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CLINICAL PRACTICE GUIDELINE: FULL TEXT

2021 AHA/ACC/ASE/CHEST/SAEM/ SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain

A Report of the American College of Cardiology/American Heart Association
Joint Committee on Clinical Practice Guidelines

[DOWNLOAD Complete 2021 AHA/ACC Guideline for Eval. and Diagnosis of Chest Pain](#)

[DOWNLOAD 2021 AHA/ACC Chest Pain Guideline Perspectives \(Exec Summary\)](#)

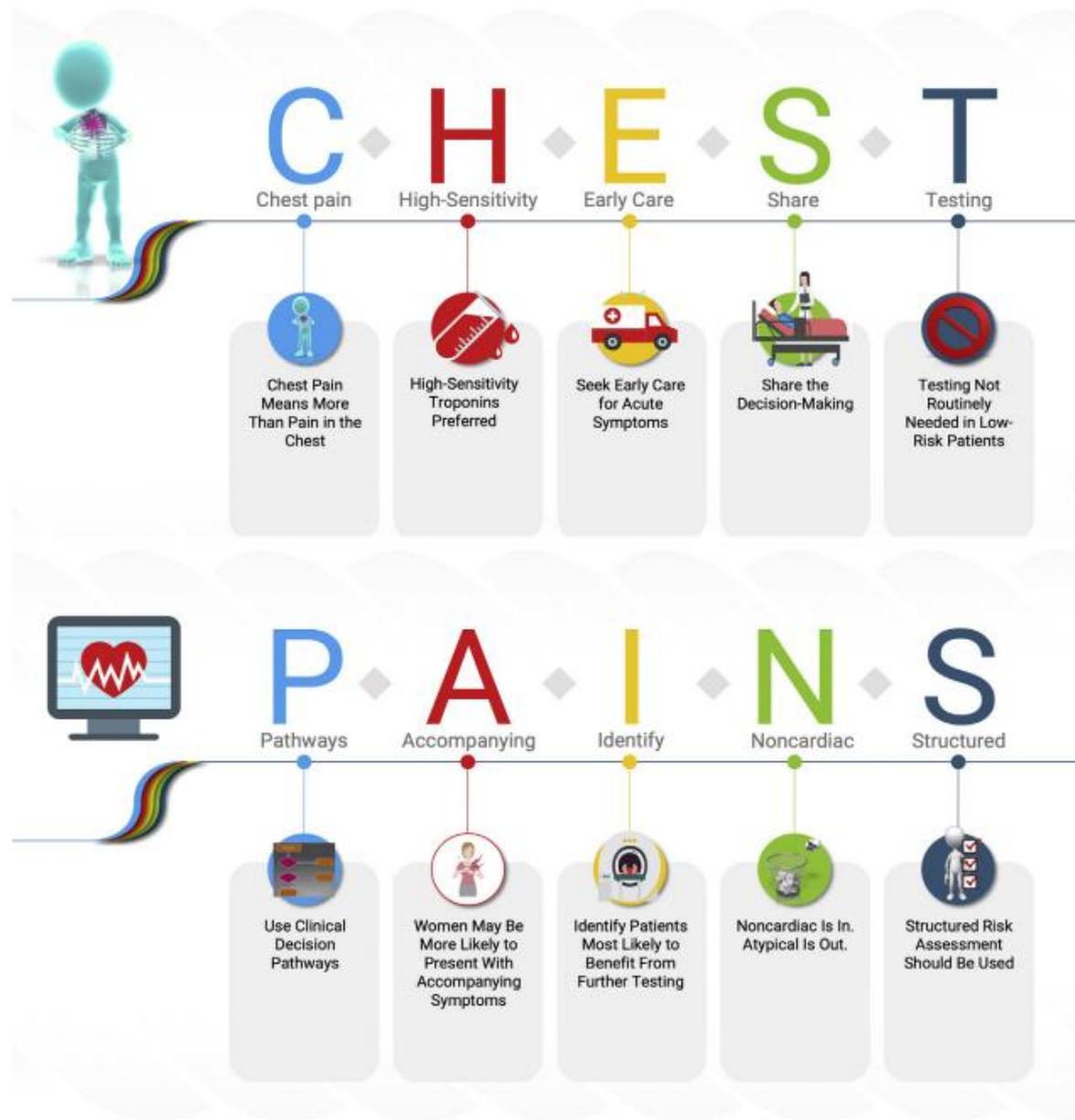
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TOP 10 TAKE-HOME MESSAGES FOR THE EVALUATION AND DIAGNOSIS OF CHEST PAIN

- 1. Chest Pain Means More Than Pain in the Chest.** Pain, pressure, tightness, or discomfort in the chest, shoulders, arms, neck, back, upper abdomen, or jaw, as well as shortness of breath and fatigue should all be considered anginal equivalents.
- 2. High-Sensitivity Troponins Preferred.** High-sensitivity cardiac troponins are the preferred standard for establishing a biomarker diagnosis of acute myocardial infarction, allowing for more accurate detection and exclusion of myocardial injury.
- 3. Early Care for Acute Symptoms.** Patients with acute chest pain or chest pain equivalent symptoms should seek medical care immediately by calling 9-1-1. Although most patients will not have a cardiac cause, the evaluation of all patients should focus on the early identification or exclusion of life-threatening causes.
- 4. Share the Decision-Making.** Clinically stable patients presenting with chest pain should be included in decision-making; information about risk of adverse events, radiation exposure, costs, and alternative options should be provided to facilitate the discussion.
- 5. Testing Not Needed Routinely for Low-Risk Patients.** For patients with acute or stable chest pain determined to be low risk, urgent diagnostic testing for suspected coronary artery disease is not needed.
- 6. Pathways.** Clinical decision pathways for chest pain in the emergency department and outpatient settings should be used routinely.
- 7. Accompanying Symptoms.** Chest pain is the dominant and most frequent symptom for both men and women ultimately diagnosed with acute coronary syndrome. Women may be more likely to present with accompanying symptoms such as nausea and shortness of breath.
- 8. Identify Patients Most Likely to Benefit From Further Testing.** Patients with acute or stable chest pain who are at intermediate risk or intermediate to high pre-test risk of obstructive coronary artery disease, respectively, will benefit the most from cardiac imaging and testing.
- 9. Noncardiac Is In. Atypical Is Out.** “Noncardiac” should be used if heart disease is not suspected. “Atypical” is a misleading descriptor of chest pain, and its use is discouraged.
- 10. Structured Risk Assessment Should Be Used.** For patients presenting with acute or stable chest pain, risk for coronary artery disease and adverse events should be estimated using evidence-based diagnostic protocols.

Figure 1 illustrates the take-home messages.

FIGURE 1 Take-Home Messages for the Evaluation and Diagnosis of Chest Pain



Chest Pain Pre-Hospital setting

Recommendation for Patient-Centric Considerations

COR	LOE	RECOMMENDATION
1	C-LD	1. In patients with acute chest pain, it is recommended that 9-1-1 be activated by patients or bystanders to initiate transport to the closest ED by emergency medical services (EMS) (1).

Chest Pain in the office setting:

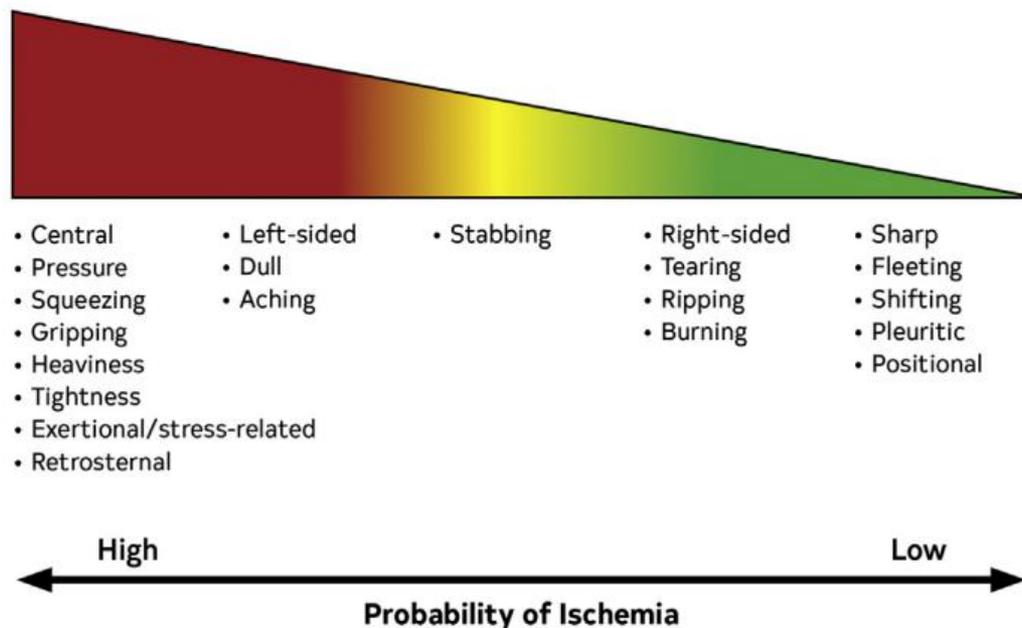
Recommendations for Setting Considerations

Referenced studies that support the recommendations are summarized in [Online Data Supplement 5](#).

COR	LOE	RECOMMENDATIONS
1	B-NR	1. Unless a noncardiac cause is evident, an ECG should be performed for patients seen in the office setting with stable chest pain; if an ECG is unavailable the patient should be referred to the ED so one can be obtained (1-5).
1	C-LD	2. Patients with clinical evidence of ACS or other life-threatening causes of acute chest pain seen in the office setting should be transported urgently to the ED, ideally by EMS (1-9).
1	C-LD	3. In all patients who present with acute chest pain regardless of the setting, an ECG should be acquired and reviewed for STEMI within 10 minutes of arrival (1-3,6,7,10).
1	C-LD	4. In all patients presenting to the ED with acute chest pain and suspected ACS, cTn should be measured as soon as possible after presentation (8,9).
3: Harm	C-LD	5. For patients with acute chest pain and suspected ACS initially evaluated in the office setting, delayed transfer to the ED for cTn or other diagnostic testing should be avoided.

Chest Pain, Subjective Assessment:

FIGURE 2 Index of Suspicion That Chest "Pain" Is Ischemic in Origin on the Basis of Commonly Used Descriptors



Recommendations for Defining Chest Pain

Referenced studies that support the recommendations are summarized in [Online Data Supplements 1 and 2](#).

COR	LOE	RECOMMENDATIONS
1	B-NR	1. An initial assessment of chest pain is recommended to triage patients effectively on the basis of the likelihood that symptoms may be attributable to myocardial ischemia (1-7).
1	C-LD	2. Chest pain should not be described as atypical, because it is not helpful in determining the cause and can be misinterpreted as benign in nature. Instead, chest pain should be described as cardiac, possibly cardiac, or noncardiac because these terms are more specific to the potential underlying diagnosis.

TABLE 3 Chest Pain Characteristics and Corresponding Causes**Nature**

Anginal symptoms are perceived as retrosternal chest discomfort (e.g., pain, discomfort, heaviness, tightness, pressure, constriction, squeezing) (Section 1.4.2, Defining Chest Pain).

Sharp chest pain that increases with inspiration and lying supine is unlikely related to ischemic heart disease (e.g., these symptoms usually occur with acute pericarditis).

Onset and duration

Anginal symptoms gradually build in intensity over a few minutes.

Sudden onset of ripping chest pain (with radiation to the upper or lower back) is unlikely to be anginal and is suspicious of an acute aortic syndrome.

Fleeting chest pain—of few seconds' duration—is unlikely to be related to ischemic heart disease.

Location and radiation

Pain that can be localized to a very limited area and pain radiating to below the umbilicus or hip are unlikely related to myocardial ischemia.

Severity

Ripping chest pain ("worse chest pain of my life"), especially when sudden in onset and occurring in a hypertensive patient, or with a known bicuspid aortic valve or aortic dilation, is suspicious of an acute aortic syndrome (e.g., aortic dissection).

