

Delays in Presentation by Patients with ST Elevation Myocardial Infarction

A single centre experience from Oman

Suhaib Almashari,¹ Yasir Al-Malki,¹ Adil Al-Riyami,² *Sunil K. Nadar²

ABSTRACT: Objectives: To assess the causes of delay for presentation with ST elevation myocardial infarction (STEMI). **Methods:** Patients who presented with STEMI to the Emergency Department at the Sultan Qaboos University Hospital, Muscat, Oman between January 2017 and December 2019 and were admitted for primary angioplasty were included in this study. **Results:** A total of 101 patients were included with a mean age of 54.8 + 10.8 years and the majority were male patients (n = 80; 79.2%). The median (interquartile range) pain-to-door time was 60 min (30–120 min). There were 66 (65.4%) patients who arrived within 90 minutes. All except one arrived by privately arranged transport. Feeling that the pain was not important (61.0%) or not cardiac (22.8%) were the main reasons for delay. Being diabetic was the only patient factor that predicted delay. **Conclusion:** A high proportion of patients presenting to our institution with a STEMI arrived within recommended times. However more public education is required to improve awareness about the importance of early evaluation of chest pain.

Keywords: ST Elevation Myocardial Infarction; Prehospital Emergency Care; Oman.

PATIENTS WITH AN ST SEGMENT ELEVATION myocardial infarction (STEMI) constitute a medical emergency.¹ It is imperative that such patients are treated as quickly as possible. The European Society of Cardiology guidelines on the management of STEMI recommend that patients are treated with a 'Door-to-balloon' (DTB) time (time taken from presentation to the emergency department [ED] until the occluded artery is open) of less than 90 minutes.¹ All hospitals that provide round the clock access to primary percutaneous coronary interventions (PPCI) have mechanisms that would facilitate short DTB times. However, the time taken from the onset of pain to first medical contact, either paramedic in the ambulance or the ED staff or the time from the onset of pain until arriving at a thrombolysis or angioplasty capable hospital for those self-presenting (i.e. 'pain-to-door' [PTD] time) are equally important. Several studies have shown that the longer the patient delays presentation, the worse the possible outcomes.² This has led public health authorities in many countries to study PTD times and evaluate possible factors that could delay patients' presentation and implement strategies that would improve patient awareness of the need for early presentation.^{3,4} Such data, however, is lacking from the Middle-East. Previous studies from the region have reported on the delays, but did not evaluate the reasons for delay.^{5,6} This study aimed to assess the PTD times in patients presenting with a STEMI at our institution and to understand the factors that might have caused any delay.

Methods

This was a retrospective study involving patients who presented with a STEMI at the Sultan Qaboos University Hospital, Muscat, Oman, between January 2017 and December 2019. All patients who presented with a STEMI and were taken up for primary angioplasty during this period were considered for inclusion in this study. Eligible patients were identified and their electronic health records (EHR) were retrieved to acquire the required information. This information included the PTD time, the clinical features, education level and employment status of the patients and mode of transport to the hospital. Where information was not available, patients were contacted by telephone for additional information after ascertaining that they were well. We excluded patients where complete data was not available or where we were unable to communicate with them—either due to language differences or unavailability of the contact details. We also excluded patients who had first presented to another hospital and were then transferred to our institute for PPCI as their EHR were incomplete. We also excluded patients who developed a STEMI whilst admitted in hospital for another medical complaint.

The European Society of Cardiology guidelines recommend a DTB time of 60 minutes for those presenting to a hospital with PPCI facilities and 90 minutes for those presenting to hospitals without PPCI facilities (including transfer times).¹ Studies

have shown that those who present with a pain-to-balloon time (time from symptom onset to opening the occluded artery) of less than 180 minutes have the best prognosis.^{2,7} A cut off time of 90 minutes was therefore used in the analysis to determine those who arrived early or late.

