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EDITORIAL COMMENT

Evaluating Chest Pain in the Emergency Department

Searching for the Optimal Gatekeeper*

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Approximately 7 million patients present to the emergency department (ED) each year with chest pain, at an estimated cost of $5 billion (1). Although a cardiovascular cause may be present in up to 20% of patients presenting with chest discomfort, only 5.5% of these patients have an acute life-threatening condition, whereas more than one-half of the huge number of patients presenting with chest discomfort receive a diagnosis of noncardiac pain (2); the great majority of these patients are low risk. Physicians must therefore decipher which patients should be hospitalized for treatment from those patients with lesser urgent conditions who might be discharged safely from the ED. Failure to accurately sort out these patients may have significant ramifications because patients with acute myocardial infarction (MI) mistakenly discharged from the ED have almost double the risk of mortality compared with those who are hospitalized (3). On the other hand, prolonged assessment of all patients who present to the ED with chest pain is costly and associated with ED overcrowding, and needless admissions add to costs of care. As such, the principal objective in the evaluation of chest discomfort in the ED is rapid, but accurate, diagnosis and risk stratification.

History, physical examination, electrocardiogram, and serial measurement of troponin form the cornerstone of assessment for patients with suspected MI. However, if these are unrevealing, the clinician is faced with the challenging decision whether to admit or discharge the patient.

The acceptable risk at which a patient can be discharged from the hospital without further testing is a matter of debate and, in clinical practice, oftentimes dependent on personal comfort. Kline et al. (4) demonstrated that a 2% miss rate should be acceptable on the basis of the risk of harm from further testing exceeding the benefit from confirming acute coronary syndrome (ACS) at this cutoff. However, a survey of 1,029 emergency medicine physicians found that a major adverse cardiac event (MACE) miss rate of <1% to be tolerable among the majority of respondents (5). What options exist to help achieve the optimal balance of speed and accuracy?

Refinement in assay technology has led to the development of high-sensitivity troponin (hsTn) assays that may identify acute MI as early as 1 to 2 h from coronary ischemia onset and provide useful risk stratification; such tests remain limited by context: many patients presenting very early after pain onset may yet have a low hsTn concentration, whereas a significant percentage of patients may have unambiguously elevated hsTn but without acute MI. Thus, clinical contextualization is needed to improve performance of these assays. In an effort to achieve this goal, several risk scores have been explored, including the modified History, Electrocardiogram, Age, Risk factors and Troponin (HEART) score, the

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TABLE 1 Risk Assessment Scores for Evaluating Low-Risk Chest Pain in the ED

Score	Components			Criteria for Low Risk
TIMI score	Age ≥65 yrs		1 point	TIMI score of 0
	≥3 risk factors for ACS		1 point	
	Coronary stenosis ≥50%		1 point	
	Aspirin use within 7 days		1 point	
	Elevated cardiac biomarkers		1 point	
	≥2 anginal events in 24 h		1 point	
	ST-segment deviation of ≥0.05 mV on ECG		1 point	
Modified TIMI score	Age >65 years		1 point	Modified TIMI score of 0
	Ischemic EKG changes		1 point	
	History of CAD		1 point	
	Elevated cardiac marker		1 point	
GRACE score	Age		Graded score from 0 to 258	Score ≤72 points
	Heart rate			
	Systolic blood pressure			
	Creatinine level			
	Killip class			
	ST-segment depression on ECG			
	Elevated cardiac biomarkers			
	Cardiac arrest on presentation			
ASPECT score	TIMI score ≥1		Positive score	No positive score
	Ischemic ECG changes		Positive score	
	Elevated troponin, CK-MB, or myoglobin		Positive score	
ADAPT score	TIMI score ≥1		Positive score	No positive score
	Ischemic ECG changes		Positive score	
	Elevated 0- or 2-h cardiac troponin I		Positive score	
NACPR	Ischemic ECG		Positive score	No positive score
	History of CAD		Positive score	
	Pain typical of ACS		Positive score	
	Initial and 6-h troponin >99th percentile		Positive score	
	Age >50 yrs		Positive score	
HEART score	History	Highly suspicious	2 points	Score ≤3
		Moderately suspicious	1 point	
		Slightly suspicious	0 points	
	ECG	Significant ST-segment depression	2 points	
		Nonspecific repolarization abnormality	1 point	
		Normal	0 points	
	Age, yrs	≥65	2 points	
		45–65	1 point	
		≤45	0 points	
	Risk factors	3 or more	2 points	
		1–2	1 point	
		No risk factors	0 points	
	Troponin	≥3 × normal limit	2 points	
		1–3 × normal limit	1 point	
		≤Normal limit	0 points	
HEART Pathways score	Heart score >3		Positive score	No positive score
	Serial troponin measures at 0 and 3 h after ED presentation >99th percentile		Positive score	

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Emergency Department Assessment of Chest pain Score (EDACS), and the simplified EDACS score. Though each is helpful, it remains somewhat uncertain how incorporation of hsTn into these algorithms affects their performances.

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In this issue of the *Journal*, Mark et al. (6) retrospectively evaluated performance of several risk scores for chest pain evaluation in a large study sample of patients seen in the Kaiser Permanente health system. To do so, the authors incorporated troponin concentrations down to the limit of quantitation; although the assay used was not an hsTn method, this cutoff provides sensitivity comparable to the hsTn assays soon to be launched in the United States. The primary endpoint was major adverse cardiac events (MACE) (MI, cardiogenic shock, fatal events) by 60 days.

The results of the study suggest this approach further refined the ability to exclude risk, with reclassification yields ranging between 3.4% and 3.9% while maintaining similar negative predictive values (range 99.49% to 99.55%; $p = 0.27$) (6). The original EDACS score performed the best, identifying the largest proportion of patients as low risk (60.6%, 95% confidence interval [CI]: 60.3% to 60.9%), compared with the modified HEART (51.8%, 95% CI: 51.6% to 52.1%) and the simplified EDACS (48.1%, 95% CI: 47.8% to 48.3%; $p < 0.0001$), without compromising prediction of MACE (6).

A strength of the study is the cohort size (118,822 patients), whereas limitations include the retrospective design and the use of conventional troponin assays, as opposed to hsTn; nonetheless, this study affirms the value of very low troponin concentrations to exclude risk, whether the assay is of high sensitivity or not, and further emphasizes the importance of adding clinical color to the laboratory result to obtain best performance.

In addition to the modified scores presented by Mark et al. (6), clinicians now have several clinical scores at their disposal when evaluating chest pain in the ED (**Table 1**). Although further validation of these scores in large prospective randomized trials is warranted, their use with hsTn (or very low conventional troponin concentrations as in the study by Mark et al.) is promising. For example, a prospective study compared the ability of 5 established risk scores (modified Goldman, TIMI [Thrombolysis In Myocardial Infarction], GRACE [Global Registry of Acute Coronary Events], HEART, and the Vancouver