Use of Emergency Medical Services in Patients with Acute Myocardial Infarction in China

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ABSTRACT

Background: Although guidelines strongly recommend use of the Emergency Medical Systems (EMS) by patients with acute myocardial infarction (AMI), it remains underutilized in western countries. Information about its current use in China is unclear. The objective of this study was to examine the use of the EMS by patients with AMI in China, and investigate factors affecting its use.

Methods: A prospective survey study, which included 803 patients with AMI who were admitted to 21 hospitals in China between November 1, 2005 and December 31, 2006.

Results: Only 39.5% of patients called up the EMS at the onset of symptoms (EMS group, $n = 317$), whereas the rest presented to the hospital by some other means (self-transport group, $n = 486$, 60.5%). Predictors of EMS users were older age, symptom onset at evening, unbearable symptoms, having received training and acquired knowledge on heart attack, as well as having a higher income and medical history of heart failure or stroke. Prehospital delay (median 110 min vs. 143 min, $p < 0.001$), door to needle time (median 85 min vs. 93 min, $p < 0.005$) and door-to-balloon time (median 118 min vs. 160 min, $p < 0.001$) were significantly shorter in the EMS group. The early reperfusion rate was also significantly higher in the EMS group (84.8% vs. 78.2%, $p = 0.019$), mainly because of a greater incidence of primary percutaneous coronary intervention (68.1% vs. 61.7%, $p = 0.046$).

Conclusions: The emergency medical services are underutilized by patients with AMI in China. Use of the EMS may be advantageous in view of greater administration of reperfusion therapy. New public health strategies should be developed to facilitate greater use of the EMS for AMI.

Key words: emergency medical services, acute myocardial infarction, prehospital delay, in-hospital delay, reperfusion, Chinese

Introduction

Reperfusion therapy with either fibrinolytic therapy or percutaneous coronary intervention (PCI) reduces mortality for eligible ST-segment elevation myocardial infarction (STEMI) patients.^{1–3} The shorter the time from symptom onset to treatment, the greater the survival benefit from either therapy.^{3–5} However, of those who experience a fatal myocardial infarction (MI), more than half will die within the first hour of the onset of symptoms before reaching a medical facility.⁶ Therefore, guidelines for MI strongly recommend activation of Emergency Medical Services (EMS) by patients who have symptoms consistent with AMI.⁷ The EMS may dispatch personnel who are trained to treat life-threatening complications, such as cardiac arrest, with rapid defibrillation, if needed. Unfortunately, previous research shows that almost half of all AMI patients arrive at the hospital by means other than an ambulance.^{8–14}

The reasons for the underutilization of the EMS by patients with AMI are still not entirely understood. To date, there are no Chinese data specifically investigating the current use of the EMS in patients with AMI. The purpose

of this study was to establish current EMS transport rate and to identify predictors for EMS usage by patients with AMI in China.

Methods

Patients

This prospective survey study was conducted between December 1, 2005 and November 31, 2006. We consecutively recruited 868 patients admitted to the coronary care unit (CCU) at 21 hospitals in Beijing, China. All hospitals were able to provide cardiac catheterization 24 h/day. To be recruited for the study, patients needed to be: (i) Hospitalized within 24 h after the onset of MI symptoms; (ii) Diagnosed with acute STEMI.⁹ All patients gave informed consent. The study protocol was approved by all the 21 Hospital Ethics Committees. Patients presenting with the following criteria were excluded: if AMI onset occurred after hospitalization with another clinical presentation, if their clinical condition did not permit them to be interviewed, or if they did not consent to participate. After exclusions, the final sample consisted of 803 patients.

