

Pre-hospital Delay in Treatment after Acute Myocardial Infarction

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Significance of the study. Acute myocardial infarction (AMI) is a major cause of death. Most of the deaths from AMI, if diagnosed and treated early enough, can be prevented. Delay in treatment may cause unnecessary exacerbation of the disease and even death in AMI patients.

Purpose of the study. A retrospective survey was conducted to (1) investigate the delay time in AMI patients' seeking treatment from symptom onset to arrival at the first hospital (overall pre-hospital delay), the length of time taken for decision-making (patients' delay) and transport (transportation time); (2) to identify factors associated with delay times; (3) to compare delay times between the group who called 119 and the group who did not.

Results. The mean of overall pre-hospital delay time was 17.42 (± 24.03) hours and it was consisted of patients' delay, 17.07 (± 24.45), and transportation time, .84 (± 2.34). None of socio-demographic variables such as age, sex, marital status, monthly income, education, and living environment was associated with either the patients' delay or the overall delay time. Living rural area ($F=4.483, p=.016$), having previous MI ($F=35.252, p=.000$), and other heart disease ($F=69.435, p=.000$) decreased transportation time; having previous heart disease decreased overall pre-hospital delay ($F=4.489, p=.039$); and having angina ($F=92.907, p=.000$) and CAD ($F=9.724, p=.003$) increased transportation time. Place of symptom attack, bystander, whether patients or bystander called 119, modes of transportation, intensity of pain, presence of typical chest pain and anxiety perceived by patients were not associated with any of delay times. No significant differences appeared between the group who called 119 and the group who did not in any of delay times.

Conclusion and suggestions. Although number of patients who arrive at the hospital early enough for treatment tend to be increasing, considerable number of patients still delayed longer than desired when they experienced symptoms of AMI, and calling 119 did not diminish this delay because patients delayed mostly before they decided to call. Living urban area, having previous MI, and heart disease decreased transportation time whereas having previous heart disease decreased the overall pre-hospital delay time and having previous angina and CAD increased transportation time. Further studies to identify reasons for real late arrivals as well as public campaigns to reduce delay time in treatment are needed.

Key Words: Acute myocardial infarction (AMI); Pre-hospital delay; Response to symptoms

INTRODUCTION

AMI is a leading cause of death in Korea and many

other industrialized countries (AHA, 1999; Korea National Statistical Office, 1999; NIH, 1998). The incidence of ischemic heart disease, including AMI, has doubled twice in the last decade and the incidence of death

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due to these diseases has increased more than six times during same period (Korea National Statistical Office, 1999). Due to the rapid process of the disease, AMI has to be treated immediately and intensively; and delay in treatment may result in irreversible necrosis of the myocardium, fatal damage of the heart and a sudden death.

Delay in diagnosis and treatment are sometimes caused by patients' delay in seeking treatment (Holmberg, Holmberg, & Herlitz, 1999). Many studies have been conducted in the US and the European countries to investigate the delay time of patients in seeking treatment after AMI and to identify the factors associated with this delay (Dracup & Moser, 1991; Dracup & Moser, 1997; Dracup et al., 1995; Herlitz, et al., 1992; Schwartz, Schoberberger, Rieder and Kunze, 1994). Older Age, female sex, low socioeconomic status, history of angina or diabetes, family member as witness, self-treatment, failure to perceive or recognize symptoms as cardiac in origin, consultation with a physician and low somatic or emotional awareness are characteristics of patients who tend to delay (Dracup et al, 1995). Cognitive and emotional responses affect patients' decision to seek treatment whereas severity, nature, and knowledge of symptoms are not related to delay (Dracup & Moser, 1997). Degree of anxiety and fear perceived by patient was positively associated with an earlier decision and presence of typical symptoms and history of AMI decreased delay time (Schwartz, Schoberberger, Rieder and Kunze, 1994). Based on these findings, some groups have mobilized public campaigns to decrease this delay time, especially focused on the people in high risk (Herlitz, et al., 1989; Ho, Eisenberg & Litwin, 1989; Oude-Ophuis, et al., 1999). The value of these public campaigns is still controversial and long-term studies on their value are still pending.