Precipitating factors

Physical exercise or emotional stress are common triggers of anginal symptoms.

Occurrence at rest or with minimal exertion associated with anginal symptoms usually indicates ACS.

Positional chest pain is usually nonischemic (e.g., musculoskeletal).

Relieving factors

Relief with nitroglycerin is not necessarily diagnostic of myocardial ischemia and should not be used as a diagnostic criterion.

Associated symptoms

Common symptoms associated with myocardial ischemia include, but are not limited to, dyspnea, palpitations, diaphoresis, lightheadedness, presyncope or syncope, upper abdominal pain, or heartburn unrelated to meals and nausea or vomiting.

Symptoms on the left or right side of the chest, stabbing, sharp pain, or discomfort in the throat or abdomen may occur in patients with diabetes, women, and elderly patients.

ACS indicates acute coronary syndrome.

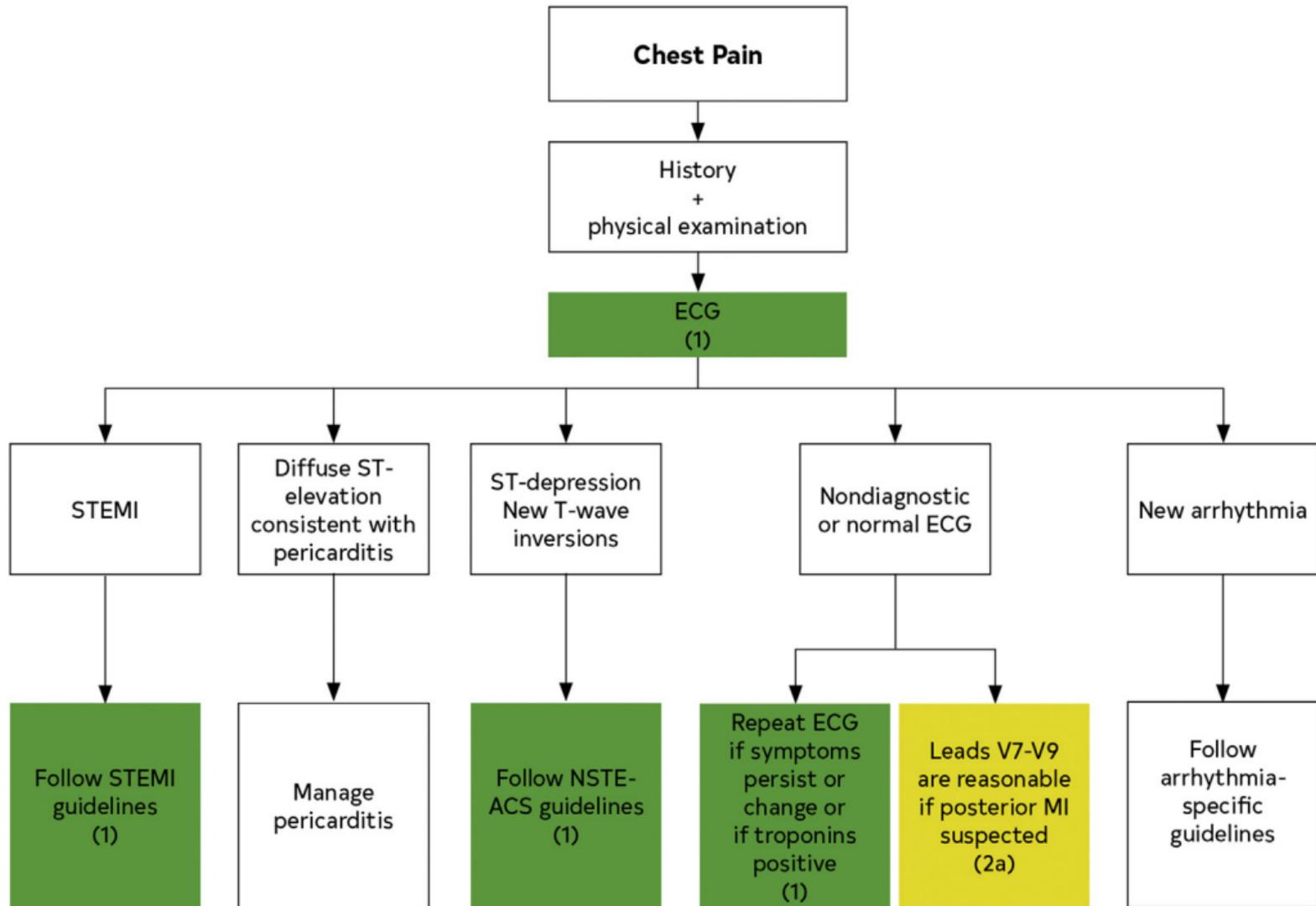
EKG

Recommendations for Electrocardiogram

Referenced studies that support the recommendations are summarized in [Online Data Supplement 6](#).

COR	LOE	RECOMMENDATIONS
1	C-EO	1. In patients with chest pain in which an initial ECG is nondiagnostic, serial ECGs to detect potential ischemic changes should be performed, especially when clinical suspicion of ACS is high, symptoms are persistent, or the clinical condition deteriorates (1).
1	C-EO	2. Patients with chest pain in whom the initial ECG is consistent with an ACS should be treated according to STEMI and NSTEMI-ACS guidelines (1,2).
2a	B-NR	3. In patients with chest pain and intermediate-to-high clinical suspicion for ACS in whom the initial ECG is nondiagnostic, supplemental electrocardiographic leads V7 to V9 are reasonable to rule out posterior MI (3-5).

FIGURE 4 Electrocardiographic-Directed Management of Chest Pain



History

2.1. History

Recommendation for History

COR	LOE	RECOMMENDATION
1	C-LD	1. In patients with chest pain, a focused history that includes characteristics and duration of symptoms relative to presentation as well as associated features, and cardiovascular risk factor assessment should be obtained.

Specific Patient Considerations

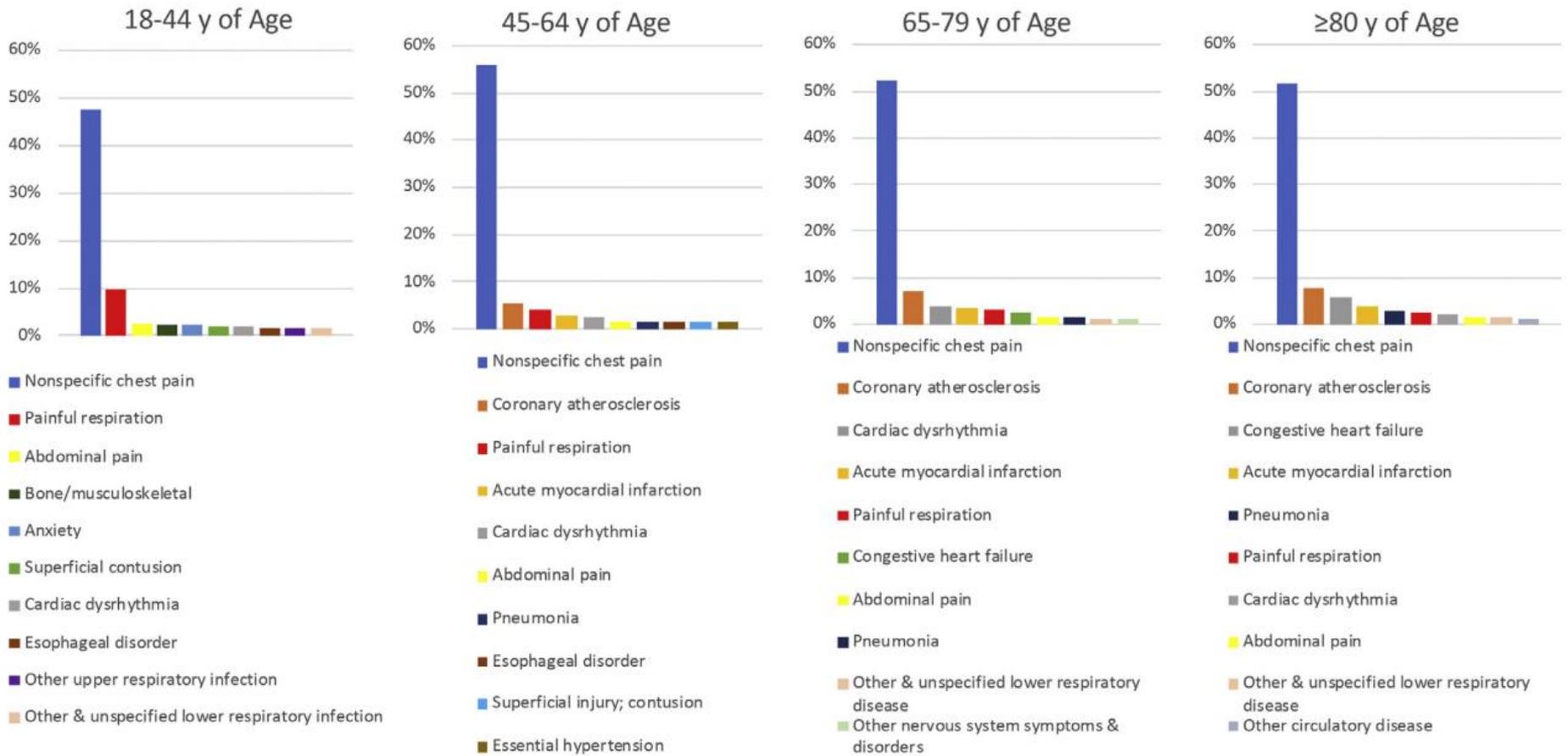
Recommendations for a Focus on the Uniqueness of Chest Pain in Women
Referenced studies that support the recommendations are summarized in [Online Data Supplements 3 and 4](#).

COR	LOE	RECOMMENDATIONS
1	B-NR	1. Women who present with chest pain are at risk for underdiagnosis, and potential cardiac causes should always be considered (1-7).
1	B-NR	2. In women presenting with chest pain, it is recommended to obtain a history that emphasizes accompanying symptoms that are more common in women with ACS (1-7).

Recommendations for Considerations for Diverse Patient Populations With Chest Pain

COR	LOE	RECOMMENDATIONS
1	C-LD	1. Cultural competency training is recommended to help achieve the best outcomes in patients of diverse racial and ethnic backgrounds who present with chest pain.
1	C-LD	2. Among patients of diverse race and ethnicity presenting with chest pain in whom English may not be their primary language, addressing language barriers with the use of formal translation services is recommended.

FIGURE 3 Top 10 Causes of Chest Pain in the ED Based on Age (Weighted Percentage)



Recommendation for Considerations for Older Patients With Chest Pain

COR	LOE	RECOMMENDATION
1	C-LD	1. In patients with chest pain who are >75 years of age, ACS should be considered when accompanying symptoms such as shortness of breath, syncope, or acute delirium are present, or when an unexplained fall has occurred (1).

Recommendation for Physical Examination

COR	LOE	RECOMMENDATION
1	C-EO	1. In patients presenting with chest pain, a focused cardiovascular examination should be performed initially to aid in the diagnosis of ACS or other potentially serious causes of chest pain (e.g., aortic dissection, PE, or esophageal rupture) and to identify complications.

