

4. An ultrasound-enhancing agent is indicated when visual assessment of LV function is uncertain.
5. An urgent TTE should be performed in hemodynamically unstable patients with suspected or confirmed ACS, to evaluate LV/RV function, mechanical complications, or pericardial effusion/tamponade.
6. CMR is an alternative test for assessment of LV/RV function if echocardiography is inconclusive and the patient is stable.

Myocardial Perfusion Imaging

In suspected ACS, resting myocardial perfusion imaging may show a lack of coronary blood flow even without regional wall motion abnormality, but this is quite rare.^{73,80} Hypoperfusion at rest (as opposed to during stress) almost always causes a WMA. Contrast echocardiography permits real-time bedside evaluation of myocardial perfusion as well as contractile function following intravenous injection of a UEA. Ischemia is identified by a delay in the replenishment of UEA after a high-energy destructive pulse. Identifying the absence of a perfusion defect in conjunction with normal ventricular function virtually excludes ongoing acute ischemia in a symptomatic patient evaluated for acute chest pain.⁷³ Conversely, finding a defect in a patient without a history of prior MI supports the diagnosis of ACS.

Stress TTE and MPI studies have shown that early testing in the emergency department (ED) or in an outpatient setting are both safe and diagnostic in acute chest pain patients who do not have recurrent ischemic symptoms, remain hemodynamically stable, and had a negative initial evaluation with biomarkers and ECG. Stress TTE offers the advantage that LV function and assessments for other causes of cardiac symptoms can be evaluated at the time of baseline imaging (Supplementary data online, [Movie S1](#)). In randomized controlled trials, compared to standard care, both stress modalities have been shown to be cost-effective and to reduce unnecessary admissions without compromising appropriate admissions.⁸¹ For these reasons, functional testing by any of these modalities might be used also in the chest pain unit or ED, if troponin or/and other parameters fail to establish the diagnosis.

Myocardial perfusion CMR is able to detect perfusion defects with limited evidence in low-risk, hemodynamically stable ACS patients.^{82,83} Evidence of microvascular obstruction by CMR has been shown to have incremental prognostic value over evaluation of LV function ([Figure 15](#)).

Key Points

1. Myocardial perfusion imaging may show reduction or loss of myocardial perfusion, most often combined with regional wall motion abnormality, in patients with ACS due to obstructive CAD.
2. Stress modalities are cost-effective and may reduce unnecessary admissions.

Coronary Artery Anatomy

Coronary CTA in patients with suspected NSTEMI-ACS has demonstrated high diagnostic accuracy and efficiency to rule out obstructive CAD and thus allow for safe and early patient discharge from the ED. It can be performed quickly and safely (with minimal radiation and iodinated contrast) and interpreted rapidly (less than 20 min). Coronary CTA can be used to exclude CAD and the need for ICA in patients with unclear NSTEMI-ACS.⁸⁴ Additionally, coronary CTA may be useful in patients with equivocal elevations in troponin that are not clearly due to ACS.^{85,86} CTA in patients with known prior CAD might be less useful in patients with prior stents.

A normal CTA might facilitate early discharge from the ED. On the other hand, coronary CTA may be associated with increased downstream testing and revascularization procedures ([Figure 10](#)). It is often difficult to differentiate bystander from culprit coronary disease. The choice of coronary CTA vs. stress testing will mostly depend on local availability and expertise. In a meta-analysis that compared the diagnostic accuracy of coronary CTA, stress echocardiography, and MPI for the assessment of chest pain in the ED, there were no significant differences between all these modalities in terms of their negative predictive accuracy for short-term cardiac events.⁸⁷ The utilization of CT-derived FFR in patients with possible ACS has been shown to result in the safe deferral of ICA in a large prospective observational study and may further enhance the diagnostic accuracy of coronary CTA.⁸⁸ The clinical utility of non-contrast CT in the ED is limited.⁸⁹

Key Points

1. Coronary CTA in patients with suspected ACS has demonstrated high diagnostic accuracy and efficiency to rule out obstructive CAD.
2. Coronary CTA might result in a shorter length of stay in the ED.

Myocardial Scar and Edema Assessment

In patients presenting with acute chest pain of uncertain etiology and unrevealing initial diagnostic workup (TTE, coronary CTA), non-invasive imaging of edema (and scar in subacute cases) can be used to confirm ACS vs. other causes of chest pain and elevated troponin such as myocarditis or stress-induced (takotsubo) cardiomyopathy. Imaging might also guide identification of culprit vessels in patients with established ACS, but with uncertainty on which vessel to revascularize. The high resolution of LGE CMR enables detection of micro-infarctions involving as little as 1 g of myocardial tissue and is more sensitive for the detection of subendocardial infarcts than is SPECT.⁹⁰ Edema by CMR can be detected with T2-weighted imaging or parametric mapping, and can also often be seen on standard steady-state free precession cine images, in which signal is determined by the T2/T1 ratio of tissues. In clinical practice, edema by CMR contributes to the detection of ACS and allows identification of the culprit artery in patients with multi-vessel disease. It is important to remember that in ACS the edema and/or scar should reflect the coronary territories and is usually transmural or subendocardial in CAD. Myocardial edema and mid-myocardial or epicardial LGE are indicative of acute myocarditis.

Key points

1. Myocardial edema is an early manifestation of myocardial damage that can be evaluated with edema-sensitive CMR methods.
2. LGE CMR detects infarction and edema in ACS and can contribute to the diagnosis of other causes of acute chest pain.

Differential Diagnosis in Acute Chest Pain

The main goal of the initial diagnostic evaluation is to confirm or exclude the most frequent life-threatening conditions, namely ACS, acute aortic syndromes (AAS), and acute PE. Although the vast majority of patients with acute chest pain are not critically ill, the diagnostic process can be challenging and imaging can be of great help. Possible differential diagnoses are many and comprise both ischemic and non-ischaemic cardiovascular causes ([Table 1](#)), as well as a multitude of non-cardiac conditions. All cardiac imaging tests can aid in the