Diagnosing and Managing Unstable Angina

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Abstract This Quick Reference Guide for Clinicians contains recommendations on the care of patients with unstable angina based on a combination of evidence obtained through extensive literature reviews and consensus among members of an expert panel. Principal conclusions include the following. (1) Many patients suspected of having unstable angina can be discharged home after adequate initial evaluation. (2) Further outpatient evaluation may be scheduled for up to 72 hours after initial presentation for patients with clinical symptoms of unstable angina judged at initial evaluation to be at low risk for complications. (3) Patients with acute ischemic heart disease judged to be at intermediate or high risk of complications should be hospitalized for careful monitoring of their clinical course. (4) Intravenous thrombolytic therapy should not be administered to patients without evidence of ST segment elevation and acute myocardial infarction. (5) Assessment of prognosis by noninvasive testing often aids selection of appropriate therapy. (6) Coronary angiography is appropriate for patients judged to be at high risk for cardiac complications or death based on their clinical course or results of noninvasive testing. (7) Coronary artery bypass surgery should be recommended for almost all patients with left main disease and many patients with three-vessel disease, especially those with left ventricular dysfunction. (8) The discharge care plan should include continued monitoring of symptoms; appropriate drug therapy, including aspirin; risk-factor modification; and counseling. (Circulation. 1994;90:613-622.)

Purpose and Scope

Unstable angina is a transitory syndrome that causes significant disability and death in the United States. In 1991 alone, 570,000 hospitalizations for this principal diagnosis resulted in 3.1 million hospital days. Unstable angina most often results from disruption of an atherosclerotic plaque and the subsequent cascade of pathological processes that critically decrease coronary blood flow. In most but not all patients presenting with unstable angina (Table 1), symptoms are caused by significant coronary artery disease (CAD).

This article provides recommendations and supporting evidence for all aspects of the diagnosis and treatment of unstable angina in both the inpatient and outpatient settings.

Throughout this article, unstable angina is defined as a clinical syndrome falling between stable angina and myocardial infarction (MI) in the spectrum of patients with CAD.

See Table 2 for a listing of information to be entered into the medical record during each phase of care.

Initial Evaluation and Treatment

Initial Evaluation

Diagnosis of unstable angina depends on a careful clinical history, physical examination, and examination of a resting 12-lead ECG. Therefore, the initial evalu-
TABLE 1. Unstable Angina Presentations

| Presentation                             | Medical Therapy, and Increase Dosages as Appropriate for Symptom Management and As Tolerated. Consider Prescribing Long-Acting Forms of Antianginal Drugs for Enhanced Patient Compliance.

Intensive Medical Management

Intensive medical treatment should begin immediately in the emergency department in patients at high or intermediate risk of death or nonfatal MI. For high-risk patients, as such as those with ongoing angina at rest and/or those who appear unstable, simultaneous evaluation and treatment assume an urgency greater than for intermediate-risk patients, such as those with prior discomfort who are asymptomatic during the initial evaluation.

Establish intravenous access while simultaneously obtaining a brief cardiovascular history, physical examination, and ECG.

Institute daily aspirin and intravenous heparin plus nitrates and β-blockers, the latter to a heart rate of 50 to 60 beats per minute (Table 6).

Consider adding calcium channel blockers in the subset of patients who have significant hypertension (systolic blood pressure ≥150 mm Hg), in patients who have refractory ischemia on β-blockers, and in those with variant angina.

Recumbent symptoms after the initial hemodynamic goals of therapy have been achieved may be regarded as a failure of medical therapy and should prompt consideration of urgent cardiac catheterization. Although it is theoretically desirable to have the maximal medical regimen in place for ≥24 hours before declaring any patient a failure of medical therapy, to do so in all cases may be inappropriate or even dangerous.

Assign patients who have one or more recurrent severe, prolonged (>20 minutes) ischemic episodes, particularly when accompanied by pulmonary edema, a new or worsening mitral regurgitation murmur, hypotension, or new ST- or T-wave changes, to the high-risk category regardless of the level of medical therapy and triage them to early cardiac catheterization.

