.0 mg/min for up to 6 hours and then a maintenance infusion of 0.5 mg/min may also be helpful.

Class III

1. Treatment of isolated ventricular premature beats, couplets, runs of accelerated idioventricular rhythm, and nonsustained VT.
2. Prophylactic administration of antiarrhythmic therapy when using thrombolytic agents.

Bradyarrhythmias and Heart Block

Atropine

Class I

1. Symptomatic sinus bradycardia (generally, heart rate less than 50 bpm associated with hypotension, ischemia, or escape ventricular arrhythmia).
2. Ventricular asystole.
3. Symptomatic AV block occurring at the AV nodal level (second-degree type I or third-degree with a narrow-complex escape rhythm).

Class IIa

None.

Class III

1. AV block occurring at an infranodal level (usually associated with anterior MI with a wide-complex escape rhythm).
2. Asymptomatic sinus bradycardia.

Temporary Pacing

Placement of Transcutaneous Patches* and Active (Demand) Transcutaneous Pacing†

Class I

1. Sinus bradycardia (rate less than 50 bpm) with symptoms of hypotension (systolic blood pressure less than 80 mm Hg) unresponsive to drug therapy.†
2. Mobitz type II second-degree AV block.†
3. Third-degree heart block.†
4. Bilateral BBB (alternating BBB, or right BBB [RBBB] and alternating left anterior fascicular block [LAFB], left posterior fascicular block [LPFB]) (irrespective of time of onset).*
5. Newly acquired or age-indeterminate LBBB, LBBB and LAFBa, RBBB, and LPFBa.*
6. RBBB or LBBB and first-degree AV block.*

* Transcutaneous patches applied; system may be attached and activated within a brief time if needed. Transcutaneous pacing may be very helpful as an urgent expedient. Because it is associated with significant pain, high-risk patients likely to require pacing should receive a temporary pacemaker.

† Apply patches and attach system; system is in either active or standby mode to allow immediate use on demand as required. In facilities in which transvenous pacing or expertise are not available to place an intravenous system, consideration should be given to transporting the patient to one equipped and competent in placing transvenous systems.

Class IIa

1. Stable bradycardia (systolic blood pressure greater than 90 mm Hg, no hemodynamic compromise, or compromise responsive to initial drug therapy).*
2. Newly acquired or age-indeterminate RBBB.*

Class IIb

1. Newly acquired or age-indeterminate first-degree AV block.*

Class III

1. Uncomplicated AMI without evidence of conduction system disease.

Temporary Transvenous Pacing†

Class I

1. Asystole.
2. Symptomatic bradycardia (includes sinus bradycardia with hypotension and type I second-degree AV block with hypotension not responsive to atropine).
3. Bilateral BBB (alternating BBB or RBBB with alternating LAFB/LPFB) (any age).
4. New or indeterminate-age bifascicular block (RBBB with LAFB or LPFB, or LBBB) with first-degree AV block.
5. Mobitz type II second-degree AV block.

Class IIa

1. RBBB and LAFB or LPFB (new or indeterminate).
2. RBBB with first-degree AV block.
3. LBBB, new or indeterminate.
4. Incessant VT, for atrial or ventricular overdrive pacing.
5. Recurrent sinus pauses (greater than 3 seconds) not responsive to atropine.

Class IIb

1. Bifascicular block of indeterminate age.
2. New or age-indeterminate isolated RBBB.

Class III

1. First-degree heart block.
2. Type I second-degree AV block with normal hemodynamics.
3. Accelerated idioventricular rhythm.
4. BBB or fascicular block known to exist before AMI.

Permanent Pacing After AMI

Class I

1. Persistent second-degree AV block in the His-Purkinje system with bilateral BBB or complete heart block after AMI.
2. Transient advanced (second- or third-degree) AV block and associated BBB.‡
3. Symptomatic AV block at any level.

Class IIb

1. Persistent advanced (second- or third-degree) block at the AV node level.

Class III

1. Transient AV conduction disturbances in the absence of intraventricular conduction defects.
2. Transient AV block in the presence of isolated LAFB.
3. Acquired LAFB in the absence of AV block.
4. Persistent first-degree AV block in the presence of BBB that is old or age indeterminate.

Other Surgical Interventions

Emergency or Urgent Cardiac Repair of Mechanical Defects

Class I

1. Papillary muscle rupture with severe acute mitral insufficiency.

* Transcutaneous patches applied; system may be attached and activated within a brief time if needed. Transcutaneous pacing may be very helpful as an urgent expedient. Because it is associated with significant pain, high-risk patients likely to require pacing should receive a temporary pacemaker.

