Factors associated with prolonged prehospital delay in patients with acute myocardial infarction

Akut miyokard infarktüslü hastalarda hastaneye geç geliş ile ilişkili faktörler

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Objectives: We investigated factors associated with prolonged prehospital delay in patients with acute myocardial infarction (AMI).

Study design: A total of 439 patients (351 males, 88 females; mean age 57±12 years) with ST-elevation AMI were interviewed within 48 hours of hospitalization. Patients were pain-free and hemodynamically stable at the time of interview. Data were collected on the time from the onset of chest pain to hospital admission and on sociodemographic and clinical characteristics. The patients were evaluated in two groups according to the place to which the first presentation was made, i.e., a local clinic/ small hospital (clinic group: n=209, 47.6%) or our tertiary fully equipped cardiovascular center (hospital group: n=230, 52.4%).

Results: The median and mean delay times were 70 min and 185.2±334.8 min, respectively. Of the study group, 136 patients (31%) arrived within 60 minutes after the onset of symptoms. The median delay time was significantly longer in the clinic group (120 min *vs* 60 min; p<0.001). Female sex, age ≥55 years, and total education time <9 years were associated with a longer prehospital delay, whereas a history of coronary artery disease (CAD), smoking, and the absence of diabetes were associated with a shorter prehospital delay. In multivariate regression analysis, total education time <9 years, female sex, age ≥55 years, and the absence of previous CAD were independent predictors of prolonged prehospital delay. The incidence of direct hospital presentation significantly increased with older age, smoking, aspirin use, and previous CAD. In multivariate analysis, only previous CAD was an independent predictor of direct hospital presentation.

Conclusion: The median delay time of 70 min in this Turkish cohort is in accordance with the data from western populations. Public education campaigns to shorten prehospital delay should place more emphasis on the factors and patient subgroups associated with prolonged prehospital delay.

Key words: Myocardial infarction; patient admission; prognosis; time factors; transportation of patients.

Amaç: Çalışmamızda, akut miyokard infarktüslü (AMİ) hastalarda hastaneye geç geliş ile ilişkili faktörler araştırıldı.

Çalışma planı: Hastanemize ST-yükselmeli AMİ nedeniyle başvuran 439 hastaya (351 erkek, 88 kadın; ort. yaş 57±12) ait bilgiler, yatış sonrası 48 saat içinde hastalarla görüşülerek toplandı. Görüşme sırasında hastalar ağrısız ve hemodinamik olarak stabil idi. Göğüs ağrısı başlangıcından hastaneye yatışa kadar geçen süre ve hastaların sosyodemografik ve klinik özellikleri sorgulandı. Ayrıca, hastalar ilk başvuruların yapıldığı merkeze göre iki grupta değerlendirildi: En yakın küçük bir klinik veya tıp merkezi (n=209, %47.6) veya doğrudan tam teşekküllü bir kardiyoloji merkezi (n=230, %52.4).

Bulgular: Ortanca ve ortalama gecikme süreleri sırasıyla 70 dk ve 185.2±334.8 dk bulundu. Semptomların başlangıcından sonra 60 dakika içinde hastaneye ulaşabilen hasta sayısı 136 (%31) idi. Ortanca gecikme süresi, ilk başvurunun bir kliniğe yapıldığı grupta anlamlı derecede uzun bulundu (120 dk ve 60 dk; p<0.001). Kadın cinsiyet, yaşın ≥55 olması ve dokuz yıldan az eğitim görmüş olmak hastaneye gelişin uzamasıyla ilişkili bulundu. Klinik özelliklerden ise, koroner arter hastalığı (KAH) varlığı, sigara içme, diyabetin olmaması süreyi kısaltıcı etki gösterdi. Çokdeğişkenli regresyon analizinde, dokuz yıldan az eğitim, kadın cinsiyet, yaşın ≥55 olması ve KAH öyküsü olmaması hastane öncesi gecikmenin bağımsız öngördürücüleriydi. Tam teşekküllü bir merkeze başvuruyu belirleyen etkenler şunlardı: İleri yaş, sigara içme, aspirin kullanımı ve KAH öyküsü olması. Çokdeğişkenli analizde, tek bağımsız öngördürücü KAH öyküsü olması idi.