TABLE 4 Physical Examination in Patients With Chest Pain

Clinical Syndrome	Findings
Emergency	
ACS	Diaphoresis, tachypnea, tachycardia, hypotension, crackles, S3, MR murmur (2); examination may be normal in uncomplicated cases
PE	Tachycardia + dyspnea—>90% of patients; pain with inspiration (7)
Aortic dissection	Connective tissue disorders (e.g., Marfan syndrome), extremity pulse differential (30% of patients, type A>B) (8) Severe pain, abrupt onset + pulse differential + widened mediastinum on CXR >80% probability of dissection (9) Frequency of syncope >10% (8), AR 40%–75% (type A) (10)
Esophageal rupture	Emesis, subcutaneous emphysema, pneumothorax (20% patients), unilateral decreased or absent breath sounds
Other	
Noncoronary cardiac: AS, AR, HCM	AS: Characteristic systolic murmur, tardus or parvus carotid pulse AR: Diastolic murmur at right of sternum, rapid carotid upstroke HCM: Increased or displaced left ventricular impulse, prominent a wave in jugular venous pressure, systolic murmur
Pericarditis	Fever, pleuritic chest pain, increased in supine position, friction rub
Myocarditis	Fever, chest pain, heart failure, S3
Esophagitis, peptic ulcer disease, gall bladder disease	Epigastric tenderness Right upper quadrant tenderness, Murphy sign
Pneumonia	Fever, localized chest pain, may be pleuritic, friction rub may be present, regional dullness to percussion, egophony
Pneumothorax	Dyspnea and pain on inspiration, unilateral absence of breath sounds
Costochondritis, Tietze syndrome	Tenderness of costochondral joints
Herpes zoster	Pain in dermatomal distribution, triggered by touch; characteristic rash (unilateral and dermatomal distribution)

ACS indicates acute coronary syndrome; AR, aortic regurgitation; AS, aortic stenosis; CXR, chest x-ray; LR, likelihood ratio; HCM, hypertrophic cardiomyopathy; MR, mitral regurgitation; PE, pulmonary embolism; and PUD, peptic ulcer disease.

Biomarkers

Recommendations for Biomarkers

Referenced studies that support the recommendations are summarized in [Online Data Supplement 7](#).

COR	LOE	RECOMMENDATIONS
1	B-NR	1. In patients presenting with acute chest pain, serial cTn I or T levels are useful to identify abnormal values and a rising or falling pattern indicative of acute myocardial injury (1-21).
1	B-NR	2. In patients presenting with acute chest pain, high-sensitivity cTn is the preferred biomarker because it enables more rapid detection or exclusion of myocardial injury and increases diagnostic accuracy (17,21-25).
1	C-EO	3. Clinicians should be familiar with the analytical performance and the 99th percentile upper reference limit that defines myocardial injury for the cTn assay used at their institution (23,26).
3: No benefit	B-NR	4. With availability of cTn, creatine kinase myocardial (CK-MB) isoenzyme and myoglobin are not useful for diagnosis of acute myocardial injury (27-32).

Patient arrives with chest pain or anginal equivalent

Order hsTn at presentation and 1 hour later

Note: Bravera Health High Sensitivity Troponin Value / Cutoff: 76 ng/L

Step 1:
TROPONIN

ANY troponin
52 ng/L OR
 $\Delta > 5$ ng/L

Neither rule in nor rule out:
Order 3 hour troponin, if any criteria for rule in zone met, follow recommendation

ALL troponins < 10 ng/L (female) or < 12 ng/L (male) with $\Delta < 3$ ng/L if presenting > 3 hours after symptom onset

Rule in

Observation zone

Rule out

Step 2:
RISK SCORE

HEART ≥ 7 :
High probability

HEART 0-6:
Low to Intermediate probability

HEART ≥ 7
High probability

HEART 0-6:
Low to Intermediate probability

HEART ≥ 7 :
High probability

HEART 0-6:
Low to Intermediate probability

Step 3:
DISPOSITION

Admit to Cardiology

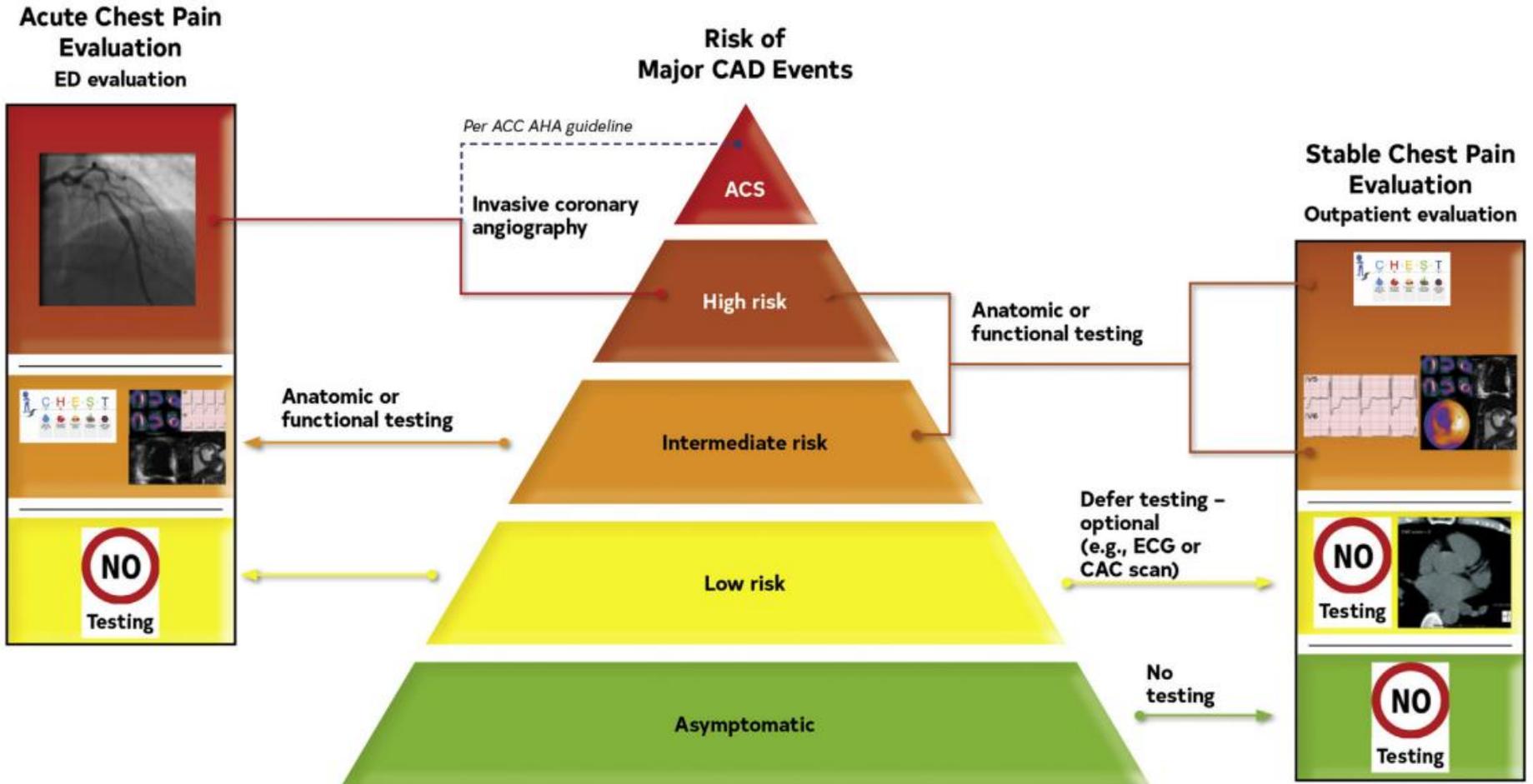
Admit to Medicine

ED Observation for further evaluation

Discharge home

Diagnostic Testing

FIGURE 5 Chest Pain and Cardiac Testing Considerations



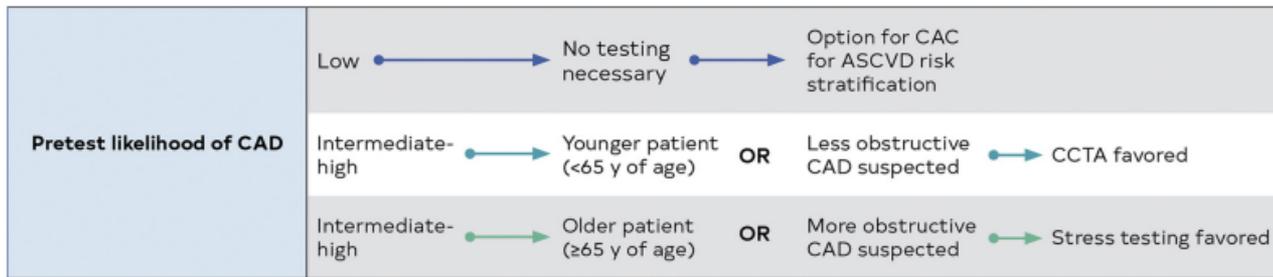


CCTA and CAC

The new Guideline emphasizes the use of the following diagnostic imaging:

- CAC (Coronary Artery Calcium)
- CCTA (Coronary Computed Tomographic Angiography)

FIGURE 6 Choosing the Right Diagnostic Test



	Favors use of CCTA	Favors use of stress imaging
Goal	<ul style="list-style-type: none"> • Rule out obstructive CAD • Detect nonobstructive CAD 	<ul style="list-style-type: none"> • Ischemia-guided management
Availability and expertise	<ul style="list-style-type: none"> • High-quality imaging and expert interpretation routinely available 	<ul style="list-style-type: none"> • High-quality imaging and expert interpretation routinely available
Likelihood of obstructive CAD	<ul style="list-style-type: none"> • Age <65 y 	<ul style="list-style-type: none"> • Age ≥65 y
Prior test results	<ul style="list-style-type: none"> • Prior functional study inconclusive 	<ul style="list-style-type: none"> • Prior CCTA inconclusive
Other compelling indications	<ul style="list-style-type: none"> • Anomalous coronary arteries • Require evaluation of aorta or pulmonary arteries 	<ul style="list-style-type: none"> • Suspect scar (especially if PET or stress CMR available) • Suspect coronary microvascular dysfunction (when PET or CMR available)

Stress testing information					
	ETT	Stress echocardiography	SPECT MPI	PET MPI	Stress CMR MPI
Patient capable of exercise	✓	✓	✓		
Pharmacologic stress indicated		✓	✓	✓	✓
Quantitative flow				✓	✓
LV dysfunction/scar		✓	✓	✓	✓

TABLE 5 Contraindication by Type of Imaging Modality and Stress Protocol

Exercise ECG	Stress Nuclear (1)*	Stress Echocardiography (2-5)	Stress CMR (6)	CCTA (7)*
<ul style="list-style-type: none"> ■ Abnormal ST changes on resting ECG, digoxin, left bundle branch block, Wolff-Parkinson-White pattern, ventricular paced rhythm (unless test is performed to establish exercise capacity and not for diagnosis of ischemia) ■ Unable to achieve ≥ 5 METs or unsafe to exercise ■ High-risk unstable angina or AMI (<2 d) i.e., active ACS ■ Uncontrolled heart failure ■ Significant cardiac arrhythmias (e.g., VT, complete atrioventricular block) or high risk for arrhythmias caused by QT prolongation ■ Severe symptomatic aortic stenosis ■ Severe systemic arterial hypertension (e.g., $\geq 200/110$ mm Hg) 	<ul style="list-style-type: none"> ■ High-risk unstable angina, complicated ACS or AMI (<2 d) ■ Contraindications to vasodilator administration <ul style="list-style-type: none"> ■ Significant arrhythmias (e.g., VT, second- or third-degree atrioventricular block) or sinus bradycardia <45 bpm ■ Significant hypotension (SBP <90 mm Hg) ■ Known or suspected bronchoconstrictive or bronchospastic disease 	<ul style="list-style-type: none"> ■ Limited acoustic windows (e.g., in COPD patients) ■ Inability to reach target heart rate ■ Uncontrolled heart failure ■ High-risk unstable angina, active ACS or AMI (<2 d) ■ Serious ventricular arrhythmia or high risk for arrhythmias attributable to QT prolongation ■ Respiratory failure ■ Severe COPD, acute pulmonary emboli, severe pulmonary hypertension ■ Contraindications to dobutamine (if pharmacologic stress test needed) 	<ul style="list-style-type: none"> ■ Reduced GFR (<30 mL/min/1.73 m²) ■ Contraindications to vasodilator administration ■ Implanted devices not safe for CMR or producing artifact limiting scan quality/interpretation ■ Significant claustrophobia ■ Caffeine use within past 12 h 	<ul style="list-style-type: none"> ■ Allergy to iodinated contrast ■ Inability to cooperate with scan acquisition and/or breath-hold instructions ■ Clinical instability (e.g., acute respiratory distress, severe hypotension, unstable arrhythmia) ■ Renal impairment as defined by local protocols ■ Contraindication to beta blockade in the presence of an elevated heart rate and no alternative medications available for achieving target heart rate ■ Heart rate variability and arrhythmia ■ Contraindication to nitroglycerin (if indicated)