† It should be noted that in choosing an intravenous pacemaker system, patients with substantially depressed ventricular performance, including right ventricular infarction, may respond better to atrial/AV sequential pacing than ventricular pacing.

‡ An electrophysiology study should be considered to assess the site and extent of heart block in uncertain cases.

JACC page no.	CIRC page no.	Original Recommendation (1996)	Revised Recommendation (1999)
1368–69	2348	<p>Emergency or Urgent Cardiac Repair of Mechanical Defects</p> <p><i>Class I</i></p> <p>2. Postinfarction VSD or free wall rupture and pulmonary edema or cardiogenic shock (emergency or urgent).</p>	<p>Emergency or Urgent Cardiac Repair of Mechanical Defects</p> <p><i>Class I</i></p> <p>2. Postinfarction VSD or free wall rupture.</p>

3. Postinfarction ventricular aneurysm associated with intractable ventricular tachyarrhythmias and/or pump failure (urgent).

Class III

1. Acute infarctectomy in hemodynamically stable patients.

Rationale and Approach to Pharmacotherapy

Antithrombotics/Anticoagulants

Heparin

Class I

1. Patients undergoing percutaneous or surgical revascularization.

JACC page no.	CIRC page no.	Original Recommendation (1996)	Revised Recommendation (1999)
1377–78	2348	<p>Heparin</p> <p><i>Class IIa</i></p> <p>1. Intravenously in patients undergoing reperfusion therapy with alteplase. Comment: The recommended regimen is 70 U/kg as a bolus at initiation of alteplase infusion, then an initial maintenance dose of $\approx 15 \mu\text{g}/\text{kg}$ per hour, adjusted to maintain aPTT at 1.5 to 2.0 times control (50 to 75 seconds) for 48 hours. Continuation of heparin infusion beyond 48 hours should be restricted to patients at high risk for systemic or venous thromboembolism.</p> <p>2. (new text)</p> <p>3. Subcutaneously (7500 U twice daily) (intravenous heparin is an acceptable alternative) in all patients not treated with thrombolytic therapy who do not have a contraindication to heparin. In patients who are at high risk for systemic emboli (large or anterior MI, atrial fibrillation [AF], previous embolus, or known LV thrombus), intravenous heparin is preferred.</p> <p>4. Intravenously in patients treated with nonselective thrombolytic agents (streptokinase, anistreplase, urokinase) who are at high risk for systemic emboli (large or anterior MI, AF, previous embolus, or known LV thrombus). Comment: It is recommended that heparin be withheld for 4 hours and that aPTT testing begin at that time. Heparin should be started when aPTT returns to < 2 times control (≈ 70 seconds), then infused to keep aPTT 1.5 to 2.0 times control (initial infusion rate ≈ 1000 U/h). After 48 hours, a change to subcutaneous heparin, warfarin, or aspirin alone should be considered.</p>	<p>Unfractionated Heparin</p> <p><i>Class IIa</i></p> <p>1. Intravenously in patients undergoing reperfusion therapy with alteplase. Comment: The recommended regimen is 60 U/kg as a bolus at initiation of alteplase infusion, then an initial maintenance dose of ≈ 12 U/kg per hour (with a maximum of 4000 U bolus and 1000 U/h infusion for patients weighing > 70 kg), adjusted to maintain aPTT at 1.5 to 2.0 times control (50 to 70 seconds) for 48 hours. Continuation of heparin infusion beyond 48 hours should be considered in patients at high risk for systemic or venous thromboembolism.</p> <p>2. Intravenous unfractionated heparin (UFH) or low-molecular-weight heparin (LMWH) subcutaneously for patients with non-ST-elevation MI.</p> <p>3. Subcutaneous UFH (eg, 7500 U BID) or LMWH (eg, enoxaparin 1 mg/kg BID) in all patients not treated with thrombolytic therapy who do not have a contraindication to heparin. In patients who are at high risk for systemic emboli (large or anterior MI, AF, previous embolus, or known LV thrombus), intravenous heparin is preferred.</p> <p>4. Intravenously in patients treated with nonselective thrombolytic agents (streptokinase, anistreplase, urokinase) who are at high risk for systemic emboli (large or anterior MI, AF, previous embolus, or known LV thrombus). Comment: It is recommended that heparin be withheld for 6 hours and that aPTT testing begin at that time. Heparin should be started when aPTT returns to < 2 times control (≈ 70 seconds), then infused to keep aPTT 1.5 to 2.0 times control (initial infusion rate ≈ 1000 U/h). After 48 hours, a change to subcutaneous heparin, warfarin, or aspirin alone should be considered.</p>

Class IIb

1. Patients treated with nonselective thrombolytic agents, not at high risk, subcutaneous heparin, 7500 U to 12 500 U twice a day until completely ambulatory.

