Now Evaluate Chest Pain with 12 Lead Electrocardiograms and Rapid Assays for Early Recognition of Myocardial Infarction in the Ambulance (NEW ERA)

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Citation

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Abstract

Introduction: Paramedics play a vital role in the diagnosis of acute myocardial infarction (AMI). Rapid bedside cardiac markers (RBCMs) are an additional tool that may be used to identify patients with AMI and non-diagnostic ECGs.

Study Objectives: This study was performed to determine if paramedics can identify patients with AMI by using 12-lead ECG and RBCMs.

Methods: In this multi-center trial, 12-lead ECGs and RBCMs were performed before arrival to the emergency department (ED). AMI was identified if either pre-hospital 12-lead ECG or RBCM were positive.

Results: Of the 247 enrolled patients, 28 (11.3%) patients were identified with AMI in the pre-hospital setting. Of the 9 AMI missed by EMS, all had initial pre-hospital negative RBCMs but subsequent positive RBCMs in the ED.

Conclusion: Paramedics can identify AMI in the pre-hospital setting using 12-lead ECG and RBCMs.

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INTRODUCTION

In the United States, more than one million people experience acute myocardial infarctions (AMIs) each year. Approximately half of these individuals die and about 30% never even reach a hospital. [1] Many experimental and clinical studies have shown that early mobilization of hospital resources results in early reperfusion with thrombolytic therapies and the ultimate salvage of myocardium. [2,4] Pre-hospital detection of AMI using a 12-lead electrocardiogram (ECG) reduces morbidity and mortality associated with AMI. [2,3,4]

To achieve early reperfusion, the goal is to make a pre-hospital diagnosis of AMI and communicate this diagnosis with the emergency physician. [5] Pre-hospital diagnosis of AMI reduced the average 60 minute emergency department (ED) wait time for thrombolytics to 22 minutes. [6] However, it is well known that a 12-lead ECG indicates AMI only 50% of the time. [7,8,9] Therefore, the use of point-of-care rapid bedside cardiac markers (RBCMs) may be vital to detecting additional patients who are experiencing an AMI.

Many studies have performed a 12-lead ECG in the pre-hospital setting, [2,6,10,11] but the use of RBCMs in conjunction with the 12-lead ECG has not been performed to the best of our knowledge. The objective of this pilot study was to determine if paramedics can identify patients with chest pain who are experiencing AMI by using the combination of 12-lead ECGs and RBCMs as diagnostic tools in the pre-hospital setting.

METHODS

With the approval of the St. Francis Hospital Institutional Review Board and the Illinois Department of Public Health, this multi-center study includes advanced life support (ALS) providers from five fire departments and five area hospitals in the St. Francis Emergency Medical Services (EMS) System. The St. Francis EMS System is located in the northern and northwestern suburbs of Chicago. In this prospective observational study, we examined the ability of paramedics to enroll patients with non-cardiac chest pain, draw and read RBCMs, and obtain and fax a 12-lead ECG after a training intervention. Extensive training was provided to all paramedics involved in this study. Prior to this study, the paramedics in the St. Francis EMS System have only used the 3-lead ECG monitor system and have not used RBCMs.

The objective and protocols were discussed with the paramedics. The proper technique of obtaining an ECG and RBCMs was demonstrated to the paramedics. They then performed each procedure to demonstrate their proficiency including send ECG recordings via cellular fax. Each paramedic completed a competency exam. Continuing education was performed every two months during the study.

The RBCMs included a qualitative test with a platform of myoglobin, troponin I, and CKMB. We followed the guidelines per the package insert.

The paramedics enrolled all consecutive non-traumatic patients complaining of chest pain over the age of 18. All run sheets were reviewed by the EMS Medical Officers to ensure all patients who met inclusion criteria were included. Written consent was obtained. A 12-lead ECG was performed, and once the paramedics established intravenous access, blood was drawn and put into the well of a RBCM. The paramedics interpreted the tests as positive if a purple band appeared on either the myoglobin and CKMB areas and/or myoglobin and troponin I areas. Each test must have had a purple line appear at the internal control to validate the positive and negative test results. These results were interpreted within 15 minutes to avoid any false-positive readings. The results of the RBCMs were communicated via radio to the Emergency Physician, while the ECGs were transmitted to the ED via a cellular fax system. AMI by ECG was defined as ST-segment elevation >0.1 mm in two consecutive precordial leads or >0.2 mm in two consecutive limb leads, significant Q waves >0.4mm, which were thought to be new, and a new left bundle branch block (LBBB). With the paramedics reporting RBCM results and the Emergency Physicians interpreting the ECG, a teamwork approach led to pre-hospital identification of the patient with an AMI.