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 21 (IBM Corp., Chicago, Illinois, USA). Data was presented as number (%), mean + standard deviation or median (interquartile range [IQR]). Data analysis was done using Chi-squared test or student t-test as appropriate. Binary logistic regression was performed to study the factors that affected any delay to presentation. The outcome measure was whether the patient had presented late or not (beyond 90 minutes of chest pain) and the input variables included age, gender, educational and occupational status and premorbid conditions. Ethical approval was obtained from the research committee of the Sultan Qaboos University (#2288).

Results

A total of 268 patients were eligible for the study. However, complete information was available for 101 patients with a mean age of 54.8 + 10.8 years and 80 (79.2%) patients being male. Approximately half of the patients were diabetic (55.4%) and hypertensive (51.5%) while dyslipidaemia (73.3%) and smoking (67.3%) were the most common risk factors. The majority of the patients had either anterior (50.5%) or inferior (39.6%) MI [Table 1].

A total of 22 (21.8%) patients had attended up to primary school or less, 59 (58.4%) had completed secondary school while 20 (19.8%) had attended university. Around half (n = 49; 48.5%) were either unemployed or retired, whilst the remaining (n = 52; 51.5%) were inactive employment. The PTD time ranged from 20 minutes to 25 hours with a median (IQR) of 60 minutes (30–120 minutes). More than half (n = 66) of the patients reached the hospital within the recommended time of 90 minutes since the onset of pain. Most of the patients were brought in by a relative or friend (n = 90; 89.1%), while 9 patients drove themselves to the hospital. Only one patient had called an ambulance whilst another came by taxi.

When analysing the factors that affected the PTD time, the only factor that had a significant difference in the two groups was the presence of diabetes ($P = 0.007$) [Table 2]. The patients who presented late were slightly older but no statistical significance was observed. Diabetic patients were more likely to have

Table 1: Clinical features of the patients who presented with a STEMI at the Sultan Qaboos University Hospital, Muscat, Oman, between January 2017 and December 2019 (N = 101)

Clinical feature	n (%)
Gender	
Male	80 (79.2)
Female	21 (20.8)
Site of MI	
Anterior	51 (50.5)
Inferior	40 (39.6)
Posterior	4 (4.0)
Lateral	6 (5.9)
Diabetes	56 (55.4)
Hypertensive	52 (51.5)
Dyslipidaemia	74 (73.3)
Smoking	68 (67.3)
Previous MI	9 (8.9)
Previous PCI	17 (16.8)
Previous CABG	0 (0)
Positive family history	74 (73.3)

MI = myocardial infarction; PCI = percutaneous coronary intervention; CABG = coronary artery bypass grafting.

a delay in reaching the hospital. The gender, previous medical history or other demographic features such as education or employment history were not statistically significant.

Of those who presented late (n = 35), the main reasons for delay were thinking that this pain was not important (n = 21; 60%) or thinking that it was related to gas or stomach pain (n = 8; 22.8%). Five patients (14.2%) did not have anyone to bring them and had to wait for transport while another one patient delayed coming as he was just visiting Muscat and was by himself.

Discussion

“Time is muscle” is the often quoted dictum guiding the management of patients with STEMI.⁸ There has been a considerable amount of investment of resources and manpower to improve DTB times in patients once they seek medical attention either by the paramedics in the ambulance or by the ED staff. And indeed, many centres have demonstrated falling DTB times over the years.⁹ Yet, a major determinant of outcomes in patients with STEMI that remains unchanged is prehospital delays, with patients seeking medical help

Table 2: Characteristics of patients based on whether there was a delay (N = 101)

