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REVIEW ARTICLE

Role of cardiac imaging in acute chest pain

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ABSTRACT

Chest pain is the second most common complaint in the emergency department. The need to diagnose the cause of chest pain in a timely manner and appropriately direct care is crucial. This article discusses the role of imaging in acute chest pain, after first differentiating chest pain into cardiac and non-cardiac causes with upfront clinical and biochemical assessment. The role of non-invasive imaging including point-of-care ultrasound, echocardiography, myocardial perfusion imaging, cardiac MRI, coronary computed tomography angiography and novel cardiac CT applications are discussed. Updates in the literature regarding the role of coronary plaque imaging in acute chest pain are reviewed, as are ongoing challenges and future directions. This includes a discussion on the yield of diagnostic testing in low-risk acute chest pain cohorts *vs* intermediate-high risk cohorts. The incremental value of further testing in the former is low, which is reflected in contemporary guidelines that discourage the use of costly diagnostic tests in these cohorts. In the latter cohort, emerging evidence has shown specifically the role coronary computed tomography angiography could play in reducing the need for invasive coronary angiography in selective patients where the true probability of acute coronary syndrome is thought to be low. Real-world considerations such as accessibility and affordability are also discussed in the paper because while guidelines offer clinicians the flexibility of evidence-based choice, physician decision must necessarily be made in consideration of real-world constraints.

BACKGROUND

Chest pain is the second most common presenting complaint in the emergency department (ED) in the United States, accounting for approximately 7.6 million visits annually.[1] It exacts a significant burden on the healthcare system due to inordinately high admission costs. While only a minority of these visits are actually due to acute coronary syndrome, risk stratification for appropriate downstream care comes with high clinical stakes.[2,3] The evaluation of suspected acute coronary syndrome accounts for over $3 billion in hospital costs per year.[4] In the United States, 0.9% of all admissions for acute myocardial infarction (MI) are missed at the emergency department.[5] Younger age and black race are associated with higher odds of missed diagnosis, whereas teaching hospital status, availability of cardiac catheterisation, high ED admission rates, high inpatient occupancy rates and urban location are associated with lower odds.[5]

Diagnostic work-up of acute chest pain

Differential diagnoses of chest pain presentation include acute coronary syndrome (ACS), other potentially life-threatening conditions, as well as non-life-threatening conditions, some of which may be quite common (Table 1). Clinical judgment based on history and physical examination must be exercised to establish the likelihood of specific conditions in order to prioritise initial investigations. Electrocardiography (ECG) is obligatory for screening for ST-elevation and non-ST-elevation myocardial infarction. Chest X-ray (CXR) is useful for diagnosis of other potentially life-threatening conditions like pneumothorax (Table 1).

For patients with suspected ACS, guidelines recommend the use of serial cardiac troponin assays (preferably high-sensitivity cardiac troponin assays, hs-cTn).[6] These assays possess high diagnostic accuracy for myocardial injury at presentation compared with conventional assays, allowing for more rapid 'rule-in' and 'rule-out' of myocardial infarction. These series of tests, combined with ECG and clinical examination, are recommended for use in algorithms to identify patients with non-ST elevation ACS, and have a negative-predictive value of >99%. However, confounders such as age, renal dysfunction, time from chest pain onset and sex can affect hs-cTn concentrations. Patients who do not qualify for 'rule-in' or 'rule-out' are advised observation. In patients with low-to-intermediate likelihood of ACS based on clinical judgement, non-invasive imaging should be considered either at the ED or shortly after discharge

Table 1. Differential diagnoses of acute chest pain

Life-threatening conditions	Non-life-threatening conditions
Acute coronary syndrome	Cardiac causes (*e.g.* pericarditis, myocarditis, tachyarrhythmias)
Acute aortic dissection	Pulmonary/pleural causes (*e.g.* respiratory infections)
Pulmonary embolism	Gastrointestinal causes
Tension pneumothorax	Musculoskeletal causes
Pericardial tamponade	Psychiatric causes
Mediastinitis (*e.g.* oesophageal rupture)	Less commonly: referred pain (*e.g.* herpes zoster), inflammation

from the ED. For patients deemed at high clinical suspicion for ACS, invasive coronary angiography is recommended. (Figure 1)

The role of non-invasive imaging

After an ST-elevation myocardial infarction has been excluded echocardiography, CT or MRI are valuable for the urgent detection or exclusion of various other life-threatening condition presenting with chest pain (Figure 2). The test of choice will depend on the suspected condition, urgency of diagnosis and availability of the modality at the time of presentation. Table 2 summarises non-invasive imaging recommendations for patients presenting with acute chest pain, based on risk stratification.[7] When deciding on an appropriate test, contraindications for each modality must first be considered.