Assign patients with shorter, less severe ischemic episodes without accompanying hemodynamic or ECG changes to a substantially lower risk category and continue medical therapy.

Monitoring Medical Therapy

During the period of intensive medical therapy, appropriate monitoring includes the following.

Heparin

Obtain an activated partial thromboplastin time (aPTT) 6 hours after initial therapy is started or any dosage change occurs and every 6 hours thereafter until a therapeutic level of 1.5 to 2.5 times control is obtained on two consecutive aPTTs.

Obtain an aPTT every 24 hours, once a therapeutic range is achieved.

Obtain an immediate aPTT if the patient’s clinical condition changes significantly (eg, recurrent definite ischemia, bleeding, hypotension). Obtain an immediate hemoglobin/hematocrit and platelet determination if any of the following occur: clinically significant bleeding, recurrent symptoms, or hemodynamic instability.
**TABLE 2. Medical Record: Information to be Recorded in the Medical Record Summarizing Initial Evaluation and Management for Each Patient Includes the Following**

**After Initial Evaluation**
- Age and sex
- Duration and nature of symptoms before presentation
- Previous history of coronary artery disease; if yes, prior noninvasive test result, prior cardiac catheterization result, prior revascularization procedure (bypass or angioplasty)
- Medication and drug use
- Risk factors (diabetes, smoking, hypercholesterolemia, hypertension)
- Systemic causes for precipitating or exacerbating ischemia
- ECG interpretation
- Initial and final assignment of likelihood of coronary artery disease (high, intermediate, low) and basis
- Initial and final risk assignment (high, intermediate, low) and basis
- Summary of other pertinent positive and negative findings
- Major or minor complications of diagnosis or treatment
- Patient counseling, including assessment of patient response
- Disposition for further care
- Death classified as noncardiac or cardiac
- Cardiac deaths classified as precipitated by arrhythmia, progressive ischemia, or progressive cardiac failure

**After outpatient management**
- Results of ancillary clinical studies
- Final diagnosis
- Final disposition
- Effectiveness of antianginal medication used

**After intensive medical management**
- Intensity of pain (1-10) and duration (<20 min, <1 h, >1 h) of each episode of angina or equivalent ischemic symptoms
- Duration of longest anginal episode during the phase
- Summary of pharmacological therapy used
- Documentation of the status of patient teaching, including evidence of what the patient appears to understand
- Documentation of alternative treatment options discussed with the patient
- Documented plan for further care as patient with stable coronary artery disease

**After nonintensive medical management**
- Medications at the beginning and conclusion of this phase
- Number, severity, and duration of ischemic episodes
- Complications during this phase
- Evaluation of patient’s understanding of recommended lifestyle changes and assessment of the patient’s willingness to adhere to recommendations

**After noninvasive testing**
- Indications for test
- Type of test performed
- Summary of test results, including ECG changes, symptoms, hemodynamic changes, reason for termination (exercise tests)
- Test complications
- Summary of posttest prognosis (low, intermediate, high risk, or probability of adverse event calculation)

**After cardiac catheterization and myocardial revascularization**
- Reasons for cardiac catheterization
- Cardiac catheterization findings summarized by number of major coronary arteries with ≥70% stenosis, presence or absence of a ≥50% left main stenosis, left ventricular ejection fraction, presence and severity of valvular disease
- For patients undergoing interventional therapy, the primary reason for the procedure, indicated as enhanced survival, pain relief, both, or other
- Complications occurring during one procedure that led to another, different procedure (angioplasty failure leading to coronary artery bypass graft surgery), including assessment of severity at the beginning of the second procedure

**After hospital discharge**
- Indicate discharge medical regimen
- Major instructions about postdischarge activities and rehabilitation, and the patient’s understanding and plan for adherence to the recommendations

**At final outpatient visit**
- Summarize cardiac events
- Document current symptoms
- Medication changes since hospital discharge or last outpatient visit
TABLE 3. Likelihood of Significant CAD in Patients With Symptoms Suggesting Unstable Angina