Class III

1. Routine intravenous heparin within 6 hours to patients receiving a nonselective fibrinolytic agent (streptokinase, anistreplase, urokinase) who are not at high risk for systemic embolism.

β -Adrenoceptor Blocking Agents**Early Therapy**

JACC page no.	CIRC page no.	Original Recommendation (1996)	Revised Recommendation (1999)
1381-82	2348	β-Adrenoceptor Blocking Agents Early Therapy (see also "PredischARGE Preparation") <i>Class I</i> 1. Patients without a contraindication to β -adrenoceptor blocker therapy who can be treated within 12 hours of onset of infarction, irrespective of administration of concomitant thrombolytic therapy. 2. Patients with continuing or recurrent ischemic pain. 3. Patients with tachyarrhythmias, such as AF with a rapid ventricular response.	β-Adrenoceptor Blocking Agents Early Therapy <i>Class I</i> 1. Patients without a contraindication to β -adrenoceptor blocker therapy who can be treated within 12 hours of onset of infarction, irrespective of administration of concomitant thrombolytic therapy or performance of primary angioplasty.

JACC page no.	CIRC page no.	Original Recommendation (1996)	Revised Recommendation (1999)
1381-82	2348	4. (new text) <i>Class IIb</i> 1. Non-Q-wave MI. <i>Class III</i> 1. Patients with moderate or severe LV failure or other contraindications to β -adrenoceptor blocker therapy.	4. Non-ST-elevation MI. <i>Class IIb</i> 1. Patients with moderate LV failure (the presence of bibasilar rales without evidence of low cardiac output) or other relative contraindications to β -adrenoceptor blocker therapy, provided patients can be monitored closely. <i>Class III</i> 1. Patients with severe LV failure.

Angiotensin-Converting Enzyme Inhibitors

JACC page no.	CIRC page no.	Original Recommendation (1996)	Revised Recommendation (1999)
1382	2348	Angiotensin-Converting Enzyme Inhibitors <i>Class I</i> 1. Patients within the first 24 hours of a suspected AMI with ST-segment elevation in ≥ 2 anterior precordial leads or with clinical heart failure in the absence of significant hypotension or known contraindications to use of ACE inhibitors.	Angiotensin-Converting Enzyme Inhibitors <i>Class I</i> 1. Patients within the first 24 hours of a suspected AMI with ST-segment elevation in ≥ 2 anterior precordial leads or with clinical heart failure in the absence of hypotension (systolic BP <100 mm Hg) or known contraindications to use of ACE inhibitors.

2. Patients with MI and LV ejection fraction less than 40% or patients with clinical heart failure on the basis of systolic pump dysfunction during and after convalescence from AMI.

Class IIa

- All other patients within the first 24 hours of a suspected or established AMI, provided significant hypotension or other clear-cut contraindications are absent.
- Asymptomatic patients with mildly impaired LV function (ejection fraction 40% to 50%) and a history of old MI.

Class IIb

- Patients who have recently recovered from MI but have normal or mildly abnormal global LV function.

Calcium Channel Blockers**Class I**

- None.

Class IIa

- Verapamil or diltiazem may be given to patients in whom β -adrenoceptor blockers are ineffective or contraindicated (ie, bronchospastic disease) for relief of ongoing ischemia or control of a rapid ventricular response with AF after AMI in the absence of CHF, LV dysfunction, or AV block.

Class IIb

1. In non–ST-elevation infarction, diltiazem may be given to patients without LV dysfunction, pulmonary congestion, or CHF. It may be added to standard therapy after the first 24 hours and continued for 1 year.

Class III

1. Nifedipine (short acting) is generally contraindicated in routine treatment of AMI because of its negative inotropic effects and the reflex sympathetic activation, tachycardia, and hypotension associated with its use.
2. Diltiazem and verapamil are contraindicated in patients with AMI and associated LV dysfunction or CHF.

Magnesium**Class I**

None.