Sonuç: Hastane öncesindeki ortanca 70 dakikalık gecikme Batı kaynaklı veriler ile örtüşmektedir. Miyokard infarktüsünde hastane öncesi gecikmeyi kısaltmak için yürütülen eğitim ve bilgilendirme çalışmalarında bu gecikmeyi artıran etkenlere ve hasta altgruplarına daha fazla önem verilmelidir.

Anahtar sözcükler: Miyokard infarktüsü; hasta kabulü; prognoz; zaman faktörü; hasta transportu.

Received: December 23, 2007 *Accepted:* February 26, 2008

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Coronary artery disease (CAD) is the most common cause of morbidity and mortality in Turkey and worldwide.[1-3] Being a life threatening manifestation of CAD, acute myocardial infarction (AMI) needs prompt recognition and management. Approximately one-third of deaths from AMI occurs within few hours of onset of symptoms and usually before the patients reach to hospital.[4] In the last decades, overall morbidity and mortality from AMI have declined due to developments in in-hospital treatment of MI (early use of aspirin, beta-blockers, angiotensin-converting enzyme inhibitors, reperfusion with thrombolytic agents, primary percutaneous coronary intervention, early surgery, etc.). However, delay between the time of onset of symptoms and the patient's arrival at the hospital is still a major problem contributing to morbidity and mortality. Moreover, reperfusion strategies in AMI are time-dependent and are most beneficial if applied within two hours from the onset of symptoms.[5-9] Therefore, prehospital delay decreases chance to establish reperfusion and improve survival.

Factors associated with prolonged prehospital delay in patients with AMI have been the subject of interest in various studies. Most of the studies have reported old age, female gender, solitary life, minority status, associated diseases such as diabetes and hypertension as factors associated with prolonged prehospital delay in the course of AMI.[10-20] However, the majority of these studies are concerned with western populations. Factors associated with prolonged prehospital delay might differ among populations due to diversity in ethnicity, culture, socioeconomic status, health care system organization, etc.[21-26] In Turkish health care system, emergency health care and ambulance transfers are free for everyone and patients with AMI can seek treatment at either a neighboring clinic/small hospital or a large hospital fully equipped with coronary care unit, catheterization laboratory, and operating rooms 24 hours a day, 7 days a week.

In the present study, we aimed to investigate factors associated with prolonged prehospital delay in patients with AMI in a single center study and compare the characteristics of AMI patients who initially presented to a neighborhood clinic/small hospital (clinic group) or to a hospital with continuous cardiac care (hospital group).

PATIENTS AND METHODS

Study population and protocol. We reviewed 581 consecutive patients who were admitted to coronary care unit of our institution with the diagnosis of acute ST-elevation myocardial infarction between September 2003 and August 2004. Of these, 498 patients were eligible and 439 patients (351 males, 88 females; mean age 57±12 years) agreed to participate in the study. The study protocol was approved by the Institutional Review Board of the hospital and all participants gave informed consent.

The patients were asked to participate in the investigation and if agreed, interviewed by two physicians (B.E. and E.T.) within 48 hours of hospitalization to derive information on the time from onset of chest pain to hospital admission and their sociodemographic and clinical characteristics. Patients were pain-free and hemodynamically stable at the time of interview. Data were also collected from hospital records of the patients where available.

Patients were also asked whether they first presented to a local clinic/hospital (clinic group) or directly to our hospital (hospital group), which is a tertiary cardiovascular center equipped with coronary care unit, catheterization laboratory, and operating rooms 24 hours a day, 7 days a week.

Exclusion criteria included myocardial infarction without chest pain, non-ST-elevation myocardial infarction, unstable angina pectoris, and patients who did not recall the exact time of the onset of chest pain and/or hospital/clinic admission, and those who could not understand and speak Turkish.

Study variables included age, gender, marital status, annual household income, number of children, presentation day, years of education, localization of AMI, previous history and family history of CAD, the presence of diabetes and hypertension, smoking status, alcohol use, and medications. Education level was categorized into two groups: <9 years and ≥9 years. Annual household income was categorized into two groups: <l5,000$ and ≥15,000$.