Figure 1. An approach to risk stratification of patients presenting with acute chest pain (adapted from Circulation. 2021;144:e368–e454).[7]

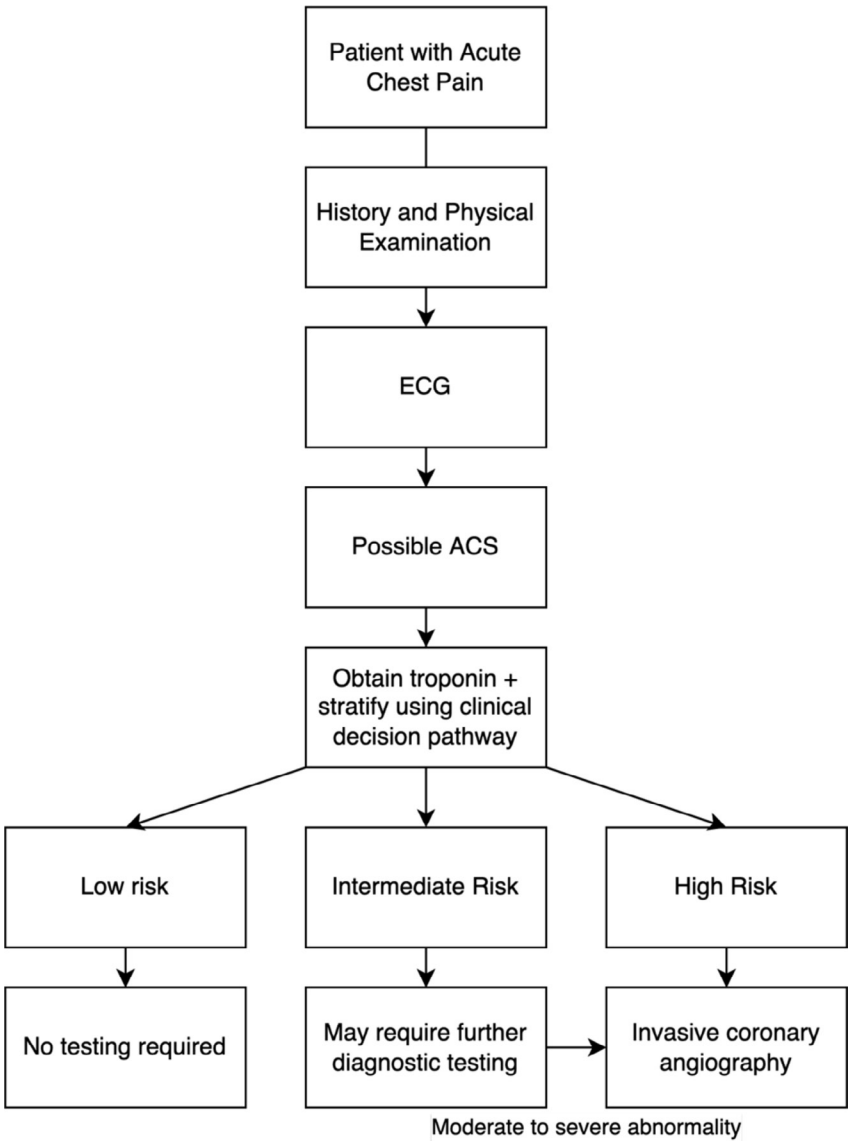
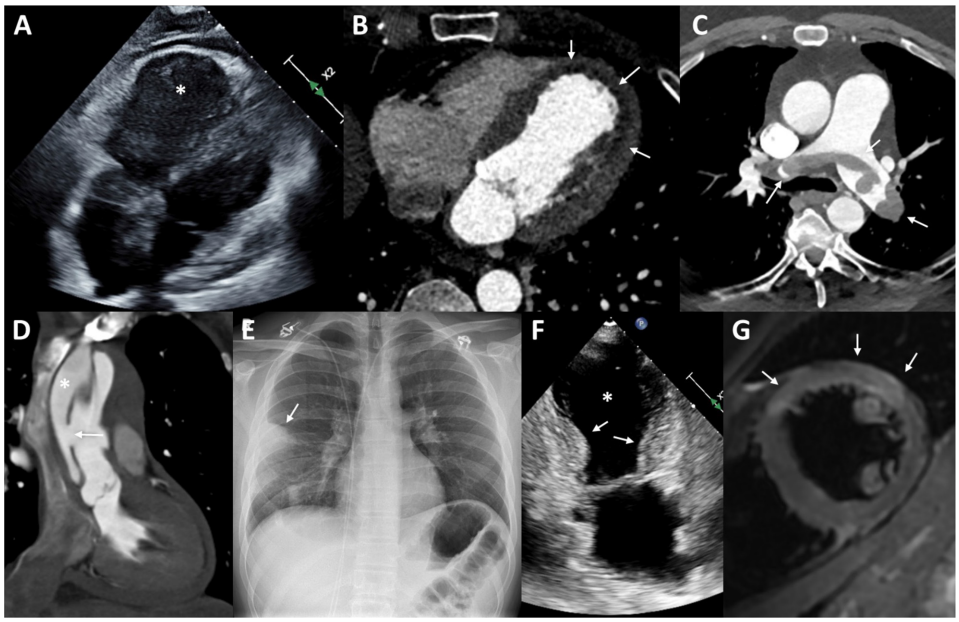