<table>
<thead>
<tr>
<th>High Likelihood</th>
<th>Intermediate Likelihood</th>
<th>Low Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any of the following features</td>
<td>Absence of high likelihood features and any of the following</td>
<td>Absence of high or intermediate likelihood features but may have</td>
</tr>
<tr>
<td>Known history of CAD</td>
<td>Definite angina: mean &lt; 60 or women &lt; 70 years old</td>
<td>Chest pain, probably not angina</td>
</tr>
<tr>
<td>Definite angina: men ≥60 or women ≥70 years old</td>
<td>Probable angina: men &gt; 60 or women &gt; 70 years old</td>
<td>One risk factor but not diabetes</td>
</tr>
<tr>
<td>Hemodynamic changes or ECG changes with pain</td>
<td>Probably not angina in diabetics or in nondiabetics with two or more other risk factors*</td>
<td>T wave flat or inverted &lt; 1 mm in leads with dominant R waves</td>
</tr>
<tr>
<td>Variant angina</td>
<td>Extracardiac vascular disease</td>
<td>Normal ECG</td>
</tr>
<tr>
<td>ST increase or decrease ≥1 mm</td>
<td>ST depression 0.05 to 1 mm</td>
<td></td>
</tr>
<tr>
<td>Marked symmetrical T-wave inversion in multiple precordial leads</td>
<td>T-wave inversion ≥1 mm in leads with dominant R waves</td>
<td></td>
</tr>
</tbody>
</table>

*Coronary artery disease (CAD) risk factors include diabetes, smoking, hypertension, and elevated cholesterol.

drop in platelets necessitates close monitoring for heparin-induced thrombocytopenia.

Monitor hemoglobin/hematocrit and platelets daily for the first 3 days of heparin therapy.

β-Blockers

Monitor heart rate and blood pressure (target heart rate for β-blockade is 50 to 60 beats per minute).

Monitor for congestive heart failure and bronchospasm.

Use continuous ECG monitoring.

Discontinuation of Intravenous Therapy

Discontinue heparin after 3 to 5 days.

Convert to an oral regimen of β-blockers after the initial intravenous load in patients without limiting side effects. Selection of the oral agent should be based on the clinician's familiarity with the agent as well as the risk of adverse effects.

Change to oral or topical nitrate therapy when the patient has been symptom-free for 24 hours. Tolerance to nitrates is dose- and duration-dependent and typically becomes significant after only 24 hours of continuous therapy. Responsiveness can be enhanced by increasing the dose; switching the patient to a topical, oral, or buccal form of therapy; and using a nitrate-free interval of 6 to 8 hours.

Reassessing Persistent Symptoms

Most patients stabilize and have improvement in their chest pain after 30 minutes of aggressive medical management and can be admitted to an intensive care unit or intermediate care unit. Failure to respond to initial therapy should prompt reconsideration of other possible serious causes of chest pain, including (1) ongoing acute MI, (2) aortic dissection, (3) pulmonary embolism, (4) pneumothorax, (5) esophageal rupture, and (6) rupture or ischemia of intra-abdominal organs.

Treatment of Severe Ischemia Refractory to Aggressive Initial Therapy

Patients considered to have unstable angina after further evaluation and who fail to respond within 30 minutes to initial treatment are at increased risk for MI or cardiac death. The major ischemic complications seen in unstable angina are recurrent unstable angina, acute ischemic pulmonary edema, new or worsening mitral regurgitation, cardiogenic shock, malignant ventricular arrhythmias, and advanced atrioventricular block. For these patients, in addition to maximizing the medical regimen described in the previous section and instituting appropriate adjunctive therapy (eg, pulmonary artery pressure monitoring and inotropic therapy for shock, antiarrhythmic therapy for malignant ventricular arrhythmias, pacemaker for symptomatic high-grade atrioventricular block), the clinician should consider insertion of an intra-aortic balloon pump and cardiac catheterization.

If emergency cardiac catheterization is not possible, an intra-aortic balloon pump should be placed in unstable angina patients who have symptoms refractory to medical management and those who have symptoms in conjunction with hemodynamic instability. An intra-aortic balloon pump can also serve as a bridge to stabilize the patient on the way to the catheterization laboratory or operating room. Exceptions to this recommendation include patients with severe peripheral vascular disease, significant aortic insufficiency, or known severe aortoiliac disease, including aortic aneurysm.

