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Factors Affecting Time to Presentation in ST-Elevation Myocardial Infarction (FAT STEMI)

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Abstract

Introduction: Advancements in ST-Elevation Myocardial Infarction (STEMI) management have led to improved outcomes and decreased mortality in recent decades. A critical factor in this improvement was developing hospital systems to decrease emergency room door to cath lab balloon times of less than 90 minutes. Continued efforts to decrease total ischemic time by reducing time to presentation are an area for further improvement. Identifying factors that affect the time from the onset of symptoms to presentation can provide hospital systems additional opportunities to improve outcomes of STEMI patients.

Methods: Utilizing a single center, retrospective chart review, 604 STEMI activations were identified. After false activations were excluded, the remaining 529 patient cases were analyzed for various factors and variables affecting the time to presentation (TTP), including age, mode of transportation, race, language, and diabetic status.

Results: The variables found to be statistically significant with their effect on time to presentation to the hospital included race (p=0.024), mode of transportation (p=0.021), and diabetic status (p=0.0054). Additionally for every unit increase in Hgb A1c, TTP increased 1.12 minutes (R2=0.49). Time to presentation showed no statistically significant difference based on age (p=0.60), sex (p=0.15), ethnicity (p=0.46), language (p=0.20) or religion (p=0.15).

Conclusions: Mode of transportation, race, and diabetes status had a significant impact on the time from the onset of symptoms to presentation in patients with STEMI. The use of EMS decreases the time to presentation compared to self-transport. Patients, who identify themselves in the "Other" race category, including American Indians, Pacific Islanders, and Native Hawaiians, exhibited longer TTP. Diabetics took longer to present than their non-diabetic counterparts. Interestingly, no differences in TTP were found when comparing age, sex, ethnicity (Hispanic vs. non-Hispanic), language or religion.

Keywords: ST-elevation myocardial infarction; Time to presentation; Diabetes mellitus; Demographic factors

Introduction

Survival after ST-Elevation Myocardial Infarction (STEMI) has improved due to continued improvements in medical therapy from thrombolytic therapy use to, now more routine, primary percutaneous coronary intervention [1-2]. Additionally, improvements in system based care have led to decreased emergency room door to balloon times. Multiple studies have demonstrated improved outcomes with shorter ischemic times leading to recommendations for a total ischemic time of less than 2 h and a door to balloon time of less than 90 min [3-4]. Despite these efforts to reduce door to balloon times, further improvements in decreasing total ischemic times to less than 2 hours remains a problem [5-6]. Little data exists specifically examining which factors impact delays in time to presentation for STEMI patients.

Our group sought to identify factors that impact time to presentation for STEMI patients at Loma Linda University Medical Center (LLUMC), a tertiary medical center in San Bernardino County, California. We hypothesized that patients who utilized emergency medical services would present in less time than those using other modes of transportation to the hospital. We also hypothesized that non-English speakers would require a translator or interpreter in order to contact EMS which would lead to increased time to presentation. Additionally, we hypothesized that diabetic patients would have longer time to presentation because of the potential for silent ischemia secondary to diabetic neuropathy. With increased focus on access to healthcare nationwide, we viewed time to presentation in STEMI as an indicator for a population's access and as such sought to determine which groups were most adversely affected.

Methods

This retrospective, single center study gathered data on 604 patients presenting with STEMI at LLUMC from April 2008 to December 2015. After excluding false activations (patients not meeting STEMI criteria), 529 patients were included in the analysis. All patients who presented with STEMI were included in the database including patients who died during or after the index hospitalization.

Variables

The dependent variable examined was time from symptom onset to presentation. Time to presentation was defined as the time from symptom onset to presentation at the emergency department. Time to presentation was determined by performing a thorough review of medical records, pre-hospital emergency services data, and interviewing patients and their families. Demographic factors included age, sex, ethnicity, race, and religion. This was determined using self-reported patient sign-in sheets. These sheets were scanned into Loma Linda's official electronic medical record system. Extraction of the data from the electronic medical record into this study's database was performed in standard fashion by cardiology fellows, residents, and medical students.

The logistic factors included in the analysis were mode of transportation and primary language. We also compared the time to presentation for diabetic and non-diabetic patients, as neuropathy can result in silent ischemia and increase time to presentation.

Statistical analyses

All statistical analysis was done in coordination with the Loma Linda Research Consulting Group. Pearson correlation coefficient linear regression, ANOVA F, Two sample t, Fisher's Exact, and Chi-squared testing were performed to reach the various statistical conclusions. Time to presentation had a non-normal distribution, so analyses were performed on log transformed values and results were then back transformed for reporting.