Figure 2. Right ventricular dilatation and hypokinesia with sparing of the RV apex in the context of a large pulmonary embolism by transthoracic echocardiography (A, 4-chamber view). Reduced systolic thickening and endocardial hypoenhancement on chest CT angiography in the context of a subacute anterior myocardial infarction (B). Saddle pulmonary embolism on CT angiography (C). Acute Stanford Type A aortic dissection with pericardial effusion on CT angiography, coronal cross-section (D). Hampton Hump on AP chest X-ray in the context of a pulmonary embolism (E). Mid-distal left ventricular dilatation and dyskinesia (end-systolic 2-chamber transthoracic echocardiographic view), combined with hypercontractility of the basal segments, in the context of Takotsubo cardiomyopathy (F). Myocarditis with enhanced signal on T_2 weighted cardiac MRI (G). AP, anteroposterior.



Point-of-care ultrasound (POCUS)

POCUS can be used for the evaluation of pericardial effusion (associated with several conditions including cardiac tamponade, pericarditis, aortic dissection), global LV systolic function and/or regional wall motion abnormalities, suspected pulmonary embolism and pneumothorax.[8]

Echocardiography

Echocardiography is useful to evaluate regional wall abnormalities, which could be suggestive of myocardial ischaemia or prior myocardial infarction. Ischaemic myocardium can be detected by contrast echocardiography or by reduced regional function using strain and strain rate imaging, and both techniques may be employed to improve the diagnostic and prognostic value of conventional echocardiography.[9,10] Echocardiography can also aid in the detection of valvular heart disease, pericardial effusion, aortic dissection, hypertrophic cardiomyopathy or features suggestive of pulmonary embolism (such as right heart strain), each of which could present with acute chest pain.

Table 2. Non-invasive imaging options in patients presenting with acute chest pain according to 2021 US Chest Pain guidelines

Suspected condition	Imaging options
Acute chest pain and high risk (new ischaemic changes on ECG, hs-cTn confirmed myocardial injury, new LV systolic dysfunction, new moderate-severe ischaemia on functional testing, haemodynamic instability)	Invasive coronary angiography
Acute chest pain at intermediate risk (no known CAD)	Functional testing (exercise ECG, stress echocardiography, stress nuclear perfusion imaging, stress CMR) Anatomic testing (CCTA)
Acute chest pain at intermediate risk (known CAD)	Functional testing Anatomic testing (if non-obstructive CAD)
Acute chest pain and lower cardiovascular risk (30 day risk of MACE < 1%)	No additional urgent cardiac testing needed
Non-ischaemic cardiac causes of acute chest pain • Aortic dissection • PE • Myopericarditis • Valve disease	• CCTA • CT PE-protocol • CMR • Echocardiography

CAD, coronary artery disease; CCTA, coronary computed tomography angiography; CMR, cardiac magnetic resonance; ECG, electrocardiography; LV, left ventricle; PE, pulmonary embolism.

