Appropriate Use Criteria for Diagnostic Catheterization
Guideline Mapping Document

Section 1: Coronary Angiography with or without
Left Heart Catheterization and Left Ventriculography

Table 1.1 Suspected or Known Acute Coronary Syndrome

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1.</td>
<td>Cardiogenic shock due to suspected ACS</td>
</tr>
</tbody>
</table>

**PCI, STEMI, UA/NSTEMI Update (2011 Proposed DRAFT)**

5.2.2.1. Coronary Angiography Strategies in STEMI

CLASS I

1. A strategy of immediate coronary angiography with intent to perform PCI (or emergency CABG) in patients with STEMI is recommended in:
   a. Patients who are candidates for primary PCI (2-6). *(Level of Evidence: A)*
   b. Patients with severe heart failure or cardiogenic shock who are suitable candidates for revascularization (7,8). *(Level of Evidence: A)*

2. ST-segment elevation myocardial infarction or suspected STEMI

**PCI, STEMI, UA/NSTEMI Update (2011 Proposed DRAFT)**

5.2.2.1. Coronary Angiography Strategies in STEMI

CLASS I

1. A strategy of immediate coronary angiography with intent to perform PCI (or emergency CABG) in patients with STEMI is recommended in:
   a. Patients who are candidates for primary PCI (2-6). *(Level of Evidence: A)*
   b. Patients with severe heart failure or cardiogenic shock who are suitable candidates for revascularization (7,8). *(Level of Evidence: A)*

CLASS IIa

1. A strategy of immediate coronary angiography (or transfer for immediate coronary angiography) with intent to perform PCI is reasonable for patients with STEMI, moderate to large area of myocardium at risk, and evidence of failed fibrinolysis (9,10). *(Level of Evidence: B)*

2. A strategy of coronary angiography (or transfer for immediate coronary angiography) 3 to 24 hours after initiating fibrinolytic therapy with intent to perform PCI is reasonable for hemodynamically stable patients with STEMI and evidence for successful fibrinolysis, when angiography and revascularization can be performed as soon as logically feasible in this time frame (11-15). *(Level of Evidence: A)*

CLASS IIb

1. A strategy of coronary angiography performed before hospital discharge might be reasonable in stable patients with STEMI who did not undergo cardiac catheterization within 24 hours of STEMI onset. *(Level of Evidence: C)*
### CLASS III: No Benefit

1. A strategy of coronary angiography with intent to perform PCI is not recommended in patients with STEMI in whom the risk of revascularization are likely to outweigh the benefits or when the patient or designee does not want invasive care. (*Level of Evidence: C*)

### 3. UA/NSTEMI

#### PCI, STEMI, UA/NSTEMI Update (2011 Proposed DRAFT)

### 5.2.1. UA/NSTEMI

#### CLASS I

1. An early invasive strategy (i.e., diagnostic angiography with intent to perform revascularization) is indicated in UA/NSTEMI patients who have refractory angina or hemodynamic or electrical instability (without serious comorbidities or contraindications to such procedures) (16-18). (*Level of Evidence: B*)

2. An early invasive strategy (i.e., diagnostic angiography with intent to perform revascularization) is indicated in initially stabilized UA/NSTEMI patients (without serious comorbidities or contraindications to such procedures) who have an elevated risk for clinical events (16,18,19). (*Level of Evidence: A*)

#### CLASS IIa

1. It is reasonable to implement an early invasive strategy (within 12 to 24 hours of admission) over a delayed invasive strategy for initially stabilized high-risk patients with UA/NSTEMI (20). (*Level of Evidence: B*)

#### CLASS III

1. An early invasive strategy (i.e., diagnostic angiography with intent to perform revascularization) is not recommended in patients with extensive comorbidities (e.g., liver or pulmonary failure, cancer), in whom (*Level of Evidence: C*):
   a. the risks of revascularization and comorbid conditions are likely to outweigh the benefits of revascularization.
   b. in patients with acute chest pain and a low likelihood of ACS.
   c. in patients who will not consent to revascularization regardless of the findings.

### 4. Suspected ACS with newly diagnosed LV wall motion abnormality or newly diagnosed resting myocardial perfusion defect

No relevant guidelines

**References:**


Table 1.2 Suspected CAD: No Prior Noninvasive Stress Imaging (No Prior PCI, CABG, or Angiogram Showing ≥50% Angiographic Stenosis)

<table>
<thead>
<tr>
<th>Asymptomatic</th>
<th>CHRONIC STABLE ANGINA</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Low global CAD risk</td>
<td>Class III</td>
</tr>
</tbody>
</table>

**CHRONIC STABLE ANGINA**

Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina, Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms

**CLASS III**

2. Patients with an overriding personal desire for a definitive diagnosis and a low probability of CAD. *(Level of Evidence: C)*

**6. Intermediate global CAD risk**

**CHRONIC STABLE ANGINA**

Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina, Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms

**CLASS IIb**

2. Patients with an overriding desire for a definitive diagnosis and a greater-than-low probability of CAD. *(Level of Evidence: C)*

Coronary Angiography for Risk Stratification in Patients With Chronic Stable Angina
CLASS I
1. Patients with disabling (Canadian Cardiovascular Society [CCS] classes III and IV) chronic stable angina despite medical therapy. (Level of Evidence: B)
3. Patients with angina who have survived sudden cardiac death or serious ventricular arrhythmia. (Level of Evidence: B)
4. Patients with angina and symptoms and signs of CHF. (Level of Evidence: C)
5. Patients with clinical characteristics that indicate a high likelihood of severe CAD. (Level of Evidence: C)

CLASS IIa
1. Patients with significant LV dysfunction (ejection fraction less than 45%), CCS class I or II angina, and demonstrable ischemia but less than high-risk criteria on noninvasive testing. (Level of Evidence: C)
2. Patients with inadequate prognostic information after noninvasive testing. (Level of Evidence: C)

CLASS IIb
1. Patients with CCS class I or II angina, preserved LV function (ejection fraction greater than 45%), and less than high-risk criteria on noninvasive testing. (Level of Evidence: C)
2. Patients with CCS class III or IV angina, which with medical therapy improves to class I or II. (Level of Evidence: C)
3. Patients with CCS class I or II angina but intolerance (unacceptable side effects) to adequate medical therapy. (Level of Evidence: C)

7. High global CAD risk

CHRONIC STABLE ANGINA
Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina, Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms
CLASS IIa
6. Patients with a high pretest probability of left main or three-vessel CAD. (Level of Evidence: C)

CLASS IIb
2. Patients with an overriding desire for a definitive diagnosis and a greater-than-low probability of CAD. (Level of Evidence: C)

Coronary Angiography for Risk Stratification in Asymptomatic Patients
CLASS IIb
2. Patients with clinical characteristics that indicate a high likelihood of severe CAD. (Level of Evidence: C)