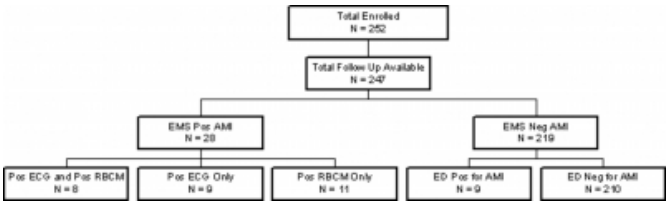
The patient was considered to be positive for AMI with positive myoglobin and CKMB or positive myoglobin and troponin I even if the ECG was non-specific for ischemia (non ST elevation myocardial infarction – NSTEMI). Additionally, if the above RBCMs were negative but the ECG had a positive finding, that patient would be considered positive for AMI. All data was collected prospectively and analyzed.

RESULTS

A total of 252 consecutive patients (114 female, 138 male) were enrolled. Of these patients, complete follow-up was achieved for 247 patients (Figure 1).

Figure 1

Figure 1



In the pre-hospital setting, of the 247 total patients, 17 (6.9%) showed positive ECGs. Of these 17 patients with positive ECGs, 9 (3.6%) exhibited negative RBCMs. Of the 247 patients, 19 (7.7%) patients showed positive RBCMs. Of these 19 patients with positive RBCMs, 11(4.5%) displayed negative ECGs. Because 8 (3.2%) patients revealed positive ECGs and positive RBCMs while 20 (8.1%) patients showed positive ECGs or positive RBCMs, a total of 28 (11.3%) patients had positive ECGs and/or positive RBCMs. As a result, these 28 patients were identified with AMI in the pre-hospital setting.

In the ED, of the 247 total enrolled and followed patients, 37 (15%) had positive ECGs and/or positive cardiac markers. The 19 patients with positive qualitative RBCMs in the field were confirmed with positive quantitative cardiac markers in the ED. The 9 patients with only positive ECGs in the field were confirmed with positive ECGs and positive RBCMs in the ED. In addition to those 28 patients who were identified as AMI in the pre-hospital setting, 9 (3.6%) other patients were diagnosed with AMI in the ED. Of these 9 AMIs with

non-diagnostic ECGs and RBCMs in the field, all had subsequent positive RBCMs in the ED. All 9 cases additionally had non-diagnostic ECGs in the ED.

DISCUSSION

To decrease the morbidity and mortality of patients, time must be decreased in four key areas commonly referred to as the 4 Ds: arrival at the ED (Door), acquiring an ECG (Data), decision to use thrombolytics or mechanical reperfusion (Decision), and administration of appropriate drugs (Drugs). [10] In an effort to decrease the time in the areas of the 4 Ds, pre-hospital ECGs and RBCMs are significant diagnostic tools. With successful reduction of the four deadly Ds, it is conceivable to diagnose a patient prior to reaching a hospital, expedite treatment, and save precious time and functional myocardium in this subset. [11]

This pilot study has shown that it is feasible to diagnose AMI with the use of 12-lead ECGs and RBCMs in the pre-hospital setting. Unlike the previous pre-hospital 12-lead investigations, [10,12] this study has targeted a population that may have been missed by using the ECGs alone: the 11 patients (4.5%) with positive RBCMs and non-diagnostic ECGs.

Another advantage of a pre-hospital and pre-treatment ECG is to make the diagnosis of AMI before treatment begins as treatment may cause improvement in the ECG. [12;13] If the 1st ECG is not done until presentation to the ED, it is difficult to know if the patient improved after treatment thus leading to normalization of the ECG. Thus, with a pre-hospital ECG, we can improve our accuracy by diagnosing AMI prior to treatment. [12] Additionally, identifying more patients with AMI can maximize treatment and decrease mortality. [10]

By comparing the pre-hospital ECG with the ED ECG the clinician can see if initial treatment in the field caused improvement.

One potentially negative aspect of the use of RBCMs in the field is that it may be too early in the patient's infarct to exhibit positive findings. RBCMs are not useful if the onset of chest pain is less than 2 hours. [14] This process can lead to a theoretical false sense of security if the RBCMs are noted to be negative by paramedics. As seen in these results, 9 patients showed negative RBCMs in the field, which converted to positive when obtained in the ED.

Finally, with the combination of pre-hospital ECGs and RBCMs we can improve the accuracy of the pre-hospital diagnosis of AMI. If paramedics can consistently diagnose AMI in the field, emergency physicians can move forward with confidence in activating hospital protocols for rapid reperfusion. [5,15]

STUDY LIMITATIONS

This was a feasibility study to see if paramedics can use the combination of 12-lead ECG and RBCMs for advanced emergency physician diagnosis of AMI. As patients were not treated in the field based on results of the 12-lead ECG and RBCMs, no comment is offered on potential improvement of outcomes.

Time was not observed; therefore conclusions regarding time to assessment, diagnosis, and treatment cannot be made.

Other chief complaints that may have included a final diagnosis of AMI, such as difficulty breathing, heartburn, nausea, or weakness, were not included in this study. As a result, in the pre-hospital setting those patients with other chief complaints who had an unrecognized AMI may have been missed [16].

CONCLUSIONS

In this pilot study, paramedics with appropriate training can identify AMI in the pre-hospital setting using 12-lead ECG and RBCMs.

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