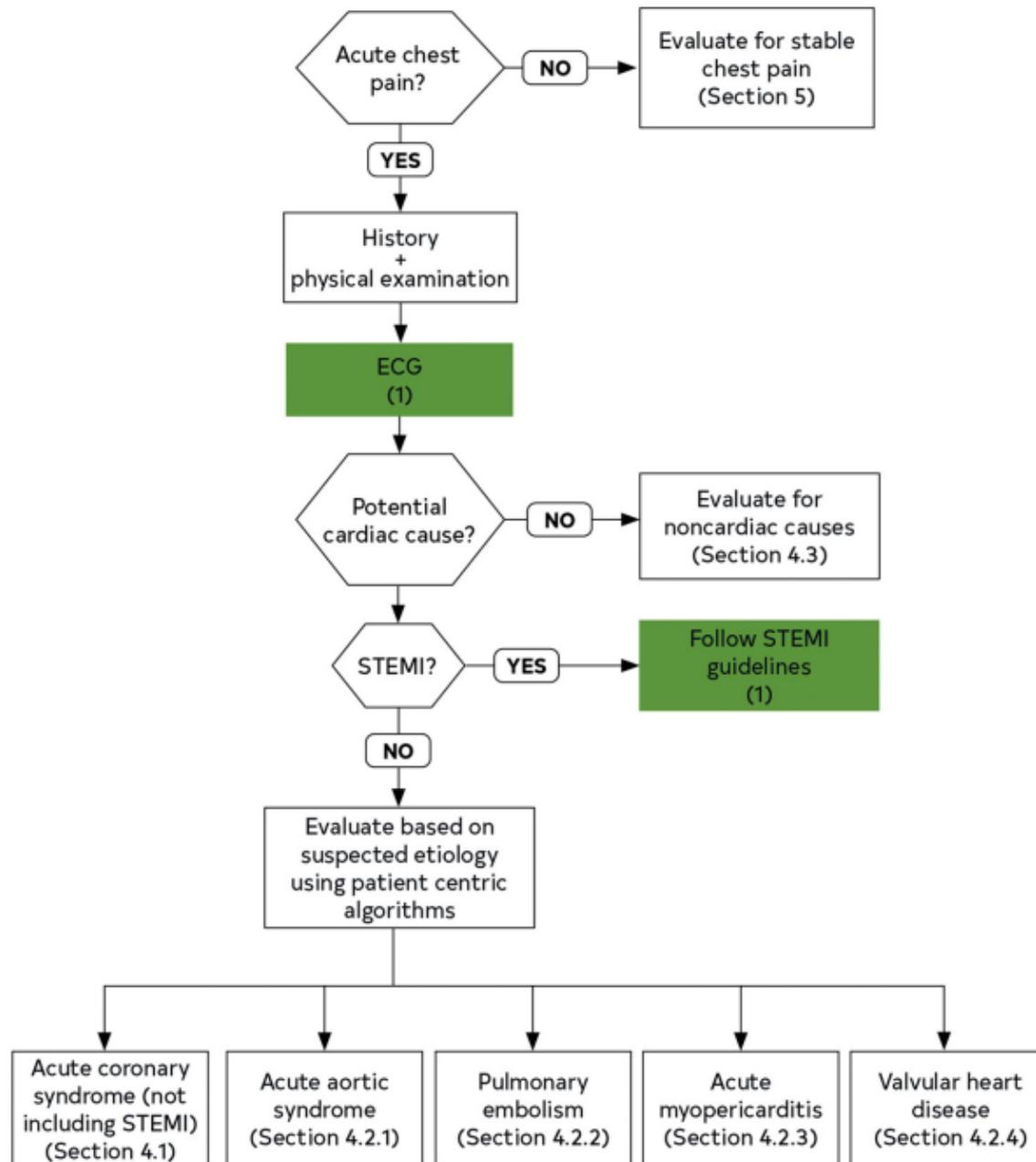
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TABLE 5 Continued

Exercise ECG	Stress Nuclear (1)*	Stress Echocardiography (2-5)	Stress CMR (6)	CCTA (7)*
<ul style="list-style-type: none"> ■ Acute illness (e.g., acute PE, acute myocarditis/pericarditis, acute aortic dissection) 	<ul style="list-style-type: none"> ■ Recent use of dipyridamole or dipyridamole-containing medications ■ Use of methylxanthines (e.g., aminophylline, caffeine) within 12 h ■ Known hypersensitivity to adenosine, regadenoson ■ Severe systemic arterial hypertension (e.g., $\geq 200/110$ mm Hg) 	<ul style="list-style-type: none"> ■ Atrioventricular block, uncontrolled atrial fibrillation ■ Critical aortic stenosis† ■ Acute illness (e.g., acute PE, acute myocarditis/pericarditis, acute aortic dissection) ■ Hemodynamically significant LV outflow tract obstruction ■ Contraindications to atropine use: <ul style="list-style-type: none"> ■ Narrow-angle glaucoma ■ Myasthenia gravis ■ Obstructive uropathy ■ Obstructive gastro intestinal disorders ■ Severe systemic arterial hypertension (e.g., $\geq 200/110$ mm Hg) 		
		<p><u>Use of Contrast Contraindicated in:</u></p>		
		<ul style="list-style-type: none"> ■ Hypersensitivity to perflutren ■ Hypersensitivity to blood, blood products, or albumin (for Optison only) 		

For all the imaging modalities, inability to achieve high-quality images should be considered, in particular for obese patients

FIGURE 7 Patient-Centric Algorithms for Acute Chest Pain



Acute Chest Pain, Suspected ACS

Recommendations for Patients With Acute Chest Pain and Suspected ACS (Not Including STEMI)

Referenced studies that support the recommendations are summarized in [Online Data Supplements 8 and 9](#).

COR	LOE	RECOMMENDATIONS
1	B-NR	1. In patients presenting with acute chest pain and suspected ACS, clinical decision pathways (CDPs) should categorize patients into low-, intermediate-, and high-risk strata to facilitate disposition and subsequent diagnostic evaluation (1-14).
1	B-NR	2. In the evaluation of patients presenting with acute chest pain and suspected ACS for whom serial troponins are indicated to exclude myocardial injury, recommended time intervals after the initial troponin sample collection (time zero) for repeat measurements are: 1 to 3 hours for high-sensitivity troponin and 3 to 6 hours for conventional troponin assays (15-17).
1	C-LD	3. To standardize the detection and differentiation of myocardial injury in patients presenting with acute chest pain and suspected ACS, institutions should implement a CDP that includes a protocol for troponin sampling based on their particular assay (18,19)
1	C-LD	4. In patients with acute chest pain and suspected ACS, previous testing when available should be considered and incorporated into CDPs (20-24).
2a	B-NR	5. For patients with acute chest pain, a normal ECG, and symptoms suggestive of ACS that began at least 3 hours before ED arrival, a single hs-cTn concentration that is below the limit of detection on initial measurement (time zero) is reasonable to exclude myocardial injury (13,25-29).

ACS Risk Stratification

- Use of a valid ACS Risk Stratification tool is recommended to determine the appropriate clinical pathway.
- ACS Risk Stratification tools recommended by the ACC are on the next two slides.....

Risk Stratification

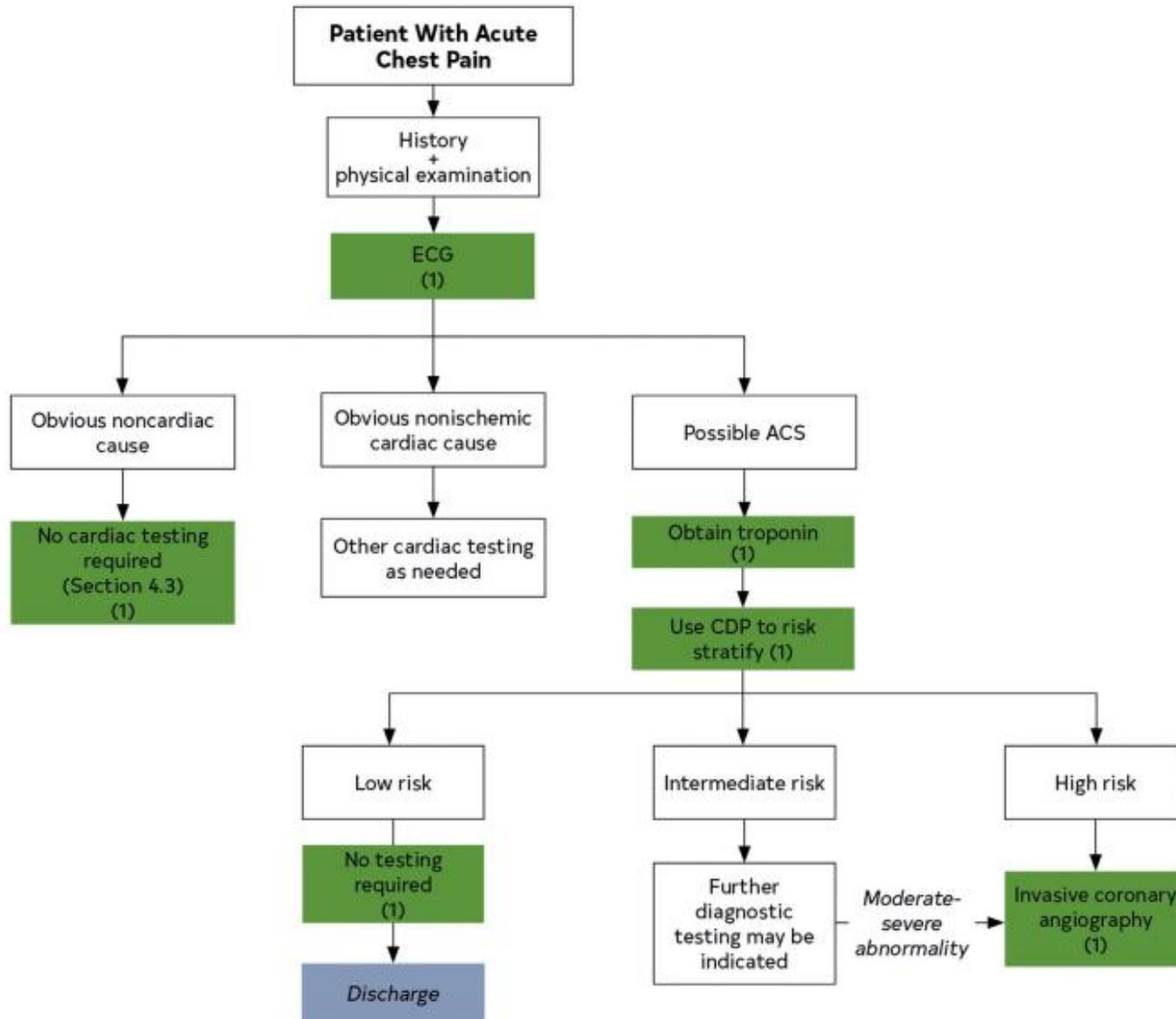
TABLE 6 Sample Clinical Decision Pathways Used to Define Risk