	No delay in presentation (n = 66)	Delay in presentation (n = 35)	P value*
Age (mean ± SD)	53.9 ± 10.3	56.5 ± 10.9	0.25
Gender			
Male	52 (78.8)	28 (80.0)	0.88
Female	14 (21.2)	7 (20.0)	
Diabetic	23 (34.9)	22 (62.9)	0.007
Hypertensive	29 (43.9)	20 (57.1)	0.20
Dyslipidemic	19 (28.8)	8 (22.9)	0.52
Smoker	22 (33.3)	10 (28.6)	0.66
Site of MI			
Anterior	34 (51.5)	17 (48.6)	0.63
Inferior	25 (37.9)	15 (42.9)	
Posterior	2 (3.0)	2 (5.7)	
Lateral	5 (7.6)	1 (2.9)	
Previous MI	4 (6.1)	5 (14.3)	0.16
Previous PCI	11 (16.7)	6 (17.1)	0.95
Family history	19 (28.8)	8 (22.9)	0.52
Education			
Illiterate or upto primary school	11 (16.7)	11 (31.4)	0.23
High School	41 (62.1)	18 (51.4)	
University Graduate	14 (21.2)	6 (17.1)	
Employment			
Unemployed	29 (43.9)	20 (57.1)	0.21
Employed	37 (56.1)	15 (42.9)	
Transport			
By themselves	4 (6.1)	5 (14.3)	0.43
Relative/ friend	60 (90.9)	30 (85.8)	
Ambulance	1 (1.5)	0 (0)	
Taxi	1 (1.5)	0 (0)	

SD = standard deviation; MI = myocardial infarction; PCI = percutaneous coronary intervention.

*Analysis by student t-test or chi-square test as appropriate.

late after the onset of chest pain. Various studies have demonstrated that approximately 40–65% of patients with STEMI present more than two hours after the onset of symptoms.^{10,11}

In the current study, the median PTD time was found to be 60 minutes and the majority of patients

reached the hospital within 90 minutes. This is very encouraging and reassuring and appears better than published data from the region.^{5,6} The Gulf-Heart study, which analysed all acute coronary syndrome from the Arabian Gulf region, reported a median PTD time of 178 minutes with almost 80% of patients arriving within 12 hours of symptom onset.⁶ A subsequent study by the same group involving the six Gulf countries studying only STEMI found a similar median PTD time of 175 minutes but with a higher proportion (90%) of patients arriving within 12 hours of symptom onset.⁵ Another study from Jordan in 2015 on 160 patients reported a median PTD time of eight hours where none of the patients presented to hospital within one hour from symptom onset.¹² Similarly Taghaddosi *et al.* found that 65.5% of patients from Iran presented after two hours of symptom onset.¹³ The shorter PTD times in the current study could reflect better awareness as compared to these former studies.

Studies have demonstrated that there are multiple factors affecting PTD times.^{5,10,11,13,14} Patients' perception of chest pain is one of the main reasons for late presentation.^{12,14} Some patients feel that the pain is not severe enough to be a heart attack or that it could be heartburn or indigestion.^{15,16} This is especially true with diabetic, elderly and female patients. These groups of patients, especially those with diabetes, have been shown to have atypical symptoms and perceive chest pain differently than non-diabetic patients.^{17,18} In addition, many studies have shown that diabetes, along with female gender and elderly age, are predictors of late diagnosis of MI.^{17,19} In the current study, it was found that misperception of the pain was the main reason for delay in presentation. Furthermore, it was evident that being diabetic was the only predictor of late presentation. Therefore, public education should focus on encouraging people to take any form of chest pain seriously and seek medical attention as soon as possible, especially if they have any cardiac risk factors. Patients with diabetes should also be made aware that they could perceive chest pain differently.

Mode of transport has also been implicated in delays in many studies reporting the underuse of ambulance service.^{5,10} Data from the USA obtained from the Rapid Early Action for Coronary Treatment (REACT) trial conducted in 20 cities across the Country demonstrated that only approximately 23% had called the emergency services, whilst more than 60% came by privately arranged transport and astonishingly 16% had driven themselves.²⁰ In the current study as well, only one patient arrived by ambulance and the rest were brought in by privately arranged transport (relatives, friends, colleagues

or taxi) or even by themselves. In the Arabian Gulf region, the use of emergency medical service (EMS) ambulances is generally low. In the Gulf Race 3Ps study, approximately 25% of patients all over the Gulf region and 19% of patients in Oman with STEMI used the ambulance service.⁵ This is also similar to findings from a previous study from Oman where almost all patients with out-of-hospital cardiac arrest were brought to the hospital by someone known to them.²¹

