RESEARCH ARTICLE

Predictors of delayed pre-hospital presentation among patients with ST–segment elevation myocardial infarction

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ABSTRACT

Background: Early treatment of ST elevation myocardial infarction (STEMI) is essential to improve survival of these patients. However, not all patients present early enough to receive optimal treatment especially in third world countries. Social factors affecting early vs. late treatment have not been studied, particularly in the Middle East. Thus, the aim of this study was to determine the social factors associated with delayed presentation of STEMI patients.

Methods: All patients with STEMI presenting to King Abdulaziz Cardiac Center (KACC) between October 2013 and July 2014 were approached. After obtaining consent, patients were interviewed regarding their psychosocial circumstances using a standardized questionnaire. Their medical charts were also reviewed for further clinical data. Patients were divided according to their symptom-to-door time into early ($\leq$6h) and late ($>$6h) presentation and group comparisons were conducted.

Results: A total of 79 patients were enrolled, of which 24 patients (30%) presented late. Patients with increased symptom-to-door time had higher prevalence of diabetes (40% vs. 79.2%, p $=$ 0.001), hypertension (43.6% vs. 70.8%, p $=$ 0.023), and dyslipidemia (23.6% vs. 54.2%, p $=$ 0.009). Most of the late presenters did not undergo primary coronary intervention (72.7% vs. 47.8%, P $=$ 0.034) and had less prior information about myocardial infarction (43.6% vs. 25%, P $=$ 0.023). Late presenters were more often illiterates and lived most often far away from the hospital. Using multivariate logistic regression; dyslipidemia was the only independent predictor for the late hospital presentation for STEMI patients.

Conclusion: One third of patients with STEMI present more than six hours after symptom onset; these patients have a higher prevalence of coronary risk factors and less information about STEMI. Programs should be designed to educate patients and the general public about the symptoms of STEMI and the necessary action to be taken if a heart attack is suspected.

Keywords: STEMI, social factors, late presentation myocardial infarction; third world countries

BACKGROUND

Early treatment of ST-elevation myocardial infarction (STEMI) is essential to improve survival of these patients. Early reperfusion therapy, when applied, limits infarct size and complications.[1–5] Thus, hospitals have implemented multiple quality improvement initiatives to reduce the delay in treatment of an acute coronary syndrome (ACS), with varying levels of success. However, not every patient presents to the hospital on time. Delayed presentation is associated with a worse outcome due to the delay in receiving appropriate management leading to larger infarct sizes.[6–7] Different factors account for the delay in presentation. For example, in the USA, lack of health insurance, advanced age and African-American race were found to be associated with delayed presentation.[2,6,8] Other studies in the UK have shown that prior knowledge of myocardial diseases influenced presentation time.[9] In the Middle East, a study showed that almost one third of the patients presented late and 10% did not receive reperfusion therapy.[10] This has resulted in a significant proportion of ACS patients not receiving adequate reperfusion therapy and lifesaving therapies. The mortality of these patients is increased compared to those who present earlier. Many factors would have limited the proportion of patients presenting early; however, the social factors associated with delayed presentation despite free healthcare are not well demonstrated.[10] Therefore, the aim of this study was to identify the social factors associated with delayed presentation of STEMI patients in Saudi Arabia.

METHODS

The study was approved by the study institution scientific and ethics committee and all patients provided written informed consent. The study included 79 patients who presented to King Abdulaziz Cardiac Center (KACC), Riyadh, Saudi Arabia between October 2013 and July 2014 with STEMI. We excluded patients who were transferred from another hospital, patients younger than 18 years, and patients who refused to sign the informed consent. Three trained medical students performed the data collection using a standardized questionnaire. The questionnaire included questions about age, gender, nationality, recent and remote cardiac history, risk factors, estimated distance from residence to the hospital and educational level. In addition to that, the electronic medical records were used to supply the data collected. All the demographic and relevant clinical data were obtained once the clinical status of the patient stabilized.