Coronary Angiography for Risk Stratification in Patients With Chronic Stable Angina
CLASS I
1. Patients with disabling (Canadian Cardiovascular Society [CCS] classes III and IV) chronic stable angina despite medical therapy. (Level of Evidence: B)
3. Patients with angina who have survived sudden cardiac death or serious ventricular arrhythmia. (Level of Evidence: B)
4. Patients with angina and symptoms and signs of CHF. (Level of Evidence: C)
5. Patients with clinical characteristics that indicate a high likelihood of severe CAD. (Level of Evidence: C)
<table>
<thead>
<tr>
<th>CLASS IIb</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Patients with CCS class III or IV angina, which with medical therapy improves to class I or II. <em>(Level of Evidence: C)</em></td>
</tr>
<tr>
<td>3. Patients with CCS class I or II angina but intolerance (unacceptable side effects) to adequate medical therapy. <em>(Level of Evidence: C)</em></td>
</tr>
</tbody>
</table>

**Symptomatic**

8. Low pretest probability

**CHRONIC STABLE ANGINA**

Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina, Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms

**CLASS III**

2. Patients with an overriding personal desire for a definitive diagnosis and a low probability of CAD. *(Level of Evidence: C)*

9. Intermediate pretest probability

**CHRONIC STABLE ANGINA**

Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina, Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms

**CLASS IIb**

2. Patients with an overriding desire for a definitive diagnosis and a greater-than-low probability of CAD. *(Level of Evidence: C)*

**Coronary Angiography for Risk Stratification in Patients With Chronic Stable Angina**

**CLASS I**

1. Patients with disabling (Canadian Cardiovascular Society [CCS] classes III and IV) chronic stable angina despite medical therapy. *(Level of Evidence: B)*

2. Patients with angina who have survived sudden cardiac death or serious ventricular arrhythmia. *(Level of Evidence: B)*

3. Patients with clinical characteristics that indicate a high likelihood of severe CAD. *(Level of Evidence: C)*

**CLASS IIa**

1. Patients with significant LV dysfunction (ejection fraction less than 45%), CCS class I or II angina, and demonstrable ischemia but less than high-risk criteria on noninvasive testing. *(Level of Evidence: C)*

2. Patients with inadequate prognostic information after noninvasive testing. *(Level of Evidence: C)*

**CLASS IIb**

1. Patients with CCS class I or II angina, preserved LV function (ejection fraction greater than 45%), and less than high-risk criteria on noninvasive testing. *(Level of Evidence: C)*

2. Patients with CCS class III or IV angina, which with medical therapy improves to class I or II. *(Level of Evidence: C)*
3. Patients with CCS class I or II angina but intolerance (unacceptable side effects) to adequate medical therapy. 
   *(Level of Evidence: C)*

10. High pretest probability

**CHRONIC STABLE ANGINA**

**Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina, Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms**

**CLASS IIa**

6. Patients with a high pretest probability of left main or three-vessel CAD. *(Level of Evidence: C)*

**CLASS IIb**

2. Patients with an overriding desire for a definitive diagnosis and a greater-than-low probability of CAD. *(Level of Evidence: C)*

**Coronary Angiography for Risk Stratification in Asymptomatic Patients**

**CLASS IIb**

2. Patients with clinical characteristics that indicate a high likelihood of severe CAD. *(Level of Evidence: C)*

**Coronary Angiography for Risk Stratification in Patients With Chronic Stable Angina**

**CLASS I**

1. Patients with disabling (Canadian Cardiovascular Society [CCS] classes III and IV) chronic stable angina despite medical therapy. *(Level of Evidence: B)*

3. Patients with angina who have survived sudden cardiac death or serious ventricular arrhythmia. *(Level of Evidence: B)*

4. Patients with angina and symptoms and signs of CHF. *(Level of Evidence: C)*

5. Patients with clinical characteristics that indicate a high likelihood of severe CAD. *(Level of Evidence: C)*

**CLASS IIb**

2. Patients with CCS class III or IV angina, which with medical therapy improves to class I or II. *(Level of Evidence: C)*

3. Patients with CCS class I or II angina but intolerance (unacceptable side effects) to adequate medical therapy. *(Level of Evidence: C)*

Reference:

### Table 1.3 Suspected CAD: Prior Noninvasive Testing (No Prior PCI, CABG, or Angiogram Showing ≥50% Angiographic Stenosis)

<table>
<thead>
<tr>
<th>ECG Stress Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Low-risk findings (e.g., Duke Treadmill score ≥5)</td>
</tr>
<tr>
<td>No relevant guidelines</td>
</tr>
<tr>
<td>12. Intermediate-risk findings (e.g., Duke Treadmill score 4 to -10)</td>
</tr>
<tr>
<td>No relevant guidelines</td>
</tr>
<tr>
<td>13. High-risk findings (e.g., Duke Treadmill score ≤-11)</td>
</tr>
</tbody>
</table>

#### CHRONIC STABLE ANGINA

**Coronary Angiography for Risk Stratification in Patients With Chronic Stable Angina**

CLASS I

2. Patients with high-risk criteria on noninvasive testing (Table 23) regardless of anginal severity. (*Level of Evidence: B*)

**Coronary Angiography for Risk Stratification in Asymptomatic Patients**

CLASS IIa

1. Patients with high-risk criteria suggesting ischemia on noninvasive testing (Table 23, items 2-9). (*Level of Evidence: C*)

14. Other high-risk findings (ST-segment elevation, hypotension with exercise, ventricular tachycardia, prolonged ST segment depression)

#### CHRONIC STABLE ANGINA

**Coronary Angiography for Risk Stratification in Patients With Chronic Stable Angina**

CLASS I

2. Patients with high-risk criteria on noninvasive testing (Table 23) regardless of anginal severity. (*Level of Evidence: B*)

**Coronary Angiography for Risk Stratification in Asymptomatic Patients**

CLASS IIa

1. Patients with high-risk criteria suggesting ischemia on noninvasive testing (Table 23, items 2-9). (*Level of Evidence: C*)

#### Stress Test With Imaging

*(SPECT MPI, Stress Echocardiography, Stress PET, Stress CMR)*

15. Low-risk findings (e.g., <5% ischemic myocardium on stress SPECT MPI or stress PET, no stress-induced wall motion abnormalities on stress echo or stress CMR)

No relevant guidelines
16. Intermediate-risk findings (e.g., 5-10% ischemic myocardium on stress SPECT MPI or stress PET, stress-induced wall motion abnormality in a single segment on stress echo or stress CMR)

No relevant guidelines

17. High-risk findings (e.g., >10% ischemic myocardium on stress SPECT MPI or stress PET, stress-induced wall motion abnormality in two or more segments on stress echo or stress CMR)

### CHRONIC STABLE ANGINA

**Coronary Angiography for Risk Stratification in Patients With Chronic Stable Angina**

**CLASS I**
2. Patients with high-risk criteria on noninvasive testing (Table 23) regardless of anginal severity. *(Level of Evidence: B)*

**Coronary Angiography for Risk Stratification in Asymptomatic Patients**

**CLASS IIa**
1. Patients with high-risk criteria suggesting ischemia on noninvasive testing (Table 23, items 2-9). *(Level of Evidence: C)*

18. Other high-risk finding (e.g., transient ischemic dilation, significant stress-induced LV dysfunction)

### CHRONIC STABLE ANGINA

**Coronary Angiography for Risk Stratification in Patients With Chronic Stable Angina**

**CLASS I**
2. Patients with high-risk criteria on noninvasive testing (Table 23) regardless of anginal severity. *(Level of Evidence: B)*

**Coronary Angiography for Risk Stratification in Asymptomatic Patients**

**CLASS IIa**
1. Patients with high-risk criteria suggesting ischemia on noninvasive testing (Table 23, items 2-9). *(Level of Evidence: C)*