Table 3. Sensitivity and specificity of echocardiography in the evaluation of chest pain[12]

Condition	Sensitivity	Specificity
Asthma and COPD	89%	97%
Infectious endocarditis (children)	86%	
Infectious endocarditis (adults)	34%	99%
Pericardial effusion	95%	91%
Pericardial tamponade	85%	92%
Pericarditis (constrictive)	87%	91%
Pneumonia	89%	94%
Pneumothorax	81%	100%
Pulmonary embolus (direct visual)	50%	
Pulmonary embolus (indirect signs of)	93%	81%
Pulmonary embolus: DVT +Neglung ultrasound	81%	99%
Pulmonary oedema	97%	95%
Thoracic aortic aneurysm A	78%	
Wall motion abnormality (CAD)	90–95%	80%

CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; DVT, deep vein thrombosis.

Echocardiography has been shown to change therapy in 60–80% of patients in the pre-hospital setting, improve diagnostic accuracy and efficiency in the emergency department, and reveal the aetiology of unexplained hypotension in 48% of medical intensive care patients.[11] Table 3 summarises the sensitivity and specificity of echocardiography in acute chest pain.[12]

NON-INVASIVE EVALUATION OF CORONARY ARTERY DISEASE

Functional and anatomical testing is generally recommended in patients with acute chest pain who have an intermediate risk of ACS. Functional testing for identification of inducible myocardial ischaemia is favoured in patients with known coronary artery disease (CAD) or those at high risk of having CAD. Also, in case of prior normal or non-conclusive angiograms (by CT or catheterisation), specific functional imaging tests can provide a better understanding. There are several well-established functional cardiac imaging techniques that assess contractile reserve, vasodilatory reserve, or ECG changes. Myocardial perfusion imaging [single photon emission computed tomography (SPECT), positron emission tomography (PET), MRI] typically has a higher sensitivity, while assessment of wall motion or ECG changes during stress often demonstrates a higher specificity. Exercise stress provides valuable physiological information, while pharmacological stress by dobutamine or vasodilators provide practical advantages. A systematic review[13] that compared diagnostic tests in patients with acute chest pain and suspected CAD found no significant differences in performance between echocardiography, radionuclide myocardial perfusion imaging (MPI), and CCTA for the detection of both ACS and CAD (Table 4). While the diagnostic performance between functional tests vary slightly, test selection is often driven by local availability, expertise and economic context, as well as individual contraindications to stressors or imaging techniques. Stress imaging can be performed during hospitalisation or shortly after discharge in lower-risk patients who are pain-free with normal ECGs and serum troponins.[6]

Stress echocardiography

Stress imaging is preferred over exercise ECG because of its greater diagnostic accuracy[14] and superior prognostic value.[15] Physical exercise or pharmacological (dobutamine) stress echocardiograms have a high negative-predictive value for ischaemia and a normal test result is associated with excellent outcomes.[16,17] ECG requires adequate acoustic windows, and quality and interpretation of the exam is operator-dependent. Contrast echocardiography is recommended if acoustic windows are not adequate to assess regional wall motion abnormalities to improve the accuracy of assessment. Adverse effects from dobutamine stress imaging, while infrequent, preclude the achievement of diagnostic end point in 5–10% of tests, and include tachycarrhythmias and arterial hypotension.[18]

Nuclear imaging

Most nuclear myocardial perfusion scans are performed using SPECT, although PET perfusion imaging is becoming more widely available. Advantages of PET myocardial perfusion imaging are a higher spatial resolution, lower radiation exposure and the quantification of myocardial blood flow, depending on PET technique that is used. Resting MPI can detect fixed perfusion defects indicative of myocardial infarction or scar, which can be useful for the initial triage of patients presenting with chest pain without ECG changes or elevated cardiac troponins.[14] More commonly, combined stress–rest imaging or (conditional) stress-only imaging may identify both reversible ischaemia and fixed defects. Commonly used vasodilators for pharmacological stress nuclear perfusion studies include regadenason, dipyridamole and adenosine. Regadenason and adenosine are superior in achieving maximum coronary vasodilatation.[19] A normal nuclear perfusion study is associated with good prognosis.[20] However, restrictions include availability of this modality in a 24-h service, and exposure to radiation, as well as adverse reactions from vasodilator agents including atrioventricular block and bronchospasm.

