Imaging for chest pain in the emergency room: Finding the right gate not the right gatekeeper

David G. Wolinsky, MD, FACC, MASNC[a]

[a] Heart and Vascular Institute, Cleveland Clinic Florida, Weston

Received Aug 28, 2016; accepted Aug 29, 2016
doi:10.1007/s12350-016-0668-z

See related article, pp. 2004–2011

CASE HISTORY

It is Friday morning at 11AM. A 68-year-old female with history of hypertension, hyperlipidemia, and depression comes to the ER with three weeks of near constant throbbing left arm, chest, and shoulder pain exacerbated by arm movement. ECG is normal, CPK is mildly elevated but troponin-T is normal. Her stress test 3 years ago was normal. The ER physician calls the hospitalist to admit for further evaluation of possible ischemic chest pain. A coronary CTA is ordered and is interpreted as ''severe stenosis of right coronary artery and moderately severe stenosis of left anterior descending and circumflex arteries''. Cardiology is called to assess at 5PM, Friday. What is the next step?

Cardiovascular disease remains the leading cause of death in the United States based on data published by the Center for Disease Control and Prevention.[1] It is not surprising, therefore, that over 7 million patients are evaluated yearly in our Emergency Departments (ED).[2] The vast majority of patients with acute myocardial infarction or acute coronary syndrome are readily identified based on clinical presentation, electrocardiographic changes, and early positive biomarkers. What remains is the challenge of identifying a small number of clinically stable patients who are at short-term risk for cardiac events. The cost to the American health care system of these evaluations is becoming increasingly prohibitive.

Reprint requests: David G. Wolinsky, MD, FACC, MASNC, Heart and Vascular Institute, Cleveland Clinic Florida, Weston; *dwolinsk@gmail.com*
J Nucl Cardiol 2017;24:2012–4.
1071-3581/$34.00
Copyright © 2016 American Society of Nuclear Cardiology.

The protocols by which these patients are evaluated are far from standardized. The cost to evaluate patients for chest pain continues to rise despite a very low yield. Traditional workup includes either an anatomic or functional imaging test. This is a costly process of increasingly low value. From 1999 to 2008, despite a 44.9% reduction in ER visits resulting in a diagnosis of acute coronary syndrome, there was a 367.6% increase in advanced imaging in this population.[1]

In this issue of the Journal of Nuclear Cardiology, Delaney et al. review the variety of tools available to evaluate patients with acute chest pain in the Emergency Room.[3] Despite the vast amount of published data, no clinical consensus has been reached on the management of these patients. There are well established clinical guidelines for management of STEMI and NSTEMI/ acute coronary syndrome and multimodality appropriate use criterion for assessment of stable ischemic heart disease that have been embraced universally,[4–6] no such standards have the same level of acceptance for evaluation in the emergency room. The AHA Scientific Statement on testing low-risk patients presenting to the ED with chest pain fails to come to a consensus recommendation.[2] A recent American College of Cardiology/ American College of Radiology Appropriate Utilization document on emergency department patients with chest pain has met with controversy and lack of universal acceptance.[7] Cost effectiveness analyses focus on the effect of a given test on outcome. Because chest pain populations are so heterogeneous, an algorithm validated in one group of patients stratified by one type of clinician may not be able to be extrapolated to another group.

The ER evaluation process is unique in that various stakeholders, all of whom have different goals and different benchmarks for success, may make the ultimate patient triage decisions. Each stakeholder engages a different algorithm, and may be validating their data with different populations making comparisons difficult. The ER physician's goal is to avoid discharging a patient with a potential acute coronary syndrome based

on historical data suggesting high mortality in patients in whom the diagnosis is missed. Many emergency room protocols rely on the TIMI score, which was meant to assess the risk of complications in patients with established ACS. Use of the HEART score is associated with more effective risk stratification in the chest pain patient without obvious ACS. A HEART score of 0-3 excludes MACE over a six week period with over 98% accuracy. These patients might be managed with outpatient stress testing or even no testing with clinical follow-up. On the other hand, HEART scores of 7-10 would merit more expeditious workup.[8]

Once admitted to a chest pain unit or observation unit, clinical decision-making is often the responsibility of hospitalists. Evaluation usually involves serial biomarkers followed by a functional test. Chest pain units are effective but inefficient in that too many patients spend too many hours in the hospital for a negative workup. Unfortunately patients admitted to chest pain units are a heterogeneous population. Once through the gates of admission or observation status, they automatically undergo testing that is often inappropriate. Cardiology consultation may later be called for further increasing length of stay.