Class IIa

1. Correction of documented magnesium (and/or potassium) deficits, especially in patients receiving diuretics before onset of infarction.
2. Episodes of torsade de pointes–type VT associated with a prolonged QT interval should be treated with 1 to 2 g of magnesium administered as a bolus over 5 minutes.

Class IIb

1. Magnesium bolus and infusion in high-risk patients such as the elderly and/or those for whom reperfusion therapy is not suitable.

Preparation for Discharge From the Hospital**Noninvasive Evaluation of Low-Risk Patients****Class I**

1. Stress ECG
 - a. Before discharge for prognostic assessment or functional capacity (submaximal at 4 to 6 days or symptom limited at 10 to 14 days).
 - b. Early after discharge for prognostic assessment and functional capacity (14 to 21 days).
 - c. Late after discharge (3 to 6 weeks) for functional capacity and prognosis if early stress was submaximal.
2. Exercise, vasodilator stress nuclear scintigraphy, or exercise stress echocardiography when baseline abnormalities of the ECG compromise interpretation.*

Class IIa

1. Dipyridamole or adenosine stress perfusion nuclear scintigraphy or dobutamine echocardiography before discharge for prognostic assessment in patients judged to be unable to exercise.
2. Exercise two-dimensional echocardiography or nuclear scintigraphy (before or early after discharge for prognostic assessment).

Class III

1. Stress testing within 2 to 3 days of AMI.
2. Either exercise or pharmacological stress testing at any time to evaluate patients with unstable postinfarction angina pectoris.
3. At any time to evaluate patients with AMI who have uncompensated CHF, cardiac arrhythmia, or noncardiac conditions that severely limit their ability to exercise.
4. Before discharge to evaluate patients who have already been selected for cardiac catheterization. In this situation, an exercise test may be useful after catheterization to evaluate function or identify ischemia in distribution of a coronary lesion of borderline severity.

Assessment of Ventricular Arrhythmia—Routine Testing**Class I**

None.

Class IIa

None.

*Marked abnormalities in the resting ECG such as LBBB, LV hypertrophy with strain, ventricular pre-excitation, or a ventricular paced rhythm render a displacement of ST segments virtually uninterpretable. For patients taking digoxin or who have less than 1 mm ST depression on their resting tracing who undergo standard stress ECG testing, it must be realized that further ST depression with exercise may have minimal diagnostic significance.

Class IIb

1. Ambulatory (Holter) monitoring, signal-averaged ECG, heart rate variability, baroreflex sensitivity monitoring, alone or in combination with these or other tests, including functional tests (ejection fraction, treadmill testing) for risk assessment after MI, especially in patients at higher perceived risk, when findings might influence management issues, or for clinical research purposes.

Invasive Evaluation

Coronary Angiography and Possible PTCA

Class I

1. Patients with spontaneous episodes of myocardial ischemia or episodes of myocardial ischemia provoked by minimal exertion during recovery from infarction.
2. Before definitive therapy of a mechanical complication of infarction such as acute mitral regurgitation, VSD, pseudoaneurysm, or LV aneurysm.
3. Patients with persistent hemodynamic instability.

Class IIa

1. When MI is suspected to have occurred by a mechanism other than thrombotic occlusion at an atherosclerotic plaque. This would include coronary embolism, certain metabolic or hematological diseases, or coronary artery spasm.
2. Survivors of AMI with depressed LV systolic function (LV ejection fraction less than or equal to 40%), CHF, prior revascularization, or malignant ventricular arrhythmias.
3. Survivors of AMI who had clinical heart failure during the acute episode but subsequently demonstrated well-preserved LV function.

Class IIb

1. Coronary angiography performed in all patients after infarction to find persistently occluded infarct-related arteries in an attempt to revascularize the artery or to identify patients with three-vessel disease.
2. All patients after a non-Q-wave MI.
3. Recurrent VT or VF or both, despite antiarrhythmic therapy in patients without evidence of ongoing myocardial ischemia.

Class III

1. Routine use of coronary angiography and subsequent PTCA of the infarct-related artery within days after receiving thrombolytic therapy.
2. Survivors of MI who are thought not to be candidates for coronary revascularization.

Routine Coronary Angiography and PTCA After Successful Thrombolytic Therapy

Class I

None.

Class IIa

None.

Class III

1. Routine PTCA of the stenotic infarct-related artery immediately after thrombolytic therapy.
2. PTCA of the stenotic infarct-related artery within 48 hours of receiving a thrombolytic agent in asymptomatic patients without evidence of ischemia.

