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Factors associated with advanced cardiac care in prehospital chest pain patients

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ABSTRACT

Introduction: Many patients transported by emergency medical services (EMS) may require advanced cardiac care but do not have ST-segment elevation (STEMI) on the initial prehospital EKG. We sought to identify factors associated with the need for advanced cardiac care in undifferentiated EMS patients reporting chest pain in the absence of STEMI on EKG.

Methods: We performed a retrospective analysis of all adult patients, reporting atraumatic chest pain from a single EMS agency, presenting to a single, urban hospital over a 10-year period. Patients with STEMI on prehospital electrocardiogram were excluded. Patient demographics, chest pain characteristics and prehospital factors were abstracted for all patients. We identified those patients that required advanced cardiac care and performed regression analysis to determine associated factors.

Results: A total of 956 charts were analyzed. Of this total, 193 patients (20.2%) met the primary composite outcome. Of the outcome group, 185 patients (95.9%) had coronary artery disease documented on cardiac catheterization, 22 patients (11.4%) underwent CABG, and seven patients (3.6%) died in the hospital. Most significant variables (multivariable IRR) included age (1.02), male gender (1.65), history of MI (1.47), PCI (1.66), hyperlipidemia (1.40), diaphoresis (1.51), home aspirin (1.53), and improvement with EMS treatment (1.60).

Conclusion: We have identified several factors that could be considered when risk stratifying prehospital patients reporting chest pain. While potentially predictive, the factors are broad and support the need for other objective factors that could augment prediction of patients who may benefit from early advanced cardiac care.

1. Introduction

In the United States, approximately 8 million people per year present to an Emergency Department (ED) with chest pain [1]. Many of these patients are transported by Emergency Medical Services (EMS) [2]. For EMS to be most effective, these patients must be rapidly evaluated and transported to an appropriate hospital for further evaluation and management. Prehospital evaluation for chest pain includes a history, physical exam, and electrocardiogram (EKG) [3]. Prehospital providers are taught to look for ST segment elevations on EKG as this may indicate a time dependent issue requiring emergent percutaneous intervention (PCI) and transfer to a facility with PCI capabilities [4].

There are less defined EMS guidelines for hospital selection in patients where the EKG does not show evidence of ST elevation myocardial infarction (STEMI) [5]. These patients may still have cardiac disease or injury requiring advanced cardiac care (PCI, CABG, etc.). More than 780,000 people in the U.S. each year experience acute coronary syndrome (ACS) and about 70% are of the non ST segment elevation variety (NSTE-ACS) [6]. At six months, the mortality of NSTE-ACS may equal or even exceed that of STEMI and delays in care may worsen patient outcomes [4]. Therefore, as regionalization and specialization of many cardiac services continues, the need to identify and differentiate patients reporting chest pain without evidence of STEMI, but who may still require advanced cardiac care becomes increasingly important.

Hospital based assessment tools such as the Thrombolysis in Myocardial Infarction (TIMI) score [7,8], the Emergency Department Assessment of Chest Pain Score (EDACS) [9], and the HEART score [10], have been established, to help risk-stratify patients in the absence of STEMI. All of these scoring systems however, require blood testing of cardiac biomarkers [7-10], a capability currently not readily available in the prehospital setting. As such, there are limited tools to assist prehospital

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providers in identifying which patients reporting chest pain, but without STEMI on EKG, will require advanced cardiac care [5]. We sought to identify factors associated with the need for advanced cardiac care in undifferentiated EMS patients reporting chest pain in the absence of STEMI on EKG.

2. Methods

2.1. Setting and selection of participants

We identified patients transported by a single suburban EMS agency, with roughly 8500 annual emergency calls transported to a single, urban Emergency Department with an annual volume of 65,000 visits. The EMS agency is a third party, private, paid EMS agency. All potential cardiac calls have a paramedic dispatched. The receiving hospital has 24-hour cardiac catheterization and cardiothoracic surgery capability. Only patients transported with the initial dispatch diagnosis of "chest pain" were included. Calls for "palpitations", "shortness of breath", or other potential anginal equivalents were not included. We excluded cases with patients <18 years of age, those transported from another facility, or those diagnosed with STEMI in the prehospital setting. Patients that did not have any ED record, such as those directly admitted to the hospital, had a documented traumatic etiology of pain, or found in cardiac arrest prior to EMS arrival were also excluded. The study was approved by our hospital's Institutional Review Board.