Results

The time to presentation (Table 1) showed no statistically significant difference based on sex, ethnicity (Hispanic vs. non-Hispanic), language or religion. Male patients did show a trend toward significantly shorter TTP compared to female patients (153 min *vs.* 182 min, p=0.148). Additionally there was a trend toward significant difference between English and Spanish speakers (157 min *vs* 207 min, p=0.1988). However, race, mode of transportation to the hospital, and diabetes status did have a statistically significant effect on time to presentation to the hospital.

Variable			Time to presentation (minutes)	p-value**
		N	Mean	
Sex				0.148
	Male	409	153	
	Female	120	182	
Ethnicity				0.456
	Non-Hispanic	412	156	
	Hispanic	116	170	
Transportation				0.021
	EMS	462	152	
	Self/Family/Friend	67	216	
Race				0.0239
	Caucasian	459	156	
	African-American	31	157	
	Asian-American	15	104	
	Other	24	303	
Language				0.1988
	English	478	157	
	Spanish	40	207	
	Other	10	108	
Religion				0.1458
	SDA* Christian	28	131	
	Non-SDA Christian	299	148	
	Other	196	180	

*SDA: Seventh-Day Adventist
** p-values obtained via Two sample t and ANOVA F-testing for binomial and >3 variable categories respectively.

Table 1: Demographic and Logistic Factors compared to Time to Presentation.

Regarding race, patients were categorized as Caucasian (n=459), which included Hispanic ethnicity, African-American (31), Asian American (15), and Other (24). Asian-Americans had the shortest TTP with a mean of 104 minutes. African-Americans and Caucasians had similar TTP of 156 and 157 minutes, respectively. Those who self-identified as "Other" had significantly longer TTP with an average time of 303 minutes.

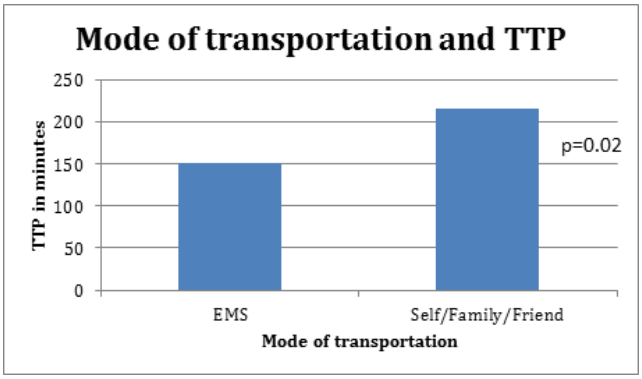

Figure 1: Mode of transportation and TTP.

Patients with STEMI (Figure 1) who utilized Emergency Medical Services (EMS) had shorter TTP with a mean of 152 minutes, compared to those who did not use EMS, who had a mean TTP of 216 minutes (p=0.021). Further analysis was done to ensure no other factors were confounding the time to presentation. There was no significant correlation between race, religion, ethnicity, language, sex or mode of transportation (Table 2).

Variable		Mode of Transportation		p-values*
		EMS	Non-EMS	
		N (%)	N (%)	
Sex				0.339
	Male	363 (76)	56 (81)	
	Female	115 (24)	13 (19)	
Race				0.429
	Caucasian	417 (87)	58 (84)	
	African-American	29 (6)	3 (4)	
	Asian-American	12 (3)	3 (4)	
	Other	20 (4)	5 (7)	
Ethnicity				0.318
	Non-Hispanic	377 (79)	50 (74)	
	Hispanic	101 (21)	18 (26)	
Language				0.858
	English	434 (91)	61 (90)	
	Spanish	35 (7)	6 (9)	
	Other	9 (2)	1 (1)	
Religion				0.32
	SDA	24 (5)	6 (9)	
	Non-SDA	272 (57)	39 (59)	
	Other	179 (38)	21 (32)	
*p-values obtained via Chi-squared and Fischer's Exact Test for binomial and >2 variable categories respectively				

Table 2: Comparison of Mode of Transportation between Demographic and Socioeconomic variables.

Diabetic patients with STEMI had a significantly longer TTP compared to non-diabetic patients. Diabetics presented on average in 195 minutes as compared to non-diabetics, who presented in 145 minutes (P=0.0054) when analyzed by two-sample t-test (Table 3). Additionally when linear regression was undertaken comparing Hgb A1c during index hospitalization to time to presentation, the slope was 1.12 minutes/unit Hgb A1c (R^2=0.49). In other words, for every unit increase in Hgb A1c, it took 1.12 minutes longer to present.