Refer for urgent diagnostic catheterization patients who have received an intra-aortic balloon pump for stabilization. Transfer patients who have received an intra-aortic balloon pump for stabilization to a facility capable of providing diagnostic catheterization and revascularization.

Reevaluate patients who have not stabilized after placement of the pump to reaffirm the diagnosis of
TABLE 5. Short-term Risk of Death or Nonfatal Myocardial Infarction in Patients With Symptoms Suggesting Unstable Angina

<table>
<thead>
<tr>
<th>High Risk</th>
<th>Intermediate Risk</th>
<th>Low Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least one of the following features must be present</td>
<td>No high-risk feature but must have any of the following</td>
<td>No high- or intermediate-risk feature but may have any of the following</td>
</tr>
<tr>
<td>Prolonged ongoing (&gt;20 min) rest pain</td>
<td>Rest angina now resolved but not low likelihood of CAD</td>
<td>Increased angina frequency, severity, or duration</td>
</tr>
<tr>
<td>Pulmonary edema</td>
<td>Rest angina (&gt;20 min or relieved with rest or nitroglycerin)</td>
<td>Angina provoked at a lower threshold</td>
</tr>
<tr>
<td>Angina with new or worsening mitral regurgitation murmurs</td>
<td>Angina with dynamic T-wave changes</td>
<td>New-onset angina within 2 weeks to 2 months</td>
</tr>
<tr>
<td>Rest angina with dynamic ST changes ≥1 mm</td>
<td>Nocturnal angina</td>
<td>Normal or unchanged ECG</td>
</tr>
<tr>
<td>Angina with S3 or rales</td>
<td>New-onset CCSC III or IV angina in past 2 weeks but not low likelihood of CAD</td>
<td></td>
</tr>
<tr>
<td>Angina with hypotension</td>
<td>Q waves or ST depression ≥1 mm in multiple leads</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Age &gt;65 years</td>
<td></td>
</tr>
</tbody>
</table>

CAD indicates coronary artery disease; CCSC, Canadian Cardiovascular Society Classification.

acute ischemic heart disease and then consider for emergency catheterization.

Selection of Further Therapy in Stabilized Patients

For patients who stabilize after initial treatment, this guideline proposes two alternative strategies for definitive treatment of unstable angina: "early invasive" and "early conservative" (Table 7).

Patients who prefer continued intensive medical management and patients who are not candidates for revascularization should continue to receive care at a level and duration dictated by the level of their disease activity.

Fig 2 describes the cardiac catheterization and myocardial revascularization phase.

Progression to Nonintensive Medical Therapy

Most patients with unstable angina stabilize and become pain-free with appropriate intensive medical management. Transfer from intensive to nonintensive medical management occurs when (1) the patient is hemodynamically stable (including no uncompensated congestive heart failure) for ≥24 hours and (2) ischemia has been successfully suppressed for ≥24 hours. Once these criteria are reached, (1) convert parenteral to nonparenteral medications. (2) Reassess heparin use. Discontinue in selected patients (for example, those found to have a secondary cause for ischemia such as anemia). Continue for 2 to 5 days in others. (3) Continue aspirin at 80 to 324 mg/d. (4) Ensure that appropriate enzyme levels are obtained: total creatinine kinase (CK) and CK-MB (cardiac muscle) every 6 to 8 hours for the first 24 hours after admission. Lactate dehydrogenase levels may be useful in detecting cardiac damage in patients presenting between 24 and 72 hours after symptom onset.

Obtain a follow-up 12-lead ECG 24 hours after admission or whenever the patient has recurrent symptoms or a change in clinical status.

Obtain a chest radiograph within 48 hours of admission in all stable patients. In hemodynamically unstable patients, obtain a chest radiograph initially and repeat as necessary.