	HEART Pathway (31)	EDACS (44)	ADAPT (mADAPT) (45)	NOTR (34)	2020 ESC/hs-cTn* (46,47)	2016 ESC/GRACE (11,38)
Target population	Suspected ACS	Suspected ACS, CP >5 min, planned serial troponin	Suspected ACS, CP >5 min, planned observation	Suspected ACS, ECG, troponin ordered	Suspected ACS, stable	Suspected ACS, planned serial troponin
Target outcome	↑ ED discharge without increasing missed 30-d or 1-y MACE	↑ ED discharge rate without increasing missed 30-d MACE	↑ ED discharge rate without increasing missed 30-d MACE	↑ Low-risk classification without increasing missed 30-d MACE	Early detection of AMI; 30-d MACE	Early detection of AMI
Patients with primary outcome in study population, %	6-22	12	15	5-8	9.8	10-17
Troponin	cTn, hs-cTn	hs-cTn	cTn, hs-cTn	cTn, hs-cTn	hs-cTn	cTn, hs-cTn
Variables used	History ECG Age Risk factors Troponin (0, 3 h)	Age Sex Risk factors History Troponin (0, 2 h)	TIMI score 0-1 No ischemic ECG changes Troponin (0, 2 h)	Age Risk factors Previous AMI or CAD Troponin (0, 2 h)	History ECG hs-cTn (0, 1 or 2 h)	Age HR, SBP Serum Cr Cardiac arrest ECG Cardiac biomarker Killip class
Risk thresholds:						
■ Low risk	HEART score <3 Neg 0, 3-h cTn Neg 0, 2-h hs-cTn	EDACS score <16 Neg 0, 2 h hs-cTn No ischemic ECG Δ	TIMI score 0 (or <1 for mADAPT) ■ Neg 0, 2-h cTn or hs-cTn ■ No ischemic ECG Δ	Age <50 y <3 risk factors Previous AMI or CAD Neg cTn or hs-cTn (0, 2 h)	■ Initial hs-cTn is "very low" and Sx onset >3 h ago Or ■ Initial hs-cTn "low" and 1- or 2-h hs-cTn Δ is "low"	Chest pain free, GRACE <140 ■ Sx <6 h - hs-cTn <ULN (0, 3 h) ■ Sx >6 h - hs-cTn <ULN (arrival)

TABLE 6 Continued

	HEART Pathway (31)	EDACS (44)	ADAPT (mADAPT) (45)	NOTR (34)	2020 ESC/hs-cTn* (46,47)	2016 ESC/GRACE (11,38)
■ Intermediate risk	HEART score 4-6	NA	TIMI score 2-4	NA	<ul style="list-style-type: none"> ■ Initial hs-cTn is between "low" and "high" And/Or ■ 1- or 2-h hs-cTn Δ is between low and high thresholds 	<ul style="list-style-type: none"> ■ TO hs-cTn = 12-52 ng/L or ■ 1-h Δ = 3-5 ng/L
■ High risk	HEART score 7-10 (48,49)	NA	TIMI score 5-7 (49)	NA	<ul style="list-style-type: none"> ■ Initial hs-cTn is "high" Or ■ 1- or 2-h hs-cTn Δ is high 	<ul style="list-style-type: none"> ■ TO hs-cTn >52 ng/L Or ■ Δ 1 h >5 ng/L
Performance	<ul style="list-style-type: none"> ↑ ED discharges by 21% (40% versus 18%) ↓ 30-d objective testing by 12% (69% versus 57%) ↓ length of stay by 12 h (9.9 versus 21.9 h) 	More patients identified as low risk versus ADAPT (42% versus 31%)	ADAPT: More discharged \leq 6 h (19% versus 11%)	30-d MACE sensitivity =100% 28% eligible for ED discharge	AMI sensitivity >99% 62% Ruled out (0.2% 30-d MACE) 25% Observe 13% Rule in	AMI sensitivity >99% 30-d MACE not studied
AMI sensitivity, %	100	100	100	100	>99	96.7
cTn accuracy: 30-d MACE sensitivity, %	100	100	100	100	NA	NA
hs-cTn accuracy: 30-d MACE sensitivity, %	95	92	93	99	99	-
ED discharge, %	40	49	19 (ADAPT) 39 (mADAPT)	28	-	-

FIGURE 8 General Approach to Risk Stratification of Patients With Suspected ACS



Low Risk with acute chest pain

Recommendations for Low-Risk Patients With Acute Chest Pain

Referenced studies that support the recommendations are summarized in [Online Data Supplements 10 and 11](#).

COR	LOE	RECOMMENDATIONS
1	B-NR	1. Patients with acute chest pain and a 30-day risk of death or MACE <1% should be designated as low risk (1-11).
2a	B-R	2. In patients with acute chest pain and suspected ACS who are deemed low-risk (<1% 30-day risk of death or MACE), it is reasonable to discharge home without admission or urgent cardiac testing (12-16).

TABLE 7 Warranty Period for Prior Cardiac Testing

Test Modality	Result	Warranty Period
Anatomic	Normal coronary angiogram CCTA with no stenosis or plaque	2 y
Stress testing	Normal stress test (given adequate stress)	1 y

Table 8 provides a definition used for low-risk chest pain patients.

CCTA indicates coronary computed tomographic angiography.

TABLE 8 Definition Used for Low-Risk Patients With Chest Pain

Low Risk (<1% 30-d Risk for Death or MACE)	
hs-cTn Based	
T-0	T-0 hs-cTn below the assay limit of detection or "very low" threshold if symptoms present for at least 3 h
T-0 and 1- or 2-h Delta	T-0 hs-cTn and 1- or 2-h delta are both below the assay "low" thresholds (>99% NPV for 30-d MACE)
Clinical Decision Pathway Based	
HEART Pathway (20)	HEART score ≤ 3 , initial and serial cTn/hs-cTn < assay 99th percentile
EDACS (14)	EDACS score ≤ 16 ; initial and serial cTn/hs-cTn < assay 99th percentile
ADAPT (21)	TIMI score 0, initial and serial cTn/hs-cTn < assay 99th percentile
mADAPT	TIMI score 0/1, initial and serial cTn/hs-cTn < assay 99th percentile
NOTR (15)	0 factors

ADAPT indicates 2-hour Accelerated Diagnostic Protocol to Access Patients with Chest Pain Symptoms Using Contemporary Troponins as the Only Biomarkers; cTn, cardiac troponin; EDACS, Emergency Department Acute Coronary Syndrome; HEART Pathway, History, ECG, Age, Risk Factors, Troponin; hs-cTn, high-sensitivity cardiac troponin; MACE, major adverse cardiovascular events; mADAPT, modified 2-hour Accelerated Diagnostic Protocol to Access Patients with Chest Pain Symptoms Using Contemporary Troponins as the Only Biomarkers; NOTR, No Objective Testing Rule; NPV, negative predictive value; and TIMI, Thrombolysis in Myocardial Infarction.

Low Risk with stable CP, no CAD history

Recommendations for Low-Risk Patients With Stable Chest Pain and No Known CAD

Referenced studies that support the recommendations are summarized in [Online Data Supplements 27 and 28](#).

COR	LOE	RECOMMENDATIONS
1	B-NR	1. For patients with stable chest pain and no known CAD presenting to the outpatient clinic, a model to estimate pretest probability of obstructive CAD is effective to identify patients at low risk for obstructive CAD and favorable prognosis in whom additional diagnostic testing can be deferred (1-5).
2a	B-R	2. For patients with stable chest pain and no known CAD categorized as low risk, CAC testing is reasonable as a first-line test for excluding calcified plaque and identifying patients with a low likelihood of obstructive CAD (6-9).
2a	B-NR	3. For patients with stable chest pain and no known CAD categorized as low risk, exercise testing without imaging is reasonable as a first-line test for excluding myocardial ischemia and determining functional capacity in patients with an interpretable ECG (10).

Intermediate Risk with acute chest pain

Recommendations for Intermediate-Risk Patients With Acute Chest Pain
Referenced studies that support the recommendations are summarized in [Online Data Supplements 12 and 13](#).

COR	LOE	RECOMMENDATIONS
1	C-EO	1. For intermediate-risk patients with acute chest pain, TTE is recommended as a rapid, bedside test to establish baseline ventricular and valvular function, evaluate for wall motion abnormalities, and to assess for pericardial effusion.
2a	A	2. For intermediate-risk patients with acute chest pain, management in an observation unit is reasonable to shorten length of stay and lower cost relative to an inpatient admission (1-7).

Intermediate Risk, NO history CAD

Recommendations for Intermediate-Risk Patients With No Known CAD

Referenced studies that support the recommendations are summarized in [Online Data Supplements 14 and 15](#).

Anatomic Testing

- | | | |
|----|------|--|
| 1 | A | 1. For intermediate-risk patients with acute chest pain and no known CAD eligible for diagnostic testing after a negative or inconclusive evaluation for ACS, CCTA is useful for exclusion of atherosclerotic plaque and obstructive CAD (1-11). |
| 1 | C-EO | 2. For intermediate-risk patients with acute chest pain, moderate-severe ischemia on current or prior (≤ 1 year) stress testing, and no known CAD established by prior anatomic testing, ICA is recommended. |
| 2a | C-LD | 3. For intermediate-risk patients with acute chest pain with evidence of previous mildly abnormal stress test results (≤ 1 year), CCTA is reasonable for diagnosing obstructive CAD (12,13). |

Stress Testing

- | | | |
|---|------|---|
| 1 | B-NR | 4. For intermediate-risk patients with acute chest pain and no known CAD who are eligible for cardiac testing, either exercise ECG, stress echocardiography, stress PET/SPECT MPI, or stress CMR is useful for the diagnosis of myocardial ischemia (1,4,10,14-36). |
|---|------|---|

Sequential or Add-on Diagnostic Testing

- | | | |
|----|------|---|
| 2a | B-NR | 5. For intermediate-risk patients with acute chest pain and no known CAD, with a coronary artery stenosis of 40% to 90% in a proximal or middle coronary artery on CCTA, FFR-CT can be useful for the diagnosis of vessel-specific ischemia and to guide decision-making regarding the use of coronary revascularization (37-43). |
| 2a | C-EO | 6. For intermediate-risk patients with acute chest pain and no known CAD, as well as an inconclusive prior stress test, CCTA can be useful for excluding the presence of atherosclerotic plaque and obstructive CAD. |
| 2a | C-EO | 7. For intermediate-risk patients with acute chest pain and no known CAD, with an inconclusive CCTA, stress imaging (with echocardiography, PET/SPECT MPI, or CMR) can be useful for the diagnosis of myocardial ischemia. |

FIGURE 9 Evaluation Algorithm for Patients With Suspected ACS at Intermediate Risk With No Known CAD

