BRIEF RESEARCH REPORT

Mode of arrival does not predict myocardial infarction in patients who present to the ED with chest pain

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Abstract

Aims This study aims to determine if patients who arrive by ambulance with a chief complaint of chest pain have a higher risk of myocardial infarction (MI) than those who arrive via alternate transportation.

Methods All patients ages 18–99 who presented to an urban academic ED between January 2006 and July 2006 with a chief complaint that included "chest pain" were eligible for retrospective analysis. Patients who were transferred or who left without being seen or against medical advice were excluded. Myocardial infarction was defined as patients who were admitted and who had elevated troponin I or went urgently to catheterization laboratory and had >90% occlusion of a vessel, with a final clinical impression of MI.

Results There were 690 visits for chest pain during the study period, representing 4% of total ED census. A total of 39 visits met exclusion criteria, and 37 patients had 52 repeat visits, leaving 599 unique patients included for analysis. Mean age was 48.8±1.4 years (SD 17.7), 44.6% were female, and 35 patients (5.8%) were diagnosed with MI. In all, 157 patients (26.2%) arrived via EMS. Patients who arrived by ambulance did not have a significant difference in rate of MI when compared with alternate transportation [7.0% vs. 5.4%, OR (95% CI) = 1.3 (0.6–2.7), p=0.469]. Only 31.4% (11/35) of patients who ultimately were diagnosed with MI arrived by ambulance.

Conclusion We were unable to show a significant difference in rate of MI between patients who arrived via ambulance or private transportation. Equal consideration and urgency should be given to both types of patients when they arrive at the ED.

Keywords Chest pain · Myocardial infarction · Emergency medical services

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Introduction

Patients with signs suggestive of heart attack are instructed to call for an ambulance immediately after symptoms start [1]. Emergency medical services (EMS) have the advantage of commencing important therapy such as aspirin, of alerting the emergency department and/or catheterization laboratory of a patient arriving with myocardial infarction (MI), and of being able to perform resuscitation should the MI portend cardiac arrest [2, 3]. Still, studies show that only about 25 to 50% percent of chest pain patients call an ambulance when they have chest pain [4, 5].

It is known that patients with certain pathologies who present to the hospital via EMS are more likely to be ill than their alternately transported counterparts. In trauma, mortality was found to be twice as high [6]. Patients with headaches have been found to have a much higher likelihood of serious intracranial pathology when they present via EMS [7]. Overall, patients with all complaints who come to the ED via EMS are more likely to be acutely sick and severely injured than those who arrived by private transport [8].

Chest pain is a common complaint, with 6.4 million patients presenting to US EDs each year [9]. In order to prioritize patient evaluations, we wished to determine if patients who arrived to the ED via EMS with undifferentiated chest pain were more likely to have a final diagnosis of MI than those who presented by alternate transportation.

Methods

The study was conducted at a tertiary care, urban emergency department that sees approximately 39,000 adult and pediatric patients each year. Physicians treating adult patients are all board certified in emergency medicine. Midlevel providers supervised by these physicians include residents from internal medicine, surgery and gynecology, as well as physician assistants. The study was deemed exempt for formal review by our hospital's Institutional Review Board.

All adult patients ages 18–99 who presented between 1 January 2006 and 7 July 2006 with a chief complaint that included "chest pain" were eligible for retrospective analysis. For patients with multiple visits, only the first visit for this complaint during the study period was included. Patients who were transferred or who left without being seen or against medical advice were excluded. Myocardial infarction was defined according to the Universal Definition of Myocardial Infarction [10]. That is, all patients had detection of rise and/or fall of troponin I (with at least one value greater than our laboratory's reference range of 0–0.10 ng/ml) with evidence of myocardial ischemia being the symptom of chest pain. Furthermore, patients who went urgently to cardiac catheterization and had at least one vessel with >90% occlusion with a final clinical impression of myocardial infarction but in whom cardiac biomarkers were not followed were also considered to have suffered an MI.