19. Discordant findings (e.g., low risk prior imaging with ongoing symptoms c/w ischemic equivalent)

### CHRONIC STABLE ANGINA

**Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina, Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms**

**CLASS IIa**
1. Patients with an uncertain diagnosis after noninvasive testing in whom the benefit of a more certain diagnosis outweighs the risk and cost of coronary angiography. *(Level of Evidence: C)*

**Coronary Angiography for Risk Stratification in Patients With Chronic Stable Angina**

**CLASS IIa**
2. Patients with inadequate prognostic information after noninvasive testing. *(Level of Evidence: C)*
## Coronary Angiography for Risk Stratification in Asymptomatic Patients

**CLASS IIb**

1. Patients with inadequate prognostic information after noninvasive testing. *(Level of Evidence: C)*

20. Discordant findings (e.g., low risk stress imaging with high risk stress ECG response or stress-induced typical angina)

## CHRONIC STABLE ANGINA

**Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina, Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms**

**CLASS IIa**

1. Patients with an uncertain diagnosis after noninvasive testing in whom the benefit of a more certain diagnosis outweighs the risk and cost of coronary angiography. *(Level of Evidence: C)*

## Coronary Angiography for Risk Stratification in Patients With Chronic Stable Angina

**CLASS IIa**

2. Patients with inadequate prognostic information after noninvasive testing. *(Level of Evidence: C)*

## Coronary Angiography for Risk Stratification in Asymptomatic Patients

**CLASS IIb**

1. Patients with inadequate prognostic information after noninvasive testing. *(Level of Evidence: C)*

21. Equivocal/uninterpretable findings (e.g., perfusion defect vs. attenuation artifact, uninterpretable stress imaging)

## CHRONIC STABLE ANGINA

**Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina, Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms**

**CLASS IIa**

1. Patients with an uncertain diagnosis after noninvasive testing in whom the benefit of a more certain diagnosis outweighs the risk and cost of coronary angiography. *(Level of Evidence: C)*

## Coronary Angiography for Risk Stratification in Patients With Chronic Stable Angina

**CLASS IIa**

2. Patients with inadequate prognostic information after noninvasive testing. *(Level of Evidence: C)*

## Coronary Angiography for Risk Stratification in Asymptomatic Patients

**CLASS IIb**

1. Patients with inadequate prognostic information after noninvasive testing. *(Level of Evidence: C)*

22. Fixed perfusion defect on SPECT MPI or a persistent wall motion abnormality on stress echo c/w infarction without significant ischemia (<5% myocardium ischemic)

No relevant guidelines
23. Baseline resting LV dysfunction (i.e., LVEF ≤40%) AND Evidence (e.g., PET, CMR, delayed thallium uptake, dobutamine echo) of myocardial viability in dysfunctional segment

No relevant guidelines

<table>
<thead>
<tr>
<th>Echocardiography (TTE)</th>
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<tbody>
<tr>
<td>24. Newly recognized LV systolic dysfunction (i.e., LVEF ≤40%) with an unknown etiology</td>
</tr>
</tbody>
</table>

**HEART FAILURE**

3. Initial and Serial Clinical Assessment of Patients Presenting With Heart Failure (UPDATED)

CLASS I

1. Coronary arteriography should be performed in patients presenting with HF who have angina or significant ischemia unless the patient is not eligible for revascularization of any kind (4-8). (Level of Evidence: B)

CLASS IIa

2. Coronary arteriography is reasonable for patients presenting with HF who have chest pain that may or may not be of cardiac origin who have not had evaluation of their coronary anatomy and who have no contraindications to coronary revascularization. (Level of Evidence: C)

3. Coronary arteriography is reasonable for patients presenting with HF who have known or suspected coronary artery disease but who do not have angina unless the patient is not eligible for revascularization of any kind. (Level of Evidence: C)

**CHRONIC STABLE ANGINA**

Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina, Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms

CLASS IIa

1. Patients with an uncertain diagnosis after noninvasive testing in whom the benefit of a more certain diagnosis outweighs the risk and cost of coronary angiography. (Level of Evidence: C)

25. Newly recognized LV systolic dysfunction (i.e., LVEF 41-49%) with an unknown etiology

**HEART FAILURE**

3. Initial and Serial Clinical Assessment of Patients Presenting With Heart Failure (UPDATED)

CLASS I

4. Coronary arteriography should be performed in patients presenting with HF who have angina or significant ischemia unless the patient is not eligible for revascularization of any kind (4-8). (Level of Evidence: B)

CLASS IIa

5. Coronary arteriography is reasonable for patients presenting with HF who have chest pain that may or may not be of cardiac origin who have not had evaluation of their coronary anatomy and who have no contraindications to coronary revascularization. (Level of Evidence: C)

6. Coronary arteriography is reasonable for patients presenting with HF who have known or suspected coronary
artery disease but who do not have angina unless the patient is not eligible for revascularization of any kind.
(Level of Evidence: C)

**CHRONIC STABLE ANGINA**

Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina,
Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms

CLASS IIa

1. Patients with an uncertain diagnosis after noninvasive testing in whom the benefit of a more certain diagnosis
   outweighs the risk and cost of coronary angiography. *(Level of Evidence: C)*

26. New regional wall motion abnormality with an unknown etiology and normal LV systolic function

**CHRONIC STABLE ANGINA**

Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina,
Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms

CLASS IIa

1. Patients with an uncertain diagnosis after noninvasive testing in whom the benefit of a more certain diagnosis
   outweighs the risk and cost of coronary angiography. *(Level of Evidence: C)*

27. Suspected significant ischemic complication related to CAD (e.g., ischemic MR or VSD)

No relevant guidelines

<table>
<thead>
<tr>
<th>Coronary Calcium Score</th>
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<tbody>
<tr>
<td>28. Agatston Score &lt;100</td>
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<tr>
<td>No relevant guidelines</td>
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<tr>
<td>29. Agatston Score 100-400</td>
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<td>No relevant guidelines</td>
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<tr>
<td>30. Agatston Score 400-1,000</td>
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<tr>
<td>No relevant guidelines</td>
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<tr>
<td>31. Agatston Score &gt;1,000</td>
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<td>No relevant guidelines</td>
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<thead>
<tr>
<th>Coronary CTA</th>
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<tbody>
<tr>
<td>32. Lesion 0 – 49% non-left main</td>
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<td>No relevant guidelines</td>
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**CHRONIC STABLE ANGINA**

**Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina, Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms**

CLASS IIa

1. Patients with an uncertain diagnosis after noninvasive testing in whom the benefit of a more certain diagnosis outweighs the risk and cost of coronary angiography. *(Level of Evidence: C)*

**Coronary Angiography for Risk Stratification in Patients With Chronic Stable Angina**

CLASS IIa

2. Patients with inadequate prognostic information after noninvasive testing. *(Level of Evidence: C)*

**Coronary Angiography for Risk Stratification in Asymptomatic Patients**

CLASS IIb

1. Patients with inadequate prognostic information after noninvasive testing. *(Level of Evidence: C)*

**Lesion of unclear significance, possibly obstructive (left main)**

**CHRONIC STABLE ANGINA**

**Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina, Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms**

CLASS IIa

1. Patients with an uncertain diagnosis after noninvasive testing in whom the benefit of a more certain diagnosis outweighs the risk and cost of coronary angiography. *(Level of Evidence: C)*