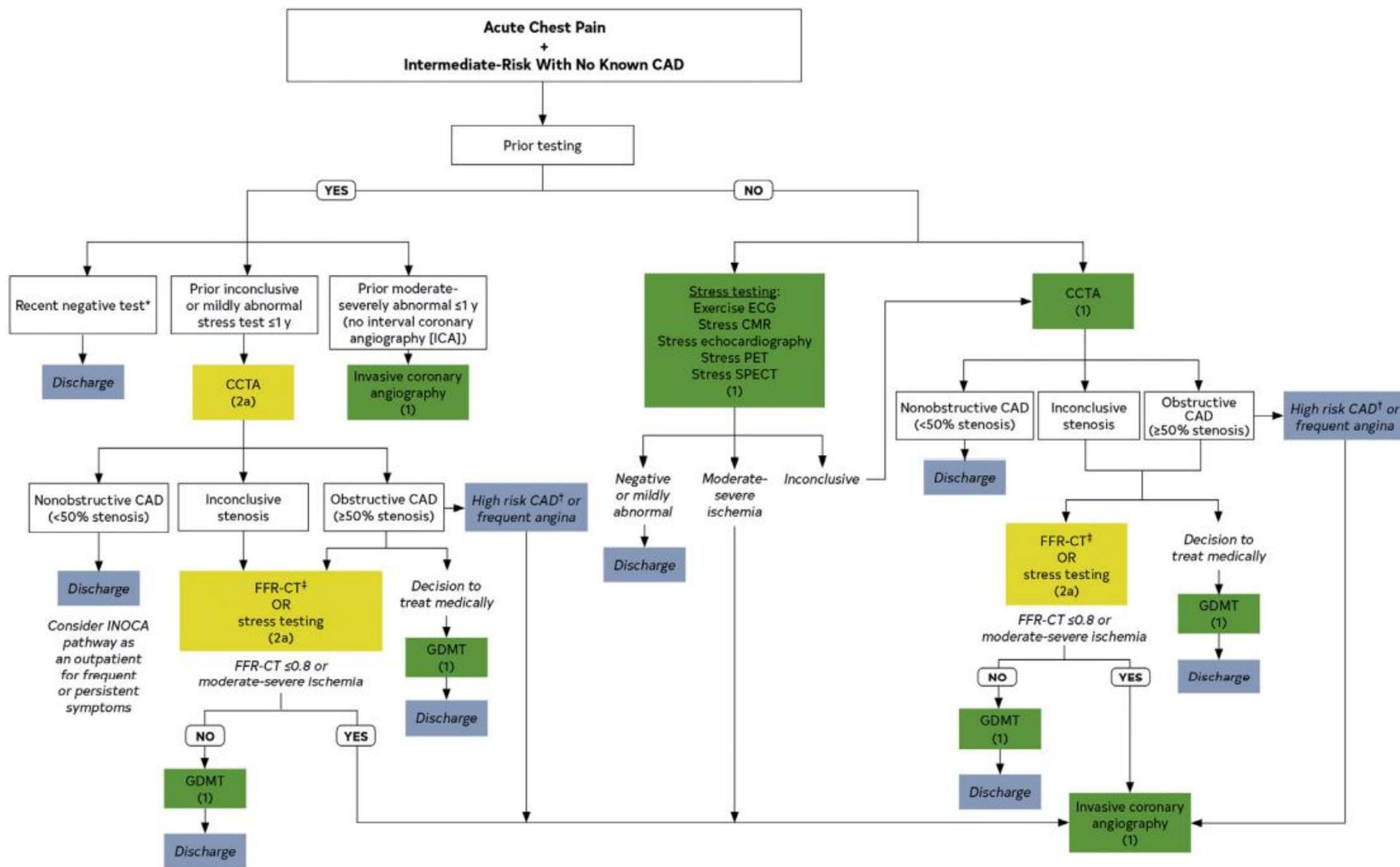
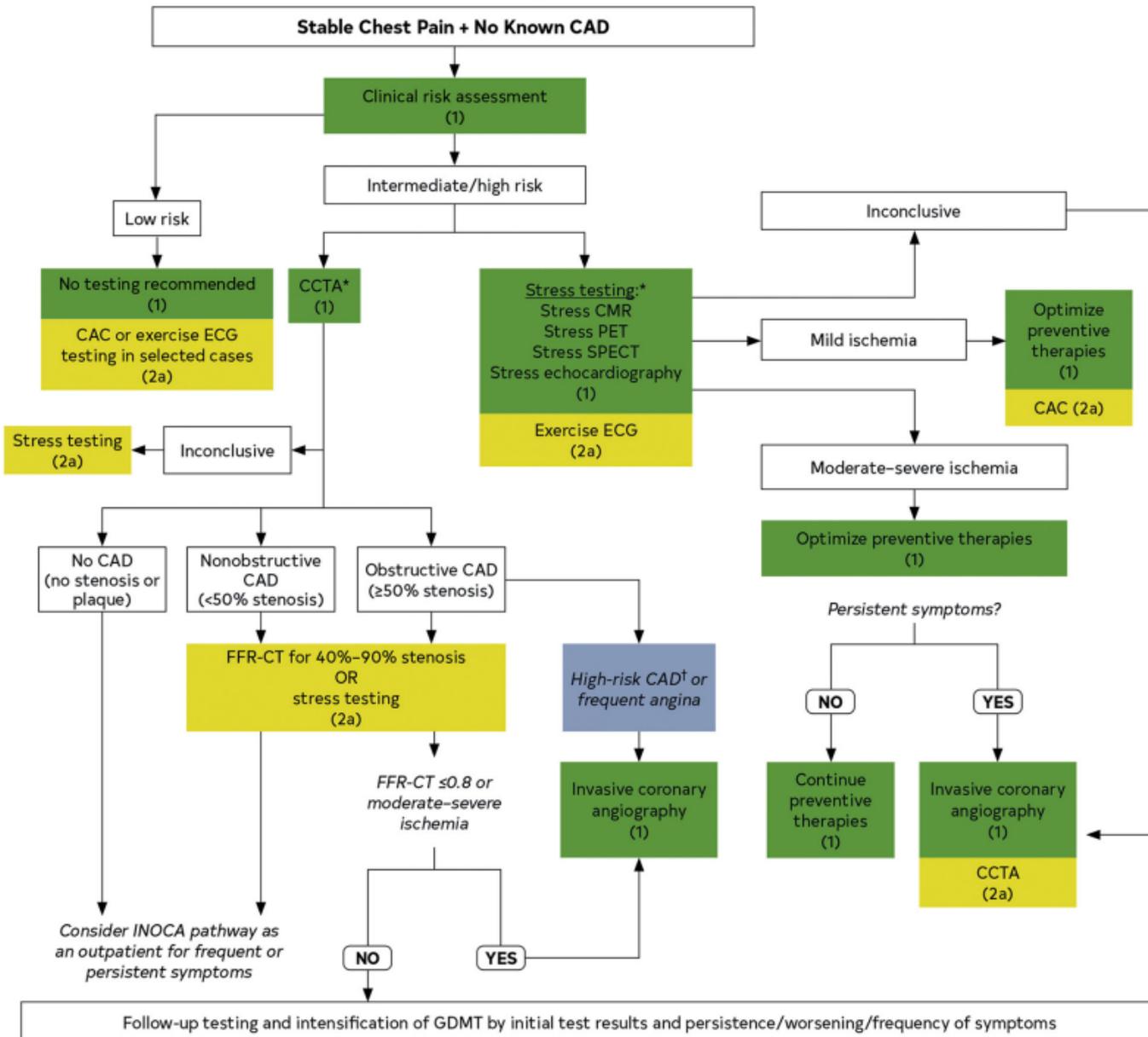


FIGURE 12 Clinical Decision Pathway for Patients With Stable Chest Pain and No Known CAD



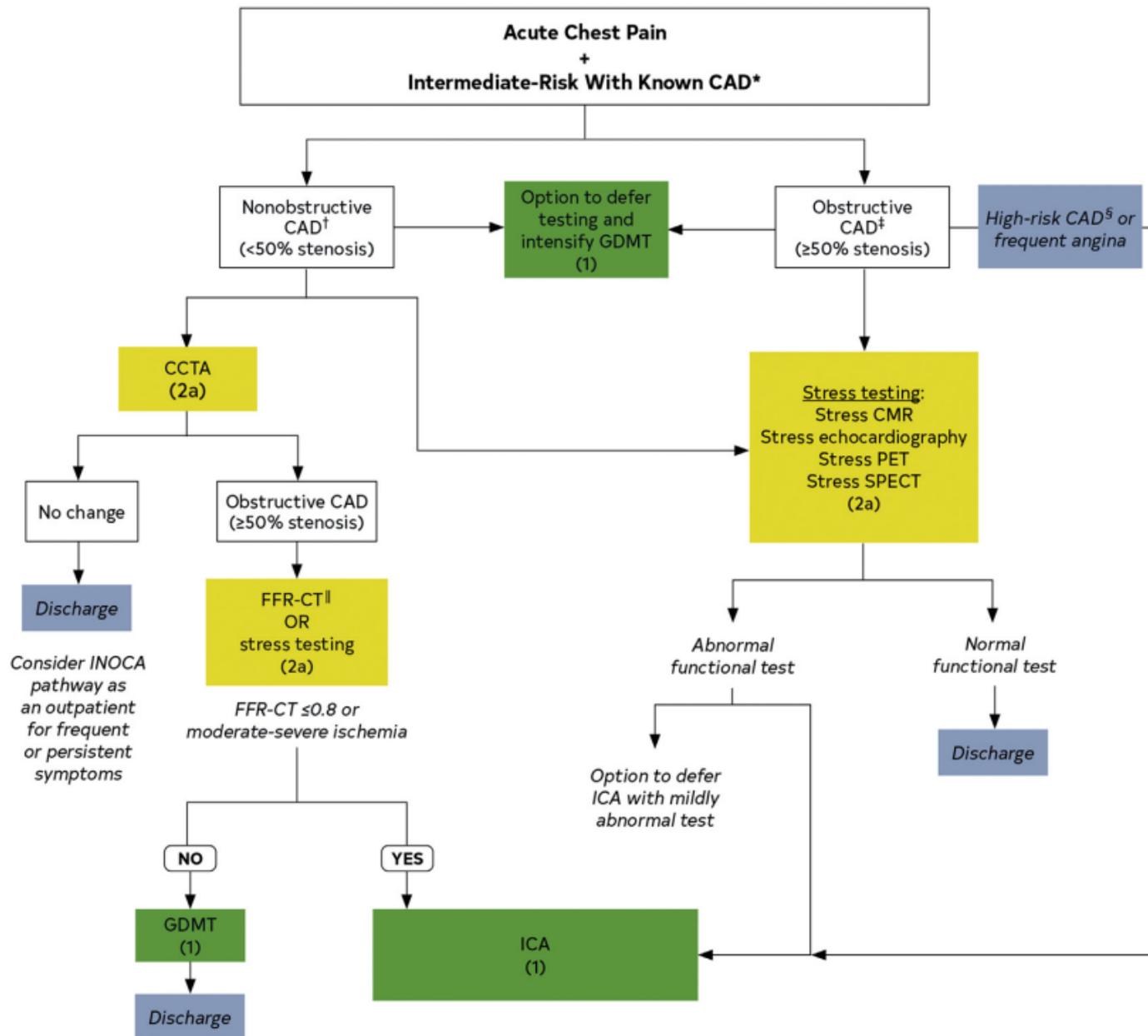
Intermediate Risk, known history CAD

Recommendations for Intermediate-Risk Patients With Acute Chest Pain and Known CAD

Referenced studies that support the recommendations are summarized in [Online Data Supplements 16 and 17](#).

COR	LOE	RECOMMENDATIONS
1	A	1. For intermediate-risk patients with acute chest pain who have known CAD and present with new onset or worsening symptoms, GDMT should be optimized before additional cardiac testing is performed (1,2).
1	A	2. For intermediate-risk patients with acute chest pain who have worsening frequency of symptoms with significant left main, proximal left anterior descending stenosis, or multivessel CAD on prior anatomic testing or history of prior coronary revascularization, ICA is recommended (3-8).
2a	B-NR	3. For intermediate-risk patients with acute chest pain and known nonobstructive CAD, CCTA can be useful to determine progression of atherosclerotic plaque and obstructive CAD (9-11).
2a	B-NR	4. For intermediate-risk patients with acute chest pain and coronary artery stenosis of 40% to 90% in a proximal or middle segment on CCTA, FFR-CT is reasonable for diagnosis of vessel-specific ischemia and to guide decision-making regarding the use of coronary revascularization (12-17).
2a	B-NR	5. For intermediate-risk patients with acute chest pain and known CAD who have new onset or worsening symptoms, stress imaging (PET/SPECT MPI, CMR, or stress echocardiography) is reasonable (18-21).

FIGURE 10 Evaluation Algorithm for Patients With Suspected ACS at Intermediate Risk With Known CAD



Intermed-High Risk, stable CP, No known CAD

Recommendations for Intermediate-High Risk Patients With Stable Chest Pain and No Known CAD

Referenced studies that support the recommendations are summarized in [Online Data Supplements 29 and 30](#).