Measure resting left ventricular function in patients who do not have early cardiac catheterization but who have had previous infarct or who have cardiomegaly by physical examination or chest radiograph. Either a radionuclide ventriculogram or a two-dimensional echocardiogram may be used.

Nonintensive Medical Management

Patients with unstable angina judged to be at moderate risk may be admitted initially to a monitored intermediate care unit until the diagnosis of MI can be
### Table 6. Drugs Commonly Used in Intensive Medical Management of Patients With Unstable Angina

<table>
<thead>
<tr>
<th>Drug Category</th>
<th>Clinical Condition</th>
<th>When to Avoid*</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspirin†</td>
<td>Unstable angina</td>
<td>Hypersensitivity</td>
<td>324 mg (160-324) daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Active bleeding</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Severe bleeding risk</td>
<td></td>
</tr>
<tr>
<td>Heparin</td>
<td>Unstable angina in high-risk category</td>
<td>Active bleeding</td>
<td>80 units/kg IV bolus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>History of heparin-induced thrombocytopenia</td>
<td>Constant IV infusion at 18 U·kg⁻¹·h⁻¹</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Severe bleeding risk</td>
<td>Titrated to maintain aPTT between 1.5 to 2.5 times control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recent stroke</td>
<td></td>
</tr>
<tr>
<td>Nitrates</td>
<td>Symptoms are not fully relieved with three sublingual nitroglycerin tablets and initiation of β-blocker therapy</td>
<td>Hypotension</td>
<td>5 to 10 μg/min by continuous infusion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Titrated up to 75 to 100 μg/min until relief of symptoms or limiting side effects (headache or hypotension with a systolic blood pressure &lt;90 mm Hg or more than 30% below starting mean arterial pressure levels if significant hypertension is present)</td>
</tr>
<tr>
<td>β-Blockers‡</td>
<td>Unstable angina</td>
<td>PR ECG segment &gt;0.24 seconds</td>
<td>Metoprolol</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2° or 3° atrioventricular block</td>
<td>5-mg increments by slow (over 1 to 2 minutes) IV administration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heart rate &lt;60 beats per minute</td>
<td>Repeated every 5 minutes for a total initial dose of 15 mg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blood pressure &lt;90 mm Hg</td>
<td>Followed in 1 to 2 hours by 25 to 50 mg by mouth every 6 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shock</td>
<td>If a very conservative regimen is desired, initial doses can be reduced to 1 to 2 mg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left ventricular failure with congestive heart failure</td>
<td>Propranolol</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Severe reactive airway disease</td>
<td>0.5 to 1.0 mg IV dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Followed in 1 to 2 hours by 40 to 80 mg by mouth every 6 to 8 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Esmolol</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Starting maintenance dose of 0.1 mg·kg⁻¹·min IV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Titration in increments of 0.05 mg·kg⁻¹·min every 10 to 15 minutes as tolerated by blood pressure until the desired therapeutic response has been obtained, limiting symptoms develop, or a dose of 0.20 mg·kg⁻¹·min is reached</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Optional loading dose of 0.5 mg/kg may be given by slow IV administration (2 to 5 minutes) for more rapid onset of action</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Atenolol</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5-mg IV dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Followed 5 minutes later by a second 5-mg IV dose and then 50 to 100 mg orally every day initiated 1 to 2 hours after the IV dose</td>
</tr>
</tbody>
</table>

*IV indicates intravenous; aPTT, activated partial thromboplastin time.

†Allergy or prior intolerance contraindication for all categories of drugs listed in this chart.

‡Choice of the specific agent is not as important as ensuring that appropriate candidates receive this therapy. If there are concerns about patient intolerance due to existing pulmonary disease, especially asthma, left ventricular dysfunction, or risk of hypotension or severe bradycardia, initial selection should favor a short-acting agent, such as propranolol or metoprolol or the ultra-short-acting agent esmolol. Mild wheezing or a history of chronic obstructive pulmonary disease should prompt a trial of a short-acting agent at a reduced dose (eg, 2.5 mg IV metoprolol, 12.5 mg oral metoprolol, or 25 μg · kg⁻¹ · min⁻¹ esmolol as initial doses) rather than complete avoidance of β-blocker therapy.