**Coronary Angiography for Risk Stratification in Patients With Chronic Stable Angina**

CLASS IIa

2. Patients with inadequate prognostic information after noninvasive testing. *(Level of Evidence: C)*

**Coronary Angiography for Risk Stratification in Asymptomatic Patients**

CLASS IIb

1. Patients with inadequate prognostic information after noninvasive testing. *(Level of Evidence: C)*
38. Lesion <50% with extensive partly calcified and non-calcified plaque

No relevant guidelines

CMR

39. Area of delayed gadolinium myocardial enhancement of unknown etiology

No relevant guidelines

References:


Table 1.4 Adjunctive Invasive Diagnostic Testing in Patients Undergoing Appropriate Diagnostic Coronary Angiography

<table>
<thead>
<tr>
<th>FFR for Lesion Severity</th>
<th></th>
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<tbody>
<tr>
<td>40. Angiographically indeterminate severity LMCA stenosis (defined as two or more orthogonal views contradictory whether stenosis &gt;50%)</td>
<td>No relevant guidelines</td>
</tr>
</tbody>
</table>

PCI, STEMI, UA/NSTEMI Update (2011 Proposed DRAFT)

5.4.1 Fractional Flow Reserve
CLASS IIa
1. FFR is reasonable to assess angiographic intermediate coronary lesions (50% to 70% diameter stenosis) and can be useful in guiding revascularization decisions in patients with SIHD (2-6). (Level of Evidence: A)

43. Angiographically obstructive significant disease (non-LMCA) ≥70% stenosis

No relevant guidelines

**IVUS for Lesion Severity**
44. Angiographically indeterminate LMCA stenosis (defined as two or more orthogonal views contradictory whether stenosis >50%)

**PCI, STEMI, UA/NSTEMI Update (2011 Proposed DRAFT)**
5.4.2. Intravascular Ultrasound
CLASS IIa
1. IVUS is reasonable for the assessment of angiographically indeterminate left main CAD (7-9). (Level of Evidence: B)

CLASS III: No Benefit
1. IVUS for routine lesion assessment is not recommended when revascularization with PCI or CABG is not being contemplated. (Level of Evidence: C)

45. Non-obstructive disease by angiography (non-LMCA) <50%

**PCI, STEMI, UA/NSTEMI Update (2011 Proposed DRAFT)**
5.4.2. Intravascular Ultrasound
CLASS IIb
1. IVUS may be reasonable for the assessment of non-left main coronary arteries with angiographically intermediate coronary stenosis (50% to 70% diameter stenosis) (7, 10-11). (Level of Evidence: B)

CLASS III: No Benefit
1. IVUS for routine lesion assessment is not recommended when revascularization with PCI or CABG is not being contemplated. (Level of Evidence: C)

46. Angiographically intermediate disease (non-LMCA) 50% – 69%

**PCI, STEMI, UA/NSTEMI Update**
5.4.2. Intravascular Ultrasound
CLASS IIb
1. IVUS may be reasonable for the assessment of non-left main coronary arteries with angiographically intermediate coronary stenosis (50% to 70% diameter stenosis) (7, 10-11). (Level of Evidence: B)

CLASS III: No Benefit
1. IVUS for routine lesion assessment is not recommended when revascularization with PCI or CABG is not being contemplated. (Level of Evidence: C)
47. Angiographically obstructive significant disease (non-LMCA) ≥70% stenosis

No relevant guidelines

**IVUS – Examination of Lesion or Artery Morphology**

48. Coronary lesions or structures difficult to characterize angiographically (e.g., aneurysm, extent of calcification, stent fracture, stent apposition, stent expansion, dissections) or for sizing of vessel before stent placement

**PCI, STEMI, UA/NSTEMI Update (2011 Proposed DRAFT)**

5.4.2. Intravascular Ultrasound

CLASS IIa

1. IVUS is reasonable for the assessment of angiographically indeterminant left main CAD (7-9). (*Level of Evidence: B*)

CLASS III: No Benefit

1. IVUS for routine lesion assessment is not recommended when revascularization with PCI or CABG is not being contemplated. (*Level of Evidence: C*)

References:


**Table 1.5 Patients With Known Obstructive CAD (e.g., Prior MI, Prior PCI, Prior CABG, or Obstructive Disease on Invasive Angiography)**

<table>
<thead>
<tr>
<th>Medically Managed Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>49. Low-risk noninvasive findings</td>
</tr>
</tbody>
</table>

No relevant guidelines
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.</td>
<td>Intermediate-risk noninvasive findings</td>
</tr>
<tr>
<td></td>
<td>No relevant guidelines</td>
</tr>
<tr>
<td>51.</td>
<td>High-risk noninvasive findings</td>
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<tr>
<td></td>
<td>No relevant guidelines</td>
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<tr>
<td></td>
<td><strong>Post Revascularization (PCI or CABG)</strong></td>
</tr>
<tr>
<td>52.</td>
<td>Asymptomatic or stable symptoms</td>
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<tr>
<td></td>
<td>No relevant guidelines</td>
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<tr>
<td>53.</td>
<td>Low-risk noninvasive findings</td>
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<tr>
<td></td>
<td>Worsening or limiting symptoms</td>
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<tr>
<td></td>
<td>No relevant guidelines</td>
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<tr>
<td>54.</td>
<td>Intermediate-risk noninvasive findings</td>
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<tr>
<td></td>
<td>Worsening or limiting symptoms</td>
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<td>No relevant guidelines</td>
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<tr>
<td>55.</td>
<td>High-risk noninvasive findings</td>
</tr>
<tr>
<td></td>
<td>Worsening or limiting symptoms</td>
</tr>
<tr>
<td></td>
<td>No relevant guidelines</td>
</tr>
<tr>
<td></td>
<td><strong>Post Revascularization (PCI)</strong></td>
</tr>
<tr>
<td>56.</td>
<td>Asymptomatic</td>
</tr>
<tr>
<td></td>
<td>Prior unprotected left main PCI</td>
</tr>
<tr>
<td></td>
<td>No relevant guidelines</td>
</tr>
</tbody>
</table>

References: None

**Table 1.6 Arrhythmias**

<table>
<thead>
<tr>
<th>Etiology Unclear After Initial Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>57. Resuscitated cardiac arrest with return of spontaneous circulation</td>
</tr>
</tbody>
</table>

**VENTRICULAR ARRHYTHMIAS**

**5.2.5. Left Ventricular Function and Imaging**

CLASS Ila

2. Coronary angiography can be useful in establishing or excluding the presence of significant obstructive CHD in...
patients with life-threatening ventricular arrhythmias or in survivors of SCD, who have an intermediate or greater probability of having CHD by age, symptoms, and gender. (Level of Evidence: C)

7.4. Polymorphic VT
CLASS I
4. Urgent angiography with a view to revascularization should be considered for patients with polymorphic VT when myocardial ischemia cannot be excluded. (Level of Evidence: C)

CHRONIC STABLE ANGINA

Recommendations for Coronary Angiography to Establish a Diagnosis in Patients With Suspected Angina, Including Those With Known CAD Who Have a Significant Change in Anginal Symptoms
CLASS I
1. Patients with known or possible angina pectoris who have survived sudden cardiac death. (Level of Evidence: B)

