

## Predictors of Prehospital Delay in Patients With Acute Myocardial Infarction in Kashan City

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**Background:** The prehospital delay might result in death in patients with acute myocardial infarction (AMI).

**Objectives:** This study aimed to investigate the prehospital delay and its related factors in patients with AMI admitted to Kashan's Shahid Beheshti Hospital.

**Patients and Methods:** This cross-sectional study was conducted on 117 patients with AMI in the second half of 2013. The interval between the onset of symptoms and arrival at the hospital was noted and in cases of delay, the factors leading to the delay were investigated using a questionnaire. The content validity of the questionnaire was confirmed through content validity method and its internal consistency was confirmed using Cronbach's alpha coefficient. Chi-square test, odds ratio, and logistic regression analysis were used in data analysis.

**Results:** The median delay was 129 minutes (mean  $\pm$  SD, 240.44  $\pm$  295.30). Overall, 32.5% of patients were admitted within 90 minutes of symptom onset. The long distance between living locations to the hospital was the most common cause of delay to hospital admission (31.7%). Significant associations were observed between the delay time and location of residency ( $P = 0.00$ ) and type of transportation vehicle ( $P = 0.003$ ). Multivariate logistic regression analysis showed that the location of residency and type of transportation vehicle could significantly predict the delay time in patients with AMI ( $P = 0.039$  and  $0.036$ , respectively).

**Conclusions:** The delay time from symptom onset to hospital admission was high in patients with AMI. It is necessary to create emergency medical system (EMS) stations in suburbs and train the public on the importance of quick contact with the EMS when the symptoms of an AMI are observed.

**Keywords:** Myocardial Infarction; Hospital; Patient Admission; Emergency Medical Service

### 1. Background

Ischemic heart disease is one of the leading causes of death in the world (1). Coronary artery diseases (CAD) are also the main causes of death in Iran (2). It is reported that CAD is accounted for one-sixth of deaths in the United States (US) in the year 2010 (3). These diseases are associated with a mortality rate of 28% in developing countries and also accounted for 30% to 35% of the total mortality in Iran and annually, nearly 150000 Iranians die from CAD (4). Over 50% of cardiac deaths occur within the first 30 minutes of symptom onset, when the patient still has not reached the hospital (5). Reducing the interval between symptom onset and initiation of medical treatment is a crucial factor in survival of these patients. According to the European guideline for the management of AMI, reperfusion therapy should be started within the first 120 minutes after symptom onset (6). The College of Cardiology/American Heart Association and European Society of Cardiology recommend a golden time of 30 minutes or less to proper care for patients with ST-elevation myocardial infarction (STEMI) from admission in a primary care

hospital to a reperfusion therapy center (7). As a result, patient should be hospitalized within 90 minutes after the onset of symptoms. An increased delay is often associated with adverse outcomes (8). The reported mean time from onset of chest pain to hospital admission ranges from 273  $\pm$  258 to 1302  $\pm$  1524 minutes in different cities (9-11), and a delay over 180 minutes was observed in 70% of patients with AMI in Tehran City (11). The mean delay has been reported to be 185.2  $\pm$  334.8 minutes in Turkey (12), 255  $\pm$  285 minutes in Korea (13), and 1415  $\pm$  5105 minutes in China (14). In addition, the median delay was 216 minutes in London (15), and 56.2% of patients presented to a hospital within 240 minutes of symptom onset in India (16). The mean delay time was 127  $\pm$  174 minute in a previous study in Kashan (17).

Several factors such as patients' gender, age, education level, place of residence, their awareness of symptoms, quality, location, type, and time of pain, presence or absence of sweating, history of cardiac disorders, the type of transportation vehicle, and the type of physician the

patients had been referred to, influence the prehospital delay time (12-18).

## 2. Objectives

Due to the crucial importance of identifying the factors influencing prehospital delay in reducing the mortality and complications of AMI, and considering the lack of updated studies in this regard in Kashan, the present study aimed to investigate the prehospital delay time and its related factors in patients with AMI admitted to Kashan's Shahid Beheshti Medical Center.

## 3. Patients and Methods

This cross-sectional study was conducted on patients with AMI who were referred to Shahid Beheshti Hospital in the second half of 2013 ( $n = 117$ ). Sampling was through a consecutive method in which all patients with AMI referred to the aforementioned hospital were enrolled in the study. Inclusion criteria were having a medical diagnosis of AMI, being resident in Kashan or in its suburbs, and willingness to participate in the study. Data was collected by the third author who is an expert nurse researcher in the field of Emergency nursing. The questionnaire was designed through literature review and its face and content validity were confirmed by ten faculty members and cardiologists in the Kashan University of Medical Sciences. The reliability of the questionnaire was assessed through test-retest in ten patients (with a ten-day interval) and its internal consistency was confirmed by calculation of Cronbach's alpha of 0.91.

