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

1. Cardiogenic shock due to suspected ACS
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 recommend 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 recommend 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:

1. Levine GN, Bates ER, Blankenship JC, et al. 2011 ACCF/AHA/SCAI guidelines for percutaneous coronary intervention: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. (J Am Coll Cardiol 2011; unpublished).
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12. Di Mario C, Dudek D, Piscione F, et al. Immediate angioplasty versus standard therapy with rescue angioplasty after thrombolysis in the Combined Abciximab REteplase Stent Study in Acute Myocardial Infarction (CARESS-in-AMI): an open, prospective, randomised, multicentre trial. Lancet. 2008;371:559-68.
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14. Borgia F, Goodman SG, Halvorsen S, et al. Early routine percutaneous coronary intervention after fibrinolysis vs. standard therapy in ST-segment elevation myocardial infarction: a meta-analysis. Eur Heart J. 2010;31:2156-69.
15. Cantor WJ, Fitchett D, Borgundvaag B, et al. Routine early angioplasty after fibrinolysis for acute myocardial infarction. N Engl J Med. 2009;360:2705-18.
16. Fox KA, Clayton TC, Damman P, et al. Long-term outcome of a routine versus selective invasive strategy in patients with non-ST-segment elevation acute coronary syndrome a meta-analysis of individual patient data. J Am Coll Cardiol. 2010;55:2435-45.
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19. Invasive compared with non-invasive treatment in unstable coronary-artery disease: FRISC II prospective randomised multicentre study. FRagmin and Fast Revascularisation during InStability in Coronary artery disease Investigators. Lancet. 1999;354:708-15.
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Table 1.2 Suspected CAD: No Prior Noninvasive Stress Imaging (No Prior PCI, CABG, or Angiogram Showing ≥50% Angiographic Stenosis)

Asymptomatic
5. Low global CAD risk
<u>CHRONIC STABLE ANGINA</u> **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
<u>CHRONIC STABLE ANGINA</u> **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

<u>CHRONIC STABLE ANGINA</u>

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*)

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*)
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*)

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:

1. Gibbons RJ, Abrams J, Chatterjee K, Daley J, Deedwania PC, Douglas JS, Ferguson TB Jr., Fihn SD, Fraker TD Jr., Gardin JM, O'Rourke RA, Pasternak RC,Williams SV. ACC/AHA 2002 guideline update for the management of patients with chronic stable angina: a report of the American College of Cardiology/ American Heart Association Task Force on Practice Guidelines (Committee to Update the 1999 Guidelines for the Management of Patients with Chronic Stable Angina). 2002.

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

ECG Stress Testing
11. Low-risk findings (e.g., Duke Treadmill score ≥5)
No relevant guidelines
12. Intermediate-risk findings (e.g., Duke Treadmill score 4 to -10)
No relevant guidelines
13. High-risk findings (e.g., Duke Treadmill score ≤ -11)
<u>CHRONIC STABLE ANGINA</u> **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)
<u>CHRONIC STABLE ANGINA</u> **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

Echocardiography (TTE)

24. Newly recognized LV systolic dysfunction (i.e., LVEF ≤ 40%) with an unknown etiology

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

Coronary Calcium Score

28. Agatston Score <100

No relevant guidelines

29. Agatston Score 100-400

No relevant guidelines

30. Agatston Score 400-1,000

No relevant guidelines

31. Agatston Score >1,000

No relevant guidelines

Coronary CTA

32. Lesion 0 – 49% non-left main

No relevant guidelines

33. Lesion ≥50% non-left main

No relevant guidelines

34. Lesion ≥50% left main

No relevant guidelines

35. Lesions ≥50% in more than one coronary territory

No relevant guidelines

36. Lesion of unclear significance, possibly obstructive (non-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*)

37. 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:

1. Gibbons RJ, Abrams J, Chatterjee K, Daley J, Deedwania PC, Douglas JS, Ferguson TB Jr., Fihn SD, Fraker TD Jr., Gardin JM, O'Rourke RA, Pasternak RC,Williams SV. ACC/AHA 2002 guideline update for the management of patients with chronic stable angina: a report of the American College of Cardiology/ American Heart Association Task Force on Practice Guidelines (Committee to Update the 1999 Guidelines for the Management of Patients with Chronic Stable Angina). 2002.
2. Warnes CA, Williams RG, Bashore TM, Child JS, Connolly HM, Dearani JA, del Nido P, Fasules JW, Graham TP Jr., Hijazi ZM, Hunt SA, King ME, Landzberg MJ, Miner PD, Radford MJ, Walsh EP, Webb GD. ACC/AHA 2008 guidelines for the management of adults with congenital heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Develop Guidelines for the Management of Adults With Congenital Heart Disease). J Am Coll Cardiol 2008;52:e143–263.
3. Hunt SA, Abraham WT, Chin MH, Feldman AM, Francis GS, Ganiats TG, Jessup M, Konstam MA, Mancini DM, Michl K, Oates JA, Rahko PS, Silver MA, Stevenson LW, Yancy CW. 2009 focused update incorporated into the ACC/AHA 2005 guidelines for the diagnosis and management of heart failure in adults: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 2009;53:e1–90.
4. Alderman EL, Fisher LD, Litwin P, et al. Results of coronary artery surgery in patients with poor left ventricular function (CASS). Circulation. 1983;68:785–95.
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6. Fox KF, Cowie MR, Wood DA, et al. Coronary artery disease as the cause of incident heart failure in the population. Eur Heart J. 2001;22:228 –36.
7. Arques S, Ambrosi P, Gelisse R, et al. Prevalence of angiographic coronary artery disease in patients hospitalized for acute diastolic heart failure without clinical and electrocardiographic evidence of myocardial ischemia on admission. Am J Cardiol. 2004;94:133–5.
8. Kurtz CE, Gerber Y, Weston SA, et al. Use of ejection fraction tests and coronary angiography in patients with heart failure. Mayo Clin Proc. 2006;81:906 –13.

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

FFR for Lesion Severity
40. Angiographically indeterminate severity LMCA stenosis (defined as two or more orthogonal views contradictory whether stenosis >50%)
No relevant guidelines
41. Non-obstructive disease by angiography (non-LMCA) <50%
No relevant guidelines
42. Angiographically intermediate disease (non-LMCA) 50% – 69%
<u>PCI, STEMI, UA/NSTEMI Update (2011 Proposed DRAFT)</u> **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 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*)

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:

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4. Pijls NH, van Schaardenburgh P, Manoharan G, et al. Percutaneous coronary intervention of functionally nonsignificant stenosis: 5-year follow-up of the DEFER Study. J Am Coll Cardiol. 2007;49:2105-11.
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6. Tonino PA, Fearon WF, De BB, et al. Angiographic versus functional severity of coronary artery stenosis in the FAME study fractional flow reserve versus angiography in multivessel evaluation. J Am Coll Cardiol. 2010;55:2816-21.
7. Briguori C, Anzuini A, Airoldi F, et al. Intravascular ultrasound criteria for the assessment of the functional significance of intermediate coronary artery stenoses and comparison with fractional flow reserve. Am J Cardiol. 2001;87:136-41.
8. Fassa AA, Wagatsuma K, Higano ST, et al. Intravascular ultrasound-guided treatment for angiographically indeterminate left main coronary artery disease: a long-term follow-up study. J Am Coll Cardiol. 2005;45:204-11.
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10. Takagi A, Tsurumi Y, Ishii Y, et al. Clinical potential of intravascular ultrasound for physiological assessment of coronary stenosis: relationship between quantitative ultrasound tomography and pressure derived fractional flow reserve. Circulation. 1999;100:250-5.
11. Magni V, Chieffo A, Colombo A. Evaluation of intermediate coronary stenosis with intravascular ultrasound and fractional flow reserve: Its use and abuse. Catheter Cardiovasc Interv. 2009;73:441-8.

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

Medically Managed Patients

49. Low-risk noninvasive findings

No relevant guidelines

50. Intermediate-risk noninvasive findings
No relevant guidelines
51. High-risk noninvasive findings
No relevant guidelines
Post Revascularization (PCI or CABG)
52. Asymptomatic or stable symptoms
No relevant guidelines
53. Low-risk noninvasive findings Worsening or limiting symptoms
No relevant guidelines
54. Intermediate-risk noninvasive findings Worsening or limiting symptoms
No relevant guidelines
55. High-risk noninvasive findings Worsening or limiting symptoms
No relevant guidelines
Post Revascularization (PCI)
56. Asymptomatic Prior unprotected left main PCI
No relevant guidelines

References: None

Table 1.6 Arrhythmias

Etiology Unclear After Initial Evaluation
57. Resuscitated cardiac arrest with return of spontaneous circulation
<u>VENTRICULAR ARRHYTHMIAS</u> **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*)

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*)

No Prior Noninvasive Assessment of Ischemia With Normal Systolic Function
60. Syncope
No relevant guidelines
61. New-onset atrial fibrillation or flutter
No relevant guidelines
62. Heart block (e.g., second degree type II or third degree AV block) OR Symptomatic bradyarrhythmias
No relevant guidelines
63. Newly diagnosed LBBB
No relevant guidelines