Cardiac magnetic resonance

Cardiac magnetic resonance (CMR) imaging offers multiparametric assessment and excellent tissue contrast. This is useful for identifying diverse ischaemic and non-ischaemic pathologies that may co-exist. For instance, T_2 weighted MRI allows differentiation of acute from chronic infarction and is sensitive for acute myocardial damage.[21] CMR exams are relatively long and require trained radiographers and imaging specialists for interpretation. For practical reasons, its use in the ED is limited by accessibility, particularly outside regular hours.

Table 4. Pooled sensitivity and specificity (confidence intervals) of imaging techniques in the detection of myocardial infarction or acute coronary syndrome during the index visit as well as for the detection of coronary artery disease[13]

	Advantages	Disadvantages			
Rest echocardiography	Wide availability Bedside performed Relatively inexpensive Evaluation of non-ischemic causes of acute chest pain	Dependent on acoustic window and operator expertise			
Stress echocardiography	Wide availability during office hours High specificity for the detection of myocardial ischemia No exposure to nephrotoxic contrast or radiation Acoustic contrast media improve diagnostic performance	Dependent on acoustic window and operator expertise Lower sensitivity for the detection of myocardial ischemia			
Nuclear myocardial perfusion imaging	Wide availability during office hours High sensitivity for detection of myocardial ischemia	Limited ability to distinguish old from acute myocardial infarction Exposure to radiation			
Cardiac MRI	Evaluation of structure and function, including tissue characterization of myocardial injury. Comprehensive investigation of MINOCA, positive troponins in the absence of CAD in CT or invasive angiography High sensitivity for the detection of myocardial ischemia No exposure to radiation	Practical limitations, such as long scan time, limiting its use in the acute setting. Required equipment and expertise not widely available. Limitations of claustrophobia, arrhythmia, and ferromagnetic implants.			
Cardiac CT	Wide availability, often also outside office hours High sensitivity for the detection of CAD Evaluation of aortic dissection, pulmonary embolism and other potentially life-threatening conditions Opportunity for initiating long-term CV risk management CT-FFR can determine the functional severity of coronary stenoses	Lower specificity, particularly in patients with extensive calcifications Image quality affected by arrhythmia, tachycardia or inadequate breath holding Functional evaluation of coronary stenoses recommended Exposure to radiation			
Detection MI/ACS during index visit	Sensitivity	Specificity	Detection of CAD	Sensitivity	Specificity
CCTA	0.94 (0.74–0.99)	0.73 (0.46–0.90)	CCTA	0.93 (0.84– 0.97)	0.90 (0.83– 0.95)
Rest Echocardiography	0.86 (0.72–0.93)	0.82 (0.65–0.91)	Stress echocardiography	0.78 (0.57–0.90)	0.92 (0.83–0.96)
Rest MPI	0.91 (0.85–0.95)	0.76 (0.64–0.85)	Stress MPI	0.92 (0.84–0.97)	0.88 (0.78–0.94)

CCTA, coronary computed tomography angiography; MPI, myocardial perfusion imaging.
Diagnostic imaging modalities in acute chest pain.

CMR represents an alternative to other myocardial perfusion techniques for the identification of inducible myocardial ischaemia, and guide management in patients with established CAD. In the subacute stage, CMR is uniquely equipped to assess alternative diagnoses such as myocarditis or Takotsubo cardiomyopathy in patients with positive troponins but no demonstrated CAD by CT or invasive angiography (MINOCA). A recent study showed that upfront imaging with CMR in patients with unclear NSTEMI diagnosis reduced the need for ICA by providing an alternative diagnosis.[22]

After myocardial infarction, with or without coronary intervention, assessment of regional and global ventricular function, the presence and extent of myocardial infarction, oedema, microvascular obstruction and intramyocardial haemorrhage by CMR provide incremental prognostic value and may guide further management.[23,24] In the case of an ACS, myocardial oedema develops before necrosis and can persist for weeks after myocardial dysfunction has normalised, and symptoms subsided. The myocardial salvage index is the proportion of myocardium at risk (based on the presence of myocardial oedema by T_2 weighted imaging) after deduction of the myocardium that is thought to be permanently injured based on late-enhancement imaging. The myocardial salvage index can also be determined using T1-mapping based on differences in calculated extracellular volume within the myocardium. CMR can be an alternative for echocardiography to monitor left ventricular function after myocardial infarction.