2.2. Study design

We performed a retrospective chart review linking both prehospital and in-hospital electronic health records for all EMS calls for "chest pain" that were transferred to our Emergency Department over a 10-year period from January 1, 2005 through December 31, 2014. The list of prehospital charts was initially generated by an EMS administrator based on the chief complaint of "chest pain". We linked these EMS medical records to their respective hospital records using the date of EMS transport, the date of ED visit, patient name, and patient birthdate.

Two research assistants (RAs) were tasked with data abstraction after several training sessions with the principal investigators. Each RA was assigned to abstract data exclusively from either the hospital (McKesson, San Francisco, CA) or prehospital (EMSCharts, Pittsburgh, PA) records. The RAs each used a single standardized data collection form containing the predefined variables to be abstracted throughout the length of the study. Each RA remained blinded to the data collected by the other RA but was not blinded to the primary hypothesis. Regular meetings were held throughout the length of the study to address any questions or concerns. Medical records with ambiguous recordings were identified by the RAs and discussed among the investigators until a consensus regarding the correct interpretation was reached. After data was collected by the RAs, the investigators, to ensure consistency, reviewed a 10% random subset.

2.3. Definitions and data elements

We defined "chest pain in the absence of STEMI" as cases that were documented to have a chief complaint of "chest pain" on the prehospital medical record, and did not meet STEMI criteria on a prehospital EKG. While previously established risk assessment tools have not been directly applied to the prehospital setting [5], there are elements within these that are routinely documented in the prehospital phase. Based upon this, a list of potential risk factors was generated a priori for abstraction.

Data were abstracted as coded in the prehospital medical record on age, gender, vital signs, pain score, past medical history, signs and symptoms, medications administered prior to EMS arrival and during EMS care, improvement during EMS care, and if the prehospital EKG was abnormal as defined below. Age and gender were predefined and abstracted using standard definitions [11]. Both initial and final sets of vital signs taken by EMS were abstracted. Specific past medical history elements and signs and symptoms were abstracted (Table 1). The administration and dosages of aspirin and nitroglycerin were recorded as either self-administered prior to EMS arrival or as given by an EMS provider. An abnormal EKG was predefined as any EKG that was not normal sinus rhythm.

The same categorical information for patient demographics, vital signs, and past medical history were also collected from the inpatient side, however this was done to ensure correct linkage between the in-hospital and prehospital charts [12] and not used in the statistical analysis. Both prehospital and in-hospital data were entered into the standardized collection form as documented from the records in the following formats. Quantitative variables and outcomes, such as age, vital signs, and pain score, were entered numerically. Descriptive findings such as nature of pain and EKG findings were entered in writing.

2.4. Study outcomes

As we sought to determine which prehospital factors associated with the need of advanced cardiac care, a priori, we chose a primary composite outcome including any of the following during the patient's hospital stay: abnormal cardiac catheterization, performance of coronary artery bypass graft (CABG), or all cause death. Performance of cardiac catheterization and the presence of abnormalities on catheterization were abstracted from the in hospital record. Abnormal coronary findings, defined as stenosis or lumen irregularities documented on the cardiac catheterization report, were considered abnormal cardiac catheterizations. The performance of PCI, CABG, and the number of grafts placed were recorded. Death in the hospital was also measured. We believe that patients with an abnormal cardiac catheterization or in need of CABG required a health care facility with a high level of cardiac care capabilities. We have elected to not include normal cardiac catheterizations in the composite outcome as we were concerned that patients may have been "over triaged" simply because the catheterization lab existed. We believe the combination of these three outcomes best represents a subset of patients with the greatest need for advanced cardiac care (Table 2).

2.5. Statistical analysis

Using a standardized data collection form, both the prehospital and in-hospital records were matched according to the patient's name, date of birth, and date of visit. Continuous variables were reported as means and categorized whether or not the composite outcome was met. Confidence intervals of 95% were calculated. Variables with a p-value of <0.05 were considered significant. Categorical variables were presented as totals within each category. We then calculated the

Table 1
Prehospital variables abstracted.

Past medical history elements	Signs/symptoms
Myocardial infarction	Dyspnea
Coronary artery disease	Diaphoresis
Percutaneous coronary intervention	Nausea and Vomiting
Cardiac stent	Lightheadedness
Coronary artery bypass grafting	Dizziness
Hypertension	Jaw Pain
Hyperlipidemia	Shoulder Pain
Diabetes mellitus	Arm Pain
Atrial fibrillation	Back Pain
Congestive heart failure	
Mitral valve prolapse	
Deep vein thrombosis/pulmonary embolism	
Gastroesophageal reflux disease	
Anxiety/panic attacks	

-List of prehospital factors that were abstracted from EMS records.

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