However, there is a lack of data in the Korean population regarding delay in treatment after AMI and many health care professionals are concerned about this delay and its negative consequences for Koreans. Available data regarding pre-hospital delay after symptom onset and the factors associated with this delay time among Koreans are not sufficient to be conclusive and far more studies are needed. Additionally, at 'which stage' the patients delay, and 'how long they delay needs to be studied.

OBJECTIVES

The purpose of the study was to investigate the pre-hospital delay time in seeking treatment after AMI symptom onset, and to identify factors associated with delay. The findings from this study will provide basic data that support future intervention to reduce delay time in seeking treatment, thus increase the survival rate among AMI patients. Specific aims of this study were as follows:

(1) Describe the delay time in AMI patients seeking treatment from symptom onset to arrival at the first hospital (overall pre-hospital delay), the length of time taken for decision-making (patients' delay) and transport (transportation time).

(2) Examine effects of various factors on delay time. These factors included socio demographic factors such as age, sex, marital status, monthly income, living environment and education; health history such as history of hypertension, diabetes mellitus, smoking, history of angina or MI, history of other heart disease, history of coronary artery disease; circumstantial factors such as place of symptoms attack, bystander, calling 119, mode of transportation; and symptom related factors such as presence of typical chest pain, pain intensity; and the degree of anxiety perceived by patient.

(3) Compare the delay time due to patients-related factors, transportation time, and the overall pre-hospital delay time between the group who called 119 and the group who did not.

DEFINITION OF TERMS

(1) Pre-hospital delay (in hours): delay time from symptom onset to arrival at the first hospital

(2) Patients' delay (delay time due to patient-related factors') (in hours): delay time from symptom onset to calling 119 (if the patient called 119), or from symptom onset to departure for the hospital (if the patient did not call 119).

(3) Transportation time (in hours): time taken from departure from the place where patients decided to go to the hospital to arrival at the first hospital

LITERATURE REVIEW

AMI is a major cause of death in Korea (National

Statistical Office, 1999). Known as 'heart attack', AMI often causes sudden death to the victims. Because of the rapid progress of the disease, early mortality rate of AMI is high. Although there are some discrepancies among statistical reports, approximately 50% of patients die before they arrive at the hospital; and the mortality rate for patients in one hour and 24 hours after an attack can reach 68% and 85%, respectively (National Statistical Office, 1999). Therefore, to save patients' lives and to minimize the infarct size, which later on crucially influences on the prognosis of the disease, AMI has to be diagnosed and treated immediately and intensively (Berger et al., 1999; Carton, Jaison, & David, 1999; Deswood, Spores, & Notske, 1980; Edhouse, Wardrope & Morris, 1999; George, Hunsberger, Savitha, & Pais, 1999).

Fortunately, early mortality of AMI patients has been gradually decreasing over the last few decades, owing to the development of emergency care and intensive care techniques (AHA, 1999; Kannal, Sorlie & McNamara, 1979; Kereiakes, et al., 1992; Mayer, 1984). By using thrombolytic therapy, more people are surviving without surgical intervention (Kelion, Banning, Shahi, & Bell, 1998; McAleer, et al., 1992; GISSI, 1986). Thrombolytics are a group of drugs that resolve the blood clots and open up the clogged coronary arteries that has blocked blood supply to the myocardium and has caused myocardial ischemia. However, for the successful treatment of thrombolytic therapy, patients have to arrive at the hospital soon enough to fit into the "time window" of optimal thrombolytic treatment before the myocardial damage become irreversible and fatal (Boersma, Mass, Deckers & Simons 1996; GISSI, 1986; Goldberg, et al., 1992; Gonzalez, et al., 1992; Leizorovicz, Boissel & Robert, 199). If the thrombolytic therapy can be initiated within one hour after symptom onset, the mortality rate can be reduced about 45.8%. The mortality rate is reduced only 15% when thrombolytic therapy is begun 2-6 hours after symptom onset (GISSI, 1986). Along with the recognition of importance of early treatment in mortality reduction and improving prognosis after AMI, health care professionals and researchers are putting more effort into public campaign in order to reduce delay time (Herlitz, et al., 1989; Mitiz & Perkins, 1984) and conducting research to discover vulnerable population groups.