Secondary Prevention

Management of Lipids

Class I

1. The AHA Step II diet, which is low in saturated fat and cholesterol (less than 7% of total calories as saturated fat and less than 200 mg/d cholesterol), should be instituted in all patients after recovery from AMI.
2. Patients with LDL cholesterol levels greater than 125 mg/dL despite the AHA Step II diet should be placed on drug therapy with the goal of reducing LDL to less than 100 mg/dL.
3. Patients with normal plasma cholesterol levels who have a high-density lipoprotein (HDL) cholesterol level less than 35 mg/dL should receive nonpharmacological therapy (eg, exercise) designed to raise it.

Class IIa

1. Drug therapy may be added to diet in patients with LDL cholesterol levels less than 130 mg/dL but greater than 100 mg/dL after an appropriate trial of the AHA Step II diet alone.*
2. Patients with normal total cholesterol levels but HDL cholesterol less than 35 mg/dL despite diet and other non-pharmacological therapy may be started on drugs such as niacin to raise HDL levels.

JACC page no.	CIRC page no.	Original Recommendation (1996)	Revised Recommendation (1999)
1395	2349–50	Management of Lipids <i>Class IIb</i> 1. Drug therapy using either niacin or gemfibrozil may be added to diet regardless of LDL and HDL levels when triglyceride levels are >400 mg/dL.	Management of Lipids <i>Class IIb</i> 1. Drug therapy with either niacin or gemfibrozil may be added to diet regardless of LDL and HDL levels when triglyceride levels are >200 mg/dL.

Long-Term β -Adrenoceptor Blocker Therapy in Survivors of Myocardial Infarction

Class I

1. All but low-risk patients without a clear contraindication to β -adrenoceptor blocker therapy. Treatment should begin within a few days of the event (if not initiated acutely) and continue indefinitely.

Class IIa

1. Low-risk patients without a clear contraindication to β -adrenoceptor blocker therapy.

JACC page no.	CIRC page no.	Original Recommendation (1996)	Revised Recommendation (1999)
1397	2350	β-Adrenoceptor Blockers Long-Term Therapy in Survivors of Myocardial Infarction <i>Class IIa</i> 2. (new text) <i>(Class IIb</i> None.) <i>Class III</i> 1. Patients with a contraindication to β -adrenoceptor blocker therapy.	β-Blockers Long-Term Therapy in Survivors of Myocardial Infarction <i>Class IIa</i> 2. Survivors of non-ST-elevation MI. <i>Class IIb</i> 1. Patients with moderate or severe LV failure or other relative contraindication to β -adrenoceptor blocker therapy, provided patients can be monitored closely. <i>Class III</i> No recommendation.

Anticoagulants

Long-Term Anticoagulation After AMI

Class I

1. For secondary prevention of MI in post-MI patients unable to take daily aspirin.†
2. Post-MI patients in persistent AF.
3. Patients with LV thrombus.

Class IIa

1. Post-MI patients with extensive wall motion abnormalities.
2. Patients with paroxysmal AF.

Class IIb

1. Post-MI patients with severe LV systolic dysfunction with or without CHF.

* HMG-CoA reductase drugs produce the greatest lowering of LDL cholesterol. Niacin is less effective in lowering LDL, although it is more effective in raising HDL levels. Resins are rarely sufficiently effective to be used alone, but they may be used to supplement lowering LDL with either niacin or HMG-CoA reductase drugs.

† See “Initial Recognition and Management in the Emergency Department,” “Aspirin.”

Estrogen Replacement Therapy and Myocardial Infarction

JACC page no.	CIRC page no.	Original Recommendation (1996)	Revised Recommendation (1999)
1399	2350	Estrogen Replacement Therapy and Myocardial Infarction <i>Class IIa</i> 1. All postmenopausal patients who have an MI should be carefully counseled about the potential beneficial effects of estrogen replacement therapy (ERT) and offered the option of ERT if they desire it. 2. (New text)	Estrogen Replacement Therapy and Myocardial Infarction <i>Class IIa</i> 1. Hormone replacement therapy (HRT) with estrogen plus progestin for secondary prevention of coronary events should not be given de novo to postmenopausal women after AMI. 2. Postmenopausal women who are already taking HRT with estrogen plus progestin at the time of AMI can continue this therapy.

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1999 Update: ACC/AHA Guidelines for the Management of Patients With Acute Myocardial Infarction: Executive Summary and Recommendations: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction)

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