All emergency department records, including physician and nurse charts, are electronic in our department (EDIS, Medhost, Addison, TX). Inpatient data are stored electronically as well (Soarian, Siemens Medical Solutions, Malvern, PA). Patients' records were evaluated for mode of arrival, demographic information, co-morbidities, presentation vital signs, disposition and final diagnosis.

The data extraction process was stepwise and objective. Data from the ED visit were extracted by one author (JTW) from the ED medical record. For all admitted patients, a second author (PB) flagged all patients with any documented elevated cardiac biomarkers and/or performance of cardiac catheterization from the inpatient medical record system. A third author (SGW) determined which of the remaining patients had suffered an acute MI based on the aforementioned criteria. All analyzed data were exported to a spreadsheet (Excel, Microsoft, Redmond, WA) and analyzed with Statistical Analysis Software (SAS) version 9.0 (SAS Institute, Inc., Cary, NC). Student's t-test was used to compare continuous variables, and chi-squared analysis was used to compare proportions.

Results

There were 690 visits for chest pain during the study period, representing 4% of the total ED census. A total of 39 visits were excluded because the patients left without being seen or were transferred. An additional 37 patients had 52 repeat visits for chest pain. Only the first chest pain visit for each individual during the study period was analyzed. In all, there were 599 unique patients included for analysis.

The characteristics of the cohort are demonstrated in Table 1. Of the patients, 26.2% (157/599) arrived by ambulance; 52.3% (313/599) of the patients were admitted to the hospital; 5.8% (35/599) of the patients had a final diagnosis of myocardial infarction. Of these patients, 32/35 (91.4%) had elevated troponin I with a clinical impression of MI. The remaining three patients went urgently to catheterization, had >90% occlusion of at least one vessel, but their cardiac biomarkers were not followed. Table 1 also demonstrates the comparisons between the ambulance and alternate transportation groups.

When comparing the two groups, several significant differences were found. Ambulance-transported patients were older in age (51.9±2.7 vs. 47.7±1.6 years, p= 0.010), more likely to have a higher heart rate (86.7±3.1 vs. 81.7±1.7 bpm, p = 0.004), and less likely to have a lower oxygen saturation on arrival (98.2±0.4 vs. 97.8±0.2 percent, p=0.018). Insurance status was an indicator of ambulance utilization, with 35.7% (46/129) of Medicare patients vs. 23.1% (108/467) of patients with other insurance or self-pay [OR 1.84 (95% CI 1.21–2.80), p= 0.005] utilizing EMS for transfer. Past medical histories of diabetes [31.9% (26/69) vs. 24.1% (118/490), OR 1.91 (95% CI 1.12–3.24), p=0.020] and hypertension [34.5% (57/165) vs. 22.4% (89/397), OR 1.83 (95% CI 1.23–2.72), p=0.003] were also significant predictors of ambulance use

Table 1 A comparison among the characteristics of the total cohort, and patients brought in by ambulance vs. alternate transportation