Note: Some of the recommendations in this guide suggest the use of agents for purposes or in doses other than those specified by the Food and Drug Administration. Such recommendations are made after consideration of concerns regarding nonapproved indications. Where made, such recommendations are based on more recent clinical trials or expert consensus.
excluded and it is clear that the patient's symptoms are adequately controlled on medical therapy. These patients then enter the nonintensive phase of management.

Other moderate-risk and some low-risk patients may be admitted directly to a regular hospital bed with telemetry capabilities, thereby proceeding directly to the nonintensive phase. High-risk unstable angina patients will be moved to the nonintensive phase after 1 or more days of intensive management and stabilization.

Once patients reach the nonintensive phase of management, reasons for continued hospitalization include optimization of medical therapy, evaluation of the propensity for recurrent ischemia or ischemic complications, and risk stratification to determine the need for catheterization and revascularization.

Discontinue continuous monitoring of the ECG in this phase for most patients.

Instruct all patients to notify nursing personnel immediately if chest discomfort recurs.

Recurrent ischemic episodes should prompt a brief nursing assessment and an emergent ECG and should be brought to the attention of a physician.

Reevaluate the patient's medical regimen and adjust doses of anti-ischemic agents as tolerated.

Encourage the patient to progress gradually to a level of activity, under the observation of the health care team, commensurate with that required to perform activities of daily living.

Advise the patient and his or her family regarding risk-factor modification and have them work with the health care team to set appropriate goals.

Many patients reaching this phase will be referred within 1 to 2 days for either noninvasive functional testing or cardiac catheterization.

Recurrence of Pain and Return to Intensive Management

Transfer patients who have pain or ECG evidence of ischemia increasing in severity >20 minutes and unresponsive to nitroglycerin back to the intensive medical management phase protocol.

Patients who respond to sublingual nitroglycerin generally do not need to return to intensive medical management. However, a second recurrence of chest pain of at least 20 minutes' duration in the setting of appropriate medical therapy should prompt return of the patient to a monitored environment and the management steps outlined in the intensive management phase.

Noninvasive Testing

The goals of noninvasive testing in a recently stabilized patient with unstable angina are to estimate the subsequent prognosis, especially for the next 3 to 6 months, decide which additional tests and adjustments in therapy are required based on this prognosis, and provide the patient with the information and reassurances necessary to return to a lifestyle as full and productive as possible (Fig 3).

Conduct exercise or pharmacological stress testing of low-risk patients with unstable angina who are to be managed as outpatients, unless contraindicated.

Perform noninvasive testing within 72 hours of presentation (in most cases) in low-risk patients who are to be managed as outpatients.

Perform noninvasive exercise or pharmacological stress testing in low- or intermediate-risk patients hospitalized with unstable angina who have been stabilized and free of angina and congestive heart failure for a minimum of 48 hours, unless cardiac catheterization is indicated.

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TABLE 6. Continued

<table>
<thead>
<tr>
<th>Drug Category</th>
<th>Clinical Condition</th>
<th>When to Avoid*</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium channel blockers</td>
<td>Patients whose symptoms are not relieved by adequate doses of nitrates and β-blockers or in patients unable to tolerate adequate doses of one or both of these agents or in patients with variant angina</td>
<td>Pulmonary edema; Evidence of left ventricular dysfunction</td>
<td>Dependent on specific agent</td>
</tr>
<tr>
<td>Morphine sulfate</td>
<td>Patients whose symptoms are not relieved after three serial sublingual nitroglycerin tablets or whose symptoms recur with adequate anti-ischemic therapy</td>
<td>Hypotension; Respiratory depression; Confusion; Obtundation</td>
<td>2- to 5-mg IV dose; May be repeated every 5 to 30 minutes as needed to relieve symptoms and maintain patient comfort</td>
</tr>
</tbody>
</table>

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TABLE 7. Alternative Early Strategies for Treatment of Unstable Angina

Early invasive strategy

All hospitalized patients with unstable angina and without contraindications receive cardiac catheterization within 48 hours of presentation.