This in itself is not harmful, as long as transportation can be arranged quickly. Indeed in the current study, proximity to the hospital and the fact that the study was conducted in Muscat, where transport could be arranged quickly, could partly explain the low PTD times. Retrospective analysis from the REACT trial showed that patients who were brought in by private transportation arrived quicker than those arriving by EMS.²² However, those arriving by EMS had earlier treatment as many of them had electrocardiograms done by the EMS personnel. In the Gulf Race 3Ps study, as well, those arriving by EMS had a longer PTD time, as the EMS would take them directly to the PCI capable centre rather than the nearest hospital.⁵ Waiting for transport or waiting for someone to be free to bring them to a hospital could potentially add to the delay as was the case with a few of the patients in the current study. The general public should be encouraged to call for EMS if private transport is not available.

Public health education campaigns via electronic media and mass media campaigns have been shown to be useful in improving awareness of a variety of conditions such as diabetes and smoking cessation.²³ However, their role in other conditions such as salt reduction have not been as successful.²⁴ There have been studies examining the role of public education campaigns to increase awareness regarding early presentation of chest pain. A study from Sweden in the early 1990s demonstrated that mass media campaigns—advertising on the radio, public transport and television—helped to increase the percentage of patients with STEMI that were eligible to receive thrombolysis.^{25,26} The REACT trial was a randomised control trial in the USA where one city of a predetermined pair, was subjected to 18-months of targeted educational campaigns through various modalities to increase appropriate patient actions for acute myocardial infarction symptoms, while the paired city did not have such an intervention.²² They found that despite this intensive 18 month targeted education, there was no difference in the time from symptom onset to arrival in hospital. However, it significantly increased appropriate EMS call outs.

Nevertheless, it is important to remind patients, especially those who are at high risk for cardiovascular disease, about the importance of not neglecting any type of chest pains and seeking help early.

The current study had a few limitations. Most of the patients who were eligible for the study had incomplete data and a large number of patients had to be excluded, which could have affected the validity of the study. Much of the data was collected retrospectively; however, it was incomplete in many cases and patients had to be contacted by telephone to get additional information. This retrospective collection of data would have brought in some recall bias. Similarly, the researchers were unable to contact some eligible patients with incomplete data due to incorrect contact details. Finally, this was a single centre study with a small sample size. A nationwide study would be a better representation of different regions in the country.

Conclusion

The majority of patients with a STEMI sought medical help within 90 minutes of pain. Patient misperception of chest pain was a main reason for delay. Larger studies involving other centres and other areas of Oman would help gain a better understanding of the true causes of delay in presentation of patients with chest pain. Health education programmes for the public are recommended to ensure better recognition of cardiac-related chest pain and also highlight the importance of avoiding delays with chest pain and seeking immediate medical help.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

FUNDING

No funding was received for this study.

AUTHORS' CONTRIBUTION

SA and YAM collected the data. SKN analysed the data. AAR and SKN drafted and edited the manuscript. All authors approved the final version of the manuscript.

References

1. Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *Eur Heart J* 2018; 39:119–77. <https://doi.org/10.1093/eurheartj/ehx393>.