Anatomic Testing

- | | | |
|---|---|--|
| 1 | A | 1. For intermediate-high risk patients with stable chest pain and no known CAD, CCTA is effective for diagnosis of CAD, for risk stratification, and for guiding treatment decisions (1-12). |
|---|---|--|

Stress Testing

- | | | |
|----|------|---|
| 1 | B-R | 2. For intermediate-high risk patients with stable chest pain and no known CAD, stress imaging (stress echocardiography, PET/SPECT MPI or CMR) is effective for diagnosis of myocardial ischemia and for estimating risk of MACE (8,13-35). |
| 2a | B-R | 3. For intermediate-high risk patients with stable chest pain and no known CAD for whom rest/stress nuclear MPI is selected, PET is reasonable in preference to SPECT, if available to improve diagnostic accuracy and decrease the rate of nondiagnostic test results (36-39). |
| 2a | B-R | 4. For intermediate-high risk patients with stable chest pain and no known CAD with an interpretable ECG and ability to achieve maximal levels of exercise (≥ 5 METs), exercise electrocardiography is reasonable (8,13,15,40-45). |
| 2b | B-NR | 5. In intermediate-high risk patients with stable chest pain selected for stress MPI using SPECT, the use of attenuation correction or prone imaging may be reasonable to decrease the rate of false-positive findings (46-51). |

Assessment of Left Ventricular Function

- | | | |
|---|------|--|
| 1 | B-NR | 6. In intermediate-high risk patients with stable chest pain who have pathological Q waves, symptoms or signs suggestive of heart failure, complex ventricular arrhythmias, or a heart murmur with unclear diagnosis, use of TTE is effective for diagnosis of resting left ventricular systolic and diastolic ventricular function and detection of myocardial, valvular, and pericardial abnormalities (13,14,52). |
|---|------|--|

Intermed-High Risk, stable CP, No known CAD

Sequential or Add-on Testing: What to Do if Index Test Results are Positive or Inconclusive

2a	B-NR	7. For intermediate-high risk patients with stable chest pain and known coronary stenosis of 40% to 90% in a proximal or middle coronary segment on CCTA, FFR-CT can be useful for diagnosis of vessel-specific ischemia and to guide decision-making regarding the use of coronary revascularization (12,53-58).
2a	B-NR	8. For intermediate-high risk patients with stable chest pain after an inconclusive or abnormal exercise ECG or stress imaging study, CCTA is reasonable (5,59-63).
2a	B-NR	9. For intermediate-high risk patients with stable chest pain and no known CAD undergoing stress testing, the addition of CAC testing can be useful (64-70).
2a	B-NR	10. For intermediate-high risk patients with stable chest pain after inconclusive CCTA, stress imaging is reasonable (13,14,20-23, 40,71-76).
2b	C-EO	11. For intermediate-high risk patients with stable chest pain after a negative stress test but with high clinical suspicion of CAD, CCTA or ICA may be reasonable.

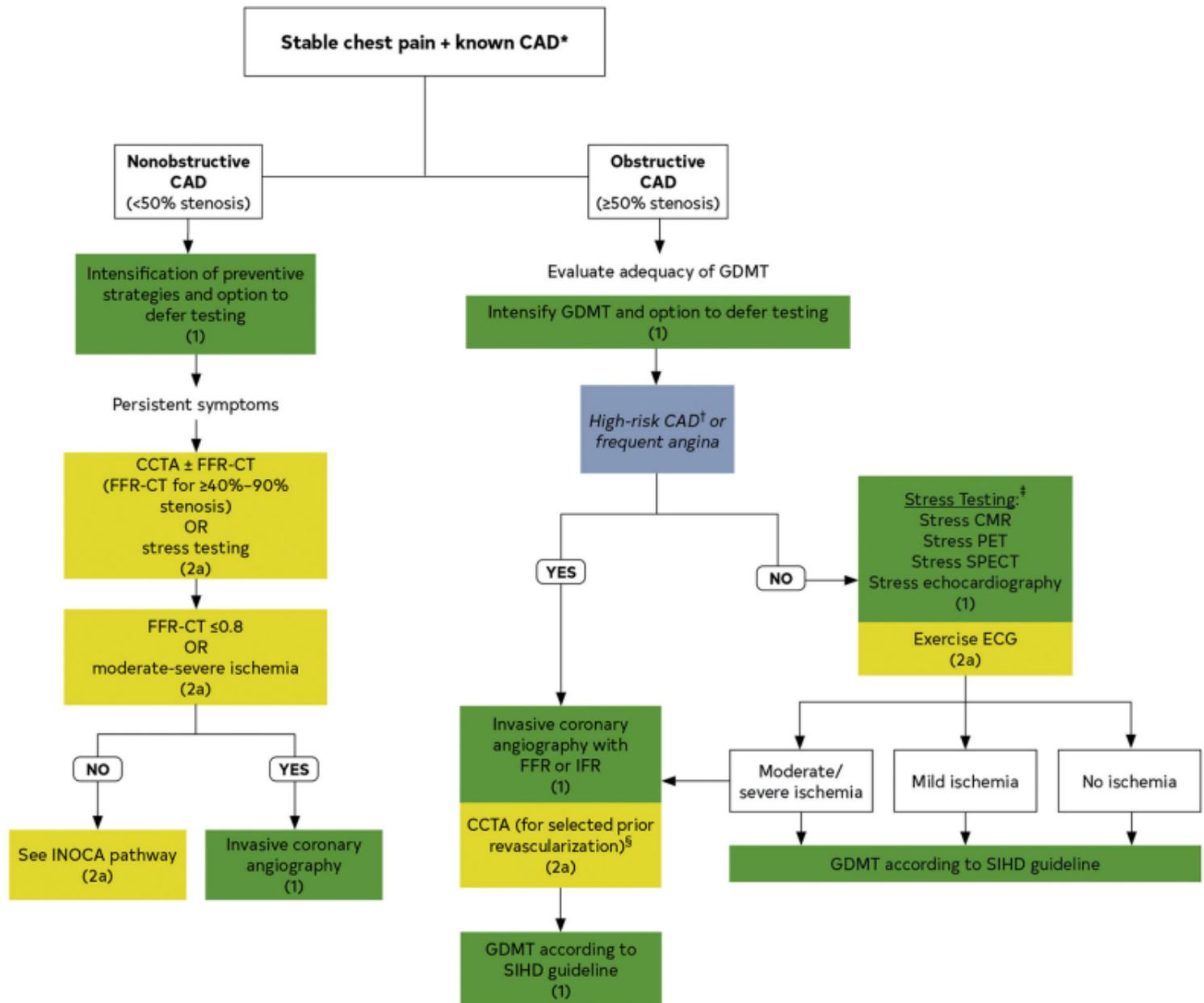
High Risk, acute chest pain

Recommendations for High-Risk Patients With Acute Chest Pain

Referenced studies that support the recommendations are summarized in [Online Data Supplements 18 and 19](#).

COR	LOE	RECOMMENDATIONS
Recommendations for High-Risk Patients, Including Those With High-Risk Findings on CCTA or Stress Testing		
1	B-NR	1. For patients with acute chest pain and suspected ACS who have new ischemic changes on electrocardiography, troponin-confirmed acute myocardial injury, new-onset left ventricular systolic dysfunction (ejection fraction <40%), newly diagnosed moderate-severe ischemia on stress testing, hemodynamic instability, and/or a high clinical decision pathway (CDP) risk score should be designated as high risk for short-term MACE (1-3).
1	C-EO	2. For patients with acute chest pain and suspected ACS who are designated as high risk, ICA is recommended (4-7).
2a	B-NR	3. For high-risk patients with acute chest pain who are troponin positive in whom obstructive CAD has been excluded by CCTA or ICA, CMR or echocardiography can be effective in establishing alternative diagnoses (8-12).

FIGURE 13 Clinical Decision Pathway for Patients With Stable Chest Pain (or Equivalent) Symptoms With Prior MI, Prior Revascularization, or Known CAD on Invasive Coronary Angiography or CCTA, Including Those With Nonobstructive CAD



Stable Chest Pain, Known CAD:

Recommendations for Patients With Known CAD Presenting With **Stable Chest Pain**
Referenced studies that support the recommendations are summarized in [Online Data Supplement 31](#).

COR	LOE	RECOMMENDATIONS
1	A	1. For patients with obstructive CAD and stable chest pain, it is recommended to optimize GDMT (1-3).
1	C-EO	2. For patients with known nonobstructive CAD and stable chest pain, it is recommended to optimize preventive therapies (4,5).

Stable CP, Known Non-Obstructive CAD:

Recommendations for Patients With **Known Nonobstructive CAD** Presenting With **Stable Chest Pain**
Referenced studies that support the recommendations are summarized in [Online Data Supplements 34 and 35](#).

COR	LOE	RECOMMENDATIONS
Index Diagnostic Testing		
Anatomic Testing		
2a	B-NR	1. For symptomatic patients with known nonobstructive CAD who have stable chest pain, CCTA is reasonable for determining atherosclerotic plaque burden and progression to obstructive CAD, and guiding therapeutic decision-making (1-7).
2a	B-NR	2. For patients with known coronary stenosis from 40% to 90% on CCTA, FFR can be useful for diagnosis of vessel-specific ischemia and to guide decision-making regarding the use of ICA (8-14).
Stress Testing		
2a	C-LD	3. For patients with known extensive nonobstructive CAD with stable chest pain symptoms, stress imaging (PET/SPECT, CMR, or echocardiography) is reasonable for the diagnosis of myocardial ischemia (15-24).

Stable CP, Known Obstructive CAD:

Recommendations for Patients With **Obstructive CAD** Who Present With **Stable Chest Pain**
 Referenced studies that support the recommendations are summarized in [Online Data Supplements 32 and 33](#).

COR	LOE	RECOMMENDATIONS
Index Diagnostic Testing		
Anatomic Testing		
1	A	1. For patients with obstructive CAD who have stable chest pain despite GDMT and moderate-severe ischemia, ICA is recommended for guiding therapeutic decision-making (1-4).
1	A	2. For patients with obstructive CAD who have stable chest pain despite optimal GDMT, those referred for ICA without prior stress testing benefit from FFR or instantaneous wave free ratio (3,5-7).
1	B-R	3. For symptomatic patients with obstructive CAD who have stable chest pain with CCTA-defined $\geq 50\%$ stenosis in the left main coronary artery, obstructive CAD with FFR with CT ≤ 0.80 , or severe stenosis ($\geq 70\%$) in all 3 main vessels, ICA is effective for guiding therapeutic decision-making (4,8).
2a	B-NR	4. For patients who have stable chest pain with previous coronary revascularization, CCTA is reasonable to evaluate bypass graft or stent patency (for stents ≥ 3 mm) (9-13).
Stress Testing		
1	B-NR	5. For patients with obstructive CAD who have stable chest pain despite optimal GDMT, stress PET/SPECT MPI, CMR, or echocardiography is recommended for diagnosis of myocardial ischemia, estimating risk of MACE, and guiding therapeutic decision-making (14-36).
2a	B-R	6. For patients with obstructive CAD who have stable chest pain despite optimal GDMT, when selected for rest/stress nuclear MPI, PET is reasonable in preference to SPECT, if available, to improve diagnostic accuracy and decrease the rate of nondiagnostic test results (37).
2a	B-NR	7. For patients with obstructive CAD who have stable chest pain despite GDMT, exercise treadmill testing can be useful to determine if the symptoms are consistent with angina pectoris, assess the severity of symptoms, evaluate functional capacity and select management, including cardiac rehabilitation (4,38-40).
2a	B-NR	8. For patients with obstructive CAD who have stable chest pain symptoms undergoing stress PET MPI or stress CMR, the addition of MBFR is useful to improve diagnosis accuracy and enhance risk stratification (31-36).

Chest Pain, Prior CABG:

4.1.4. Acute Chest Pain in Patients With Prior Coronary Artery Bypass Graft (CABG) Surgery

Recommendations for Acute Chest Pain in Patients With Prior CABG Surgery

COR	LOE	RECOMMENDATIONS
1	C-LD	1. In patients with prior CABG surgery presenting with acute chest pain who do not have ACS, performing stress imaging is effective to evaluate for myocardial ischemia or CCTA for graft stenosis or occlusion (1-7).
1	C-LD	2. In patients with prior CABG surgery presenting with acute chest pain, who do not have ACS (8-14) or who have an indeterminate/nondiagnostic stress test, ICA is useful (8).