n	Total cohort n=599	Ambulance arrival n=157 (26.2%)	Alternate transport n=442 (73.8%)	p
Age				
(Years, mean ± 95% CI, n)	48.8±1.4 (599)	51.9±2.7 (157)	47.7±1.6 (442)	p=0.010
Sex				p=0.706
Female (%, n)	44.6% (267)	45.9% (72)	44.1% (195)	
Male (%, n)	55.4% (332)	54.1% (85)	55.9% (247)	
Race				
White (%, n)	64.3% (385/599)	66.9% (105/157)	63.3% (280/442)	p=0.714
Black (%, n)	18.0% (108/599)	17.2% (27/157)	18.3% (81/442)	
Asian (%, n)	8.9% (53/599)	7.0% (11/157)	9.5% (42/442)	
Hispanic (%, n)	6.0% (36/599)	7.0% (11/157)	5.7% (25/442)	
Other (%, n)	2.8% (17/599)	1.0% (3/157)	3.2% (14/157)	
Insurance				
Private (%, n)	41.7% (250/599)	35.7% (56/157)	43.9% (194/442)	p=0.038
Medicaid (%, n)	25.4% (152/599)	22.9% (36/157)	26.2% (116/442)	
Medicare (%, n)	21.5% (129/599)	29.3% (46/157)	18.8% (83/442)	
Self pay/other (%, n)	11.4% (68/599)	12.1% (19/157)	11.1% (49/442)	
Insurance				
Private/self/Medicaid (%, n)	78.4% (467/596)	70.1% (108/154)	81.2% (359/442)	p=0.004
Medicare (%, n)	21.6% (129/596)	29.9% (46/154)	18.8% (83/442)	
Time of arrival				
7:00 am-6:59 pm (%, n)	70.6% (423/599)	65.6% (103/157)	72.4% (320/442)	p=0.108
7:00 pm-6:59 am (%, n)	29.4% (176/599)	34.4% (54/157)	27.6% (122/422)	
Day of arrival				
Weekday (%, n)	75.0% (449/599)	79.6% (125/157)	77.4% (342/442)	p=0.560
Weekend (%, n)	25.0% (150/599)	20.4% (32/157)	22.6% (100/442)	
Shortness of breath				
No (%, n)	92.0% (551/599)	94.9% (149/157)	91.0% (402/442)	p=0.117
Yes (%, n)	8.0% (48/599)	5.1% (8/157)	9.0% (40/442)	
History of CAD				
No (%, n)	76.3% (425/557)	70.6% (101/143)	78.3% (324/414)	p=0.064
Yes (%, n)	23.7% (132/557)	29.4% (42/143)	21.7% (90/414)	
History of diabetes				
No (%, n)	87.7% (490/559)	81.9% (118/144)	89.6% (372/415)	p=0.016
Yes (%, n)	12.3% (69/559)	18.1% (26/144)	10.4% (43/415)	
History of hypertension				
No (%, n)	70.6% (397/562)	61.0% (89/146)	74.0% (308/416)	p=0.003
Yes (%, n)	29.4% (165/562)	39.0% (57/146)	26.0% (108/416)	
History of hypercholesterolemia				
No (%, n)	86.2% (483/560)	83.3% (120/144)	87.3% (363/416)	p=0.238
Yes (%, n)	13.8% (77/560)	16.7% (24/144)	12.7% (53/416)	
Smoker				
No (%, n)	67.2% (379/564)	67.6% (92/136)	67.1% (287/428)	p=0.898
Yes (%, n)	32.8% (185/564)	32.4% (44/136)	32.9% (141/428)	
Systolic blood pressure				
mmHg, mean ± 95% CI, n	134.5±1.7 (594)	134.9±3.7 (154)	134.3±2.0 (440)	p=0.802
Diastolic blood pressure				
mmHg, mean ± 95% CI, n	75.0±1.2 (594)	78.6±2.2 (154)	73.7±1.4 (440)	p<0.001

Table 1 (continued)

n	Total cohort n=599	Ambulance arrival n=157 (26.2%)	Alternate transport n=442 (73.8%)	p
Heart rate				
Bpm, mean ± 95% CI, n	83.0±1.5 (595)	86.7±3.1 (154)	81.7±1.7 (441)	p=0.004
Respiratory rate				
Rpm, mean ± 95% CI, n	18.3±0.4 (573)	18.5±1.2 (142)	18.2±0.2 (431)	p=0.508
Temperature				
°C, mean ± 95% CI, n	36.6±0.1 (535)	36.7±0.1 (139)	36.6±0.1 (396)	p=0.134
Oxygen saturation				
Percent, mean ± 95% CI, n	97.9±0.2 (542)	98.2±0.4 (141)	97.8±0.2 (401)	p=0.018
Disposition				
Discharged (%, n)	47.7% (286/599)	37.6% (59/157)	51.4% (227/442)	p=0.003
Admitted (%, n)	52.3% (313/599)	62.4% (98/157)	48.6% (215/442)	
Final diagnosis of MI				
No (%, n)	94.2% (564/599)	93.0% (146/157)	94.6% (418/442)	p=0.469
Yes (%, n)	5.8% (35/599)	7.0% (11/157)	5.4% (24/442)	

vs. alternate transportation. Ambulance-transported patients were significantly more likely to be admitted to the hospital than those who arrived with alternate transportation (62.4% vs. 48.6%, p=0.003).

