

## RESEARCH LETTERS

### Prehospital Cardiac Markers in Defining Ambiguous Chest Pain

The presentation of a life-threatening acute coronary syndrome is often not straightforward. Electrocardiographic (ECG) features can also be equivocal. The utility of several different types of point-of-care testing in the prehospital setting has been assessed and verified during the past 2 decades, but none has been officially recommended for routine use.<sup>1,2</sup> We therefore designed this retrospective observational study to assess the utility of 3 cardiac markers (troponin I/CK-MB/myoglobin) measured with a stat kit in the prehospital setting for confirming or ruling out acute coronary syndrome (ACS) in patients with nonspecific, nontraumatic chest pain and a nondiagnostic ECG.

**Methods.** SHL telemedicine, a well-established telemedicine system,<sup>3</sup> has subscribers (approximately 60 000) all over Israel, with the telemedicine center based in Tel-Aviv; all subscribers were eligible for study recruitment. The data (January 1, 2001–December 31, 2010) for those who called to complain of 6 hours or more of nonspecific chest pain and who had inconclusive ECGs were retrospectively retrieved from the call center's database (**Table**).

The CARDIAC STATus Troponin I/CK-MB (creatine kinase myocardial band)/Myoglobin assay (Nexus Dx Inc) qualitatively detects these 3 markers in human blood samples using solid-phase chromatographic immunoassay technology.<sup>4</sup> The test is carried out no earlier than 6 hours from symptom onset. The markers in the blood bind

to antibody dye conjugates and migrate through the test areas, binding to immobilized antimyoglobin, anti-CK-MB and antitroponin antibodies. Unbound dye complexes migrate out of the test region. At the point of care, several drops of whole blood are added to the sample area, completely covering the membrane surface. The results are read 15 minutes later. A positive result is indicated by the presence of at least 2 colored bands, 1 in the control area and 1 in at least 1 of the test areas for troponin I, CK-MB, or myoglobin. A negative test result is defined as a single colored band in the control area alone.

All subjects had been examined in the prehospital setting by physicians and paramedics of the system's mobile intensive care unit who also checked their cardiac markers. Patients with 1 positive marker as well as those considered to be undergoing ACS and those whose chest pain was most likely due to some other cardiac origin were immediately transported to hospital. Patients whose chest pain was considered to be of nonischemic origin, based on the findings of the physical examination—taken together with a new ECG recorded on the scene and the information provided by the call center—and who were planned to be left at home, were also examined on-site by a triple cardiac marker kit (troponin/CK-MB/myoglobin). Those with negative results were left at home and treated with, for example, analgetics and relaxants, if warranted. The system is programmed to monitor their records for 72 hours after the index call under the assumption that anything untoward associated with the index call would occur within this time frame.

**Results.** Of the 821 subscribers (aged 39–98 years; 57% male) who fulfilled entry criteria, 180 had a positive result. Specifically, troponin I, CK-MB, and myoglobin were positive in 112, 92, and 120 kit results, respectively. Eighty-

**Table. Selected Epidemiological Data and Medical History of the 821 Study Patients<sup>a</sup>**

Variable	Entire Study Cohort (N=821)	Positive Kit Result and AMI (n=90)	Positive Kit Result and No AMI (n=90)	Negative Kit Result (n=641)
Male sex	465 (57)	67 (74)	52 (58)	348 (54)
Age, mean (SD), y	74 (12)	71 (11)	71 (12)	72 (12)
History of AMI	383 (47)	39 (43)	43 (48)	302 (47)
s/p PCI	293 (36)	30 (33)	35 (39)	226 (35)
s/p CABG	219 (27)	20 (22)	20 (22)	176 (27)
s/p Stroke or TIA	106 (13)	10 (11)	11 (12)	85 (13)
Supraventricular arrhythmia	220 (27)	17 (19)	17 (19)	186 (29)
Ventricular arrhythmia	47 (6)	3 (3)	3 (3)	39 (6)
Cardiomyopathy	41 (5)	2 (2)	3 (3)	35 (5)
Previous resuscitation	45 (5)	5 (6)	6 (7)	35 (5)
Hypertension	545 (66)	56 (62)	61 (68)	421 (66)
Diabetes mellitus	243 (30)	20 (22)	23 (26)	182 (28)
Dyslipidemia	474 (58)	53 (59)	59 (66)	385 (60)
Smoker in the past 5 y	98 (12)	8 (9)	9 (10)	81 (13)
Chronic renal failure	95 (12)	15 (17)	15 (17)	67 (10)
Congestive heart failure	178 (22)	21 (23)	22 (24)	137 (21)
COPD	78 (10)	7 (8)	8 (9)	68 (11)
Pacemaker/AICD	80 (10)	10 (11)	10 (11)	63 (10)
Hypothyroidism	90 (11)	3 (3)	3 (3)	77 (12)