Definitions. The diagnosis of AMI was based on typical chest pain for at least 30 minutes, ST elevation of 0.2 mV or more in at least two contiguous electrocardiogram leads, and a confirmatory, at least two-fold elevation in serum creatine kinase-MB isoenzyme level. Prehospital delay was defined as the time interval from the onset of chest pain to the arrival at the hospital/local clinic. Diabetes mellitus was defined by the patient's account of diabetes history, use of insulin or hypoglycemic agents, or a fasting glucose ≥126 mg/dl. Hypertension was defined as a systolic pressure ≥140 mmHg or a diastolic pressure ≥90 mmHg on at least two separate occasions or prior use of anti-

hypertensive agents. Smoking was defined as current regular use (any amount). Alcohol consumption was defined as more than two drinks a week.

Statistical analysis. All analyses were carried out with the SPSS software (version 11.5). Data were expressed as frequency and percentage, mean ± standard deviation or median where appropriate. Because delay time was highly skewed, a logarithmic transformation was performed to obtain a normal distribution. This transformed value was used in all analyses. Values were then transformed back and reported in their original form for presentation. The association of sociodemographic and clinical characteristics of patients with prehospital delay times were evaluated with an independent t-test and the chi-square test. Multivariate logistic regression analysis was performed to identify predictors of prehospital delay and admission to a local clinic/hospital or a tertiary hospital. For all statistical analysis, significance was accepted at $p<0.05$.

RESULTS

Comparison of prehospital delay times by sociodemographic and clinical characteristics of the patients are presented in Table 1. The overall mean delay time was

Table 1. Comparison of prehospital delay times by sociodemographic and clinical characteristics

			Delay time (min)		
		n	Median	Mean±SD	*p*
Total		439	70.0	185.2±334.8	
Sociodemographic characteristics					
Sex (n=439)	Male	351	60.0	177.1±345.6	**0.003**
	Female	88	120.0	216.7±288.6	
Age (years) (n=399)	<55	184	60.0	140.2±219.0	**0.006**
	≥55	215	90.0	236.1±422.1	
Education (years) (n=439)	<9	297	90.0	190.5±325.8	**0.001**
	≥9	142	60.0	174.2±353.9	
Marital status (n=388)	Married	331	72.5	181.9±323.1	0.93
	Single/Divorced	57	60.0	203.1±315.3	
Household annual income (n=323)	<15,000$	247	60.0	190.9±359.7	0.94
	≥15,000$	76	75.0	201.2±363.7	
Number of children (n=371)	<3	243	70.0	186.2±326.5	0.87
	≥3	128	67.5	172.2±251.2	
Day of presentation (n=393)	Weekday	276	90.0	206.1±378.3	0.26
	Weekend	117	60.0	140.5±237.1	
Clinical characteristics					
Previous coronary artery disease (n=412)	Yes	97	60.0	164.5±376.4	**0.020**
	No	315	85.0	191.8±328.9	
Hypertension (n=408)	Yes	159	90.0	193.6±309.2	0.274
	No	249	60.0	170.7±318.4	
Diabetes (n=407)	Yes	84	90.0	184.3±215.8	**0.004**
	No	323	60.0	162.3±336.2	
Family history of coronary artery disease (n=409)	Yes	88	60.0	115.6±170.7	0.137
	No	321	75.0	205.4±372.8	
Current smoker (n=414)	Yes	243	60.0	163.2±275.8	**0.028**
	No	171	90.0	216.4±412.6	
Alcohol use (n=404)	Yes	84	60.0	153.8±276.4	0.136
	No	320	75.0	192.3±357.5	
History of aspirin use (n=412)	Yes	88	75.0	190.9±363.2	0.903
	No	324	60.0	184.1±334.4	
Beta-blocker use (n=412)	Yes	31	60.0	103.4±108.2	0.455
	No	381	75.0	192.2±351.8	
Localization of myocardial infarction (n=439)	Anterior	200	75.0	205.3±365.8	0.35
	Inferior	239	60.0	168.1±311.0	

185.2±334.8 min while the median delay time was 70 min. Of the study group, 136 patients (31%) arrived within 60 minutes after the onset of symptoms. Among sociodemographic characteristics, female sex, age ≥55 years, and total education time of less than nine years were associated with a longer prehospital delay (Table 1). Marital status, household annual income, number of children, localization of AMI, and day of presentation were not associated with prehospital delay.