References:

1. Zipes DP, Camm AJ, Borggrefe M, Buxton AE, Chaitman B, Fromer M, Gregoratos G, Klein G, Moss AJ, Myerburg RJ, Priori SG, Quinones MA, Roden DM, Silka MJ, Tracy C. ACC/AHA/ESC 2006 guidelines for management of patients with ventricular arrhythmias and the prevention of sudden cardiac death: a report of the American College of Cardiology/American Heart Association Task Force and the European Society of Cardiology Committee for Practice Guidelines (Writing Committee to Develop Guidelines for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death). J Am Coll Cardiol 2006;48:e247– e346.
2. Gibbons RJ, Abrams J, Chatterjee K, Daley J, Deedwania PC, Douglas JS, Ferguson TB Jr., Fihn SD, Fraker TD Jr., Gardin JM, O'Rourke RA, Pasternak RC,Williams SV. ACC/AHA 2002 guideline update for the management of patients with chronic stable angina: a report of the American College of Cardiology/ American Heart Association Task Force on Practice Guidelines (Committee to Update the 1999 Guidelines for the Management of Patients with Chronic Stable Angina). 2002.

Table 1.7 Preoperative Coronary Evaluation for Noncardiac Surgery in Stable Patients

64. Low risk surgery
No relevant guidelines
65. ≥4 METS functional capacity without symptoms
No relevant guidelines
66. Prior to solid organ transplantation
No relevant guidelines
<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)

67. No risk factors
No relevant guidelines
68. 1-2 risk factors
No relevant guidelines
69. ≥3 risk factors
No relevant guidelines

References: None

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

70. Preoperative assessment before valvular surgery
No relevant guidelines
71. Pulmonary hypertension out of proportion to the severity of valvular disease
<u>VALVULAR HEART DISEASE</u> **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

<u>VALVULAR HEART DISEASE</u>

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*)

86. 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*)

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:

1. Bonow RO, Carabello BA, Chatterjee K, de Leon AC Jr., Faxon DP, Freed MD, Gaasch WH, Lytle BW, Nishimura RA, O'Gara PT, O'Rourke RA, Otto CM, Shah PM, Shanewise JS. 2008 focused update incorporated into the ACC/AHA 2006 guidelines for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Develop Guidelines for the Management of Patients With Valvular Heart Disease. J Am Coll Cardiol 2008;52:e1–142.

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

contraindications to coronary revascularization. (Level of Evidence: C)

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:

1. Hunt SA, Abraham WT, Chin MH, Feldman AM, Francis GS, Ganiats TG, Jessup M, Konstam MA, Mancini DM, Michl K, Oates JA, Rahko PS, Silver MA, Stevenson LW, Yancy CW. 2009 focused update incorporated into the ACC/AHA 2005 guidelines for the diagnosis and management of heart failure in adults: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 2009;53:e1–90.
2. Alderman EL, Fisher LD, Litwin P, et al. Results of coronary artery surgery in patients with poor left ventricular function (CASS). Circulation. 1983;68:785–95.
3. Eagle KA, Guyton RA, Davidoff R, et al. ACC/AHA 2004 guideline update for coronary artery bypass graft surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Update the 1999 Guidelines for Coronary Artery Bypass Graft Surgery). Circulation. 2004;110:e340 –7.
4. Fox KF, Cowie MR, Wood DA, et al. Coronary artery disease as the cause of incident heart failure in the population. Eur Heart J. 2001;22:228 –36.
5. Arques S, Ambrosi P, Gelisse R, et al. Prevalence of angiographic coronary artery disease in patients hospitalized for acute diastolic heart failure without clinical and electrocardiographic evidence of myocardial ischemia on admission. Am J Cardiol. 2004;94:133–5.
6. Kurtz CE, Gerber Y, Weston SA, et al. Use of ejection fraction tests and coronary angiography in patients with heart failure. Mayo Clin Proc. 2006;81:906 –13.

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

Equivocal or borderline elevated estimated right ventricular systolic pressure on resting echo study
No relevant guidelines
98. Suspected pulmonary hypertension Elevated estimated right ventricular systolic pressure on resting echo study
No relevant guidelines
99. Resting pulmonary hypertension Determine response to pulmonary vasodilators given in cath lab
No relevant guidelines
100. Resting pulmonary hypertension Determine response after initiation of drug therapy
No relevant guidelines
101. Post heart transplant patient With or without the performance of endomyocardial biopsy
No relevant guidelines
102. Indeterminate intravascular volume status Etiology unclear after initial evaluation
No relevant guidelines

References: None