Abbreviations: AICD, automatic implantable cardioverter/defibrillator; AMI, acute myocardial infarction; CABG, coronary artery bypass grafting; COPD, chronic obstructive pulmonary disease; PCI, percutaneous coronary intervention; s/p, status post; TIA, transient ischemic attack.

<sup>a</sup>Data are given as number (percentage) of patients unless otherwise specified.

two patients had 1 positive marker, 36 had 2, and 44 had 3. A total of 176 patients were immediately transported to hospital (4 refused). Of these, 90 (51%) were discharged with the hospital record–determined diagnosis of acute myocardial infarction (AMI). One-fifth of the remaining 641 patients (126 of 641) were reexamined within the 3-day follow-up because of continuing complaints, and another 15 AMIs were diagnosed. The sensitivity, specificity, and positive and negative predictive values were 86.6%, 83.3%, 53.8%, and 97.6%, respectively.

The overall mortality rate for the study population was 3.3% (27 patients). Mortality among patients with a negative kit result was 3% (19 patients) during the 3 days of follow-up (4 from cardiogenic shock, 2 from sudden cardiac death with failed resuscitation, and 13 from unrelated causes). Of 180 patients, 8 (4.4%) with a positive kit result died from sequelae of an AMI (7 underwent cardiogenic shock and 1 had a post-AMI stroke).

**Comment.** Elevation of cardiac markers in individuals in whom an AMI is not diagnosed in the end is well known,<sup>5,6</sup> and this finding characterized 50% of our patients in whom the uncertainty was clarified by appropriately extended evaluations in the emergency services.

Ninety AMI cases (9.1%) were identified but would probably have been missed because of the patients' inconclusive clinical and ECG presentations. Positive test results alone determined their transport to hospital, sparing them possible serious untoward consequences.

Than et al<sup>7</sup> recently reported satisfactory results in ruling out an AMI by following a protocol in which the same cardiac markers were measured twice in patients with early (<6 hours) symptom onset and who had already arrived to the emergency department. We needed to test those markers only once and could do so at the point of care, thus safely obviated unnecessary trips to the emergency department. Importantly, 6 hours or more from symptom onset, the 98% negative predictive value of assessment by cardiac markers provides further support to the physician at the point of care in the decision-making process, which is sometimes daunting when the source of the pain is inconclusive.

Eran Leshem-Rubinow, MD, MHA  
Yigal Abramowitz, MD  
Nomi Malov, RN  
Maor Hadad  
Mira Tamari, RN  
Michal Golovner, MD  
Arie Roth, MD

**Author Affiliations:** Departments of Internal Medicine "E" (Dr Leshem-Rubinow) and Cardiology (Drs Abramowitz and Roth), Tel-Aviv Sourasky Medical Center (affiliated with the Sackler Faculty of Medicine, Tel Aviv University), and SHL Telemedicine (Mss Malov, Hadad, and Tamari and Dr Golovner), Tel Aviv, Israel.

**Correspondence:** Dr Leshem-Rubinow, Department of Internal Medicine, Tel Aviv Sourasky Medical Center, 6 Weizman St, Tel Aviv 64239, Israel (dr.eranleshem@gmail.com).

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## ONLINE FIRST | HEALTH CARE REFORM

### Prevalence and Characteristics of Outpatient Palliative Care Services in California

Outpatient palliative care services (PCSs) offer the opportunity to intervene earlier in the disease trajectory and result in improved patient outcomes.<sup>1,2</sup> Outpatient PCSs can provide improved continuity of care, reduce unnecessary rehospitalizations, and address the needs of patients and caregivers.<sup>3</sup> While the potential benefits of outpatient PCSs are increasingly recognized, there is a paucity of information regarding the structure of outpatient PCSs,<sup>4</sup> and, to our knowledge, there are