DEFINITIONS

Hypertension was defined as patients known to be hypertensive or on any blood pressure lowering medication. Diabetes mellitus reported for patients use of anti-hyperglycemic medication or a database verified diagnosis of diabetes. Dyslipidemia was defined by any prior diagnosis with lipid abnormality or use of lipid lowering therapies. Cardiac chest pain was defined as a localized, dull retrosternal chest pain lasting for approximately 1–5 minutes, relieved by rest or nitroglycerin with no change in the intensity on respiration or position. Previous knowledge of coronary artery disease was reported if patients could identify two or more cardiovascular risk factors and presentation symptoms of CAD. Use of ambulance service was defined as patients who reached the hospital by ambulance after dialing the Saudi Red Crescent emergency number. Patients who presented to the hospital and lived in Riyadh city were considered as "living in the city". Level of education was defined as the highest level of education the patient had attained. ST elevation myocardial infarction was defined as stated in the American College of Cardiology/American Heart Association guidelines "characteristic symptoms of myocardial ischemia in association with persistent ST segment elevation and subsequent release of biomarkers of myocardial necrosis".[11]

STATISTICAL ANALYSIS

Patients were divided into two groups based on the time from the onset of chest pain to arrival to the emergency department. Early presentation was considered as ≤ 6 hours from the onset of symptoms
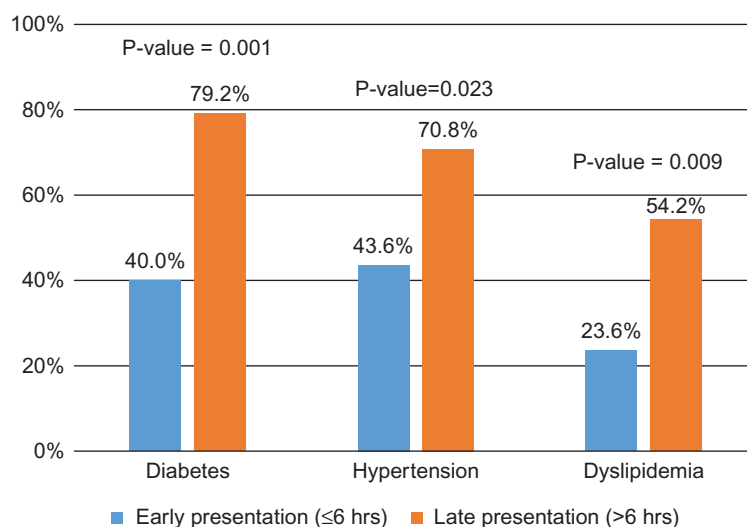
Figure 1. Common CAD risk factors associated with time to hospital presentation.

and late presentation was > 6 hours. Categorical and continuous variables were presented as frequencies and mean (± standard deviation), respectively. Group comparisons was conducted using SPSS software (version 21, IBM Statistics, IL, USA). Chi–square test and Students' t-test were used to compare the risk factors between the two groups. Multivariate logistic regression model was used to predict late hospital presentation after developing chest pain. The model consisted of baseline characteristics (age, gender and nationality), main cardiovascular risk factors (hyper-tension, diabetes, dyslipidemia, smoke, previous MI and family history of CAD) and psychosocial factors (use of ambulance, living in the city, level of education and previous knowledge about STEMI).

RESULTS

A total of 79 patients (mean age 56 ± 12 year, 87% males) were included. The mean body mass index was 27.4 ± 4.3 kg/m^2. The patients had a high prevalence of cardiovascular risk factors including hypertension 52%, diabetes 52% and dyslipidemia 33%. Most patients had a family history of premature coronary artery disease (42%), and (58%) were illiterate or did not complete primary education. The median time patients presented to the emergency department after onset of chest pain was three hours (range between 30 minutes - 72 hours).

A total of 24 (30%, 95% confidence interval 21 – 41%) patients presented late (> 6 hours), 83.3% were male and mean age was 59 ± 12 years. The prevalence of coronary artery disease risk factors

including hypertension, diabetes and dyslipidemia were 70.8%, 79.2% and 54.2, respectively (Fig. 1). Moreover, 11 (47.8%) patients underwent primary percutaneous coronary intervention. Late hospital presentation was significantly higher among those living outside the city and for those who level of education was primary and below (Table 1).

Using the multivariate logistic regression model, dyslipidemia was the only independent predictor for late hospital presentation after developing chest pain and dyslipidemic patients had a four times greater risk of presenting late (Table 2).