The primary endpoint of interest was final diagnosis of myocardial infarction. A total of 11 of the 157 (7.0%) patients brought in by ambulance were diagnosed with myocardial infarction, while 24 of the 442 (5.4%) patients arriving by alternate transportation were diagnosed with myocardial infarction (p=0.469). This equates to an odds ratio (95% CI) = 1.3 (0.6–2.7) of MI for patients who arrive via ambulance. Only 31.4% (11/35) of patients who ultimately were diagnosed with MI arrived by ambulance.

Discussion

When a patient has chest pain, arrival to the emergency department by EMS is clearly advantageous. A sub-analysis of the National Registry of Myocardial Infarction 2 (NRMI2) study demonstrated that use of EMS was associated with wider use of reperfusion therapies and faster time to either fibrinolytics or cardiac catheterization [2]. Likewise, the REACT trial showed that patients with chest pain who arrived to the hospital via private transportation often arrived more quickly than if they activated EMS, but did not have the benefit of prehospital treatment and had longer times to reperfusion therapy [3]. The newest suggestion that EMS be able to obtain an electrocardiogram and bypass the emergency department to go directly to the catheterization laboratory to reduce door-to-balloon times in ST-elevation MI patients is a further advantage of EMS transport [11].

Motives of why people choose to use alternate transportation instead of an ambulance have been studied. A telephone survey demonstrated that 89% of respondents stated that they would activate EMS with a suspected cardiac event, but only 23% actually did use the service [4]. Being prompted to "wait before going" after speaking with an on-call physician or taking an antacid or aspirin at home were risk factors for decreased likelihood of EMS use [4]. The aforementioned NRMI2 study found that nonusers of EMS were younger, more likely to be male and were "lower risk" on presentation. Furthermore, racial and payer status differences were also detected, with blacks using EMS more than whites, and patients with HMO insurance, the uninsured and those with Medicaid more likely to use EMS than those with private insurance [2].

In our study, we detected differences in age and insurance status. Patients who used EMS were older and were more likely to have Medicare than other insurance. We did not detect a difference in gender, or in the time of day or weekday vs. weekend arrival periods. Even though patients who arrived by ambulance were more likely to be admitted to the hospital, rates of MI were not significantly different.

Our study has several potential limitations. The first limitation is that this was a retrospective study and therefore relies on the accuracy of data recorded on the medical record. Second, we assumed that patients who were discharged did not have MI, though it is possible that some of these patients may have been erroneously discharged. We also only considered the diagnosis of MI. There are several other potentially life-threatening causes of chest pain, from pneumothorax to aortic dissection to certain abdominal emergencies. It is not known if patients with these pathologies are more likely to present via EMS than

alternate transportation. Additionally, it should be noted that the abstractors were not blinded to patient mode of transport and there was no measurement of inter-rater reliability among the abstractors in this study.

Most importantly, our study may not be powered sufficiently to find a truly statistically significant difference. We determined that our current power to detect the odds ratio is only 12.9%. Maintaining a 2.8:1 ratio of alternate transportation to ambulance arrival for patients with chest pain as determined in our patient population, we would need to include a total of 9,000 patients (5,803 alternate transportation vs. 3197 ambulance arrival) to obtain sufficient power. Our hope is that this study has raised an interesting question with large public health implications, and we believe that future multi-center trials are warranted.

Conclusion

Although we were able to detect differences in which patients with the complaint of chest pain utilize EMS, we were not able to determine a difference in the final diagnosis of MI between those who arrive via EMS or alternate transportation. For this reason, equal consideration and urgency should be given to these patients regardless of their mode of arrival to the ED.

Conflicts of interest   None.

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