2. Shiomi H, Nakagawa Y, Morimoto T, Furukawa Y, Nakano A, Shirai S, et al. Association of onset to balloon and door to balloon time with long term clinical outcome in patients with ST elevation acute myocardial infarction having primary percutaneous coronary intervention: observational study. *BMJ* 2012; 344:e3257. <https://doi.org/10.1136/bmj.e3257>.
3. Alsamara M, Degheim G, Gholkar G, Hiner E, Zughaib M. Is symptom to balloon time a better predictor of outcomes in acute ST-segment elevation myocardial infarction than door to balloon time? *Am J Cardiovasc Dis* 2018; 8:43–7.
4. Pereira H, Pinto FJ, Cale R, Pereira E, Mello S, Vitorino S, et al. The Stent for Life initiative: Factors predicting system delay in patients with ST-segment elevation myocardial infarction. *Rev Port Cardiol (Engl Ed)* 2018; 37:681–90. <https://doi.org/10.1016/j.repc.2018.01.011>.
5. AlHabib KF, Sulaiman K, Al SJ, Almahmeed W, Alsheikh-Ali AA, Amin H, et al. Patient and System-Related Delays of Emergency Medical Services Use in Acute ST-Elevation Myocardial Infarction: Results from the Third Gulf Registry of Acute Coronary Events (Gulf RACE-3Ps). *PLoS One* 2016; 11:e0147385. <https://doi.org/10.1371/journal.pone.0147385>.
6. AlHabib KF, Sulaiman K, Al-Motarreb A, Almahmeed W, Asaad N, Amin H, et al. Baseline characteristics, management practices, and long-term outcomes of Middle Eastern patients in the Second Gulf Registry of Acute Coronary Events (Gulf RACE-2). *Ann Saudi Med* 2012; 32:9–18. <https://doi.org/10.5144/0256-4947.2012.9>.
7. Rollando D, Puggioni E, Robotti S, De LA, Ferrari BM, Vardanega A, et al. Symptom onset-to-balloon time and mortality in the first seven years after STEMI treated with primary percutaneous coronary intervention. *Heart* 2012; 98:1738–42. <https://doi.org/10.1136/heartjnl-2012-302536>.
8. Gibson CM, de Lemos JA, Antman EM. Time is muscle in primary PCI: the strength of the evidence grows. *Eur Heart J* 2004; 25:1001–2. <https://doi.org/10.1016/j.ehj.2004.04.029>.
9. Yudi MB, Hamilton G, Farouque O, Andrianopoulos N, Duffy SJ, Lefkovits J, et al. Trends and Impact of Door-to-Balloon Time on Clinical Outcomes in Patients Aged <75, 75 to 84, and ≥85 Years With ST-Elevation Myocardial Infarction. *Am J Cardiol* 2017; 120:1245–53. <https://doi.org/10.1016/j.amjcard.2017.07.005>.
10. Beig JR, Trambo NA, Kumar K, Yaqoob I, Hafeez I, Rather FA, et al. Components and determinants of therapeutic delay in patients with acute ST-elevation myocardial infarction: A tertiary care hospital-based study. *J Saudi Heart Assoc* 2017; 29:7–14. <https://doi.org/10.1016/j.jsha.2016.06.001>.
11. Saczynski JS, Yarzebski J, Lessard D, Spencer FA, Gurwitz JH, Gore JM, et al. Trends in prehospital delay in patients with acute myocardial infarction (from the Worcester Heart Attack Study). *Am J Cardiol* 2008; 102:1589–94. <https://doi.org/10.1016/j.amjcard.2008.07.056>.
12. Darawad MW, Alfafos N, Saleh Z, Saleh AM, Hamdan-Mansour A. Predictors of delay in seeking treatment by Jordanian patients with acute coronary syndrome. *Int Emerg Nurs* 2016; 26:20–5. <https://doi.org/10.1016/j.ienj.2015.09.003>.
13. Taghaddosi M, Dianati M, Fath Gharib BJ, Bahonar J. Delay and its related factors in seeking treatment in patients with acute myocardial infarction. *ARYA Atheroscler* 2010; 6:35–41.
14. Novak K, Aljinovic J, Kostic S, Capkun V, Novak RK, Batinic T, et al. Pain to hospital times after myocardial infarction in patients from Dalmatian mainland and islands, southern Croatia. *Croat Med J* 2010; 51:423–31. <https://doi.org/10.3325/cmj.2010.51.423>.