Recommendations for Patients With Prior CABG Surgery With Stable Chest Pain

COR	LOE	RECOMMENDATIONS
1	C-LD	1. In patients who have had prior CABG surgery presenting with stable chest pain whose noninvasive stress test results show moderate-to-severe ischemia (1-7), or in those suspected to have myocardial ischemia with indeterminate/nondiagnostic stress test, ICA is recommended for guiding therapeutic decision-making (1).
2a	C-LD	2. In patients who have had prior CABG surgery presenting with stable chest pain who are suspected to have myocardial ischemia, it is reasonable to perform stress imaging or CCTA to evaluate for myocardial ischemia or graft stenosis or occlusion (8-15).

Suspected Ischemic Non-Obstructive CAD (INOCA):

Recommendations for Patients With Suspected INOCA

Referenced studies that support the recommendations are summarized in [Online Data Supplements 36 and 37](#).

COR	LOE	RECOMMENDATIONS
2a	B-NR	1. For patients with persistent stable chest pain and nonobstructive CAD and at least mild myocardial ischemia on imaging, it is reasonable to consider invasive coronary function testing to improve the diagnosis of coronary microvascular dysfunction and to enhance risk stratification (1-4).
2a	B-NR	2. For patients with persistent stable chest pain and nonobstructive CAD, stress PET MPI with MBFR is reasonable to diagnose microvascular dysfunction and enhance risk stratification (5-11).
2a	B-NR	3. For patients with persistent stable chest pain and nonobstructive CAD, stress CMR with the addition of MBFR measurement is reasonable to improve diagnosis of coronary myocardial dysfunction and for estimating risk of MACE (12-14).
2b	C-EO	4. For patients with persistent stable chest pain and nonobstructive CAD, stress echocardiography with the addition of coronary flow velocity reserve measurement may be reasonable to improve diagnosis of coronary myocardial dysfunction and for estimating risk of MACE.

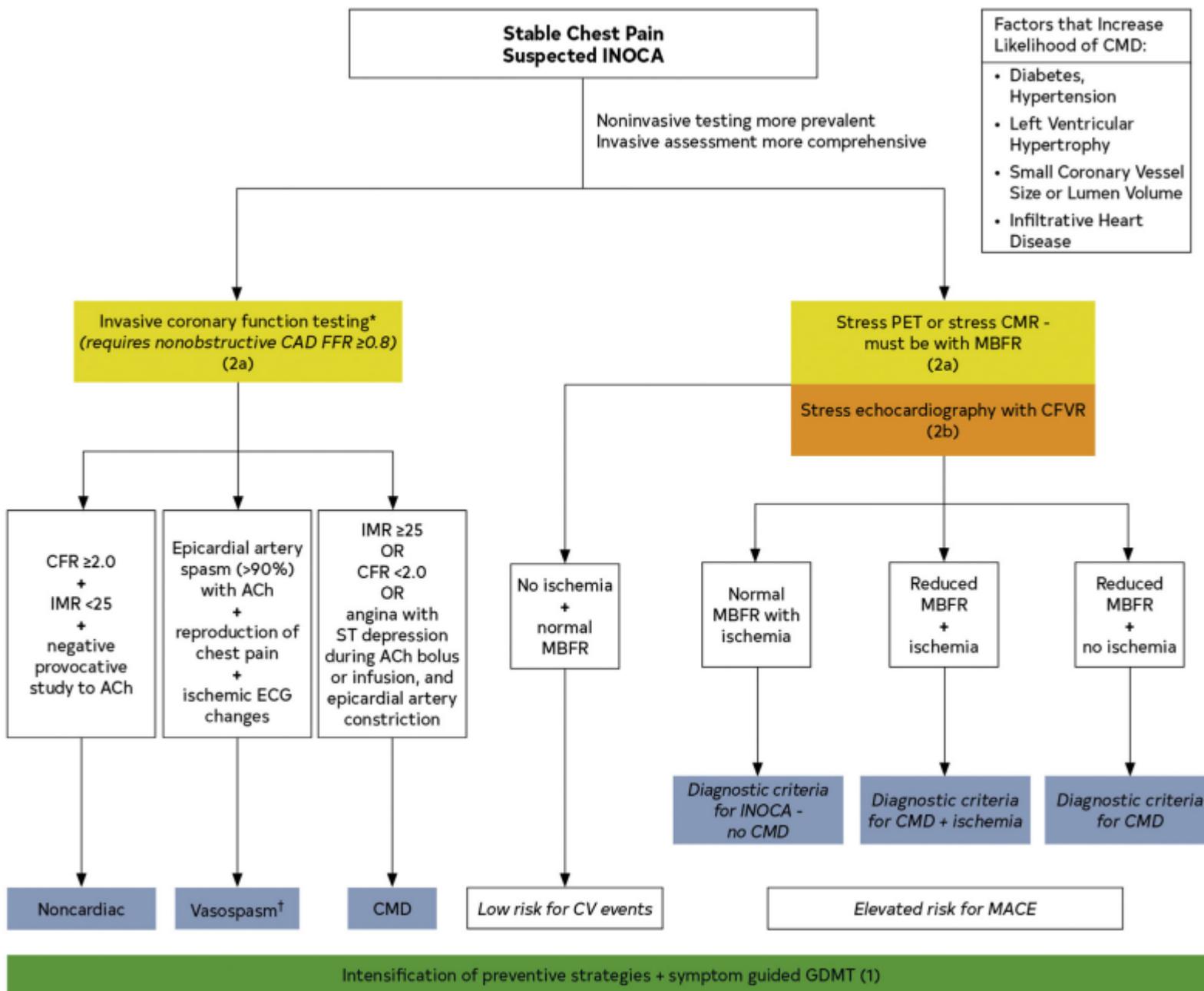
Shared Decision-Making

Recommendations for Shared Decision-Making in Patients With Acute Chest Pain

Referenced studies that support the recommendations are summarized in [Online Data Supplement 22](#).

COR	LOE	RECOMMENDATIONS
1	B-R	1. For patients with acute chest pain and suspected ACS who are deemed low risk by a CDP, patient decision aids are beneficial to improve understanding and effectively facilitate risk communication (1,2).
1	B-R	2. For patients with acute chest pain and suspected ACS who are deemed intermediate risk by a CDP, shared decision-making between the clinician and patient regarding the need for admission, for observation, discharge, or further evaluation in an outpatient setting is recommended for improving patient understanding and reducing low-value testing (1,2).

FIGURE 14 Clinical Decision Pathway for INOCA



Acute Chest Pain, Non-Ischemic Pathologies:

Recommendation for Evaluation of Acute Chest Pain With Nonischemic Cardiac Pathologies

COR	LOE	RECOMMENDATION
1	C-EO	1. In patients with acute chest pain in whom other potentially life-threatening nonischemic cardiac conditions are suspected (e.g., aortic pathology, pericardial effusion, endocarditis), TTE is recommended for diagnosis.

Suspected Acute Aortic Syndrome:

Recommendations for Acute Chest Pain With Suspected Acute Aortic Syndrome

COR	LOE	RECOMMENDATIONS
1	C-EO	1. In patients with acute chest pain where there is clinical concern for aortic dissection, computed tomography angiography (CTA) of the chest, abdomen, and pelvis is recommended for diagnosis and treatment planning.
1	C-EO	2. In patients with acute chest pain where there is clinical concern for aortic dissection, TEE or CMR should be performed to make the diagnosis if CT is contraindicated or unavailable.

Chest Pain, Suspected PE:

Recommendations for Acute Chest Pain With Suspected PE

Referenced studies that support the recommendations are summarized in [Online Data Supplement 23](#).

COR	LOE	RECOMMENDATIONS
1	B-NR	1. In stable patients with acute chest pain with high clinical suspicion for PE, CTA using a PE protocol is recommended (1-4).
1	C-EO	2. For patients with acute chest pain and possible PE, need for further testing should be guided by pretest probability.

Acute CP, Suspected Myopericarditis:

Recommendations for Acute Chest Pain With Suspected Myopericarditis
Referenced studies that support the recommendations are summarized in [Online Data Supplement 24](#).

COR	LOE	RECOMMENDATIONS
1	B-NR	1. In patients with acute chest pain and myocardial injury who have nonobstructive coronary arteries on anatomic testing, CMR with gadolinium contrast is effective to distinguish myopericarditis from other causes, including myocardial infarction and nonobstructive coronary arteries (MINOCA) (1-6).
1	B-NR	2. In patients with acute chest pain with suspected acute myopericarditis, CMR is useful if there is diagnostic uncertainty, or to determine the presence and extent of myocardial and pericardial inflammation and fibrosis (7-12).
1	C-EO	3. In patients with acute chest pain and suspected myopericarditis, TTE is effective to determine the presence of ventricular wall motion abnormalities, pericardial effusion, valvular abnormalities, or restrictive physiology.
2b	C-LD	4. In patients with acute chest pain with suspected acute pericarditis, noncontrast or contrast cardiac CT scanning may be reasonable to determine the presence and degree of pericardial thickening (7,8,13).

Acute CP with Valvular Disease:

Recommendations for Acute Chest Pain With VHD

COR	LOE	RECOMMENDATIONS
1	C-EO	1. In patients presenting with acute chest pain with suspected or known history of VHD, TTE is useful in determining the presence, severity, and cause of VHD.
1	C-EO	2. In patients presenting with acute chest pain with suspected or known VHD in whom TTE diagnostic quality is inadequate, TEE (with 3D imaging if available) is useful in determining the severity and cause of VHD.
2a	C-EO	3. In patients presenting with acute chest pain with known or suspected VHD, CMR imaging is reasonable as an alternative to TTE and/or TEE is nondiagnostic.

Acute CP with Suspected Non- Cardiac Issues:

Recommendation for Evaluation of Acute Chest Pain With Suspected Noncardiac Causes

COR	LOE	RECOMMENDATION
1	C-EO	1. Patients with acute chest pain should be evaluated for noncardiac causes if they have persistent or recurring symptoms despite a negative stress test or anatomic cardiac evaluation, or a low-risk designation by a CDP.

Acute CP, Suspected GI Syndromes:

Recommendation for Evaluation of Acute Chest Pain With Suspected Gastrointestinal Syndromes

COR	LOE	RECOMMENDATION
2a	C-LD	1. In patients with recurrent acute chest pain without evidence of a cardiac or pulmonary cause, evaluation for gastrointestinal causes is reasonable.

CP Differential Diagnosis:

TABLE 9 Differential Diagnosis of Noncardiac Chest Pain

Respiratory	Cervical radiculopathy
Pulmonary embolism	Breast disease
Pneumothorax/hemothorax	Rib fracture
Pneumomediastinum	Musculoskeletal injury/spasm
Pneumonia	Psychological
Bronchitis	Panic disorder
Pleural irritation	Anxiety
Malignancy	Clinical depression
Gastrointestinal	Somatization disorder
Cholecystitis	Hypochondria
Pancreatitis	Other
Hiatal hernia	Hyperventilation syndrome
Gastroesophageal reflux disease/gastritis/esophagitis	Carbon monoxide poisoning
Peptic ulcer disease	Sarcoidosis
Esophageal spasm	Lead poisoning
Dyspepsia	Prolapsed intervertebral disc
Chest wall	Thoracic outlet syndrome
Costochondritis	Adverse effect of certain medications (e.g., 5-fluorouracil)
Chest wall trauma or inflammation	Sickle cell crisis
Herpes zoster (shingles)	

Additional Resources:

[Clinical Guideline Library: Am Coll of Cardiol \(visit website\)](#)

[2020 AHA ACLS / BLS – ALGORITHMS and ECC Guideline Review](#)