Detecting acute coronary syndrome in the emergency department: the answer is in seeing the heart: why look further?

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This editorial refers to ‘Regional left ventricular perfusion and function in patients presenting to the emergency department with chest pain and no ST-segment elevation’† by D. Rinkevich et al., on page 1606.

The emergent assessment of chest pain continues to represent a major medical challenge. In the USA alone, 6 million patients annually present to emergency departments with chest pain. The time-honoured application of clinical assessment, electrocardiography, and markers of myocardial injury (e.g. troponins) definitively identify only 20–30% of patients with acute coronary syndrome (ACS); indeed, biochemical markers are frequently normal in the early hours of pain. Conversely, many admissions pending normal results are unnecessary and take much of the patient time and cause anxiety as well as costing billions of dollars. Worryingly, ~5% of patients with ACS are discharged inadvertently, representing a source of significant mortality (~25%) and litigation. Therefore, there is an urgent demand for effective risk stratification tools.

Can pathophysiological principles help identify the ideal test? A direct relationship between myocardial blood flow (MBF) and regional function (RF) is well recognized in acute ischaemia; RF diminishes with diminishing MBF and at 25% of resting MBF, RF abates completely. Importantly, these RF abnormalities persist for hours even after reperfusion (myocardial stunning). Consequently, despite the lack of overt myocardial necrosis as evidenced by normal troponin levels, a significant risk of future events may exist in patients with myocardial stunning owing to flow-limiting coronary disease. In addition, when only ~20% of the myocardium (especially endocardium) is infarcted, wall thickening is abolished; RF is therefore exquisitely sensitive to perfusion defects and precedes echocardiographic or biochemical defects.

As a tribute to the accuracy of these pathophysiological syntheses, comprehensive clinical studies have confirmed the comparability of rest RF as assessed by 2D echocardiography and rest perfusion as assessed by SPECT in the diagnosis of ischaemia. Both have been reported to provide a sensitivity and a negative predictive value of >90% in patients with acute chest pain for ischaemia and represent powerful independent predictors of hard cardiovascular endpoints. Nevertheless, despite its diagnostic–prognostic equality to SPECT, its greater availability, its rapid bedside utility, the wealth of structural information rendered, and advances that may further enhance the performance of 2D echocardiography, there has been a lingering suspicion among some that perfusion combined with RF as assessed by gated-SPECT may better reflect and hence more accurately assess the underlying pathophysiology of acute ischaemia. These suspicions have been heightened by suggestions that the accuracy of echocardiography may be blunted by a failure to fully characterize all myocardial segments, insensitivity to subtle RF defects, and failure to adequately visualize the endocardial border.

These criticisms have recently become potentially fully addressable through the advent of gas-filled shell-bound intravenously injected microbubble contrast agents that safely opacify the left ventricle, facilitating endocardial border definition and RF analysis. Furthermore, by being intravascularly confined, these agents also have the capacity to assess myocardial blood volume and velocity, and hence myocardial perfusion (MP). By virtue of combining both RF and MP assessments in a single technique, with a superior ability to judge perfusion compared with SPECT, myocardial contrast echocardiography (MCE) has the potential of becoming the ideal stratification tool in patients with chest pain.

This potential of MCE has been realized in the report by Rinkevich et al. which represents a landmark study due to both the size and the scope of their study. Their 2 year follow-up study in more than 1000 patients is impressive and empowers them to confidently advocate the use of early MCE to assess patients presenting to their emergency department with chest pain. Not surprisingly, they show that RF is the best predictor of both short- and long-term cardiovascular endpoints. Moreover, while confirming that MP provides an incremental prognostic value, they demonstrate that this increment is essentially confined to those with abnormal RF; those with abnormal RF and normal MP.
(stunning) fare better than those with abnormal RF and MP (Figure 1). Most importantly, the pathophysiological seed sowed earlier, contending that RF on its own powerfully predicts risk in chest pain patients, has been brought to fruition by this study. The authors provide compelling evidence that contrast improves RF assessment comparably to perfusion by improving endocardial border definition; explicitly by virtue of the presence of contrast within the myocardium, wall thickening and wall motion can be reliably discerned. It follows that contrast increases the sensitivity of RF assessment, allowing more subtle instances of impaired RF to be identified.

The clinical and scientific implications are profound. Although the AHA/ACC echocardiography guidelines mandate the early use of echocardiography in chest pain with a Class I indication,7 the European Task Force Guidelines On The Management Of Chest Pain, principally in light of the limitations of trained echo service provision, afford echocardiography only a grade B indication.8 The Rinkevich study provides a rationale for re-assessment of these recommendations and their implementation. There is now compelling evidence that early rest MCE RF assessment in the emergency department stratifies patients definitively; this is not just a relative improvement but an absolute advance obviating unnecessary admissions and discharges and cost-effectively launches patients in the right therapeutic trajectory (Figure 1).

So how should emergency echocardiography be implemented? In patients whose RF is abnormal, the prognosis is circumspect; these patients should be admitted. On the basis of the MP findings, these patients can immediately be further stratified. Those with abnormal RF and normal MP constitute a heterogeneous group of patients who have an intermediate prognosis; some have coronary disease and
stunning (these patients tend to have regional wall motion defects) and some have diverse cardiomyopathies (these patients tend to have global wall motion defects). The former stunned group should be hastened to rapid invasive assessment by cardiac catheterization and the latter group should be investigated by stress testing to exclude an ischaemic component contributing to the myopathy or three-vessel disease masquerading as a global myopathic process.

Patients with both abnormal RF and abnormal MP have an especially poor prognosis. The RF abnormality may represent the sequelae of a new cardiac event or the remnant of an older one. The former group will be identified by a rise in biochemical markers of myocardial injury (e.g. troponins) and should proceed to cardiac catheterization. The latter group will not have an acute rise in biochemical markers and should have sensitive stress imaging to identify the subgroup that would benefit from invasive revascularization (namely, those with viable but jeopardized myocardium) (Figure 1).

In patients with normal RF, the prognosis is excellent and discharge without invasive assessment or delay for biochemical markers should be facilitated. Despite this excellent prognosis, chest pain patients with normal RF have a discrete albeit small risk of cardiovascular events (up to 15% in 2 years). This risk should not be ignored. In patients who have risk factors for coronary artery disease, putting them into an intermediate risk category or in those whom clinical concern persists, we advocate early emergency department stress echocardiographic assessment pursuant to rest assessment (obviating the need for follow-up in the negative stress study group) or early assessment as outpatients. This has been shown to be safe and a negative result portends a cumulated annual risk of <4%.10

As with all good studies, the Rinkevich study, quite apart from providing food for scientific thought, presents a clear mandate for technique implementation and raises important unanswered questions: for example, who will perform and interpret the echocardiographic studies? One important feature of the studies has been the role of experts in assessing the images. Whether sonographers, emergency room physicians with an echo interest, or on-call cardiologists are designated as emergency echocardiographers, scanning patients within 4–6 h of pain commencement, it is clear that adequate training coupled with the potential application of telemedicine to consult with on-call experts will be essential for this practice to be effectively disseminated.

References