The questionnaire was consisted of three parts. The first part included of questions on demographics (i.e. age, gender, education level, employment status, marital status, smoking habit, type of insurance, location of residency, location and time of the first symptom, and the first symptom of AMI). The second part of the questionnaire that obtained from the medical records and/or patient interviews consisted of a question on the interval between time of symptoms onset and hospital admission and 11 dichotomous (yes/no) items on the causes of delay. These questions were asked from the patients or their attendants if a patient had a delay of  $> 90$  minutes. This time limit was selected according to the European guideline for the management of AMI (6) and College of Cardiology/American Heart Association and European Society of Cardiology (7). These question included the long distance between living location and the hospital, expecting for spontaneous improvement, ignoring pain, tolerating the pain, lack of knowledge about symptoms of an AMI, occurrence of symptoms at the midnight or in the early morning, referring to non-specialized medical centers, referring to a general practitioner, performing self-treatment, and not knowing the telephone number of emergency medical service (EMS). The third part of the questionnaire consisted of questions on the medical history such as hypertension (HTN), diabetes mellitus (DM), hyperlipidemia (HLP),

and heart failure (HF), previous experience of chest pain, history of AMI, history of performing a coronary angiography (CA), and history of AMI in first-degree relatives.

Data collection started after obtaining permission from the Ethics Committee of Kashan University of Medical Sciences. Eligible patients were identified and recruited through researcher's daily visits of the Emergency Department and coronary care units (CCU) of Shahid Beheshti Hospital, the only hospital with CCU in Kashan City. All patients who were diagnosed with AMI, based on the existing of a ST segment elevation in the electrocardiography and a medical diagnosis of AMI made by a cardiologist, were invited to enroll in the study and if they signed the written informed consent, were interviewed to answer the study questionnaire. All interviews were conducted after permission of a cardiologist and when the patients' clinical and hemodynamic status was stabilized. In addition, a patient's close relative was interviewed to confirm the patient's answers or respond some questions that the patient was not able to answer. Moreover, the staff of the ambulance that had transported the patient to the hospital was interviewed and the patient's records and the emergency system mission forms were reviewed by the researcher to ensure the accuracy of data related to the transportation time. If a patient's medical diagnosis was not certain in the first day, the patient's file was reviewed again on the second day of hospitalization, and the patient would be enrolled if the medical diagnosis of AMI was made.

### 3.1. Ethical Considerations

The ethical aspects of this study was approved by the Institutional Ethics Committee of Kashan University of Medical Sciences with the code of 29/5/1/1868, issued on August 13, 2013. Permissions were also obtained from the authorities of the university and hospital officials before data collection. The purpose of the study was explained to all participants and they were assured of the confidentiality of their personal information.

### 3.2. Statistical Analysis

Data was analyzed by SPSS 13 (SPSS Inc, Chicago, IL, USA). Descriptive statistics (frequency, mean, and standard deviation) were calculated for all variables. Moreover, Chi-square test was used to examine the association between the nominal variables. Moreover, odds ratio (OR) was calculated if the associations were significant. Logistic regression analysis was also used to identify the predictive variables for prehospital delay. A P value  $< 0.05$  was selected as statistically significant level in all the tests.

## 4. Results

Totally, 117 patients participated in this study with 77.8% being males. Moreover, 90.6% of patients were married, 95.7% had insurance, 85.5% had an education level lower diploma, 81.2% did not smoke, and 84.6% resided in Kashan City.