Coronary computed tomography angiography (CCTA)

CCTA non-invasively images the coronary arteries but also allows for assessment of several other potentially life-threatening conditions in patients with acute chest pain. However, dedicated scans are recommended if specific conditions such as aortic dissection, PE, pericardial tamponade, mediastinitis or tension pneumothorax are suspected. On the basis of eight clinical trials supporting the use of CCTA as facilitating a rapid diagnosis and accurately triaging patients for prompt discharge when obstructive CAD is present, there is a Class Ia recommendation for the use of CCTA in the patient categorised as an intermediate risk following a negative or inconclusive evaluation for ACS.[7]

CCTA has a very high negative-predictive value. A normal CCTA virtually excludes CAD and is associated with excellent outcomes in patients presenting to the ED with low-to-intermediate pretest probability for ACS. In studies comparing the use of CCTA *vs* usual care (with conventional cardiac troponin essays), CCTA was associated with a reduction in ED costs and length of stay, but also increased the use of ICA.[25] In contrast, recent studies in patients with an indeterminate diagnosis of NSTEMI, upfront CCTA reduced the need for ICA.[22] hs-cTn shorten the need for observation and in one study that compared CCTA with standard of care with hs-cTn, there no longer was a difference in the length of hospital stay or early ED discharge rates.[26] The use of CCTA is more challenging in patients with known CAD, and its use in the acute setting for patients with stents or previous CABG has not been well investigated. Severe calcification (high coronary artery calcium score) and elevated heart rates reduce the accuracy of CCTA. CCTA can be performed before a NSTEMI is formally ruled out by negative serial troponins. Therefore, centres with cardiac-capable CT scanners near the ED can offer CCTA often sooner compared to functional testing.

Functional cardiac CT applications

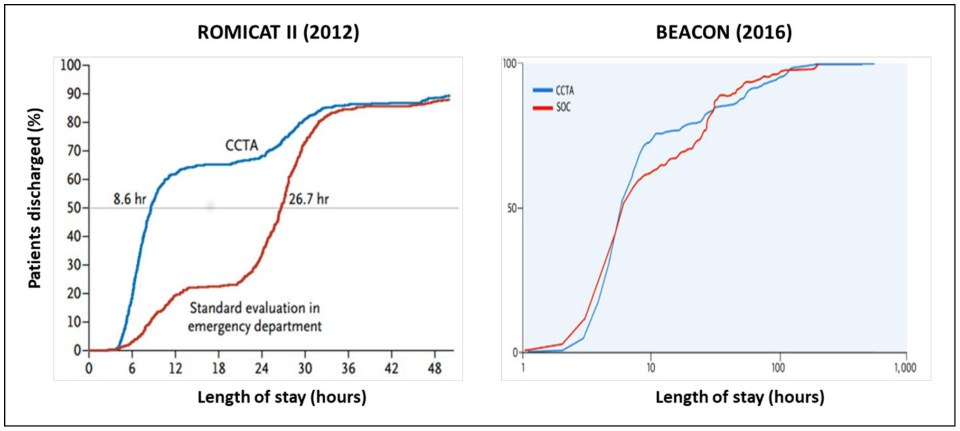
Novel applications to assess the functional impact of CAD include CT MPI and CT-based fractional flow reserve (CT-FFR). Stress CT perfusion imaging has demonstrated comparable diagnostic performance compared to other perfusion imaging techniques but has not yet been widely applied in the context of acute chest pain.[27–30] Although stress CT perfusion is the typical approach to diagnose inducible ischaemia, interpretation of myocardial enhancement on resting CT angiograms has shown utility in the diagnosis of ACS.[31,32] FFR is an invasively derived measure of haemodynamic impact based on the pressure ratio between the distal coronary artery and the aorta during hyperaemia (Figure 3). CT-FFR applies computational fluid dynamics to simulates coronary flow and pressures, and calculate FFR values from static coronary CT angiograms, which have been shown to correlate with invasive FFR values.[34–38] Although research into the incremental value of functional CT applications is ongoing, CT-FFR was recently incorporated in the US Chest Pain Guidelines as a diagnostic option in patients with CAD on CCTA.[39]

Coronary plaque imaging

Given that high-risk plaques are often defined as having a significant[40,41] proportion of non-calcified plaque, the use of coronary calcium imaging in the setting of ACS is controversial. However, recent studies[42] have found evidence supporting the role of coronary calcium imaging in the low-risk symptomatic patient with suspected ACS. Grandhi et al[43] found that a calcium score of zero ruled out obstructive CAD and revascularisation in more than 99% of patients presenting to the ED with chest pain at low-to-intermediate risk, and fewer than 5% of patients without detectible calcium had any CAD.