Several studies describe delay time from symptom onset to treatment among Korean AMI patients. Kim and Kim(1999) reported that the time from symptom onset

to treatment was 6.39 (SD 10.80) hours; that time includes 4.74(SD 9.87) hours for transportation from the first hospital to the hospital where patients received treatment. People with higher education seek treatment earlier than those with lower education. Additionally, people who experienced nausea and/or dyspnea with AMI showed shorter delay in treatment. Park, Kim, Lee and Lee (2000) reported that the mean time taken from the symptom onset to the arrival at the first hospital was 94.6min (=1.57 hours). Specifically patients who had typical chest pain seek hospital earlier than patients who had atypical symptoms of AMI. Therefore, the time from symptom onset to the first hospital at least seems to be getting shorter. However, in other study conducted by Song (1997), the mean pre-hospital delay was 393.4 minutes (6.56hours), and 53.7% of patients presented at the hospital after more than 4 hours since the symptom started. Yoo and colleagues (1995) classified the delay time from the symptom onset to the treatment into two parts: time delayed prior to hospital arrival and door to reperfusion time. They reported the delay time from symptom to the arrival at the hospital as 555(551 minutes (9.25hours). Sixty four (46%) patients arrived at the hospital within 6hours after symptom onset and 70 (54%) patients arrived later than 6 hours. Among these, only 20 patients (14%) arrived at the emergency department within 3hours after symptom onset. The mean of delay time from hospital arrival to the thrombolytic therapy was 62 minutes (Yoo, et al., 1995).

The differences in delay time among these several studies may be due to the definition of delay, onset of symptom(s), location where the data gathered, and the way of measuring it. The wide gap in delay time makes it difficult to draw any coherent conclusion, and providing a reliable data and generalization of findings are limited. Therefore, studies are needed to investigate the overall pre-hospital delay, specific delay time due to patients' decision making, time taken for the transportation to the hospital, and to identify factors associated with these delay. Additionally whether calling 119 can reduce the pre-hospital delay and how much time the patients can save need to be examined.

METHODS

1. Research Design

A retrospective and descriptive survey was conducted. A multi-center design was selected to obtain enough

number of subjects.

2. Subjects

Included were 63 patients 1) who were admitted to one of three target hospitals in Pusan, Korea between July 1st, 2000 and September 31st, 2000, 2) who met electrocardiographic criteria for AMI(>2 m ST elevation in at least two contiguous precordial leads), 3) who had no contra indications for interview and 4) who agreed to participate in this study.

Exclusion criteria were 1) who had myocardial infarction secondary to any diagnostic and treatment procedures, and delivery; 2) who were under ventilator or had any other complications diagnosed by a physician; 3) who had cognitive impairment that might affect the reliability of data.

3. Methods

Structured interview using the “response to symptoms questionnaire” and medical record review were conducted after the informed consents were granted for data collection. “Response to symptoms questionnaire” contained information about socio demographic variables, health history of patients, times for each events, information about circumstantial factors and pain-related factors. In specific, socio demographic data included age, sex, marital status, monthly income, education and living environment; health history included history of hypertension, diabetes mellitus, smoking, previous history of angina/AMI, other heart disease, and previous history of coronary artery disease. Circumstantial factors included place of symptom attack, who was with the patients (bystander), whether the patients or a bystander called 119, and the mode of transportation. Time of first recognition of symptom, time of calling 119 for the group who called 119, time of departure for the hospital, and the time of arrival at the first hospital were obtained. Based on these times for each event, patients’ delay, transportation time and overall pre-hospital delay time were calculated using SPSS. Pain related factors included the intensity of pain, presence of a typical chest pain and the anxiety perceived by patients. Intensity of pain was assessed using self-reported 0-10 scale: 0 means no pain at all and 10 means the worst pain ever experienced. Anxiety was assessed using 1 to 5 Likert-scale: 1 represented not anxious at all; 2 represented rarely anxious; 3 represented little bit anxious; 4 represented anxious; 5 represented extremely anxious.