58. VF or sustained VT with or without symptoms

VENTRICULAR ARRHYTHMIAS

5.2.5. Left Ventricular Function and Imaging
CLASS IIa
2. Coronary angiography can be useful in establishing or excluding the presence of significant obstructive CHD in patients with life-threatening ventricular arrhythmias or in survivors of SCD, who have an intermediate or greater probability of having CHD by age, symptoms, and gender. (Level of Evidence: C)

7.4. Polymorphic VT
CLASS I
4. Urgent angiography with a view to revascularization should be considered for patients with polymorphic VT when myocardial ischemia cannot be excluded. (Level of Evidence: C)

59. Nonsustained VT (<6 beat VT)
Normal LV systolic function

VENTRICULAR ARRHYTHMIAS

5.2.5. Left Ventricular Function and Imaging
CLASS IIa
2. Coronary angiography can be useful in establishing or excluding the presence of significant obstructive CHD in patients with life-threatening ventricular arrhythmias or in survivors of SCD, who have an intermediate or greater probability of having CHD by age, symptoms, and gender. (Level of Evidence: C)

7.4. Polymorphic VT
CLASS I
4. Urgent angiography with a view to revascularization should be considered for patients with polymorphic VT when myocardial ischemia cannot be excluded. (Level of Evidence: C)
<table>
<thead>
<tr>
<th></th>
<th>No Prior Noninvasive Assessment of Ischemia With Normal Systolic Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>60.</td>
<td>Syncope</td>
</tr>
<tr>
<td>No relevant guidelines</td>
<td></td>
</tr>
<tr>
<td>61.</td>
<td>New-onset atrial fibrillation or flutter</td>
</tr>
<tr>
<td>No relevant guidelines</td>
<td></td>
</tr>
<tr>
<td>62.</td>
<td>Heart block (e.g., second degree type II or third degree AV block) OR Symptomatic bradyarrhythmias</td>
</tr>
<tr>
<td>No relevant guidelines</td>
<td></td>
</tr>
<tr>
<td>63.</td>
<td>Newly diagnosed LBBB</td>
</tr>
<tr>
<td>No relevant guidelines</td>
<td></td>
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</tbody>
</table>

References:


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### Table 1.7 Preoperative Coronary Evaluation for Noncardiac Surgery in Stable Patients

<table>
<thead>
<tr>
<th></th>
<th>No relevant guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>64.</td>
<td>Low risk surgery</td>
</tr>
<tr>
<td>No relevant guidelines</td>
<td></td>
</tr>
<tr>
<td>65.</td>
<td>≥4 METS functional capacity without symptoms</td>
</tr>
<tr>
<td>No relevant guidelines</td>
<td></td>
</tr>
<tr>
<td>66.</td>
<td>Prior to solid organ transplantation</td>
</tr>
<tr>
<td>No relevant guidelines</td>
<td></td>
</tr>
</tbody>
</table>

<4 METS Functional Capacity, No Noninvasive Testing Performed, With or Without Clinical Risk Factors Present (Preoperative Clinical Risk Factors: Ischemic Heart Disease, Heart Failure, Cerebrovascular Disease, Insulin requiring Diabetes Mellitus, Renal Insufficiency Cr >2.0)
### Section 2: Right Heart Catheterization Alone or Combined Right and Left Heart Catheterization
With or Without Left Ventriculography and Coronary Angiography

#### Table 2.1 Valvular Disease

<table>
<thead>
<tr>
<th>No risk factors</th>
<th>No relevant guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 risk factors</td>
<td>No relevant guidelines</td>
</tr>
<tr>
<td>≥3 risk factors</td>
<td>No relevant guidelines</td>
</tr>
</tbody>
</table>

References: None

#### VALVULAR HEART DISEASE

##### 3.2.3.7. Indications for Cardiac Catheterization

**CLASS I**

1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is indicated for assessment of severity of regurgitation, LV function, or aortic root size when noninvasive tests are inconclusive or discordant with clinical findings in patients with AR. *(Level of Evidence: B)*

2. Coronary angiography is indicated before AVR in patients at risk for CAD. *(Level of Evidence: C)*

**CLASS III**

1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function, aortic root size, or severity of regurgitation before AVR when noninvasive tests are adequate and concordant with clinical findings and coronary angiography is not needed. *(Level of Evidence: C)*

2. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function and severity of regurgitation in asymptomatic patients when noninvasive tests are adequate. *(Level of Evidence: C)*

##### 3.6.3.8. Indications for Cardiac Catheterization

**CLASS I**

1. Left ventriculography and hemodynamic measurements are indicated when noninvasive tests are inconclusive
regarding severity of MR, LV function, or the need for surgery. *(Level of Evidence: C)*

2. Hemodynamic measurements are indicated when pulmonary artery pressure is out of proportion to the severity of MR as assessed by noninvasive testing. *(Level of Evidence: C)*

3. Left ventriculography and hemodynamic measurements are indicated when there is a discrepancy between clinical and noninvasive findings regarding severity of MR. *(Level of Evidence: C)*

4. Coronary angiography is indicated before MV repair or MV replacement in patients at risk for CAD. *(Level of Evidence: C)*

**CLASS III**

1. Left ventriculography and hemodynamic measurements are not indicated in patients with MR in whom valve surgery is not contemplated. *(Level of Evidence: C)*

---

72. Left ventricular dysfunction out of proportion to the severity of valvular disease

**VALVULAR HEART DISEASE**

3.2.3.7. Indications for Cardiac Catheterization

**CLASS I**

1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is indicated for assessment of severity of regurgitation, LV function, or aortic root size when noninvasive tests are inconclusive or discordant with clinical findings in patients with AR. *(Level of Evidence: B)*

2. Coronary angiography is indicated before AVR in patients at risk for CAD. *(Level of Evidence: C)*

**CLASS III**

1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function, aortic root size, or severity of regurgitation before AVR when noninvasive tests are adequate and concordant with clinical findings and coronary angiography is not needed. *(Level of Evidence: C)*

2. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function and severity of regurgitation in asymptomatic patients when noninvasive tests are adequate. *(Level of Evidence: C)*

3.6.3.8. Indications for Cardiac Catheterization

**CLASS I**

1. Left ventriculography and hemodynamic measurements are indicated when noninvasive tests are inconclusive regarding severity of MR, LV function, or the need for surgery. *(Level of Evidence: C)*

2. Hemodynamic measurements are indicated when pulmonary artery pressure is out of proportion to the severity of MR as assessed by noninvasive testing. *(Level of Evidence: C)*

3. Left ventriculography and hemodynamic measurements are indicated when there is a discrepancy between clinical and noninvasive findings regarding severity of MR. *(Level of Evidence: C)*

4. Coronary angiography is indicated before MV repair or MV replacement in patients at risk for CAD. *(Level of Evidence: C)*

**CLASS III**

1. Left ventriculography and hemodynamic measurements are not indicated in patients with MR in whom valve surgery is not contemplated. *(Level of Evidence: C)*
Chronic Native or Prosthetic Valvular Disease
Asymptomatic Related to Valvular Disease