Age did not show any correlation with time to presentation. Initial linear regression analysis between age and TTP resulted in a correlation coefficient of 0.03 which was insignificant (p=0.52). After running a second regression which controlled for the other factors analyzed in this study, the Pearson correlation coefficient was 0.002 and again showed no statistical significance (p=0.60).

Variable	Non-diabetic		Diabetic		p-value*
	N	Mean (min)	N	Mean (min)	
Time to presentation	440	145	195	195	0.0054
*p-value obtained via two-sample t-test					

Table 3: Diabetes and time to presentation.

Discussion

In this study we aimed to identify the factors that most greatly impact the TTP in patients presenting with STEMI. Most notably, there was a significant difference in the TTP for those patients who used EMS as compared to those who did not. A prior study demonstrated that organized systems of transportation reduce TTP in STEMI [7]. Our study adds validity and support to this previously published study and further support for additional educational and public service campaigns to encourage its use. In the current study EMS was used in 87.3% of the patients presenting with STEMI.

Additionally the study analyzed the difference between religions including Seventh Day Adventist Christians, Other Christians, and all

others. The analysis was undertaken due to Loma Linda being a Seventh Day Adventist organization with a large population of Seventh Day Adventists in the surrounding area. Seventh Day Adventists adhere to several health practices which might have been important in the prevention of myocardial infarction. However, the analysis did not show any difference in the time to presentation based on religion.

The current analysis showed no difference between Caucasians and African Americans in terms of TTP. These findings contradict a previous study in which African Americans had longer TTP than Caucasians [8]. Although the reason for the contradictory findings was not shown by our study, not all parameters were similar to the prior analysis. Some important differences between the patient populations studied: The previous study had a patient population that was 56.3% African American whereas the current analysis African Americans represented a small sample of only 5.8%. Regional differences may play a role in the discrepancy between findings.

The "Other" race category in our study included American Indians, Native Hawaiians, and Pacific Islanders. This category had longer TTP than the other races. While the underlying cause of this difference cannot be proven by our study, a potential reason is the location of the San Manual Indian Reservation in the mountainous region near Loma Linda and is further than most of the surrounding cities. Further research would be needed to determine if data support this hypothesis.

Interestingly, diabetics had a significantly longer TTP than those without diabetes. Whether this was due to atypical symptom presentation or other comorbidities or variables is unclear and requires additional study. Diabetics with worse glycemic control, as evidenced by Hgb A1c, showed higher TTP. While this finding is logical, the correlation was weaker than expected. Additionally only a slight increase in TTP was observed for every unit increase in Hgb A1c. These findings indicate that while both diabetic status and glycemic control affect time to presentation, it appears that diabetic status had a greater effect on TTP than glycemic control.

Older age has been shown to be a predictor of longer time to presentation in a previous study [9]. The data from this study contradicts the prior finding. A major difference between the previous study and the present study was all patients in the previous study were self-transported. The majority of patients in the present study presented using EMS. One probable explanation for this finding is that older individuals require greater time to drive themselves to the hospital as compared to younger individuals. When accessing EMS older and younger individuals arrive at the hospital in similar time, presumably because the age of the patient has no effect on the speed with which EMS transports them to the hospital. Further studies would be needed to gather data supporting this hypothesis, but it stands as a reasonable explanation.

Limitations

The inherent limitations of a single center study apply to this study. Uncertainty remains about the external validity of the findings in different regions of the United States and among other populations and regions within the country. Additionally, the practices within this health care system might or might not be applicable to other health care systems in the immediate geographical area.

Although we examined many factors to determine those that affected time to presentation among STEMI patients, the possibility exists that other factors not analyzed in our study may contribute to variability in time to presentation. The study was in no terms a completely comprehensive study of all factors which could contribute to time to presentation. Further study of other factors which might contribute to time to presentation still needs to be undertaken.

Conclusion

Mode of transportation, race, and diabetes status demonstrate a significant effect on the time from the onset of symptoms to presentation in patients with STEMI. The use of EMS decreased the time to presentation compared to self-transport. Patients who identify themselves in the "Other" race category, including American Indians, Pacific Islanders, and Native Hawaiians, exhibited longer TTP. Diabetics took longer to present than their non-diabetic counterparts. Furthermore, increasing Hgb A1c correlated with increasing TTP. No differences in TTP were found when comparing age, sex, ethnicity (Hispanic *vs.* non-Hispanic), language or religion.

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