**Table 1.** Baseline Characteristics of the Patients<sup>a</sup>

Variables	Value
<b>Age, y</b>	
40-59	51 (43.6)
60-79	48 (41)
80-89	18 (15.4)
<b>Gender</b>	
Male	91 (77.8)
Female	26 (22.2)
<b>Education level</b>	
Under diploma	100 (85.5)
Diploma and above	17 (14.5)
<b>Employment status</b>	
Employed	52 (44.4)
Unemployed	65 (55.6)
<b>Marital status</b>	
Single, divorce or widow	11 (9.4)
Married	106 (90.6)
<b>Insurance status</b>	
Insured	112 (95.7)
Uninsured	5 (4.3)
<b>Smoking</b>	
Yes	22 (18.8)
No	95 (81.2)
<b>Location of residency</b>	
City	99 (84.6)
Suburbs	18 (15.4)
<b>Place of symptom onset</b>	
Home	101 (86.3)
Other places	16 (13.7)
<b>Time of symptom onset</b>	
Morning (6-12)	36 (30.8)
Afternoon (12-20)	49 (41.9)
Night (20-6)	32 (27.4)
<b>The first symptom</b>	
Chest pain	109 (93.2)
Other symptoms	8 (6.8)
<b>Transportation vehicle</b>	
Ambulance	25 (21.4)
Ambulance of the health centers	44 (37.6)
A Taxi or personal vehicle	48 (41)
<b>Hypertension</b>	
Yes	53 (45.3)
No	64 (54.7)
<b>Diabetes</b>	
Yes	31 (26.5)
No	86 (73.5)
<b>Hyperlipidemia</b>	
Yes	45 (38.5)
No	72 (61.5)
<b>Heart failure</b>	
Yes	11 (9.4)
No	106 (90.6)
<b>History of chest pain</b>	
Yes	41 (35)
No	76 (65)
<b>History of angiography</b>	
Yes	21 (17.9)
No	96 (82.1)
<b>History of myocardial infarction</b>	
Yes	19 (16.2)
No	98 (83.8)

<sup>a</sup> Data are presented as No. (%).

In addition, the mean  $\pm$  SD of patients' age was 62.51  $\pm$  12.32 years (rang, 41-89) and mostly were in age range of 60 to 79 years old. In the majority of patients (93.2%), the onset symptom was chest pain that mostly had occurred at home (86.3%) and in the afternoon hours (41.9%) (Table 1). The median prehospital delay was 129 minutes (rang, 24-1458) with a mean delay of 240.44  $\pm$  295.30 minutes. Overall, 32.5% of patients were admitted within the 90 minutes of symptom onset while 32.5% had a delay of >180 minutes (Table 2). The long distance between living location and the hospital (31.7%), referring to non-specialized medical centers (24%), and lack of knowledge on symptoms of an AMI (20.2%) were the most common causes of delay to hospital admission, consecutively (Table 3).

Chi-square test showed no significant association between the delay time and age, gender, education level, employment status, marital status, insurance, smoking habit, place and time of symptom onset, and the first symptom of AMI; however, significant associations were observed between the delay time and location of residency ( $P = 0.000$ ) and type of transportation vehicle ( $P = 0.003$ ). In other words, patients residing in the city and patients that were transported by EMS system had lower delay times than patients living in suburbs or the ones who were transported using other transportation methods (Table 4). From 117 patients, 45.3% had HTN, 26.5% had DM, 38.5% had HLP, 35% had a history of chest pain, 17.9% had a history of CA, and 16.2% had a history of AMI. In addition, no significant association was observed between the delay time and a history of AMI in first-degree relatives or having HTN, AMI, DM, HLP, HF, or a history of CA (Table 5). To determine the factors predicting the delay time, multivariate logistic regression analysis was performed with all of the factors (Tables 4 and 5). The results showed that the location of residency and the type of transportation vehicle could significantly predict the delay time in patients with AMI ( $P = 0.039$  and  $0.036$ , respectively;  $R^2 = 0.24$ ) (Table 6).

**Table 2.** The Distribution of Subjects According to Interval Between Time of Onset and Hospital Admission

Variable	Value
<b>Time, min, No. (%)</b>	
$\leq 90$	38 (32.5)
91-120	18 (15.4)
121-150	13 (8.6)
151-180	10 (11.1)
181-240	9 (7.7)
241-1458	29 (24.8)
<b>Total</b>	117 (100)
<b>Mean <math>\pm</math> SD, min</b>	240.44 $\pm$ 295.30
<b>Median, min</b>	129

**Table 3.** Patients or Their Attendant Reported Reasons for Prehospital Delay<sup>a</sup>

Reasons	Value
The long distance between living location and the hospital	25 (31.7)
Referring to non-specialized medical centers	19 (24)
Lack of knowledge of symptoms of a myocardial infarction	16 (20.2)
Tolerating the symptoms	9 (11.4)
Ignoring the pain	4 (5.1)
Occurrence of symptoms in the midnight or early morning	3 (3.8)
Other reasons	3 (3.8)
<b>Total</b>	<b>79 (100)</b>

<sup>a</sup> Data are presented as No. (%).