73. Mild or moderate mitral stenosis

VALVULAR HEART DISEASE
3.4.7. Indications for Invasive Hemodynamic Evaluation

CLASS I
1. Cardiac catheterization for hemodynamic evaluation should be performed for assessment of severity of MS when noninvasive tests are inconclusive or when there is discrepancy between noninvasive tests and clinical findings regarding severity of MS. (Level of Evidence: C)
2. Catheterization for hemodynamic evaluation including left ventriculography (to evaluate severity of MR) for patients with MS is indicated when there is a discrepancy between the Doppler-derived mean gradient and valve area. (Level of Evidence: C)

CLASS IIa
1. Cardiac catheterization is reasonable to assess the hemodynamic response of pulmonary artery and left atrial pressures to exercise when clinical symptoms and resting hemodynamics are discordant. (Level of Evidence: C)
2. Cardiac catheterization is reasonable in patients with MS to assess the cause of severe pulmonary arterial hypertension when out of proportion to severity of MS as determined by noninvasive testing. (Level of Evidence: C)

CLASS III
1. Diagnostic cardiac catheterization is not recommended to assess the MV hemodynamics when 2D and Doppler echocardiographic data are concordant with clinical findings. (Level of Evidence: C)

74. Severe mitral stenosis

VALVULAR HEART DISEASE
3.4.7. Indications for Invasive Hemodynamic Evaluation

CLASS I
1. Cardiac catheterization for hemodynamic evaluation should be performed for assessment of severity of MS when noninvasive tests are inconclusive or when there is discrepancy between noninvasive tests and clinical findings regarding severity of MS. (Level of Evidence: C)
2. Catheterization for hemodynamic evaluation including left ventriculography (to evaluate severity of MR) for patients with MS is indicated when there is a discrepancy between the Doppler-derived mean gradient and valve area. (Level of Evidence: C)

CLASS IIa
1. Cardiac catheterization is reasonable to assess the hemodynamic response of pulmonary artery and left atrial pressures to exercise when clinical symptoms and resting hemodynamics are discordant. (Level of Evidence: C)
2. Cardiac catheterization is reasonable in patients with MS to assess the cause of severe pulmonary arterial hypertension when out of proportion to severity of MS as determined by noninvasive testing. (Level of Evidence: C)

CLASS III
1. Diagnostic cardiac catheterization is not recommended to assess the MV hemodynamics when 2D and Doppler echocardiographic data are concordant with clinical findings. *(Level of Evidence: C)*

### 75. Mild or moderate mitral regurgitation

**VALVULAR HEART DISEASE**

#### 3.6.3.8. Indications for Cardiac Catheterization

**CLASS I**

1. Left ventriculography and hemodynamic measurements are indicated when noninvasive tests are inconclusive regarding severity of MR, LV function, or the need for surgery. *(Level of Evidence: C)*

2. Hemodynamic measurements are indicated when pulmonary artery pressure is out of proportion to the severity of MR as assessed by noninvasive testing. *(Level of Evidence: C)*

3. Left ventriculography and hemodynamic measurements are indicated when there is a discrepancy between clinical and noninvasive findings regarding severity of MR. *(Level of Evidence: C)*

4. Coronary angiography is indicated before MV repair or MV replacement in patients at risk for CAD. *(Level of Evidence: C)*

**CLASS III**

1. Left ventriculography and hemodynamic measurements are not indicated in patients with MR in whom valve surgery is not contemplated. *(Level of Evidence: C)*

### 76. Severe mitral regurgitation

**VALVULAR HEART DISEASE**

#### 3.6.3.8. Indications for Cardiac Catheterization

**CLASS I**

1. Left ventriculography and hemodynamic measurements are indicated when noninvasive tests are inconclusive regarding severity of MR, LV function, or the need for surgery. *(Level of Evidence: C)*

2. Hemodynamic measurements are indicated when pulmonary artery pressure is out of proportion to the severity of MR as assessed by noninvasive testing. *(Level of Evidence: C)*

3. Left ventriculography and hemodynamic measurements are indicated when there is a discrepancy between clinical and noninvasive findings regarding severity of MR. *(Level of Evidence: C)*

4. Coronary angiography is indicated before MV repair or MV replacement in patients at risk for CAD. *(Level of Evidence: C)*

**CLASS III**

1. Left ventriculography and hemodynamic measurements are not indicated in patients with MR in whom valve surgery is not contemplated. *(Level of Evidence: C)*

### 77. Mild or moderate aortic stenosis
VALVULAR HEART DISEASE

3.1.5. Indications for Cardiac Catheterization

CLASS I
1. Coronary angiography is recommended before AVR in patients with AS at risk for CAD (see Section 10.2). (Level of Evidence: B)
2. Cardiac catheterization for hemodynamic measurements is recommended for assessment of severity of AS in symptomatic patients when noninvasive tests are inconclusive or when there is a discrepancy between noninvasive tests and clinical findings regarding severity of AS. (Level of Evidence: C)

CLASS III
1. Cardiac catheterization for hemodynamic measurements is not recommended for the assessment of severity of AS before AVR when noninvasive tests are adequate and concordant with clinical findings. (Level of Evidence: C)
2. Cardiac catheterization for hemodynamic measurements is not recommended for the assessment of LV function and severity of AS in asymptomatic patients. (Level of Evidence: C)

3.1.6. Low-Flow/Low-Gradient Aortic Stenosis

CLASS IIa
2. Cardiac catheterization for hemodynamic measurements with infusion of dobutamine can be useful for evaluation of patients with low-flow/low-gradient AS and LV dysfunction. (Level of Evidence: C)

78. Severe aortic stenosis

VALVULAR HEART DISEASE

3.1.5. Indications for Cardiac Catheterization

CLASS I
1. Coronary angiography is recommended before AVR in patients with AS at risk for CAD (see Section 10.2). (Level of Evidence: B)
2. Cardiac catheterization for hemodynamic measurements is recommended for assessment of severity of AS in symptomatic patients when noninvasive tests are inconclusive or when there is a discrepancy between noninvasive tests and clinical findings regarding severity of AS. (Level of Evidence: C)

CLASS III
1. Cardiac catheterization for hemodynamic measurements is not recommended for the assessment of severity of AS before AVR when noninvasive tests are adequate and concordant with clinical findings. (Level of Evidence: C)
2. Cardiac catheterization for hemodynamic measurements is not recommended for the assessment of LV function and severity of AS in asymptomatic patients. (Level of Evidence: C)

3.1.6. Low-Flow/Low-Gradient Aortic Stenosis

CLASS IIa
2. Cardiac catheterization for hemodynamic measurements with infusion of dobutamine can be useful for evaluation of patients with low-flow/low-gradient AS and LV dysfunction. (Level of Evidence: C)

79. Mild or moderate aortic regurgitation
VALVULAR HEART DISEASE
3.2.3.7. Indications for Cardiac Catheterization
CLASS I
1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is indicated for assessment of severity of regurgitation, LV function, or aortic root size when noninvasive tests are inconclusive or discordant with clinical findings in patients with AR. (Level of Evidence: B)
2. Coronary angiography is indicated before AVR in patients at risk for CAD. (Level of Evidence: C)

CLASS III
1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function, aortic root size, or severity of regurgitation before AVR when noninvasive tests are adequate and concordant with clinical findings and coronary angiography is not needed. (Level of Evidence: C)
2. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function and severity of regurgitation in asymptomatic patients when noninvasive tests are adequate. (Level of Evidence: C)