Requesting a cardiology consult implies that an advanced imaging test should be done. To provide value, cardiac testing must provide the following: (1) Accurate diagnosis of presence or absence of disease, (2) Risk stratification, (3) Efficiency of workup, (4) Cost effectiveness, (5) Safety, and (6) Identification of populations in which the test is superior. To date, studies have been unable to demonstrate a modality capable of satisfying all criteria.

Coronary CTA (CTA) is effective in a low-risk population. It has a high negative predictive value and in ROMICAT 2, was able to rescue length of stay by 7.6 hours.[9] However no cost savings were achieved compared to usual care. PROMISE evaluated CTA in a low to intermediate risk population with chest pain and showed no benefit of anatomic testing over functional stress testing. CTA led to a higher incidence of revascularization in what was a low-risk population (3.3% suffered an endpoint over 25 months) and higher cost.[10,11] Similar findings of increased coronary angiography and revascularization have been reported by other authors.[3] Applying CTA to a lower risk population might further reduce downstream testing and cost. Reducing subsequent angiography and revascularization based on guidelines would also improve cost effectiveness.

CTA has technical limitations in patients with renal insufficiency, contrast allergy, and rapid heart rate. In addition, many hospitals do not have technical staff available to carry out CTA around the clock. Still it appears that CTA has a major role in evaluating low-risk patients by providing the emergency room staff an adequate comfort level to allow for early expeditious discharge.

Multiple studies have demonstrated the effectiveness and safety of SPECT myocardial perfusion imaging (MPI) in evaluating emergency room patients presenting with chest pain.[3,12–15] Patients enrolled in these studies are more heterogeneous, have baseline higher risks, and in fact often have known CAD. SPECT effectively predicted which patients would need to undergo coronary angiography. Nabi et al. reported that 38.3% of patients with abnormal SPECT MPI subsequently underwent revascularization, whereas only 0.9% of patients with normal SPECT subsequently required coronary intervention. Of patients with greater than ten per cent ischemia by perfusion imaging, 55% underwent revascularization.[12]

Limitations of SPECT MPI are related to cost. Patients undergoing rest-stress studies typically require an overnight stay in the hospital. Increased length of stay is associated with greater financial burden. False positive scans may lead to downstream testing and treatment if applied to a more general population. Image quality may be limited in obese or incooperative individuals. Some have voiced concerns over the risk of cumulative radiation exposure with medical imaging.

Stress-only/stress-first imaging protocols, however, address many of the concerns above. Duvall demonstrated that low-risk patients undergoing stress with normal perfusion scan can be safely discharged early with low 1-year annual mortality (0.5%) equivalent to patients with a normal rest- stress study.[13] Similarly Lim performed stress-only imaging after 6 hours and two sets of negative cardiac biomarkers. Normal stress-only scans were associated with a very low 1-year risk (0.7%)[14] Also demonstrated was the safety of allowing patients with equivocal or low-risk stress-only scans to be discharged and return as outpatients for completion of their studies.[14]

Just as CTA may have increased value if applied to a better-defined low-risk population, so too can the value of SPECT MPI be increased with application to a higher risk rather than broad-based population. Cremer et al. found the incidence of moderate to high risk MPI scans in emergency department patients with chest pain, negative troponins, and TIMI score less than or equal to two was only 6.1% compared to 19.6% of patients with TIMI scores greater than or equal to three.[15] The 30-day event rate in both groups was very low suggesting that workup need not always be carried out or completed emergently in the absence of very-high clinical suspicion.

For patients who are not capable of exercise stress, PET perfusion imaging may provide significant information. Rb-82 PET has been shown to have improved

image quality and incremental prognostic value in the obese population.[16] Similarly, improved effective risk stratification has been shown in women undergoing Rb-82 PET imaging, while reducing radiation exposure.[17]

One cannot ignore the ongoing mortality of risk associated with coronary heart disease. In fact efforts to reduce cardiovascular disease have been blunted over 3 years.[18] The MACRA has mandated modification of Medicare payment, and will therefore modify care delivery to the Medicare population. With implementation of Merit-Based Incentive Payment System (MIPS), effective use of resources and quality assessment will increasingly affect reimbursement. Therefore, all clinicians must work together to provide optimal care.