CCTA can differentiate calcified and non-calcified plaque tissue and assess plaque features such as low-attenuation plaque volume, outward vessel remodelling and spotty calcification that have been associated with ruptured or rupture-prone plaque. Prospective data on plaque characteristics in patients with acute chest pain are relatively scarce. Meah et al demonstrated that low-attenuation plaque burden is a predictor of 1 year death or recurrent myocardial infarction in patients with suspected ACS[33]. Metanalyses have shown that overall CCTA outperforms calcium imaging in the triage of patients suspected of developing ACS, with the absence of coronary plaque on CCTA allowing safe discharge, CCTA has incremental value to clinical risk scores and the potential to reduce avoidable hospital admissions.[44] The prognostic implications low-attenuation plaque burden were found to be a major predictor of 1 year death or recurrent myocardial infarction. Even in the absence of obstructive disease, demonstration of atherosclerotic disease can provide an inroad for cardiovascular risk modification.

Figure 3. Logistic impact of cardiac CT before and after the introduction of high-sensitivity troponins. The ROMICAT two trial compared CCTA with standard of care in 1000 patients with suspected ACS in the ultrasound demonstrated a reduction in the median length of stay from 26.7 to 8.6 h. The BEACON trial, which also compared CCTA and standard care in 500 Dutch patients, was performed after the introduction of high-sensitivity troponins and showed no difference in the length of stay. Reproduced with permission. ACS, acute coronary syndrome; CCTA, coronary computed tomography angiography.[26,33]



Ongoing challenges and future directions

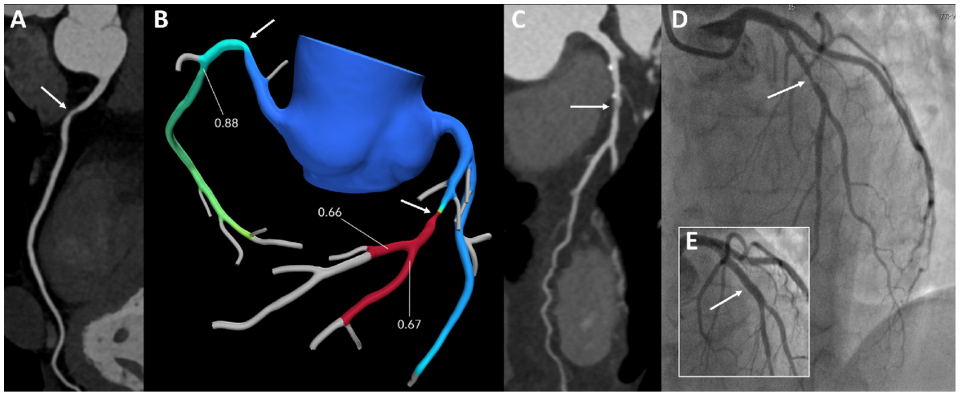
The impact of high-sensitivity troponin assays

The introduction of hs-cTn has transformed the management of patients with chest pain in the ED. The BEACON Trial, which is the first CCTA trial after the introduction of hs-cTn, randomised patients with acute chest pain to either CCTA-guided care or standard of care (which included stress ECG, functional testing or discharge without testing). The study found that CCTA did not identify more patients with CAD requiring coronary revascularisation, nor did it shorten hospitalisation or allow for more early ED discharge. These observations indicate that rapid ACS rule-out using hs-cTn assays erode earlier observed logistic benefit of CCTA in the ED (Figure 4).

Non-invasive testing of intermediate or high-risk patients

An observation from trials and registries in populations with low-risk acute chest pain presenting in the ED is that the yield of diagnostic testing is relatively low. Because there is no proven benefit of testing in low-risk patients, contemporary guidelines discourage the use of (costly) diagnostic tests if the risk of ACS is low.[6,7] Therefore, recent studies have focussed on cohorts with a higher risk of ACS to investigate the incremental value of diagnostic testing. The findings from the *Early Versus Standard Care Invasive Examination and Treatment of Patients With Non-ST-Segment Elevation Acute Coronary Syndrome* (VERDICT) trial suggest that in patients with NSTE-ACS, CCTA rapidly identifies patients in whom ICA would prove futile. A diagnostic strategy using CCTA in NSTEACS could for instance reduce the duration of antithrombotic medical therapy in patients without significant CAD. An early rule out of CAD could also improve patient flow in acute medical care facilities. This must be balanced against the higher overall contrast medium use and radiation exposure in patients who would need a subsequent ICA. The role of CCTA in intermediate risk patients with suspected ACS was prospectively

