EDITORIAL COMMENT

Defining the Role of Chest Pain Units*

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Safe, cost-effective management of patients presenting to the emergency department (ED) because of chest pain compatible with myocardial ischemia continues to present a major clinical challenge. Current standards mandate rapid institution of proven therapy for reduction of mortality and morbidity in patients with acute coronary syndromes. However, in most patients presenting to the ED with chest pain, this symptom is related to disorders without fatal potential, such as musculoskeletal, gastroesophageal or anxiety syndromes (1), in which an erroneous impression of myocardial ischemia can prompt unwarranted hospital admission, resulting in unnecessary tests and major costs. The balance of these opposing factors has traditionally favored a low threshold for admission for chest pain of possible cardiac origin because of primary concern for patient welfare, as well as litigation potential for failure to detect a coronary event. This approach is consistent with the directive of early innovators of the coronary care unit (CCU) that "patients should be admitted to the CCU solely on suspicion of having an acute myocardial infarction" (2). A low threshold for admission of these patients has also been supported by reports of at least a 2% rate of missed ACS in patients discharged from the ED (3).

Underscoring this problem are data showing that failure to diagnose myocardial infarction (MI) is the leading cause of malpractice awards against emergency medicine physicians, accounting for 21% of total litigation costs to this group (4). However, application of a low threshold for admission has resulted in annual hospitalization of millions of patients in whom a coronary event is diagnosed in <20% (5) at a cost of more than $10 billion (6). The term "rule-out myocardial infarction," or "ROMI," has traditionally been applied to patients admitted for findings suggestive, but not diagnostic, of acute MI, and these patients comprise the great majority of those admitted for evaluation of chest pain.

Studies during the last several decades have demonstrated that low-risk patients presenting with chest pain can be recognized by clinical criteria, including the history, physical examination and initial electrocardiogram (ECG) (7,8). Management of these patients differs fundamentally from that of high-risk patients who require urgent initiation of time-dependent coronary reperfusion therapy and other anti-ischemic modalities. To fulfill the dichotomous therapeutic requirements of both high- and low-risk patients presenting with chest pain, innovative strategies have been developed that include management guidelines, clinical algorithms, predictive instruments and, more recently, chest pain observation units (CPU) (9–12). The objectives of the CPU are 1) triage of high-risk patients into fast-track therapy, and 2) recognition of low-risk patients for assignment to more deliberate evaluation and treatment. Avoidance of unnecessary admissions is a major goal in the latter group. Current strategies entail accelerated diagnostic protocols comprising 6 to 12 h of monitoring and measurement of cardiac injury markers, which, if negative, are followed by exercise testing before or shortly after discharge (9,12). Further innovations include immediate exercise testing of low-risk patients who are discharged if the test is negative (12) and rest perfusion scintigraphy in the ED to identify patients who do not require admission. Outpatient follow-up is an intrinsic component of these strategies.

In this issue of the *Journal*, deFilippi et al. (13) address the questions of: 1) whether CPUs staffed by ED physicians adequately test for the presence of coronary artery disease, and 2) whether an invasive approach will lead to fewer unnecessary readmissions. Answers to these important questions will help define the role of CPUs in the management of low-risk patients presenting to the ED with acute chest pain.

First, is it essential for a CPU to absolutely exclude the presence of coronary disease, or should the unit's primary function be exclusion of moderate- to high-risk disease in which immediate intervention is likely to be beneficial to the patient? In patients who present with chest pain identified as low risk, the likelihood of a cardiac origin of the symptom is <7% (10). Therefore, the probability is >90% that the chest pain in these low-risk patients is due to a noncardiac etiology, with gastroesophageal reflux disease, panic attack, pancreatitis, gallstones and costochondritis among the leading possibilities (1).

Second, to what extent is it reasonable to expose a patient to a procedure with a low, but definite risk, such as cardiac catheterization, to exclude a disease with a very low probability? In addition, angiographic identification of coronary disease does not establish the etiology of a low-risk patient's chest pain. Therefore, it is possible that routine angiography could lead to misdiagnosis and unnecessary interventions. Once a patient has been stratified to low risk, the decision to proceed with further diagnostic tests would seem to be best reserved for the patient's primary care physician or

cardiologist and not an issue to be thrust upon a physician in an ED.

To address these questions, deFilippi et al. (13) randomized 248 selected low-risk chest pain patients (<65 years old, no history of coronary artery disease, benign ECG) who were admitted to their CPU by ED physicians and ruled out for MI, to either cardiac catheterization or predischarge treadmill testing for further risk stratification. Routine cardiac catheterization was performed in 123 patients, of whom 23 had >50% stenosis in one or more epicardial vessels. Of the 125 patients who were randomized to predischarge treadmill testing, 9 had positive tests. The percentage of patients with angiographically documented coronary disease was significantly greater than the proportion with positive treadmill tests (19% vs. 7%, p < 0.018). This result is consistent with the recognized superior sensitivity of coronary angiography to exercise testing for detecting coronary disease. The sensitivity of treadmill testing in this study may have been further reduced because 34% of patients did not achieve target heart rate and in 15% the exercise heart rate was <75% of age-predicted maximum. However, it does not follow that, in all patients with angiographically detectable disease, chest pain was due to cardiac ischemia; coronary disease may coexist with noncardiac causes of chest pain. But, as the investigators point out, making the diagnosis of subclinical coronary disease may allow for medical intervention that could reduce the risk of future events.