Early conservative strategy

Unless contraindicated, hospitalized patients with unstable angina receive a cardiac catheterization if they have one or more of the following high-risk indicators: prior revascularization; associated congestive heart failure or depressed left ventricular function (ejection fraction <0.50) by noninvasive study; malignant ventricular arrhythmia; persistent or recurrent pain/ischemia; and/or a functional study indicating high risk. All other patients receive medical management and undergo cardiac catheterization only when medical management fails.
Choice of Test

Base the choice of the stress testing modality on an evaluation of the patient's resting ECG, ability to perform exercise, and the local expertise and technologies available.

Use the exercise treadmill test as the standard mode of stress testing in patients with a normal ECG who are not taking digoxin.

Test patients with widespread resting ST depression (≥1 mm), ST changes secondary to digoxin, left ventricular hypertrophy, left bundle branch block/significant intraventricular conduction deficit, or preexcitation with an imaging modality.

Use pharmacological stress testing in combination with an imaging modality for patients unable to exercise because of physical limitations (eg, arthritis, amputation, severe peripheral vascular disease, general debility).

An exercise treadmill test is the most commonly used stress test and has the largest reported experience for use in patients with unstable angina. A nomogram useful to convert results from this test into an assessment of risk has been derived on a large sample of patients with CAD exclusively (not in patients presenting with unstable angina) (see the Clinical Practice Guideline, Unstable Angina: Diagnosis and Management). Use of this nomogram to quantify risk from results of treadmill examinations provides more clinically useful information than a simple normal/abnormal reading.

Interpreting Noninvasive Test Results

Implications and appropriate follow-up for the exercise treadmill tests are outlined in Table 8.

Cardiac Catheterization and Myocardial Revascularization

Indications for Cardiac Catheterization

The goal of cardiac catheterization in patients with unstable angina is to provide detailed structural information necessary to assess prognosis and select an appropriate long-term management strategy. The procedure is usually helpful in choosing between medical therapy, percutaneous transluminal coronary angioplasty, and coronary artery bypass graft surgery in patients at significant risk for future cardiac events (Fig 2).

Patients undergoing cardiac catheterization include those managed under either the "early invasive" or "early conservative" strategies defined in Table 7, patients undergoing emergency catheterization directly from the emergency room, and those who experienced recurrent ischemic episodes while being managed as outpatients.

Patients with contraindications to revascularization because of extensive comorbidity and patients who do not wish to consider interventional therapy should not undergo diagnostic catheterization.

Consider the possibility of noncoronary origin of symptoms in patients found at catheterization to have normal coronary arteries or insignificant lesions.

Myocardial Revascularization

Refer patients found at catheterization to have significant left main CAD (≥50%) or significant (≥70%) three-vessel disease with depressed left ventricular function (ejection fraction <0.50) for coronary artery bypass graft surgery.

Refer patients with two-vessel disease with proximal severe subtotal stenosis (≥95%) of the left anterior descending artery and depressed left ventricular function for revascularization.

Consider for prompt revascularization (angioplasty or coronary artery bypass grafting) patients with significant CAD if they have any of the following: failure to stabilize with medical treatment; recurrent angina/isch-
emor at rest or with low-level activities; and/or ischemia accompanied by congestive heart failure symptoms, an S3 gallop, new or worsening mitral regurgitation, or definite ECG changes.

For some patients without these high-risk features, revascularization may still be an option, depending on recurrent symptoms, test results, and patient preferences. The health care team should educate the patient and his or her family or advocate about the expected risks and benefits of revascularization and determine individual patient preferences and fears that may affect the selection of therapy.

**Hospital Discharge and Postdischarge Care**

The need for continued hospitalization of the patient with unstable angina is determined by whether the objectives of the hospital admission have been achieved. Patients who have undergone successful revascularization will usually have the remainder of their hospitalization defined by the standard protocol for the given procedure (eg, 1 to 2 days for angioplasty, 5 to 7 days for coronary artery bypass graft surgery).