Data Collection

Data were collected using structured interviews and reviewing medical records. The questionnaire included: (i) Baseline characteristics, which included socio-demographic data such as age and gender, marital status, educational level, employment status, income and health insurance, cardiac risk factors and cardiac medical history. Also, we asked whether the patients had received training knowledge of a heart attack; (ii) Situational factors, which included place (at home or other place) of symptom onset, time (day means 6:00–19:59; evening means 20:00–5:59) of symptom onset and presence of other people; (iii) Symptoms (Chest pain, unbearable symptoms); (iv) Prehospital delay, which was defined as the time from symptom onset to arrival at hospital; (v) In-hospital delay, which included door-to-needle time, and door-to-balloon time. Door-to-needle time was defined as the time from hospital arrival to the initiation of thrombolytic therapy. Door-to-balloon time was defined as the time from hospital arrival to the balloon inflation. (vi) Types of reperfusion procedures (thrombolytic therapy or PCI).

Group Definition

The study population was divided into two groups: the EMS group included patients who called up the EMS at the onset of AMI; the self-transport group included patients who arrived at the hospital by another means, such as, a taxi, public transportation, driven or drove themselves and walk-ins.

Statistical Analysis

SPSS version 11.5 for Windows was used for data analysis. Qualitative data were compared between the two groups using a Chi-square tests. Nonparametric tests (Mann–Whitney U test) were used for comparison of delay time. All tests of statistical significance were two-tailed and probability values of $p < 0.05$ were considered significant. A binary logistic regression was used to determine the relationship between various patient-related factors with the probability of choosing an EMS or not. The odds ratios (OR) and 95% confidence interval (CI) were calculated directly from the estimated regression coefficients.

Results

A total of 803 patients were included in the present study. Only 39.5% (317/803) of patients was transported to the hospital by EMS.

Data of baseline characteristics, situational factors and symptoms are listed in Table 1. The EMS users were older (63 ± 12 and 60 ± 13 years old, $p < 0.001$) and more likely to have higher incomes and better educational levels. Prior history of angina pectoris (30.0% vs. 21.8%, $p = 0.01$), chronic heart failure (3.5% vs. 0.6%, $p = 0.003$) or stroke (13.6% vs. 8.2%, $p = 0.02$) increased the likelihood of the EMS usage.

Patients were more likely to call up the EMS if symptom onset was at evening (42.3% vs. 33.3%, $p = 0.01$) or if they had received training knowledge of a heart attack (23.3% vs. 6.8%, $p < 0.001$). There was a lower use of the EMS among patients with a family history of coronary artery disease. The EMS users suffered more from unbearable symptoms (80.4% vs. 68.9%, $p < 0.001$) compared to the self-transported patients.

Comparison of reperfusion parameters and delay time are listed in Table 2. Percentage of prehospital ECG in the EMS group was 83.0% (263/317). Prehospital delay in the EMS group was significantly shorter (median 110 vs. 143 min, $p < 0.001$). Likewise, door-to-needle time (median 85 min vs. 93 min, $p < 0.005$) and door-to-balloon time (median 118 min vs. 160 min, $p < 0.001$) in the EMS group was shorter than in the self-transported group. The incidence of early reperfusion was significantly higher in the EMS group (84.8% vs. 78.2%, $p < 0.05$). This was relevant to higher PCI procedures in the EMS group than in the self-transported group (68.1% vs. 61.7%, $p < 0.05$).

Results of multivariate analysis are listed in Table 3. After multivariate analysis, older age (OR = 1.026, $p < 0.001$), prior history of CHF (OR = 5.300, $p = 0.014$) or stroke (OR = 1.707, $p = 0.036$), unbearable symptoms (OR = 1.863, $p = 0.001$), symptom onset at evening (OR = 1.600, $p = 0.003$), having a higher income (OR = 1.389, $p = 0.002$) and having received training knowledge of a heart attack (OR = 4.125, $p = 0.000$) remained as independent predictors of EMS usage.