80. Severe aortic regurgitation

VALVULAR HEART DISEASE
3.2.3.7. Indications for Cardiac Catheterization
CLASS I
1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is indicated for assessment of severity of regurgitation, LV function, or aortic root size when noninvasive tests are inconclusive or discordant with clinical findings in patients with AR. (Level of Evidence: B)
2. Coronary angiography is indicated before AVR in patients at risk for CAD. (Level of Evidence: C)

CLASS III
1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function, aortic root size, or severity of regurgitation before AVR when noninvasive tests are adequate and concordant with clinical findings and coronary angiography is not needed. (Level of Evidence: C)
2. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function and severity of regurgitation in asymptomatic patients when noninvasive tests are adequate. (Level of Evidence: C)

Chronic Native or Prosthetic Valvular Disease
Symptomatic Related to Valvular Disease

81. Mild or moderate mitral stenosis

VALVULAR HEART DISEASE
3.4.7. Indications for Invasive Hemodynamic Evaluation
CLASS I
1. Cardiac catheterization for hemodynamic evaluation should be performed for assessment of severity of MS when noninvasive tests are inconclusive or when there is discrepancy between noninvasive tests and clinical findings regarding severity of MS. (Level of Evidence: C)
2. Catheterization for hemodynamic evaluation including left ventriculography (to evaluate severity of MR) for patients with MS is indicated when there is a discrepancy between the Doppler-derived mean gradient and valve area. *(Level of Evidence: C)*

**CLASS IIa**

1. Cardiac catheterization is reasonable to assess the hemodynamic response of pulmonary artery and left atrial pressures to exercise when clinical symptoms and resting hemodynamics are discordant. *(Level of Evidence: C)*

2. Cardiac catheterization is reasonable in patients with MS to assess the cause of severe pulmonary arterial hypertension when out of proportion to severity of MS as determined by noninvasive testing. *(Level of Evidence: C)*

**CLASS III**

1. Diagnostic cardiac catheterization is not recommended to assess the MV hemodynamics when 2D and Doppler echocardiographic data are concordant with clinical findings. *(Level of Evidence: C)*

### 82. Severe mitral stenosis

**VALVULAR HEART DISEASE**

### 3.4.7. Indications for Invasive Hemodynamic Evaluation

**CLASS I**

1. Cardiac catheterization for hemodynamic evaluation should be performed for assessment of severity of MS when noninvasive tests are inconclusive or when there is discrepancy between noninvasive tests and clinical findings regarding severity of MS. *(Level of Evidence: C)*

2. Catheterization for hemodynamic evaluation including left ventriculography (to evaluate severity of MR) for patients with MS is indicated when there is a discrepancy between the Doppler-derived mean gradient and valve area. *(Level of Evidence: C)*

**CLASS IIa**

1. Cardiac catheterization is reasonable to assess the hemodynamic response of pulmonary artery and left atrial pressures to exercise when clinical symptoms and resting hemodynamics are discordant. *(Level of Evidence: C)*

2. Cardiac catheterization is reasonable in patients with MS to assess the cause of severe pulmonary arterial hypertension when out of proportion to severity of MS as determined by noninvasive testing. *(Level of Evidence: C)*

**CLASS III**

1. Diagnostic cardiac catheterization is not recommended to assess the MV hemodynamics when 2D and Doppler echocardiographic data are concordant with clinical findings. *(Level of Evidence: C)*

### 83. Mild or moderate mitral regurgitation

**VALVULAR HEART DISEASE**

### 3.6.3.8. Indications for Cardiac Catheterization

**CLASS I**

1. Left ventriculography and hemodynamic measurements are indicated when noninvasive tests are inconclusive regarding severity of MR, LV function, or the need for surgery. *(Level of Evidence: C)*
2. Hemodynamic measurements are indicated when pulmonary artery pressure is out of proportion to the severity of MR as assessed by noninvasive testing. *(Level of Evidence: C)*

3. Left ventriculography and hemodynamic measurements are indicated when there is a discrepancy between clinical and noninvasive findings regarding severity of MR. *(Level of Evidence: C)*

4. Coronary angiography is indicated before MV repair or MV replacement in patients at risk for CAD. *(Level of Evidence: C)*

**CLASS III**

1. Left ventriculography and hemodynamic measurements are not indicated in patients with MR in whom valve surgery is not contemplated. *(Level of Evidence: C)*

---

84. Severe mitral regurgitation

**VALVULAR HEART DISEASE**

### 3.6.3.8. Indications for Cardiac Catheterization

**CLASS I**

1. Left ventriculography and hemodynamic measurements are indicated when noninvasive tests are inconclusive regarding severity of MR, LV function, or the need for surgery. *(Level of Evidence: C)*

2. Hemodynamic measurements are indicated when pulmonary artery pressure is out of proportion to the severity of MR as assessed by noninvasive testing. *(Level of Evidence: C)*

3. Left ventriculography and hemodynamic measurements are indicated when there is a discrepancy between clinical and noninvasive findings regarding severity of MR. *(Level of Evidence: C)*

4. Coronary angiography is indicated before MV repair or MV replacement in patients at risk for CAD. *(Level of Evidence: C)*

**CLASS III**

1. Left ventriculography and hemodynamic measurements are not indicated in patients with MR in whom valve surgery is not contemplated. *(Level of Evidence: C)*

85. Mild or moderate aortic stenosis

**VALVULAR HEART DISEASE**

### 3.1.5. Indications for Cardiac Catheterization

**CLASS I**

1. Coronary angiography is recommended before AVR in patients with AS at risk for CAD (see Section 10.2). *(Level of Evidence: B)*

2. Cardiac catheterization for hemodynamic measurements is recommended for assessment of severity of AS in symptomatic patients when noninvasive tests are inconclusive or when there is a discrepancy between noninvasive tests and clinical findings regarding severity of AS. *(Level of Evidence: C)*

**CLASS III**

1. Cardiac catheterization for hemodynamic measurements is not recommended for the assessment of severity of AS before AVR when noninvasive tests are adequate and concordant with clinical findings. *(Level of Evidence: C)*

2. Cardiac catheterization for hemodynamic measurements is not recommended for the assessment of LV function and severity of AS in asymptomatic patients. *(Level of Evidence: C)*
3.1.6. Low-Flow/Low-Gradient Aortic Stenosis
CLASS IIa
2. Cardiac catheterization for hemodynamic measurements with infusion of dobutamine can be useful for evaluation of patients with low-flow/low-gradient AS and LV dysfunction. (Level of Evidence: C)

VALVULAR HEART DISEASE
3.1.5. Indications for Cardiac Catheterization
CLASS I
1. Coronary angiography is recommended before AVR in patients with AS at risk for CAD (see Section 10.2). (Level of Evidence: B)
2. Cardiac catheterization for hemodynamic measurements is recommended for assessment of severity of AS in symptomatic patients when noninvasive tests are inconclusive or when there is a discrepancy between noninvasive tests and clinical findings regarding severity of AS. (Level of Evidence: C)
CLASS III
1. Cardiac catheterization for hemodynamic measurements is not recommended for the assessment of severity of AS before AVR when noninvasive tests are adequate and concordant with clinical findings. (Level of Evidence: C)
2. Cardiac catheterization for hemodynamic measurements is not recommended for the assessment of LV function and severity of AS in asymptomatic patients. (Level of Evidence: C)

