Functional imaging for chest pain in the emergency room: To do or not to do?

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Chest pain evaluation in the emergency room (ER) is an important clinical problem that has significant economic impact for the patient and the society. Coronary artery disease (CAD) remains the number one differential diagnosis for the etiology of chest pain evaluation in ER. Therefore, based on clinical suspicion, a battery of tests that include serial cardiac markers, ECGs, and imaging studies are frequently performed. Those at high risk of CAD are generally considered appropriate for direct invasive evaluation while intermediate- to low-risk patients undergo non-invasive functional assessment. Functional/stress imaging is an important step to risk stratify the patients and acts as gatekeeper to invasive approach while reducing economic costs.^{1,2} Nuclear (single-photon emission computed tomography, SPECT) stress testing forms the major bulk of these studies. Other modalities such as coronary computed angiography, stress echocardiography, and stress cardiac magnetic resonance (stress-CMR) are also frequently used in such patient cohorts. Each method has its own unique advantages and disadvantages. A recent meta-analysis of the diagnostic accuracy of stress-CMR and stress-SPECT for evaluating CAD found similar test characteristics of the two modalities (although the sensitivity of stress CMR was somewhat better compared to SPECT).³

Direct comparison of stress CMR and SPECT for chest pain evaluation in ER with intermediate risk patient population has not been extensively studied.

Therefore, the authors of the recent study in this journal should be commended for conducting a well-designed study that addresses this important issue.⁴ This single-center prospective study was performed on a consecutive patient cohort presenting to ER for chest pain with intermediate risk of CAD. All underwent stress-CMR and SPECT within a short duration using contemporary clinical protocols. Those with positive study regardless of modality or persistent chest pain underwent cardiac catheterization. Remaining patients were followed clinically for a mean duration of 2.6 ± 1.1 years. They found similar sensitivity, specificity, and diagnostic accuracy for identifying CAD defined as $>50\%$ coronary blockage during cardiac catheterization or clinical event (composite of cardiac death, myocardial infarction [MI], or coronary revascularization), for the two modalities. Of note, they did not provide data for $>70\%$ stenosis or based on coronary artery distribution for participants who underwent coronary angiography. Furthermore, since not all patients underwent invasive coronary angiography, verification bias cannot be excluded. These study results need replication in a prospective multi-center and multi-vendor prospective studies.^{5,6}

There are important lessons from this study (Figure 1). The sensitivity and specificity obtained in this study were greater compared to the recent meta-analysis.³ The resultant positive likelihood ratio (LR+) for the SPECT was 9 and stress CMR was 12 which indicate that if the test is positive, there is moderate to high likelihood for CAD. Similarly the negative likelihood ratio (LR–) is .18 indicating that both tests are moderately useful in ruling out the disease.

A number of factors contribute to the favorable test results in the study. However, an important aspect that this study highlights relates to appropriate selection of patients (by design) for functional imaging. Low-risk patients (i.e., those with low pre-test likelihood of CAD) are unlikely to benefit from functional stress imaging. If

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Figure 1. Role of stress-CMR and stress-SPECT in evaluating CAD. Positive predictive value (PPV)-prevalence relationship for stress-CMR (*top panel A-C*) and stress-SPECT (*bottom panel D-F*) to identify CAD is depicted. **A** and **D** are based on data from Ahmad et al.⁴; **B-F** are based on summary sensitivity and specificity from meta-analysis by Chen et al.³ Prevalence of CAD corresponding to 50 % PPV for abnormal stress test is highlighted.

the test is positive in low-risk patients, it is more likely to be false positive, and therefore, a negative test is not very helpful in the diagnostic or management algorithm. Based on the results of the recent meta-analysis which indicates that for CAD disease prevalence of <20-25 %, the positive predictive value (PPV) of functional testing (i.e., to rule in the disease) is less than 50 %. As one would expect, the operating characteristics of the functional tests in the present study are better compared to the pooled data (Figure 1).

Additional important caveats for functional imaging need to be considered. Although stress testing is recommended for acute chest pain evaluation in select patients, there are concerns that stress testing followed by invasive coronary angiography may have limited overall impact on identifying patients with CAD.² In a recent study with a large cohort of patients that compared coronary CT angiography and functional testing (that included exercise test, nuclear stress test, and stress echocardiography) in ambulatory patients with suspected CAD with intermediate risk revealed that, regardless of the modality, the event rate was much lower (between 3 % and 3.3 %) compared to predicted rate based on historical data (PROMISE trial).⁷

Although the patient population studied in PROMISE trial is different from the study by Ahmad et al.,⁴ it highlights that non-invasive studies (functional or anatomic) perform well for excluding significant CAD for short- to intermediate-term cardiac events. Therefore, non-invasive study should be chosen based on pretest likelihood of the disease, local expertise, patient comorbidities, and preferences. It may be extremely useful to create indications based imaging program that is performed by a team well versed with the various techniques. The imaging experts decide on the modality for the imaging based on the clinical question and available dataset. Another aspect for evaluation of chest pain in ER that deserves greater attention is testing and incorporating advances in molecular imaging and biochemical assays for disease identification that may complement/supplement need for functional imaging. Lastly, role of tort reforms/medical liabilities needs urgent review. Chest pain evaluation in ER is a prime target for evaluating the impact of meaningful reforms as a number of studies are performed due to fear of medical liabilities and patient expectations. Robust tort reforms will allow more appropriate testing without fear of the ‘unknown.’

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Disclosures

There are no potential conflicts of Interest to disclose.

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