To validate the data about socio-demographic variables; health history; circumstantial factors; and times of symptom onset, departure, and arrival, both patients and family members were interviewed when it was available. To validate the data about the time of arrival at the hospital, the time stated by patients/ family members were verified by the time on emergency room records.

“Chart review forms” included the time of patients’ arrival at the hospital, major symptoms of patient when they first arrived at the emergency room, mode of arrival, and major treatment.

4. Data analysis

To describe the socio-demographic characteristics and delay time, descriptive statistics were used. Univariate analyses of variance using the General Linear Model were performed to identify factors associated with delay times. Patients’ delay, transportation time, and overall pre-hospital delay were used as dependent variables. Factors and covariates that potentially associated with dependent variables were conceptually classified into four groups: socio-demographic variables, comorbidities and health histories, circumstantial factors, and pain related factors. To test the significance of associations between each group of factors and each dependent variable, separate univariate analyses of variance were conducted. When the association between any of factors and dependent variables was found significant, post-hoc comparisons were conducted to identify specific differences between groups.

To compare the patients’ delay, transportation time and overall pre-hospital delay time between the group who called 119 and the group who did not, independent t-tests were conducted.

For the statistical analysis, SPSS-Window for PC 10.0 was used.

RESULTS

1. Descriptive statistics: delay times

Sixty-three AMI patients including 47 men and 16 women participated in this study. Socio-demographic characteristics of these subjects are shown in Table 1. The mean overall pre-hospital delay time was 17.42 (\pm 24.03) hours. Mean of the patients’ delay was 17.02 (\pm 24.45) hours and the transportation time was .84 (\pm 2.34) hours.

Fifteen patients (25%) arrived at the first hospital

within one hour; another 15(50% cumulative), and the next 15 (75% cumulative) subjects arrived at the first hospital within 5.25 hours and 25.54 hours, respectively. Twenty six (41.9%) subjects arrived at the first hospital within 3 hours.

Additionally, when the subjects were divided into four groups (quartile) by the pre-hospital delay time, means of the pre-hospital delay time for each quartile showed a great disparity (Figure 1). The mean of pre-hospital delay time by the first 25% patients were $.50 (\pm .16)$ hours. The second 25% of patients delayed $1.96 (\pm 1.17)$, the third delayed $11.32 (\pm 6.35)$ and the last 25% delayed 50.72 ± 21.99 hours.

2. Factors associated with overall pre-hospital delay, patients' delay, and transportation time

Univariate analyses of variance using the General Linear Model were conducted to identify factors and as-

sociated with the overall pre-hospital delay, patients' delay, and transportation time. First, socio-demographic variables such as age, sex, marital status, monthly income, education and living environment were put into the model to examine the association between these factors and the overall pre-hospital delay time, patients' delay, and transportation time as separate dependent variables. None of socio-demographic variables were associated with either the patients' delay or the overall pre-hospital delay time (Table 2). However, living environment was significantly associated with the transportation time ($F=4.483$, $p=.016$) (Table 2): People lived in rural area took longer (3.17 ± 6.54 hours) than those who lived in suburban ($.74 \pm .53$ hours) and urban area ($.47 \pm .34$ hours) for transportation to the hospital.

Among health history variables, such as diabetes, hypertension, smoking, previous MI, previous angina, histories of other heart disease and CAD, history of previ-

