Published in final edited form as:

J Emerg Nurs. 2011 January ; 37(1): 109–112. doi:10.1016/j.jen.2009.11.004.

Initial ECG Acquisition Within 10 Minutes of Arrival at the Emergency Department in Persons With Chest Pain: Time and Gender Differences

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Abstract

Introduction—The American Heart Association recommends all patients presenting to the emergency department with complaints of chest pain/anginal equivalent symptoms receive an initial ECG within 10 minutes of presentation. The Synthesized Twelve-lead ST Monitoring & Real-time Tele-electrocardiography (ST SMART) study is a prospective randomized clinical trial that enrolls all subjects who call 911 for ischemic complaints in Santa Cruz County, California. ST SMART is a 5-year study ending in 2008. The primary aim of the ST SMART study is to determine whether subjects who receive prehospital ECG have more timely hospital intervention and better outcomes.

Objective—The aims of this secondary analysis of a subset of ST SMART study data were to determine (1) the rate of adherence to the American Heart Association goal in smaller community hospitals in less populous areas of receiving initial hospital ECG within the recommended 10 minutes and (2) whether there were gender differences in meeting this goal.

Methods—The dataset included patients 30 years of age and older who were transported by ambulance to 1 of 2 rural hospitals in Santa Cruz County. All patients received an initial hospital ECG after arrival at the emergency department.

Results—In this analysis of 425 patients (mean age, 70.4 years; 53% male), the mean time for all patients from ED arrival to initial ECG was 43 minutes (± 145). The mean time to initial ECG was 34 minutes (± 125) in male patients versus 53 minutes (± 165) in female patients (Mann-Whitney test, $P = .001$). Forty-one percent of all patients presenting with ischemic symptoms received an

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initial ECG within 10 minutes of arrival. Forty-nine percent of male patients versus 32% of female patients received an initial ECG in 10 minutes or less (Fisher exact test, $P = .000$).

Conclusion—In this analysis, the majority of patients with ischemic symptoms did not receive an ECG within 10 minutes of hospital presentation as recommended in evidence-based guidelines. There is a significant delay in door to time-to-ECG for women. ED nurses are in a unique position to initiate efforts to establish processes to decrease time to initial ECG for patients with ischemic symptoms. Attention to timely ECG acquisition in women may improve treatment of acute coronary syndromes in this group.

Keywords

Acute coronary syndromes; Emergency department; Electrocardiogram

Early identification and diagnosis is pivotal in the management of patients with acute coronary syndrome (ACS) in the emergency department. The ECG remains the most widely used initial screening test for evaluating patients with chest pain.¹ It is the most important initial diagnostic tool for patients with suspected ACS because it is inexpensive, available, and non-invasive. The ECG is the first diagnostic test that should be performed on patients who present to the emergency department with chest pain or anginal equivalent symptoms.² ECG changes of ischemia occur before infarction, providing the ability to intervene to restore blood flow before myocardial cell death ensues. The American College of Cardiology/American Heart Association (ACC/AHA) guidelines specify that an ECG should be obtained and interpreted within 10 minutes of arrival to the emergency department in patients with symptoms suspicious of ACS.^{2,3}

Despite this recommendation, only one third of patients with ACS have an ECG within 10 minutes of arrival at the emergency department.⁴ A prolonged door-to-ECG time has been associated with an increase in poor clinical outcomes in patients with ACS. Studies in patients with acute myocardial infarction suggest that a prolonged time to ECG acquisition results in delayed interventions that are crucial to salvaging myocardium, such as thrombolysis or percutaneous coronary intervention.⁵ Disparities based on race and gender have been reported previously for ECG acquisition delay times in emergency cardiac care.^{6–8} Prior studies suggest there is an increased likelihood of delay in time to ECG acquisition, specifically in women and for non-white patients.⁹ To date, these studies have been conducted in large, urban trials at academic medical centers and have been retrospective in nature. Less is known about time to first hospital ECG in less populous areas and at community hospitals. The purpose of this analysis was to determine adherence to the ACC/AHA goal for door-to-ECG acquisition in smaller community hospitals in less populous areas. Secondly, we sought to determine any gender differences in adherence to this ACC/AHA goal.