In the study by deFilippi et al. (13), detection of coronary disease by randomization to angiography resulted in 3 coronary artery bypass surgeries, 11 percutaneous coronary interventions, 1 MI and no deaths. Detection of cardiac ischemia by routine treadmill testing was followed by 12 cardiac catheterizations, 5 percutaneous interventions, 1 coronary bypass surgery and no MI or deaths. After one year of follow-up, randomization to angiography was associated with 111 more cardiac catheterizations, 8 more revascularization procedures and the only MI. This resulted in 23 fewer ED revisits and 15 fewer admissions among patients with negative cardiac catheterizations compared to those with negative exercise tests. Furthermore, the investigators do not report the number of revisits or readmissions in patients with angiographic disease or positive treadmill tests. It is possible that detection of subclinical angiographic disease in this group may lead to more admissions and offset some of the savings when compared to the negative group.

As the investigators note, lack of net benefit in performing routine angiography and interventions in low- to moderate-risk coronary disease patients is consistent with other randomized studies of invasive versus noninvasive management (14,15). In the second Randomized Intervention Treatment of Angina (RITA-2) trial, coronary intervention was superior to medical therapy in terms of angina and exercise test performance (16). However, there was also a 3% excess rate of MI in the intervention group, of which 1.4% were procedure-related. In a subsequent study, the RITA investigators reported a greater improvement in quality of life measures in the intervention patients (17), but this difference was no longer significant after three years. These data suggest that routine angiography and intervention result in short-term improvement in quality of life at a cost of increased MI. Extrapolating these outcomes to low-risk CPU patients, it is reasonable to conclude that increasing the diagnostic certainty of coronary disease by performing routine angiography may afford short-term quality of life benefit (e.g., fewer return visits to the ED) at the cost of increased revascularization, MI and death from unnecessary procedures.

The answer to the question of whether routine angiography in the CPU will lead to fewer unnecessary admissions seems affirmative at first glance, but there may be less costly options. In the current study, deFilippi et al. (13) reported that patients randomized to initial evaluation with treadmill testing compared to angiography had more subsequent ED visits (26% vs. 8%) and admissions (14% vs. 2%). These results are consistent with the investigators' conclusion that diagnostic uncertainty results in greater recidivism and higher admission rates. These findings are also concordant with our data in 422 consecutive low-risk chest pain patients revealing that 11% of patients with a negative treadmill return to the ED with chest pain during a one-year follow-up (18).

However, the CPU does not operate independently of good medical care, but is instead only one component of the medical system. First, burdening the CPU with the responsibility of the decision to perform an invasive diagnostic evaluation may be inappropriate. Also, concluding that the CPU is solely responsible for solving a high rate of recidivism may be premature. When patients leave the CPU with a negative or low-risk nondiagnostic evaluation, they may be informed that the symptom is not likely due to heart disease. Upon discharge, they may or may not be given instructions to return to their primary care physician for further evaluation. Failure to discover the etiology of chest pain at the initial evaluation is not completely reassuring, and when the chest pain recurs, patients will naturally seek further medical attention. Therefore, the rate of recidivism is highly dependent not only on excluding a cardiac diagnosis, but also on establishing a diagnosis and applying appropriate therapy.

In selecting an initial diagnostic strategy, it is also essential to recognize that, although coronary angiography is superior to noninvasive testing for detecting coronary disease, it is not superior for predicting risk. In a study of 115 post-MI patients followed for five years, submaximal exercise testing was as accurate as coronary arteriography in identifying patients at risk for complications (19). Measures of regional wall motion abnormalities by echocardiography or radionuclide ventriculography were even more predictive of complications.

deFilippi et al. (13) do not state whether patients with a low-risk evaluation received follow-up appointments to their primary care physicians or referrals to a cardiologist

after discharge from the CPU. The reasons for readmission are also unclear. Patients returning to our CPU have a higher rate of psychosocial symptoms (anxiety, panic, depression) compared to those who do not return (22% vs. 8%) during the year after initial evaluation (19). High rates of recidivism may not be due to inadequate CPU evaluation, but rather to lack of outpatient follow-through. Ruling out MI or unstable angina in the CPU should not be considered a diagnostic end point. Failure to make a diagnosis of cardiac disease in the CPU is only the first step in the patient's evaluation. Not completing that evaluation may be where we fail our patients. Outpatient chest pain clinics for investigation of both cardiac and noncardiac causes of chest pain may be the next step in the evolution of the CPU.

Finally, deFilippi et al. (13) have addressed an important clinical question with a rigorous, well-conducted trial, and their work will undoubtedly stimulate significant controversy. They have demonstrated that the prevalence of coronary disease in the CPU population is considerably greater than noninvasive testing suggests. They have also demonstrated that rate recidivism to the ED in this low-risk population is lower in patients with an invasive approach. It is clear that the final word on the management of low-risk patients presenting to the ED with chest pain has not yet been heard.

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