3.1.6. Low-Flow/Low-Gradient Aortic Stenosis
CLASS IIa
2. Cardiac catheterization for hemodynamic measurements with infusion of dobutamine can be useful for evaluation of patients with low-flow/low-gradient AS and LV dysfunction. (Level of Evidence: C)

VALVULAR HEART DISEASE
3.1.6. Low-Flow/Low-Gradient Aortic Stenosis
CLASS IIa
2. Cardiac catheterization for hemodynamic measurements with infusion of dobutamine can be useful for evaluation of patients with low-flow/low-gradient AS and LV dysfunction. (Level of Evidence: C)

87. Equivocal aortic stenosis/low gradient aortic stenosis
May include pharmacologic challenge (e.g., dobutamine)

VALVULAR HEART DISEASE
3.1.6. Low-Flow/Low-Gradient Aortic Stenosis
CLASS IIa
2. Cardiac catheterization for hemodynamic measurements with infusion of dobutamine can be useful for evaluation of patients with low-flow/low-gradient AS and LV dysfunction. (Level of Evidence: C)

88. Mild or moderate aortic regurgitation

VALVULAR HEART DISEASE
3.2.3.7. Indications for Cardiac Catheterization
CLASS I
1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is indicated for assessment of severity of regurgitation, LV function, or aortic root size when noninvasive tests are inconclusive or discordant with clinical findings in patients with AR. (Level of Evidence: B)
2. Coronary angiography is indicated before AVR in patients at risk for CAD. (Level of Evidence: C)
CLASS III
1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function, aortic root size, or severity of regurgitation before AVR when noninvasive tests are adequate and concordant with clinical findings and coronary angiography is not needed. (Level of Evidence: C)
2. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function and severity of regurgitation in asymptomatic patients when noninvasive tests are adequate. (Level of Evidence: C)

89. Severe aortic regurgitation

VALVULAR HEART DISEASE
3.2.3.7. Indications for Cardiac Catheterization
CLASS I
1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is indicated for assessment of severity of regurgitation, LV function, or aortic root size when noninvasive tests are inconclusive or discordant with clinical findings in patients with AR. (Level of Evidence: B)
2. Coronary angiography is indicated before AVR in patients at risk for CAD. (Level of Evidence: C)

CLASS III
1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function, aortic root size, or severity of regurgitation before AVR when noninvasive tests are adequate and concordant with clinical findings and coronary angiography is not needed. (Level of Evidence: C)
2. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function and severity of regurgitation in asymptomatic patients when noninvasive tests are adequate. (Level of Evidence: C)

90. Acute moderate or severe mitral or aortic regurgitation

VALVULAR HEART DISEASE
3.2.3.7. Indications for Cardiac Catheterization
CLASS I
1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is indicated for assessment of severity of regurgitation, LV function, or aortic root size when noninvasive tests are inconclusive or discordant with clinical findings in patients with AR. (Level of Evidence: B)
2. Coronary angiography is indicated before AVR in patients at risk for CAD. (Level of Evidence: C)

CLASS III
1. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function, aortic root size, or severity of regurgitation before AVR when noninvasive tests are adequate and concordant with clinical findings and coronary angiography is not needed. (Level of Evidence: C)
2. Cardiac catheterization with aortic root angiography and measurement of LV pressure is not indicated for assessment of LV function and severity of regurgitation in asymptomatic patients when noninvasive tests are adequate. (Level of Evidence: C)
3.6.3.8. Indications for Cardiac Catheterization

CLASS I

1. Left ventriculography and hemodynamic measurements are indicated when noninvasive tests are inconclusive regarding severity of MR, LV function, or the need for surgery. (Level of Evidence: C)

2. Hemodynamic measurements are indicated when pulmonary artery pressure is out of proportion to the severity of MR as assessed by noninvasive testing. (Level of Evidence: C)

3. Left ventriculography and hemodynamic measurements are indicated when there is a discrepancy between clinical and noninvasive findings regarding severity of MR. (Level of Evidence: C)

4. Coronary angiography is indicated before MV repair or MV replacement in patients at risk for CAD. (Level of Evidence: C)

CLASS III

1. Left ventriculography and hemodynamic measurements are not indicated in patients with MR in whom valve surgery is not contemplated. (Level of Evidence: C)

References:

Table 2.2 Pericardial Diseases

91. Suspected pericardial tamponade

No relevant guidelines

92. Suspected or clinical uncertainty between constrictive versus restrictive physiology

No relevant guidelines

References: None

Table 2.3 Cardiomyopathies

93. Known or suspected cardiomyopathy with or without heart failure

HEART FAILURE

3. Initial and Serial Clinical Assessment of Patients Presenting With Heart Failure (UPDATED)

CLASS I

7. Coronary arteriography should be performed in patients presenting with HF who have angina or significant ischemia unless the patient is not eligible for revascularization of any kind (2-6). (Level of Evidence: B)

CLASS IIa

8. Coronary arteriography is reasonable for patients presenting with HF who have chest pain that may or may not be of cardiac origin who have not had evaluation of their coronary anatomy and who have no
9. Coronary arteriography is reasonable for patients presenting with HF who have known or suspected coronary artery disease but who do not have angina unless the patient is not eligible for revascularization of any kind. (Level of Evidence: C)

4.5. The Hospitalized Patient
CLASS IIa
10. When patients present with acute HF and known or suspected acute myocardial ischemia due to occlusive coronary disease, especially when there are signs and symptoms of inadequate systemic perfusion, urgent cardiac catheterization and revascularization is reasonable where it is likely to prolong meaningful survival. (Level of Evidence: C)

94. Re-evaluation of known cardiomyopathy
Change in clinical status or cardiac exam or to guide therapy

No relevant guidelines

95. Suspected arrhythmogenic right ventricular dysplasia
Assessment of right ventricular morphology

No relevant guidelines

References:

Section 3: Right Heart Catheterization

Table 3.1 Pulmonary Hypertension or Intracardiac Shunt Evaluation

96. Known or suspected intracardiac shunt with indeterminate shunt anatomy or shunt fraction

No relevant guidelines

Evaluation of Pulmonary Hypertension

97. Suspected pulmonary artery hypertension
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<tbody>
<tr>
<td><strong>Equivocal or borderline elevated estimated right ventricular systolic pressure on resting echo study</strong></td>
<td>No relevant guidelines</td>
</tr>
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</table>

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<tr>
<td><strong>98. Suspected pulmonary hypertension</strong></td>
<td>Elevated estimated right ventricular systolic pressure on resting echo study</td>
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<td>No relevant guidelines</td>
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<tr>
<td><strong>99. Resting pulmonary hypertension</strong></td>
<td>Determine response to pulmonary vasodilators given in cath lab</td>
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<td>No relevant guidelines</td>
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<tr>
<td><strong>100. Resting pulmonary hypertension</strong></td>
<td>Determine response after initiation of drug therapy</td>
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<td>No relevant guidelines</td>
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<tr>
<td><strong>101. Post heart transplant patient</strong></td>
<td>With or without the performance of endomyocardial biopsy</td>
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<td>No relevant guidelines</td>
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<tr>
<td><strong>102. Indeterminate intravascular volume status</strong></td>
<td>Etiology unclear after initial evaluation</td>
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<td>No relevant guidelines</td>
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References: None