Figure 4. Case example of CCTA and CT-FFR. CCTA demonstrating two-vessel disease of the proximal RCA (A) and the LAD coronary artery (C). CT-FFR (B) indicates only the LAD lesion was functionally significant (CT-FFR 0.66 in the distal LAD), the RCA lesion not (CT-FFR >0.80). Invasive angiography confirmed the angiographic lesions (D). Pressure-wire based FFR of the LAD was 0.78 and the lesion was subsequently stented (E). CAD, coronary artery disease; CCTA, coronary computed tomography angiography; FFR, fractional flow reserve; LAD, left anterior descending; RCA, right coronary artery.



tested in the RAPID CCTA trial,[45] which reported that early CCTA reduced the subsequent use of ICA or functional testing compared with those receiving standard of care. However, CCTA did not change the overall frequency of acute or preventive treatments and it did not affect subsequent adverse events. Although the study does not support routine use of CCTA in all patients with troponin-positive chest pain, CCTA can reduce the need for ICA in selective patients in whom tests results are conflicting and the probability of a true ACS is thought to be low. Functional assessment of angiographic CAD on CCTA, by CT-FFR or potentially CT perfusion imaging, in patients with acute chest pain has not yet been investigated prospectively but may be particularly helpful in patients with a higher risk of ACS, and thereby higher probability of more extensive coronary atherosclerosis.

Economic considerations

The cost-effectiveness of non-invasive imaging in the setting of acute chest pain has not been conclusively studied. Observational data[46] in a cohort of 91,250 patients demonstrated that early non-invasive cardiac stress testing (within 72 h of ED admission) offered a minor risk reduction of 1.3% AMI at 1 year follow-up, with an increase of US$ 2583 in expenditure. With a number of tests needed to avoid one AMI treat was 75 at an estimated cost of US$ 193,725. Individual trials that reported expenditures (not cost) have reported differences between diagnostic strategies. Studies published before 2013 in the era preceding hs-cTn reported that radionuclide MPI and CCTA had similar characteristics, showing them to be safe and cost-effective gatekeepers for potential hospital admissions.[47] More recent studies have found that CCTA has been associated with decreased cost and length of stay but increased ICA and revascularisation. A meta-analysis by Hulten et al[25] that included four randomised controlled trials of CCTA *vs* usual care triage of acute chest pain in the ED, all conducted before the era of high sensitivity troponin, found that CCTA in the ED had comparable safety to usual care, but reduced ED cost and length of stay. However, CCTA was also associated with 2% increased incidence of ICA as well as a 2% increased incidence of revascularisation, without evidence that these increased rates of invasive procedures led to improved patient outcomes or decreased need for future testing. While numerous randomised trials have concluded that adjunctive non-invasive imaging is safe and effective in expediting care and reducing hospital admission for low-to-intermediate-risk patients presenting with acute chest pain,[48] the cost effectiveness of additional testing in these cohorts remains subject of intense debate. While guidelines afford clinicians evidence-based recommendations, test selection in the real-world setting remains very much dependent on clinician preferences and the practice setting. Practical and economic implications play a role in the choice of test, if any, as well as the timing of the test as an inpatient or in an ambulatory setting. Even when faced with a panoply of diagnostic options, risk–benefit considerations, cost-effectiveness and, logistic practicalities such as round-the-clock availability in the ED setting will be considered.

CONCLUSION

The role of cardiac imaging in acute chest pain is a multistep decision-making process requiring clinical decision pathways and biochemical tests to risk stratify patients, right-site high risk ACS patients for early invasive management or identify non-cardiac causes that require lower urgency of workup. Of the remaining patients at intermediate risk where further diagnostic testing may be indicated, several diagnostic options are available, including echocardiography, nuclear imaging, CCTA and CMR. The decision to use one of these tests includes an understanding of their advantages and disadvantages, specific utility for a given situation (*e.g.* anatomical assessment with CCTA and myocardial tissue imaging with CMR), as well as availability and economic considerations. The performance and cost-effectiveness of non-invasive tests, *vs* deferral of any testing, should be viewed in a changing environment where high-sensitivity troponins offer high accuracy for the detection of infarction or more expedited ED discharge.

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