**Table 4.** The Distribution of Subjects According to Demographic Factors and Delay Time<sup>a</sup>

Variables	Delay Time		P Value
	≤ 90 Min	> 90 Min	
<b>Age, y</b>			0.287
40-59	13 (34.2)	38 (48.1)	
60-79	17 (44.7)	31 (39.2)	
80-99	8 (21.1)	10 (12.7)	
<b>Gender</b>			0.517
Male	30 (78.9)	61 (77.2)	
Female	8 (21.1)	18 (22.8)	
<b>Education level</b>			0.287
Under diploma	31 (81.6)	69 (87.3)	
Diploma and above	7 (18.4)	10 (12.8)	
<b>Employment status</b>			0.440
Employed	16 (42.1)	36 (45.6)	
Unemployed	22 (57.9)	43 (54.4)	
<b>Marital status</b>			0.259
Married	33 (86.8)	73 (92.4)	
Single	5 (13.2)	6 (7.6)	
<b>Insurance status</b>			0.475
Under cover	37 (97.4)	75 (94.9)	
None	1 (2.6)	4 (5.1)	
<b>Smoking</b>			0.578
Yes	7 (18.4)	15 (19)	
No	31 (81.6)	64 (81)	
<b>Location of residency</b>			0.000
City	38 (100)	64 (81)	
Suburbs	0 (0)	61 (77.2)	
<b>Place of symptom onset</b>			0.224
Home	31 (81.6)	70 (88.6)	
Other places	7 (18.4)	9 (11.4)	
<b>Time of symptom onset, hour range</b>			0.694
Morning (6-12)	10 (26.3)	26 (32.9)	
Afternoon (12-20)	16 (42.1)	33 (41.8)	
Night (20-6)	12 (31.6)	20 (25.3)	
<b>The first symptom</b>			0.514
Chest pain	35 (92.1)	74 (93.7)	
Other symptoms	3 (7.9)	5 (6.1)	
<b>Transportation vehicle</b>			0.003
Ambulance	15 (39.5)	10 (12.7)	
Ambulance of the health centers	9 (23.7)	35 (44.3)	
A Taxi or personal vehicle	14 (36.8)	34 (43)	

<sup>a</sup> Data are presented as No. (%).

**Table 5.** The Distribution of Subjects According to Patient Records and Delay Time to Hospital Admission<sup>a</sup>

Disease	Delay Time		Value		
	≤90 Min	>90 Min	P Value	OR	95% CI
<b>Hypertension</b>			0.380	0.704	0.321-1.544
Yes	15 (39.5)	38 (48.1)			
No	23 (60.5)	41 (51.9)			
<b>Diabetes</b>			0.190	1.762	0.752-4.130
Yes	13 (34.2)	18 (22.8)			
No	25 (65.8)	61 (77.2)			
<b>Hyperlipidemia</b>			0.333	1.474	0.670-3.243
Yes	17 (44.7)	28 (35.4)			
No	21 (55.3)	51 (64.6)			
<b>Heart Failure</b>			0.240	0.432	0.890-2.106
Yes	2 (5.3)	9 (11.4)			
No	36 (94.7)	70 (88.6)			
<b>History of Myocardial Infarction in Close Relatives</b>			0.822	0.914	0.418-1.999
Yes	16 (42.1)	35 (44.3)			
No	22 (57.9)	44 (55.7)			
<b>History of Chest Pain</b>			0.170	0.553	0.236-1.296
Yes	10 (26.3)	31 (39.2)			
No	28 (73.7)	48 (60.8)			
<b>History of Myocardial Infarction</b>			0.927	0.952	0.331-2.735
Yes	6 (15.8)	13 (16.5)			
No	32 (84.2)	66 (83.5)			
<b>History of Angiography</b>			0.673	0.800	0.283-2.258
Yes	6 (15.8)	15 (19)			
No	32 (84.2)	64 (81)			

<sup>a</sup> Data are presented as No. (%).