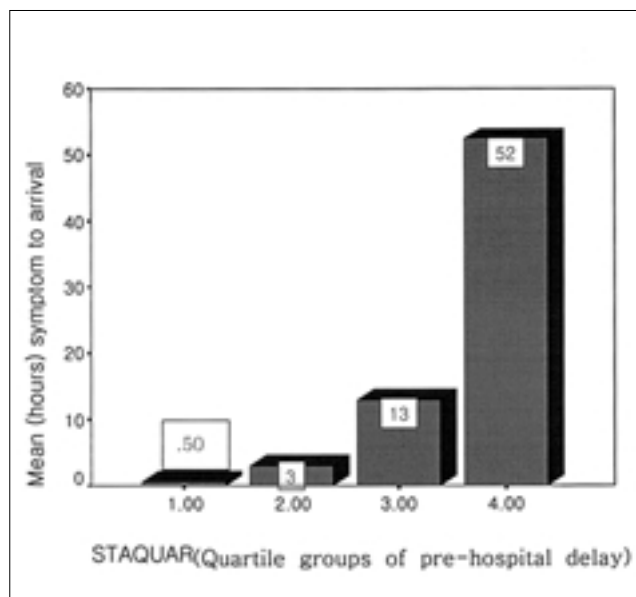


Figure 1. Comparison of pre-hospital delay by quartiles.

Table 1. Socio-demographic characteristics of subjects (N=63)

Characteristics		Frequency (%)
Sex	Male	47 (74.6)
	Female	16 (25.4)
Marital status	Married	59 (93.7)
	Single	3 (4.8)
	Divorced	1 (1.6)
Monthly income ($\times 10,000$ won)	Less than 50	17 (27.0)
	50 or more, less than 100	11 (17.5)
	100 or more, less than 200	16 (25.4)
	200 or more, less than 300	7 (11.1)
	300 or more, less than 400	4 (6.3)
	400 or more	6 (9.5)
Living environment	Not responded	2 (3.2)
	Rural	7 (11.1)
	Urban	49 (77.8)
	Suburban	7 (11.1)
		Mean \pm SD
Age (years)		61.62 \pm 11.25
Education (years)		9.89 \pm 15.00

Table 2. Effect of socio-demographic variables on patients' delay, transportation time, and overall pre-hospital delay times (N=63)

Source	Patients' delay			Transportation time			Overall pre-hospital delay		
	X ²	F	P	X ²	F	P	X ²	F	P
Sex	40.538	.057	.813	2.963	.630	.433	149.298	.228	.635
Marital status	69.446	.097	.908	.114	.024	.976	46.371	.071	.932
Income	165.097	.231	.947	2.205	.469	.797	283.376	.432	.824
Environment	54.234	.076	.927	22.989	4.890	.014*	205.849	.315	.731
Age	395.784	.553	.461	2.396	.005	.944	255.238	.390	.535
Education	1.546	.002	.963	1.164	.247	.622	14.172	.022	.884

*Significant on .05 level

ous heart disease was significantly associated with the overall pre-hospital delay ($F=4.489, p=.039$) (Table 3): people who had previous heart disease delayed shorter than those who did not (14.07 ± 24.44 vs. 16.07 ± 22.49 hours). Previous MI ($F=35.252, p=.000$), previous angina ($F=92.907, p=.000$), previous heart disease ($F=69.435, p=.000$), and previous CAD ($F=9.724, p=.003$) was significantly associated with transportation time (Table 4). Transportation took shorter for people who had previous MI ($.70 \pm .38$ vs. $.85 \pm 2.43$ hours) and other heart disease ($.69 \pm .36$ vs. $.87 \pm 2.58$) while it took longer for people who previously experienced angina (3.10 ± 6.57 vs. $.51 \pm .38$) or CAD ($.87 \pm .54$ vs. $.84 \pm 2.43$) than those who did not have these diseases. None of health history variables was significantly associated with the patients' delay time.

Univariate ANOVA were conducted to examine the effects of circumstantial factors such as where and with whom the patients' were when the symptoms of AMI appeared, whether the patients or bystander called 119, and mode of transportation on delay times. None of these factors was significantly associated with the overall pre-hospital delay time (Table 5). Neither the patients' delay nor transportation time was associated with the circumstantial factors (Table 6).