DISCUSSION

Approximately one third of patients with STEMI in our study presented more than six hours after symptom onset. Optimal management of STEMI patients is within the first six hours from onset of symptoms and is essential in improving patients' survival.[12]

In our analysis, we noted some significant differences between patients that were early and late presenters. The mean age in the late group was slightly higher than in the early group, but did not reach statistical significance. A systemic review conducted in the US[8] showed that the majority of the delayed patients were older. Thus, the lack of statistical significance in our study could be due to the small sample size in our study.

In the assessment of coronary artery disease risk factors, the results showed that chronic diseases were more with late presented patients. A significant difference between the two groups were seen for

Table 1. Group comparisons (early and late STEMI presentation) with psychosocial characteristics.

	Total n = 79	Early presentation (≤6 hrs) (69.6%)	Late presentation (>6 hrs) (30.4%)	p–value
Positive family history	33 (41.8%)	25 (45.5%)	8 (33.3%)	0.226
Cardiac chest pain	14 (17.7%)	10 (18.2%)	4 (16.7%)	0.573
Riyadh residency	60 (75.9%)	46 (83.6%)	14 (58.3%)	0.018
Use of ambulance service	15 (19.0%)	11 (20%)	4 (16.7%)	0.496
Level of education				
Primary and below	46 (58.2%)	30 (54.5%)	16 (66.7%)	
Intermediate or secondary	26 (32.9%)	19 (34.5%)	7 (29.2%)	0.018
Above secondary	7 (8.9%)	6 (10.9%)	1 (4.2%)	
Previous knowledge of MI	30 (38%)	24 (43.6%)	6 (25%)	0.092
Saudi nationality	55 (69.6%)	35 (63.6%)	20 (83.3%)	0.066

STEMI: ST–elevation myocardial infarction; ED: emergency department; MI: myocardial infarction.

those with diabetes, with nearly 80% of the delayed group being diabetics. A consequence of longstanding diabetes and development of neuropathies may limit chest pain sensation, leading to late presentation.[13] Furthermore, dyslipidemic patients were encountered more with the late presenters (54% of the delayed group), as well as those with hypertension (71% of the delayed group).

Prior myocardial infarction and typical chest pain are associated with early presentation. More than 44% of the early group had prior information about CAD or its symptoms. Conversely, only 25% in the delayed group were familiar with the disease. This could be a very important opportunity to improve patient education.

The level of education, as a surrogate for socio-economic status, played a role in the time to presentation. Low literacy patients were the majority in the delayed group. Consequently, lack of awareness of health conditions, inadequate cardiovascular risk prevention and poor interaction with medical services may have contributed to this low rate of early presentation.

This study provided information that can be used to impact the current healthcare system in Saudi Arabia. The limited knowledge of cardiac symptoms and immediate response required when a patient suffers a heart attack should prompt urgent educational activities aimed for those at risk. Effective prehospital emergency care systems should be designed to limit delays in responding to patients suffering from heart attacks and encourage the local residents to use it. Such measures may lower the rate of late presentations.

Our study had several limitations. While the study was conducted in a tertiary health facility, it was a single-center study which may lack the external validity required to support widespread changes in practice. Moreover, the small sample size and sampling technique may have influenced the interpretation and generalization of the study findings. Nevertheless,

Table 2. Multivariate logistic regression predicting time to hospital presentation.

	Odds ratio	95% confidence interval	p–value
Age	0.961	(0.892 – 1.036)	0.302
Gender	2.612	(0.347 – 19.651)	0.351
Diabetes mellitus	3.604	(0.842 – 15.431)	0.084
Hypertension	2.058	(0.563 – 7.529)	0.275
Dyslipidemia	4.787	(1.186 – 19.313)	0.028

Other variables adjusted for: smokers, previous MI, Saudi nationality, family history of CAD, type of chest pain, Riyadh residency, use of ambulance service, level of education, previous knowledge of MI; all of which were not significant.

study approaches of time to hospital presentation in a highly critical population of STEMI patients, which is influenced by receiving timely and appropriate therapies, had a crucial impact on the patient survival.

CONCLUSION

Our study demonstrated that 30% of STEMI patients presenting to KACC were late presenters (>6h), and the factors that might attribute to this delay are mainly focused on the patient's chronic diseases and lack of knowledge about heart attacks and their symptoms. Raising public awareness of the disease and creating programs to educate those at higher risk remains a high priority to ensure the best outcome for these patients.