Methods

We conducted a secondary analysis of data from the ongoing, randomized Synthesized Twelve-lead ST Monitoring and Real-Time Tele-electrocardiography clinical trial, called the ST SMART study, which began in June 2003. The ST SMART study is a county-wide, 6-

year clinical trial in Santa Cruz County, California. This large county was chosen because it includes both urban and rural areas. The total population is estimated to be about 250,000 persons. Approximately half of these people live in rural areas, while the remainder live in small cities in the county. All subjects enrolled in the study were patients who were transported by ambulance to one of two rural hospital emergency departments servicing the county. Hospital A has 300 beds, while hospital B has approximately 100 beds. There are no large university hospitals servicing this area. The larger hospital has a cardiac catheterization laboratory that provides percutaneous coronary intervention and also offers cardiac surgery. All persons 30 years of age and older who called 911 with complaints of non-traumatic chest pain, anginal equivalent symptoms including new onset shortness of breath, and syncope not related to drug overdose or intoxication were enrolled in the primary ST SMART study. In that study, eligible patients were identified by paramedics in the field and research nurses in the emergency department and invited to participate in the study after they reached the hospital. Research nurses obtained written consent from all study participants. Upon arrival at the target emergency department, all patients received an initial hospital 12-lead ECG. Enrollment for the study occurred 7 days a week, 24 hours a day. Data for this secondary analysis were extracted for all subjects enrolled in the study between the dates of June 2003 and May 2006. All data analyses were performed with SPSS software, version 15.0. Mean times to ECG were compared by Mann-Whitney tests. Median times also were reported. Proportions were compared using χ^2 analysis with the Fisher exact test. Negative binomial regression was used to determine predictors of time to ECG. The Institutional Review Board at the University of California—San Francisco approved the study.

Results

A total of 425 consecutively enrolled subjects were included in this secondary analysis. The sample comprised 223 men (52.5%) and 202 women (47.5%). The mean age for the total sample was 70 years. Women were slightly older (72.05 ± 14.06 years vs. 69.05 ± 14.7 , $P < .036$). The sample comprised 366 white patients (86.1%) and 59 non-white patients (13.9%). Of the total sample, 172 subjects (40.5%) had a final diagnosis of ACS. Types of ACS were classified as ST-elevation myocardial infarction (STEMI), non-STEMI, MI of uncertain type (eg, left bundle branch block), definite unstable angina, and probable unstable angina. Research staff determined these diagnoses based on a combination of clinical presentation, hospital ECG analysis, laboratory values, and hospital discharge diagnosis.

TIME-TO-ECG

The mean time-to-ECG for the total sample was 43 minutes. Only 59% of patients with ischemic symptoms at presentation received an ECG within 10 minutes. When taking gender into account, male subjects had a shorter mean time-to-ECG than did female subjects (34 minutes vs. 53 minutes; $P < .001$), and gender was found to be an independent predictor for time-to-ECG. This difference in gender persisted when controlling for age. The total sample had a median time-to-ECG of 12 minutes (25th to 75th percentile, 8 to 26 minutes). The median time-to-ECG acquisition for male subjects was 11 minutes versus 14 minutes for female subjects (25th to 75th percentile, 7 to 21 minutes vs. 25th to 75th percentile, 8 to 35 minutes).

Negative binomial regression revealed that persons who presented with a positive symptom of chest pain were more likely to have received their first ECG in less time (7.6 minutes faster on average) than did those who presented without chest pain.

Discussion

In a large, contemporary population of patients with ischemic symptoms presenting to the emergency department by ambulance, only 59% received an ECG within 10 minutes of presentation as recommended in the evidence-based guidelines. Reasons for the overall delay may include, but are not limited to, ED overcrowding, inadequate triage protocols, and a decreased sense of urgency in patients whose pain may have resolved during initial evaluation in the emergency department.^{9,10} Furthermore, it is possible the large number of patients presenting to the emergency department with complaints of chest pain contributed to the delay. Other possibilities may be that ED staff members were not aware of the ACC/AHA standards and the consequences of delay. Staff level of education and experience also could contribute to overall delay in ECG acquisition.