15. Berman N, Jones MM, De Coster DA. 'Just like a normal pain', what do people with diabetes mellitus experience when having a myocardial infarction: a qualitative study recruited from UK hospitals. *BMJ Open* 2017; 7:e015736. <https://doi.org/10.1136/bmjopen-2016-015736>.
16. Goel PK, Srivastava SK, Ashfaq F, Gupta PR, Saxena PC, Agarwal R, et al. A study of clinical presentation and delays in management of acute myocardial infarction in community. *Indian Heart J* 2012; 64:295–301. [https://doi.org/10.1016/s0019-4832\(12\)60090-x](https://doi.org/10.1016/s0019-4832(12)60090-x).
17. Poorhosseini H, Saadat M, Salarifar M, Mortazavi SH, Geraieli B. Pre-Hospital Delay and Its Contributing Factors in Patients with ST-Elevation Myocardial Infarction; a Cross sectional Study. *Arch Acad Emerg Med* 2019; 7:e29.
18. Sharma A, Sekaran NK, Coles A, Pagidipati NJ, Hoffmann U, Mark DB, et al. Impact of Diabetes Mellitus on the Evaluation of Stable Chest Pain Patients: Insights From the PROMISE (Prospective Multicenter Imaging Study for Evaluation of Chest Pain) Trial. *J Am Heart Assoc* 2017; 6:e007019. <https://doi.org/10.1161/JAHA.117.007019>.
19. Jager B, Farhan S, Rohla M, Christ G, Podczeczek-Schweighofer A, Schreiber W, et al. Clinical predictors of patient related delay in the VIENNA ST-elevation myocardial infarction network and impact on long-term mortality. *Eur Heart J Acute Cardiovasc Care* 2017; 6:254–61. <https://doi.org/10.1177/20488726166633882>.
20. Brown AL, Mann NC, Daya M, Goldberg R, Meischke H, Taylor J, et al. Demographic, belief, and situational factors influencing the decision to utilize emergency medical services among chest pain patients. Rapid Early Action for Coronary Treatment (REACT) study. *Circulation* 2000; 102:173–8. <https://doi.org/10.1161/01.cir.102.2.17>.
21. Nadar SK, Mujtaba M, Al-Hadi H, Sadiq M, Al-Riyami A, Ali M, et al. Epidemiology, Outcomes and Coronary Angiography Findings of Patients Following Out-of-Hospital Cardiac Arrest: A single-centre experience from Oman. *Sultan Qaboos Univ Med J* 2018; 18:e155–60. <https://doi.org/10.18295/squmj.2018.18.02.006>.
22. Luepker RV, Raczynski JM, Osganian S, Goldberg RJ, Finnegan JR, Jr, Hedges JR, et al. Effect of a community intervention on patient delay and emergency medical service use in acute coronary heart disease: The Rapid Early Action for Coronary Treatment (REACT) Trial. *JAMA* 2000; 284:60–7. <https://doi.org/10.1001/jama.284.1.60>.
23. Wakefield MA, Loken B, Hornik RC. Use of mass media campaigns to change health behaviour. *Lancet* 2010; 376:1261–71. [https://doi.org/10.1016/S0140-6736\(10\)60809-4](https://doi.org/10.1016/S0140-6736(10)60809-4).
24. Trieu K, McMahan E, Santos JA, Bauman A, Jolly KA, Bolam B, et al. Review of behaviour change interventions to reduce population salt intake. *Int J Behav Nutr Phys Act* 2017; 14:17. <https://doi.org/10.1186/s12966-017-0467-1>.
25. Blohm M, Herlitz J, Hartford M, Karlson BW, Risenfors M, Luepker RV, et al. Consequences of a media campaign focusing on delay in acute myocardial infarction. *Am J Cardiol* 1992; 69:411–13. <https://doi.org/10.1111/j.1365-2796.1991.tb00439.x>.
26. Herlitz J, Blohm M, Hartford M, Karlson BW, Luepker R, Holmberg S, et al. Follow-up of a 1-year media campaign on delay times and ambulance use in suspected acute myocardial infarction. *Eur Heart J* 1992; 13:171–7. <https://doi.org/10.1093/oxfordjournals.eurheartj.a060142>.