Evaluating Use of Coronary Computed Tomography Angiography in the Emergency Department*

Mark A. Hlatky, MD
Stanford, California

In the U.S. in 2006, a total of 6,392,000 patients were seen in emergency departments (EDs) with acute chest pain (1). After basic evaluation with a clinical history, physical examination, electrocardiogram, and initial blood work for cardiac biomarkers, many such patients have no objective evidence of active myocardial ischemia. Nevertheless, physicians may be reluctant to send these patients home, concerned that they might be among the 2% with a missed acute myocardial infarction (MI) (2). Consequently, many low-risk patients with chest pain are either observed in the ED for extended periods or admitted to the hospital and subsequently undergo further cardiac evaluation. A simple, accurate, and rapid test that would reliably exclude coronary disease as the cause of acute chest pain might save a lot of time and effort that is currently used to evaluate a low-risk population.

The newest generation of computed tomography (CT) scanners has the temporal and spatial resolution needed to perform noninvasive coronary angiography. Numerous studies of coronary computed tomography angiography (CTA) (3–5) in patients scheduled for an invasive coronary angiogram have demonstrated that CTA has high sensitivity for the detection of obstructive coronary disease but has lower specificity. Most of these studies have limited pertinence to the use of coronary CTA in the ED, however, because patients with acute chest pain differ from those undergoing elective coronary angiography. More importantly, prediction of clinical outcomes, not just statistical correlation with a gold standard diagnostic test, is a goal of CTA in the ED. There have been relatively few studies that have documented clinical outcomes after coronary CTA.

It is a higher standard of evidence to ask whether a diagnostic test affects clinical outcomes, yet this question is an essential step in the evaluation of new technology. Although there is no doubt that coronary CTA produces beautiful images, the question is whether taking these pictures provides any tangible benefit to the patient. Some might object that it raises the bar too high to insist that a test improve clinical outcomes, as most tests in common use today have never been held to this standard (6). But technologic advances now make it possible to generate almost unlimited amounts of detailed data about patients, including multiple forms of imaging and new biomarkers and genetic markers in various combinations and permutations, all of which have costs and clinical consequences. With so many ways to generate data about patients, we need to ask whether the information will change clinical management and whether patient outcomes will be improved as a result. The logical conclusion is that we need well-performed patient outcome studies, both clinical registry studies and randomized clinical trials, to evaluate new tests.

The ROMICAT study. The ROMICAT (Rule Out Myocardial Infarction using Computer Assisted Tomography) study (7), a prospective observational study of clinical outcomes, represents a step forward in the evaluation of coronary CTA. The design of the ROMICAT study was to perform coronary CTA in a series of patients after they had undergone basic evaluation in the ED and were judged to be at low clinical risk but were nevertheless deemed to need further observation in the hospital. The key feature of the ROMICAT study was that the coronary CTA was done solely for research purposes, and the results were not provided to the clinicians who managed the patients’ clinical care. Thus, the subsequent clinical outcomes were not altered on the basis of CT findings.

A total of 1,869 patients were screened for potential enrollment in the ROMICAT study. It was found that coronary CTA was infeasible in 35% of the screened patients because of a serum creatinine >1.3 mg/dl (n = 454), arrhythmias (n = 97), contrast allergy (n = 58), or contraindications to beta-blocker administration (n = 37). Of the 368 patients ultimately enrolled, 8 (2.1%) proved to have an acute MI, and a further 23 (6.3%) had a final diagnosis of acute coronary syndrome. The remaining 337 patients (91.6%) had no evidence of active myocardial ischemia at the time of hospital discharge. Over a mean follow-up of 6.2 months, none of these 337 patients died, had an MI, or underwent coronary revascularization, with the caveat that 8% could not be contacted but were apparently alive (7).

It is reassuring that no adverse events were documented in the 337 ROMICAT patients without clinical evidence of acute coronary syndrome. This evidence is fundamentally
limited in 2 ways, however. The first limitation is purely statistical, in that observing no events in N patients does not establish the event rate is 0%. The “rule of three” says an observation of 0 events has a rough 95% upper confidence limit of 3/N, so in the ROMICAT study the statistical upper confidence limit for the adverse cardiac event rate is approximately 0.9% (3 of 337). The second fundamental limitation in any study of prognosis is the rate of loss to follow-up. Complete follow-up of patients from the ED is particularly difficult, and although 92% of patients in the ROMICAT study were contacted successfully, 8% were not, and arguably anyone who had a poor clinical outcome might be more difficult to contact. So, although the low rate of adverse cardiac events in the ROMICAT study is reassuring, larger studies with more complete follow-up will be needed to assess more fully the prognostic implications of a coronary CTA in the ED.

The 337 patients without acute coronary syndrome in the ROMICAT study had a variety of findings in their coronary CTA: 183 (54%) had normal coronaries, 110 (33%) had nonobstructive coronary atherosclerosis, and 44 (13%) had indeterminate studies or a lumenal diameter narrowing of 50% or more. By design, none of these findings were provided to the clinicians managing the patients’ care, so it is uncertain what the clinicians would have done differently based on the CTA results. It is quite likely that most of the 254 stress tests would not have been performed in this population, at least among the 183 subjects with normal coronary arteries. But it is also likely that more than 13 patients would have undergone an invasive coronary angiogram, and some would surely have had coronary revascularization, as 154 patients in the ROMICAT study had CT evidence of coronary atherosclerosis. The ultimate effect of more aggressive treatment is uncertain, but it is interesting that no adverse cardiac events were seen in follow-up among these 154 patients with a CT finding of coronary atherosclerosis but no evidence of ischemia.

Use of coronary CTA has the potential to shorten the time of evaluation for low-risk patients with chest pain in the ED. The CT exam in the ROMICAT study took only 16 min to perform “door to door,” which is much less than the average hospital stay of 40.5 h. A previously published randomized trial of coronary CTA in patients with acute chest pain (8) showed that the time spent in the ED was significantly reduced by use of CTA compared with standard observation and stress testing. But the overall effects of CT angiography on costs of care and clinical outcomes are more difficult to project, as 6 patients underwent coronary revascularization after evaluation with CTA compared with only 1 patient randomized to standard care (8).

Conclusions. This study shows that use of coronary CTA in low-risk patients with chest pain in the ED is a promising development. A finding of normal coronary arteries will likely obviate additional tests and speed patient discharge to home and appears to be associated with a good short-term prognosis. A finding of some degree of coronary atherosclerosis might not, however, “clear the air,” as further investigations are likely with either stress testing or invasive coronary angiography (or both). Whether patient outcomes are ultimately improved by adopting a strategy of coronary CTA in the ED will require further investigation, optimally by randomized trials with adequate sample size to detect important differences in hard cardiac outcomes.

Reprint requests and correspondence: Dr. Mark A. Hlatky, Stanford University School of Medicine, HRP Redwood Building, Room 150, Stanford, California 94305-5405. E-mail: hlatky@stanford.edu.

REFERENCES


Key Words: cardiac CT • emergency department • acute chest pain.