Among these patients, the time-to-ECG for women was greater than the time-to-ECG for men. The mean time-to-ECG for women was 53 minutes, and only 32% received an ECG within the recommended 10-minute goal. The increased frequency of atypical symptoms in women may have contributed to the gender differences.¹¹ It is plausible that ECGs were not ordered as promptly in this group because women did not report classic cardiac chest pain symptoms or there was a low suspicion of coronary disease at presentation to the emergency department. Initial symptoms may have resolved after treatment in the prehospital setting, which may or may not have been reported to ED staff. Many prehospital protocols support aggressive therapy including oxygen, aspirin, and nitroglycerine for patients with complaints suspicious of ischemic chest pain. Another possible explanation for the increased time-to-ECG in women is that this group has been reported to present to the emergency department after symptom resolution, thus contributing to a delayed response in obtaining an ECG.⁹ Finally, the logistics behind providing a private location for ECG acquisition in women may have contributed to a delay in time for women.

Previous studies have focused on patients presenting to the emergency department with chest pain as opposed to those with anginal equivalents such as shortness of breath or diaphoresis.⁷ Our study examined patients who presented with a variety of complaints that are suggestive of acute myocardial infarction, and we determined that chest pain itself helped to expedite initial ECG acquisition. This finding suggests that ED staff need further education to recognize that myocardial ischemia presents in a variety of ways. It is critical that staff be able to recognize anginal equivalents and initiate appropriate care and treatment, beginning with obtaining an initial ECG.

Previous studies about time-to-ECG have not considered mode of transport to the emergency department. One previous study reported that it took half as long for patients arriving by ambulance to be seen by the physician as for those who transported themselves to the hospital,⁵ but to our knowledge no studies exist that have evaluated time-to-ECG and mode of transportation. It is surprising that, even though all the subjects in our study were

transported by ambulance, the time-to-ECG was still prolonged. This factor should be examined in future studies to determine the effect that mode of transport has on ECG acquisition time.

Limitations

This study has several limitations. First, results may be applicable to a rural community setting but are not generalizable to urban populations or to hospitals that treat a racially diverse population. Our study was limited to 2 community hospitals, and the population consisted primarily of white patients. Second, the present study's aims were not the primary aim of the parent ST SMART study, so additional data that addressed barriers to timely ECG acquisition in the emergency department were not obtained. For example, the study did not examine the actual time to physician interpretation of the initial ECG. Lack of this information may actually underestimate the proportion of patients who did not meet the recommended evidence-based goals. Finally, our study included all subjects who presented to the emergency department by ambulance. Because the majority of patients with chest pain and/or anginal equivalents self-present to the hospital,¹² we may have missed cases that would have been appropriate for this analysis.

Implications for Emergency Nurses

Clinicians must focus on systems that support timely ECG acquisition. This situation requires the efforts of multidisciplinary groups including physicians, nurses, hospital administrators, and EMS providers. Emergency nurses are in a pivotal position to make a difference in these prolonged time-to-ECG times for patients. They could begin setting the goal for time-to-ECG through local quality improvement projects in their own emergency departments. Emergency nurses are well versed in working with a variety of clinicians and, therefore, are in an excellent position to take the lead on this effort.

Second, triage protocols should be considered for both male and female patients presenting with ACS symptoms. Clearly some persons are not being recognized as having potential ischemic symptoms, hence contributing to the long mean time-to ECG. Moreover, special attention to the triage of women should be considered. Emergency nurses are in a unique position to provide this attention because often they are the first to assess patients who self-present to the emergency department.

Conclusions

We found that in a sample from a rural community hospital setting, despite the fact that patients presented to the emergency department by ambulance, the majority of patients with ACS symptoms did not receive a timely initial 12-lead ECG. Among these patients, the time-to-ECG for women was greater than the time-to-ECG for men.

The results of this preliminary analysis reveal that prolonged time-to-ECG remains a problem in rural community hospital settings. Future studies are needed to further examine the role of gender on time-to-ECG, as well as the potential roles of atypical presentation,

mode of transport to the emergency department, ED overcrowding, race, ethnicity, and staff education and experience.

Acknowledgments

Supported by grant RO1 NR007881 from the National Institute for Nursing Research.

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