Concerning clinical characteristics, prehospital delay was shorter in subjects with a history of CAD, in smokers, and in those without diabetes (Table 1). Hypertension, family history of CAD, use of alcohol, beta-blocker and aspirin use were not associated with prolonged prehospital delay.

In multivariate regression analysis, total education time of less than nine years, female sex, age ≥55 years, and absence of previous CAD were independent predictors of prolonged prehospital delay (Table 2).

Initial presentation after the onset of symptoms was made to a local clinic/hospital (clinic group) in 209 patients (47.6%) and to our hospital (hospital group) in 230 patients (52.4%). The former group had a significantly longer median delay time (120.0 min *vs* 60.0 min; p<0.001). Significant sociodemographic and clinical variables that increased hospital presentation included older age and higher frequencies of smoking, aspirin use, and previous CAD (Table 3). Multivariate analysis showed that, among these, only previous CAD was an independent predictor of direct hospital presentation (Table 4).

Table 2. Predictors of prolonged prehospital delay in multivariate logistic regression analysis

	Odds ratio	95% confidence interval	*p*
Education <9 years	2.27	1.42 - 3.60	**0.001**
Presence of diabetes	1.34	0.76 - 2.37	0.306
Marital status (Married)	1.64	0.81 - 3.31	0.165
Female sex	2.10	1.08 - 4.06	**0.028**
Age ≥55 years	1.77	1.10 - 2.85	**0.018**
Absence of previous coronary artery disease	1.79	1.07 - 3.02	**0.027**
Smoking	1.12	0.68 - 1.83	0.644

DISCUSSION

The present study investigated duration of prehospital delay, factors associated with prolonged prehospital delay, and characteristics of 439 patients with ST-elevation AMI who first sought care in a neighborhood clinic/small hospital or a fully equipped hospital with continuous cardiac care. Less than one-third of patients (31%) arrived to a medical center within 60 minutes after the onset of symptoms, and slightly more than half of the patients (52.4%) presented directly to a hospital with continuous cardiac care.

The duration between the onset of symptoms and the time at which the patient presents to a medical facility is among the major determinants of prognosis in AMI.[5-9] The median prehospital delay from symptom onset to hospital arrival ranges from 1.5 to 4 hours in western populations.[27-32] A median delay of 70 min in the present study is in accordance with the relevant data from western populations.

Table 3. Comparison of clinic and hospital groups in terms of sociodemographic and clinical characteristics

	No of patients	%	Clinic group (n=209)	Hospital group (n=230)	*p*
Sociodemographic characteristics					
Age (years)	439	100.0	54.4±12.3	59.0±10.8	**<0.001**
Male gender	351	79.9	168	183	0.633
Education (≥9 years)	142	32.3	71	71	0.538
Married	331 of 388	85.3	159 of 190	172 of 198	0.316
Household annual income (≥15000$)	76 of 323	23.5	38 of 157	38 of 166	0.794
Number of children (≥3)	128 of 371	34.5	60 of 182	68 of 189	0.584
Presentation at weekend	117 of 393	29.8	65 of 194	52 of 199	0.087
Clinical characteristics					
Previous coronary artery disease	97 of 412	23.5	33 of 202	64 of 210	**0.001**
Hypertension	159 of 408	39.0	69 of 200	90 of 208	0.067
Diabetes	84 of 407	20.6	42 of 200	42 of 207	0.937
Family history of coronary artery disease	88 of 409	21.5	50 of 205	38 of 204	0.148
Current smoker	243 of 414	58.7	131 of 202	112 of 212	**0.035**
Use of alcohol	84 of 404	20.8	45 of 201	39 of 203	0.392
History of aspirin use	88 of 412	21.4	33 of 203	55 of 209	**0.015**
Beta-blocker use	31 of 412	7.5	13 of 203	18 of 209	0.457
Anterior myocardial infarction	200	45.6	104 of 209	96 of 230	0.171

Table 4. Multivariate analysis of independent predictors of direct hospital presentation

	Odds ratio	95% confidence interval	*p*
Smoking	0.76	0.49 - 1.19	0.236
Aspirin use	1.27	0.72 - 2.24	0.402
Previous coronary artery disease	1.86	1.07 - 3.22	**0.027**
Age	0.78	0.50 - 1.21	0.282

Based on our results, female sex, age ≥55 years, and total education time of less than nine years were associated with a longer prehospital delay, as previously reported in several studies.[20,33-35] Female sex seemed to affect prolonged prehospital delay in two ways, in that both the mean delay time and the mean age (63.6±11.1 years *vs* 55.0±11.3 years, p<0.001) were greater in female patients.