A new model for the management of patients presenting to the ED with chest pain emphasizing value must be developed. This model must have input from all groups and be accepted by all. High-risk patients with NSTEMI or ACS can be admitted directly for further cardiologic management. Clinical decision-making must replace simple algorithms. Initial clinical evaluation using effective tools other than TIMI score must assess overall risk and decide which patients receive a ''wristband'' to go through the gate and enter a testing algorithm. There is no one test or gatekeeper for all. The right test must be chosen for the right patient based upon clinical scenario and local expertise. Equally mandatory is proper decision-making based on test results. Better adherence to guideline-driven treatments based on the results of cardiovascular testing must be achieved. Our patients need us to do the right thing.

Disclosure

Dr. Wolinsky has received speaker honoraria and consultant fees from Astellas Pharma and has received consulting fees from Adenosine Therapeutics.

References

1. Bhuiya F, Pitts S, McCaig, LF. Emergency Department Visits for Chest Pains. NCHS Data Brief; 43: September 2010.
2. Amsterdam EA, Kirk JD, Bluemke DA, et al. Testing of low-risk patients presenting to the emergency department with chest pain. Circulation. 2010;122:1756–76.
3. Delaney MC, Neth M, Thomas JJ. Chest pain triage: Current trends in the emergency departments in the United States. J Nucl Cardiol. doi:10.1007/s12350-016-0578-0.
4. Amsterdam E, Wenger N, Brindis R, et al. Guideline for the management of patients with non-ST-elevation acute coronary syndromes. J Am Coll Cardiol. 2014;64:e139–228.
5. O'Gara PT, Kushner FG, Ascheim DDR, et al. Guideline for the management of ST-elevation myocardial infarction. J Am Coll Cardiol. 2013;61:e78–140.
6. Wolk MJ, Bailey SR, Doherty JU, et al. Multimodality appropriate use criteria for the detection and risk assessment of stable ischemic heart disease. J Am Coll Cardiol. 2014;63:380–406.
7. Rybicki FJ, Udelson JE, Peacock WF, et al. Appropriate utilization of cardiovascular imaging in emergency department patients with chest pain. JACC. 2016;67:853–79.
8. Backus BE, Six AJ, Kelder JC, et al. A prospective validation of the HEART score for chest pain in patients at the emergency department. Int J Cardiol. 2013;168:2153–8.
9. Hoffmann U, Truong Q, Schoenfeld DA, et al. Coronary CT angiography versus standard evaluation in acute chest pain. N Engl J Med. 2012;367:299–308.
10. Douglas PS, Hoffman U, Patel MR, et al. Outcomes of anatomical versus functional testing for coronary artery disease. N Engl J Med. 2015;372:1291–300.
11. Mark DB, Federspeil JJ, Cowper PA, et al. Economic outcomes with anatomical versus functional diagnostic testing for coronary artery disease. Ann Intern Med. 2016;. doi:10.7326/M15-2639.
12. Nabi F, Chang SM, Xu J, et al. Assessing risk in acute chest pain: The value of stress myocardial perfusion imaging in patients admitted through the emergency department. J Nucl Cardiol. 2012;19:233–43.
13. Duvall WL, Wijetunga MN, Klein TM, et al. Stress-only Tc-99m myocardial perfusion imaging in an emergency department chest pain unit. J Emerg Med. 2012;42(6):642–50.
14. Lim SH, Anatharaman V, Sundram F. Stress myocardial perfusion imaging for the evaluation and triage of chest pain in the emergency department: A randomized controlled trial. J Nucl Cardiol. 2013;20:1002–12.
15. Cremer PC, Kahalaf S, Agarwal S, et al. Myocardial perfusion imaging in emergency department patients with negative cardiac biomarkers. Circ Cardiovasc Imaging. 2014;7:912–9.
16. Chow BJ, Dorbala S, DiCarli MF, et al. Prognostic value of PET myocardial perfusion imaging in obese patients. JACC Cardiovasc Imaging. 2014;7:278–87.
17. Kay J, Dorbala S, Goyal A. Influence of sex on risk stratification with stress myocardial Rb-82 postitron emission tomography. J Am Coll Cardiol. 2013;2:1866–76.
18. Herron MA. Changes in the leading cause of death: Recent patterns in heart disease and cancer mortality. NCHS Data Brief; 254: August 2016.