**Table 6.** The Variables Associated With a Delay of More Than Ninety Minutes by Logistic Regression Analysis<sup>a</sup>

Variable	Odds Ratio	95% CI	P Value	R <sup>2</sup>
<b>Location of Residency</b>	0.333	0.120-0.93	0.039	0.24
<b>Type of Transportation Vehicle</b>	1.278	0.469-3.483	0.036	

<sup>a</sup> No significant correlation was found between the delay time and other variables (in logistic regression analysis)

## 5. Discussion

In the present study, the interval between the symptom onset to hospital admission, and its association with basic characteristics, past medical history, and reasons for the delay to hospital admission were studied in 117 patients with AMI. The mean time to hospital admission was

240.44 minutes. The mean prehospital delay in another Iranian study was  $444 \pm 975$  minutes (9). In two studies in Turkey, the median time to the first treatment seeking contact and the mean delay to hospital admission were 90 minutes and  $185.2 \pm 334.8$  minutes, respectively (12-20). The mean delay time in our study was less than some previous studies in Iran but was more than studies conducted in other areas such as India, Korea, and Europe. Moreover, a major difference was observed between the median and the mean delay in the present study that might be attributed to the vast range of the delay (24 vs. 1458 minute). The prehospital delay time is the main barrier to receiving prompt reperfusion therapy, which has been shown to influence morbidity and mortality in patients with AMI. Reducing the interval between symptom onset and treatment is the biggest challenge faced by the patients with AMI (1). Nonetheless, this time is so different in various studies. Although the main reason for these differences is unclear, socio-cultural factors, demographic and clinical differences, and the structure of the healthcare systems, especially in the prehospital EMS, might be involved.

Results of the present study showed that the location of residence and the type of transportation vehicle had significant association with the prehospital delay time. These findings were consistent with studies conducted by Momeni et al. in Iran (9) and Peng et al. (21) and Qian et al. (14) in China who found that the type of transportation vehicle and the location of residency were associated with prehospital delay. However, some studies in Korea (13), Bushehr (10), and Bandar-Abbas (18) have found that residency and type of transportation vehicle were not associated with prehospital delay. Currently the EMS stations are mainly located within cities and then the delay time would be more in suburbs. Therefore, it is necessary to create EMS stations in suburbs to shorten the delay time for the patients residing in these areas. Moreover, our finding showed that the delay time was shorter in patients who were transported via EMS system. This finding indicated the necessity of public education on the importance of quick contact with the EMS, when the symptoms of an AMI are observed, to effectively reduce prehospital delays. However, it seems that people in our community did not receive appropriate educations about the importance of early contact with EMS system and early hospital admission. Then appropriate public education strategies should be implemented in this regard.

In the current study, no significant association was found between the delay time and HTN, AMI, DM, HLP, HF, history of CA, or having a history of AMI in first-degree relatives although some previous studies showed significant associations between the delay time and having DM (12, 13, 15), previous history of CAD, and family history of CAD (10, 18). The discrepancy might be attributed to the small sample size in this study. Moreover, it should be noted that the history of diseases are not modifiable and therefore, they might not be the target for educational

interventions. The present study showed that symptom attribution is a significant problem. In other words, attributing the chest pain to noncardiac origins was the most common cause of delay to hospital admission. This finding was consistent with results of Farshidi et al. (18) and Rezaei et al. (10) who reported that many people were unaware of the symptoms of cardiac diseases. Then, teaching AMI symptoms to people is important. This problem might be reduced through strategies for public education using mass media such as radio, television, or messaging system of cell phones.

There were several limitations to the present study. First, the number of patients was relatively small. In addition, patients who did not seek treatment or died at home or during transportation were not investigated in this study. Then, the generalizability of the results might be affected. Moreover, this study assessed admitted patients in a six-month period. Therefore, performing a study with longer period of assessment is suggested. Despite these limitations, this study can show the current status of the delay in hospital admission of patients with AMI. Hence, our findings might help the health care authorities to establish programs to decrease the mortality of AMI.

The delay time to hospital admission was high in patients with AMI. Although we did not assess the mortality rate of the patients with AMI, this long delay time might decrease the survival rate after an AMI. Therefore, creating EMS stations in suburbs might be beneficial in decreasing the delay time and the mortality of patients with AMI. Moreover, our finding showed that the delay time was less in patients who were transported via EMS system. This finding indicated the necessity of public education on the importance of quick contact with the EMS when the symptoms of an AMI are observed to reduce prehospital delays effectively. In addition, establishing some programs for public education is suggested in order to inform people of signs of infarction. Mass Medias such as radio, television, or messaging system of cell phones might be used to educate people on the symptoms of AMI and the crucial importance of early and correct transportation of such patients to the appropriate medical centers. In addition, it is suggested to assess the effects of public educations on the delay time to hospital admission after AMI.

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## Authors' Contributions

Farzaneh Saberi was responsible for the study concepts

and design, Mohsen Adib-Hajbaghery participated in the study conception and design and made critical revisions to the paper for important intellectual contents, and Javad Zohrehei participated in data collection and prepared the first draft of the paper.

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