Patients opting for medical treatment after a cardiac catheterization or functional study include both a low-risk group that can be rapidly discharged (eg, 1 to 2 days after testing) and a high-risk group unsuitable for or unwilling to have coronary revascularization. These patients may require a prolonged hospitalization to ensure adequate (or as adequate as possible) symptom control.

The goal during the hospital discharge phase is to prepare the patient for normal activities to the extent possible.

**Patient Counseling**

Give specific instructions on smoking cessation, daily exercise, and diet.

Consider referral, where possible and appropriate, to a smoking-cessation program or clinic and/or an outpatient cardiac rehabilitation program.

Discuss resumption of sexual relations (eg, 2 weeks for low-risk patients to 4 weeks for postsurgery coronary artery bypass graft patients).

Give specific instructions, beyond "daily exercise," on activities that are permissible and those that should be avoided (eg, heavy lifting, climbing stairs, yard work, household activities).

Discuss resumption of driving and return to work.

### Table 8. Implications of Stress Test Results

<table>
<thead>
<tr>
<th>Prognosis*</th>
<th>Implications</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted average annual cardiac mortality &lt;1%/yr</td>
<td>Low risk</td>
<td>Manage medically, no need for referral to cardiac catheterization</td>
</tr>
<tr>
<td>Predicted average annual cardiac mortality 2%-3%/yr</td>
<td>Intermediate risk†</td>
<td>Refer for additional testing, either cardiac catheterization or an alternative exercise imaging study</td>
</tr>
<tr>
<td>Predicted average annual cardiac mortality ≥4%/yr</td>
<td>High risk</td>
<td>Refer for prompt cardiac catheterization</td>
</tr>
</tbody>
</table>


†A stress test result of intermediate risk combined with evidence of left ventricular dysfunction should prompt referral to cardiac catheterization.

### Discharge Medical Regimen

Continue all patients on aspirin, 80 to 324 mg/d, indefinitely after discharge unless contraindications are present.

Continue medications necessary to achieve adequate symptom control.

Consider discontinuation of antianginal therapy in patients with successful revascularization without recurrent ischemia.

If patients have unsuccessful revascularization or recurrent symptoms following revascularization, continue the antianginal regimen required in hospital to control their symptoms.

Instruct patients who are continuing on antianginal therapy on the use of sublingual nitroglycerin.

Continue antihypertensive and antihyperlipidemic workups and therapies started before admission or initiated in the hospital.

Plan for follow-up medical care at the time of discharge whenever possible.

### Following and Monitoring Symptoms

Schedule follow-up of low-risk patients and patients with successful coronary artery bypass grafting or angioplasty at 2 to 6 weeks and higher-risk patients at 1 to 2 weeks.

Instruct the patient (and relevant family members or advocate) in the purpose, dose, and major side effects of each medicine prescribed, using language the patient can understand.

Give specific instructions for the proper use of sublingual nitroglycerin, especially since response of chest pain to this medication is useful in assessing the nature of recurrent symptoms.

Instruct the patient that recurrent symptoms lasting more than 1 to 2 minutes should prompt him or her to stop all activities, sit down, and place a nitroglycerin tablet under the tongue. This may be repeated twice at 5-minute intervals for two additional tablets. If symptoms persist after three nitroglycerin tablets have been taken, the patient should promptly seek medical attention.

Instruct the patient that if symptoms change in pattern (eg, asymptomatic to symptomatic, more frequent or more severe symptoms), he or she should contact his or her primary care physician and discuss whether changes in the management plan are warranted.
Instruct the patient to seek transportation to the nearest hospital emergency department, either by ambulance or by the fastest available alternative, if he or she cannot reach a physician and chest pain persists for more than 20 minutes or despite three nitroglycerin tablets.

The natural history of unstable angina is typically characterized by either progression to nonfatal MI or death on the one hand or resumption of the more quiescent clinical course of chronic stable angina/CAD on the other. The acute phase of unstable angina is usually over within 4 to 6 weeks. The goal of postdischarge outpatient care is to make adjustments in the discharge regimen that appear most appropriate after an initial period away from direct patient care.

The long-term management of unstable angina ends as the patient reenters the stable phase of CAD.

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General References

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