COMPETING INTERESTS

Authors have no competing interests.

REFERENCES

1. Angerud KH, Brulin C, Naslund U, Eliasson M. Longer pre-hospital delay in first myocardial infarction among patients with diabetes: an analysis of 4266 patients in the northern Sweden MONICA Study. *BMC Cardiovasc Disord.* 2013;13:6.

2. Foraker RE, Rose KM, McGinn AP, Suchindran CM, Goff DC Jr, Whitsel EA, Wood JL, Rosamond WD. Neighborhood income, health insurance, and prehospital delay for myocardial infarction: The atherosclerosis risk in communities study. *Arch Intern Med.* 2008;168:1874–1879.

3. Boersma E, Maas AC, Deckers JW, Simoons ML. Early thrombolytic treatment in acute myocardial infarction: Reappraisal of the golden hour. *Lancet.* 1996;348(9030):771–775.

4. Shavadia J, Zheng Y, Dianati Maleki N, Huber K, Halvorsen S, Goldstein P, Gershlick AH, Wilcox R, Van de Werf F, Armstrong PW. Infarct size, shock, and heart failure: Does reperfusion strategy matter in early presenting patients with ST-segment elevation myocardial infarction? *J Am Heart Assoc.* 2015;4(8): e002049.

5. Rentrop KP, Feit F. Reperfusion therapy for acute myocardial infarction: Concepts and controversies from inception to acceptance. *Am Heart J.* 2015;170(5):971–980.

6. McKee G, Mooney M, O'Donnell S, O'Brien F, Biddle MJ, Moser DK. Multivariate analysis of predictors of pre-hospital delay in acute coronary syndrome. *Int J Cardiol.* 2013;168:2706–2713.

7. Nallamothu B, Fox KA, Kennelly BM, VandeWerf F, Gore JM, Steg PG, Granger CB, Dabbous OH, Kline-Rogers E, Eagle KA, GRACE Investigators. Relationship of treatment delays and mortality in patients undergoing fibrinolysis and primary percutaneous coronary intervention. The Global Registry of Acute Coronary Events. *Heart.* 2007;93(12):1552–1555.

8. Nguyen HL, Saczynski JS, Gore JM, Goldberg RJ. Age and sex differences in duration of prehospital delay in patients with acute myocardial infarction: A systematic review. *Circ Cardiovasc Qual Outcomes.* 2010;3:82–92.

9. Ting HH, Bradley EH, Wang Y, Nallamothu BK, Gersh BJ, Roger VL, Lichtman JH, Curtis JP, Krumholz HM. Delay in presentation and reperfusion therapy in ST-elevation myocardial infarction. *Am J Med.* 2008;121:316–323.

10. Al-Mallah MH, Alsheikh-Ali AA, Almahmeed W, Sulaiman K, Al Suwaidi J, Ridha M, Al-Motarreb A, Alenezi F, Zubaid M. Missed opportunities in the management of ST-segment elevation myocardial infarction in the Arab Middle East: Patient and physician impediments. *Clin Cardiol.* 2010;33:565–571.

11. O'Gara PT, Kushner FG, Ascheim DD, Casey DE Jr, Chung MK, de Lemos JA, Ettinger SM, Fang JC, Fesmire FM, Franklin BA, Granger CB, Krumholz HM, Linderbaum JA, Morrow DA, Newby LK, Ornato JP, Ou N, Radford MJ, Tamis-Holland JE, Tommaso CL, Tracy CM, Woo YJ, Zhao DX, Anderson JL, Jacobs AK, Halperin JL, Albert NM, Brindis RG, Creager MA, DeMets D, Guyton RA, Hochman JS, Kovacs RJ, Kushner FG, Ohman EM, Stevenson WG, Yancy CW, American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation.* 2013;127(4):e362–e425.

12. Sheifer SE, Rathore SS, Gersh BJ, Weinfurt KP, Oetgen WJ, Breall JA, Schulman KA. Time to presentation with acute myocardial infarction in the elderly: Associations with race, sex, and socioeconomic characteristics. *Circulation.* 2000;102(14):1651–1656.

13. Malmberg K, Ryden L. Myocardial infarction in patients with diabetes mellitus. *Eur Heart J.* 1988;9(3): 259–264.