Some studies reported that single, divorced, or widow patients exhibited longer prehospital delays;[15,17,25] however, marital status was not associated with prehospital delay in our study. Similarly, in contrast to some reports,[26,35] household annual income had no influence on prehospital delay in our study, which might be attributed to the fact that emergency medical care including ambulance transfer is free in our country regardless of the social security status of the patient. The number of children, localization of AMI, and day of presentation (weekday *vs* weekend) were not associated with prehospital delay, either.

In contrast to some previous reports,[18,36,37] subjects having a history of CAD exhibited a shorter prehospital delay. Prior knowledge, clinical experience, and medical counseling probably enhanced these patients' awareness to AMI symptoms. Diabetes was expectably associated with prolonged prehospital delay. Why smoking was associated with a shorter prehospital delay might again be explained by the higher incidence of previous CAD in these patients. On the other hand, hypertension, family history of CAD, use of alcohol, medications such as beta-blocker and aspirin were not associated with prehospital delay, even though almost all these factors are known to somewhat exist in patients with a history of CAD.

Multivariate analysis showed that total education time of less than nine years, female sex, age ≥55 years, and absence of previous CAD were independent predictors of prolonged prehospital delay, suggesting that more emphasis be placed on the education of these patient subgroups in order to reduce prehospital delay in AMI.

In our study, patients with a history of CAD, those taking aspirin, smokers, and those at older ages tended to present directly to a hospital equipped with continuos cardiac care rather than to a neighboring clinic/local hospital. In multivariate analysis, only history of CAD was an independent predictor of direct hospital arrival.

The median delay time was significantly longer in patients who initially presented to a neighboring clinic/local hospital, compared to those who directly presented to a hospital fully equipped with continuos cardiac care (120.0 *vs* 60.0 min respectively, p<0.001). Initial presentation to a neighboring clinic/local hospital may lead to underutilization of reperfusion strategies, resulting in increased morbidity and mortality.[5-9,26] The results of the present study may justify the need for directly transferring patients with the signs and symptoms of AMI to a hospital equipped with coronary care unit, catheterization laboratory, rather than to a neighboring clinic/local hospital. However, this should be substantiated with the results of randomized, multicenter trials.

Despite ongoing national and international public education campaigns to shorten prehospital delay and promote early application of reperfusion strategies during AMI, the median delay time is considerably longer than the recommended limits even in western populations. Education of emergency medical personnel and transfer of the patients directly to a fully equipped hospital where available might also help shorten prehospital delay.

Study limitations. Our study has several limitations. Firstly, we studied a relatively small sample of patients with AMI, who initially presented to a clinic or hospital. Patients who did not seek treatment or died before arriving at a hospital were not included in the study. Secondly, we were not able to include data from patients who were hemodynamically unstable during the interview period, which would somewhat alter our results. Thus, our results are limited to those who survived and were hemodynamically stable during the interview period. Thirdly, although our institution is a high-volume center, the results reflect the data of a single center, which makes it difficult to draw conclusions about the general Turkish population. Thus, our results need to be verified with multicenter registries. Finally, our study did not focus on the perceptions of symptoms by the patients, or on their behaviors concerning seeking treatment, but rather, investigated sociodemographic and clinical characteristics of the patients associated with prolonged prehospital delay.

The present study investigated prehospital delay, factors associated with prolonged prehospital delay, and characteristics of 439 patients with ST-elevation AMI, who first sought care in a neighborhood clinic/small hospital or a hospital with continuous cardiac care. To our knowledge, this is the first study to investigate these issues in the Turkish population, which is a representative population of a wide geographic region covering Eastern Europe, Western Asia, and the Middle East. Less than one-third of the patients (31%) presented to a medical center within 60 minutes after the onset of symptoms, and slightly more than half of the patients (52.4%) presented directly to a hospital with continuous cardiac care. The median delay time of 70 min found in this study is comparable to that reported for western populations. These findings suggest that public education campaigns to shorten prehospital delay should continue, with more focus on patient subgroups that exhibit prolonged prehospital delay.

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