Lastly, associations between symptom related factors, such as whether a typical chest pain was presented, pain intensity, and anxiety perceived by patients, and delay times as dependent variables were examined. None of these variables was associated with the overall pre-hospital delay time (Table 7). None of pain related factors was associated with neither the patients' delay nor the trans-

Table 3. Effects of health history on overall pre-hospital delay time

Source	Frequency (%)	Mean \pm SD	X ²	F	P
Hypertension (n = 62)	Yes	22(35.4)	717.791	1.556	.218
	No	40(64.5)			
Diabetes (n = 62)	Yes	17(27.4)	61.175	.133	.707
	No	45(72.6)			
Smoker (n = 61)	yes	38(62.3)	58.195	.126	.724
	No	23(37.7)			
Previous MI (n = 61)	Yes	3(4.9)	306.644	.665	.419
	No	58(95.1)			
Previous angina (n = 61)	Yes	8(13.1)	1441.249	3.121	.083
	No	53(86.9)			
Previous heart disease (n = 61)	Yes	10(16.4)	2071.479	4.489	.039*
	No	51(83.6)			
Previous CAD (n = 61)	Yes	3(4.9)	15.744	.034	.854
	No	58(95.1)			

*Significant on .05 level

Table 4. Effects of health history on transportation time

Source	Health history	Mean \pm SD	X ²	F	P
Hypertension (n = 57)	Yes	20	1.362	.662	.420
	No	37			
Diabetes (n = 57)	Yes	15	1.310	.637	.429
	No	42			
Smoking (n = 56)	Yes	35	.767	.373	.544
	No	21			
Previous MI (n = 56)	Yes	3	72.463	35.252	.000*
	No	53			
Previous Angina (n = 56)	Yes	7	190.978	92.907	.000*
	No	49			
Previous heart disease (n = 56)	Yes	9	142.729	69.435	.000*
	No	47			
Previous CAD (n = 56)	Yes	3	19.988	9.724	.003*
	No	53			

*Significant on .01 level

Table 5. Effects of circumstantial variables on pre-hospital delay time

Source		Frequency (%)	Mean \pm SD	X ²	F	P
Place (n = 62)	Home	33(54.1)	21.58 \pm 23.68	965.936	1.916	.099
	Work	13(21.0)	3.50 \pm 5.76			
	Car/subway	2(3.2)	5.50 \pm 7.07			
	Friends/relatives'	1(1.6)	64.00			
	Public place	6(9.7)	25.39 \pm 40.86			
	Others	7(11.3)				
Bystander (n = 62)	Alone	15(24.2)	12.48 \pm 21.83	598.042	1.082	.333
	Spouse or partner	25(40.3)	25.02 \pm 27.46			
	Other family member(s)	10(16.1)	19.08 \pm 22.50			
	Friend(s)	3(4.8)	.75 \pm .25			
	Colleague at work	8(12.9)	2.65 \pm 2.66			
	Other(s)	1(1.6)	5.67			
Calling 119 (n = 62)	Yes	16(25.8)	14.18 \pm 23.22	255.024	.504	.481
	No	46(74.2)	17.52 \pm 23.89			
Mode of transportation (n = 61)	Private car	25(41.0)	20.83 \pm 25.67	220.352	.435	.729
	Ambulance	18(29.5)	12.87 \pm 22.17			
	Public transportation	15(24.6)	14.78 \pm 23.29			
	Others	3(4.9)	19.06 \pm 23.69			

Table 6. Effects of circumstantial factors on patients' delay time and transportation time

Source	Patients' delay time			Transportation time		
	X ²	F	P	X ²	F	P
Place (n = 62)	1017.452	1.888	.107	1.421	.211	.971
By stander (n = 62)	507.885	.942	.465	2.030	.302	.909
Calling 119 (n = 62)	325.137	.603	.442	.829	.123	.727
Mode of transportation (n = 61)	255.826	.475	.702	6.823	1.016	.396

Table 7. Effects of pain-related factors on pre-hospital delay time

		Mean \pm SD	X ²	F	P
Presence of typical chest pain (n = 62)	Yes (n = 48)	17.87 \pm 25.18	207.432	.353	.555
	No (n = 14)	12.49 \pm 17.05			
Pain intensity (n = 63)	Mean \pm SD	8.95 \pm 7.26	38.008	.065	.800
Anxiety perceived by patients (n = 63)	mean \pm SD	3.28 \pm 1.58	331.402	.563	.690