Discussion

This is the first Chinese study to examine the current use of the EMS in patients with AMI. The study shows that only 39.5% of patients with AMI did call the EMS prior to hospitalization. Our findings are broadly consistent with other research in this field. In Glasgow, 25% of patients with AMI called an ambulance as their first course of action.¹⁰ The REACT study reported that only 33% of patients with suspected acute ischemic heart disease arrived at hospital via the EMS.¹¹ Data from the GRACE registry showed that transport to hospitals consisted of an ambulance in 40% of cases, and self-referrals in 30%.¹²

Our study confirmed the findings of other studies^{8,15,16} that older patients are more likely to call an ambulance directly. Possible explanations include prior knowledge or lack of other available transport options. In a large registry from the US, data indicated that ambulance users more often were women.⁸ However, gender did not predict ambulance use in the present study. The present study also shows that prior medical history of CHF or stroke, unbearable symptoms and symptom onset at evening were related to greater utilization of the EMS. Having had a prior medical history of CHF or stroke, and perceiving the symptoms as unbearable, increased the likelihood that

TABLE 1: Univariate analysis of baseline characteristics, situational factors and symptom

Variable	EMS (n = 317)	Self-transported (n = 486)	p	OR	95% CI
Socio-demographic					
Age (mean $\pm$ SD)	63 $\pm$ 12	60 $\pm$ 13	<0.001	1.021	1.009–1.033
Male sex	246 (77.6%)	380 (78.2%)	0.85	1.035	0.736–1.455
Married	278 (87.7%)	440 (90.5%)	0.20	0.745	0.474–1.171
Educational level			0.003	1.332	1.134–1.565
Presecondary	119 (37.5%)	225 (46.3%)			
Secondary	78 (24.6%)	134 (27.6%)			
Undergraduate	111 (35.0%)	122 (25.1%)			
Postgraduate	9 (2.8%)	5 (1.0%)			
Employment			0.07	1.257	1.034–1.528
No job	41 (12.9%)	84 (17.3%)			
Working	89 (28.1%)	154 (31.7%)			
Retired	187 (59.0%)	248 (51.0%)			
Income (RMB/month)			0.003	1.444	1.188–1.756
<500	33 (10.4%)	84 (17.3%)			
500 ~ 2000	174 (54.9%)	282 (58.0%)			
2000 ~ 5000	89 (28.1%)	102 (21.0%)			
>5000	21 (6.6%)	18 (3.7%)			
Health insurance	241 (76.0%)	347 (71.4%)	0.15	1.270	0.918–1.757
Receiving training	74 (23.3%)	33 (6.8%)	<0.001	4.180	2.695–6.483
Cardiac risk factors					
Hypertension	165 (52.1%)	240 (49.4%)	0.46	1.113	0.838–1.477
Diabetes	64 (20.2%)	96 (19.8%)	0.88	1.028	0.722–1.464
Dyslipidemia	76 (24.0%)	92 (18.9%)	0.09	1.351	0.958–1.904
Family history of CAD	17 (5.4%)	50 (10.3%)	0.014	0.494	0.280–0.873
Current smoker	171 (53.9%)	272 (56.0%)	0.57	0.921	0.693–1.225
Medical history					
Prior MI	33 (10.4%)	43 (10.8%)	0.46	1.197	0.743–1.930
Prior angina	95 (30.0%)	106 (21.8%)	0.01	1.534	1.111–2.118
Prior CHF	11 (3.5%)	3 (0.6%)	0.003	5.788	1.602–20.91
Prior stroke	43 (13.6%)	40 (8.2%)	0.02	1.750	1.109–2.761

TABLE 1: (Continued)

Variable	EMS (n = 317)	Self-transported (n = 486)	p	OR	95% CI
Situational factors					
Symptom onset at evening	134 (42.3%)	162 (33.3%)	0.01	1.464	1.094–1.961
Symptom onset at home	255 (80.4%)	399 (82.1%)	0.56	1.1151	0.777–1.601
Presence of other persons	263 (83.0%)	379 (78.0%)	0.09	375	0.956–1.977
Symptoms					
Chest pain	276 (87.1%)	428 (88.1%)	0.67	0.912	0.595–1.399
Unbearable symptoms	255 (80.4%)	335 (68.9%)	<0.001	1.854	1.323–2.598

Abbreviations: CHF = Chronic heart failure; RMB = Chinese currency unit.