Table 8. Effects of pain-related factors on patients' delay time and transportation time

Source	Patients' delay time			Transportation time		
	X ²	F	P	X ²	F	P
Presence of typical chest pain (n = 62)	148.324	.244	.624	1.497	.262	.611
Pain intensity (n = 63)	106.487	.175	.677	.105	.018	.893
Anxiety perceived by patients (n = 63)	197.384	.324	.571	8.006	1.402	.242

Table 9. Comparison of Pre-hospital Delay Times between group called 119 and didn't call (N = 62)

Delay times (hours)	Called 119 (n = 16)	Didn't Call 119 (n = 40)	Total (N = 56)	T	P
Patients' delay time	13.62 \pm 23.30	17.03 \pm 24.45	17.02 \pm 24.45	.713	.479
Transportation time	.56 \pm .40	.94 \pm 2.75	.84 \pm 2.34	.544	.588
Overall Pre-hospital delay	14.18 \pm 23.22	17.52 \pm 23.89	17.42 \pm 24.03	.484	.630

portation times (Table 8).

3. Comparison between groups who called 119 and who did not

There was no significant difference between the group who called 119 and the group who did not in the overall pre-hospital delay time (14.18 ± 23.22 vs. 17.52 ± 23.89 hours) [$t(60) = .484$, $p = .630$], in the patients' delay (13.62 ± 23.30 vs. 17.03 ± 24.45 hours) [$t(54) = .713$, $p = .479$], and in the transportation time ($.94 \pm 2.75$ vs. $.56 \pm .40$ hours) [$t(55) = .544$, $p = .588$] (Table 9).

Transportation time included the time from calling 119 to arrival of the emergency vehicle at the place of attack, $7.86 (\pm 4.50)$ minutes, ranging from 3 to 20 minutes, and the time from departure from the scene to arrival at the hospital $23.75 (\pm 22.40)$ minutes, ranging from 5 to 85 minutes. In the group who did not call 119, transportation delay was defined as the time from departure from the scene to the arrival at the first hospital; the mean of transportation time in this group was $.94 (\pm 2.75)$ hours.

DISCUSSION

The mean of the overall pre-hospital delay in this study, 17.42 hours, was longer than recommended for optimal thrombolytic therapy. It was also longer than delay times reported in previous studies: Yoo et al. (1995) reported that the mean delay time was 555 ± 551 minutes (9.25 hours) in 138 AMI patients; Song (1999) reported 6.56, and Kim & Kim (1999) reported 6.39 hours as a mean of the pre-hospital delay time in AMI patients.

The possible reasons for the longer delay time in this study were: (1) effect of extreme cases; (2) longer delay time by patients; (3) longer transportation time; and (4) older age of the subjects. The longer delay time in this study seems mostly due to the large number of late arrivals. As shown in the Figure 1, the last 25% of patients arrived at hospital for treatment very late; and that raised the overall mean of delay time for the whole group. Pre-hospital delay time by the last 25% of subjects ranged from 25 to 101.58 hours and the mean was 50.72 ± 21.99 hours. When the last 25% of subjects were excluded, the mean of overall pre-hospital delay decreased to $4.90 (\pm 6.15)$ hours; the mean of patients' delay decreased to $4.83 (\pm 6.42)$ hours; and the transportation time decreased to $.55 (\pm .38)$ hours.

Patients' delay accounted for 65% of overall pre-hospital delay time in Kim & Kim (1999), 74.2% in Park et al (1999), and 67% in Song (1999)'s study. Given that the patients' delay time accounted for 97% of the overall pre-hospital delay time in this study, patients took a longer time to recognize their symptoms and make decisions to go to the hospital than patients in other studies.

Given that transportation took longer in this study than a previous study (Park et al., 2000) (30.68 minutes vs. 16.1 minutes) and that calling 119 did not significantly decrease either the overall pre-hospital delay time or the transportation time, longer transportation time contributed to the longer delay time in this study.