TABLE 2: Comparison of reperfusion parameters and delay time

Variable	EMS (n = 317)	Self-transported (n = 486)	p
Prehospital ECG by EMS	263 (83.0%)	0 (0.0%)	<0.001
Prehospital delay (median)	110	143	<0.001
Door-to-needle time	85	93	<0.005
Door to balloon time	118	160	<0.001
Reperfusion, n (%)	269 (84.8%)	380 (78.2%)	0.019
Thrombolytic, n (%)	53 (16.7%)	80 (16.5%)	0.923
PCI, n (%)	216 (68.1%)	300 (61.7%)	0.046

the individual believed that he or she was experiencing a heart attack. These variables may reflect the influence of episodic memories (for example, prior CHF might be a complication of AMI). Thus, an individual's evaluation of a chest pain event may depend on a combination of past experience and general knowledge regarding AMI. Lacking of other available transport means may be a possible reason accounting for greater utilization of EMS in patients with symptom onset at evening. In this study, MI patients who have a higher income were more likely to call the EMS, indicating that the ability to pay for ambulance service may influence EMS usage. This finding disagrees with those of Siepmann et al.¹⁷ and Kerr et al.¹³ who reported that patients with lower income were more likely to use the EMS. Differences of these observed results between the present and other studies, may involve cultural and environmental issues in different countries. Thus, the association between income and EMS usage needs further investigation.

TABLE 3: Multivariate analysis of variables for emergency medical services group

Variables	β	p	OR	95% CI
Age	0.025	<0.001	1.026	1.013–1.038
CHF	1.668	0.014	5.300	1.401–20.051
Stroke	0.535	0.036	1.707	1.036–2.811
Income	0.328	0.002	1.389	1.123–1.717
Symptom onset in the evening	0.470	0.003	1.600	1.171–2.186
Unbearable symptoms	0.622	0.001	1.863	1.300–2.668
Receiving training knowledge	1.417	0.000	4.125	2.597–6.554

In the present study, another interesting finding is that EMS use was associated with a significant shorter prehospital delay and a higher rate of revascularization procedures, in particular, primary angioplasty. Longer prehospital delay in self-transported patients might be explained by possible reasons which included patients' hesitation to go to hospital, no professional removal of patients, restrictions like traffic lights, and so on. The reduction in prehospital delay could partly explain the higher rate of revascularization procedures in the EMS group of patients, as this therapeutic strategy is strongly linked to time delays from symptom onset. Canto et al.⁸ and Bruno¹⁴ also underlined the relevance of the greater and faster receipt of initial reperfusion therapies in EMS patients. Use of the EMS dramatically shortens the in-hospital delay in reperfusion therapy. Possible reasons could be that today, all ambulances in China have ECG-possibilities, and utilization of the EMS for symptoms of AMI can save valuable minutes by early notification

of the hospital, which then can be prepared and ready to start therapy as soon as the patient arrives.

An important finding of this study is that those who have received training knowledge regarding a heart attack were related to greater utilization of the EMS. One possible explanation is that these individuals knew the benefits of ambulance transportation and the importance of a minimal delay when experiencing AMI. Thus, it gave us an indication that to increase EMS utilization for AMI, it is critical to increase the knowledge of the general public, particularly those at risk for AMI, about symptoms, patterns and appropriate response. One earlier example of efforts to increase EMS utilization during an AMI episode is a conducted campaign in King County, Washington. This campaign is a multimedia campaign that utilizes a combination of television and radio spots to encourage individuals to call up the EMS when they experience chest pain. Postcampaign EMS utilization rates were significantly greater than precampaign rates.¹⁸ Luepker et al.¹⁹ and Wright et al.²⁰ also have shown increased ambulance use after a general media campaign was carried out. Patients need to understand that they should never attempt to drive themselves, or even let somebody else drive them to hospital, if they think they are having MI symptoms.

In conclusion, the EMS are underutilized by patients with AMI in China. Use of the EMS may be advantageous in shortening prehospital delays and speedier administration of reperfusion therapy, especially for primary PCI. New public health strategies should be developed to facilitate greater use of the EMS for AMI.

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