The mean age of 62 years in this study was higher than previous studies: The mean age of subjects was 55.9 and 57.8 years for the group who did not have reperfusion therapy and the group who did not, respectively, in Yoo (1995)'s study. The mean age was 55 years in Kim and Kim (1999). In other studies in that age were listed as categorical variable, 34% of subjects were 60 or older (Park et al, 2000) and 46% of subjects were 60 or older in Song's study (1999). Findings from several studies conducted as nation wide survey consistently suggested that old age was associated with the pre-hospital delay time (Dracup et al., 1995; Dracup & Moser, 1997; Schmidt et al., 1990). Therefore, the older age in this study might affect the longer delay comparing to other studies.

Although the means of overall pre-hospital delay time in this study was longer than previous studies, the proportions of early arrivals in this study were similar to previous studies. 26(41.9%) of the subjects arrived at the first hospital within 3 hours after symptom onset in this study. Among these, 25% of the subjects arrived at the first hospital within one hour. In a study by Song (1999), 44.6% of subject arrived at the first hospital within 4 hours after symptom onset. Among these, 26% of subjects arrived at the first hospital within one hour.

This study did not identify any significant associations between differences in pre-hospital delay time and any socio-demographic variables. Only living environment was significantly associated with transportation time: The longer transportation time for people living in rural area comparing to people living in urban and suburban area may suggest that emergency transportation services may be improved for the rural area. People who had previous heart disease took shorter time in overall pre-hospital delay. History of previous MI and heart disease also

decreased transportation time, whereas history of previous angina and CAD increased transportation delay. The opposite effects of previous disease may indicate that experience of disease may not necessarily be helpful to decrease the delay time in next attack.

Not finding significant associations between the delay time and socio-demographic variables, circumstantial variables, and pain related factors may suggest that there are other reasons for delay other than these factors. Patients' appraisal of seriousness of symptoms, for example, may more affect the decision making time, whereas intensity of pain itself and the presence of chest pain were not associated with the delay time. Therefore, cognitive responses rather than presence of symptoms may affect patients' decision to seek treatment.

CONCLUSIONS AND RECOMMENDATIONS

Findings from this study can be summarized as follows:

1. The mean of overall pre-hospital delay time was 17.42 (± 24.03) hours, longer than those reported in previous studies. Patients' delay accounted for most of the pre-hospital delay (97%), and the mean of patients' delay was 17.07 (± 24.45) hours. Transportation took .84 (± 2.34) hours and that was longer than previous studies.

2. People living in rural area took longer for transportation when they experience an AMI ($F=4.483$, $p=.016$); previous heart disease decreased overall pre-hospital delay time ($F=4.489$, $p=.039$); previous MI ($F=35.252$, $p=.000$) and other heart disease ($F=69.435$, $p=.000$) decreased transportation time, and previous angina ($F=92.907$, $p=.000$) and CAD ($F=9.724$, $p=.003$) increased transportation time.

3. There were no significant differences in either overall pre-hospital delay time [$t(60)=.484$, $p=.630$], patients' delay [$t(54)=.713$, $p=.479$], or in the transportation delay time [$t(55)=.544$, $p=.588$] between the group who called 119 and the group who did not call 119.

Findings of this study may suggest followings: (1) Nation wide survey study is needed to identify the actual delay time from the symptom onset to the treatment and the associations between the length of delay time and prognosis in AMI patients; (2) Studies to identify other factors, such as cognitive and emotional response to the symptoms, associated with the delay time, reasons for delay in seeking treatment-particularly in people who delay real long time, and in-hospital delay time in

AMI patients are needed; (3) Public campaigns to reduce patients' delay are urgently needed as well as societal efforts to decrease the transportation delay time and to improve the quality of emergency service available. Teaching symptoms of AMI to high-risk-population may increase their capability to recognize their symptoms that urge them to go to the hospital early enough for the optimal thrombolytic therapy. Public campaigns using mass media may be another efficient way to encourage people to do their roles as a bystander when they recognize others having symptoms of an AMI. In addition, public campaign may motivate drivers to give ways to the emergency vehicle and may decrease the transportation time thus increase the number of survivals.

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