

Acute Coronary Syndrome—Factors Causing Delayed Presentation at the Emergency Department

K K Ho,*^{MBBS, FRCS}, S W Lee,**^{MBBS, FRCS}, S B S Ooi,***^{FAMS, MBBS, FRCS}, F Lateef,****^{MBBS, FRCS},
S H Lim,****^{FAMS, MBBS, FRCS}, V Anantharaman,[†]^{FAMS, MBBS, FRCP}

Abstract

Introduction: The aim of the study was to identify factors that contributed to delays in presentation of patients with acute coronary syndrome (ACS) at the Emergency Department (ED). **Materials and Methods:** The study population comprised patients presenting with the signs and symptoms of ACS at the ED of 5 government and restructured hospitals in Singapore from 1 April to 31 May 1999. These patients were interviewed with a structured questionnaire which explored patient demographic data, risk factors, prehospital symptomatology, timing of chest pain, patient response to chest pain and mode of transport to the hospital. **Results:** Three hundred and two patients who made 307 visits were recruited. More than three-quarters of the patients presented with central or left-sided chest pain. Forty-seven per cent had breathlessness and 42% had sweating. The commonest day of presentation was Monday. It took patients a median time of 2.1 hours from their worst chest pain to arrive at the ED. Past history of diabetes mellitus was associated with a longer delay in presentation. Most of the delay was due to patients awaiting symptom resolution. Forty per cent came by emergency ambulances to hospital. **Conclusion:** Our findings identified various patient characteristics that contributed to delay in presentation to hospital which should be addressed in future education campaigns.

Ann Acad Med Singapore 2002; 31:387-92

Key words: Cardiac, Chest pain, Myocardial infarction

Introduction

Acute coronary syndrome (ACS) refers to a continuum of clinical entities ranging from unstable angina pectoris (UAP) to Q-wave myocardial infarction. Mortality rates from acute myocardial infarction (AMI) have seen a worldwide decline in recent years.¹ This has been attributed to improved survival of hospitalised patients emanating from advances in acute medical care, as well as the decreasing incidence of coronary artery disease (CAD) which resulted from successful primary preventive measures. The Minnesota Heart Survey, however, observed that medical care had greater impact on mortality trends in CAD compared to primary preventive measures.² The improved in-hospital survival rate is largely attributable to the use of thrombolytic therapy, with shorter door-to-needle time yielding better outcomes. The best results are

obtained when patients are given thrombolytics within 2 hours of symptom onset.³

There has also been a decline in the incidence, mortality and morbidity associated with AMI in Singapore.⁴ Despite this observation, AMI and ischaemic heart disease remain the second commonest cause of death in Singapore.⁵ Currently, 48% of patients with AMI die each year, yielding a crude death rate of 41.5 per 100,000 population (unpublished data from Epidemiology & Disease Control Department, Ministry of Health, Singapore). Fifty-seven per cent of cardiac arrests due to AMI occur in the prehospital environment.⁶ At present, survival of out-of-hospital arrests in Singapore is poor (2.65%).⁶ It is anticipated that earlier presentation to hospital will lead to a decrease in out-of-hospital arrests and therefore better survival rates.

Delay in seeking care is commonly divided into 3 major

* Associate Consultant

**** Consultant

† Head

Department of Emergency Medicine
Singapore General Hospital

** Registrar

Department of Accident & Emergency
Changi General Hospital

*** Consultant

Department of Emergency Medicine
National University Hospital

Address for Reprints: Dr Ho Khoy Kheng, Department of Emergency Medicine, Singapore General Hospital, Outram Road, Singapore 169608.

components: prehospital patient delay, transportation delay, and delay in hospital evaluation and diagnosis prior to treatment.⁷ Studies done overseas have identified factors contributing to prehospital delay.^{3,8-10} However, these factors are usually specific to the community involved. To our knowledge, no study has been performed locally to identify the factors involved.

The aim of this study, therefore, was to identify the characteristics of patients presenting with ACS and the specific areas of prehospital delay before presenting at the Emergency Department (ED).

Materials and Methods

This is a multi-centre, prospective, cross-sectional study.

Patient Population

Patients who met the following criteria were included into the study:

- presentation at the EDs of 5 public hospitals in Singapore (Alexandra Hospital, Changi General Hospital, National University Hospital, Singapore General Hospital and Tan Tock Seng Hospital) over a period of 2 months, from 1 April to 31 May 1999;
- presentation with signs and symptoms and/or electrocardiographic changes of AMI and UAP (defined as angina occurring with minimal exertion, at rest, during sleep; new-onset angina of less than 1 month's duration or brought on by minimal exertion; or a change in a previously stable anginal syndrome; with new ST elevation >1 mm in 2 or more contiguous leads or new ST depression >1 mm in 2 or more contiguous leads); and
- were conscious, rational and able to give a coherent history.

The following patients were excluded from the study:

- patients whose chest pain was atypical in nature from the history and were diagnosed to have non-cardiac chest pain;
- patients who had stable angina; and
- patients who were confused, delirious, intubated or unconscious.

The subjects were interviewed by trained interviewers (all qualified doctors) at the EDs with a structured questionnaire. The questionnaire was planned by a group of senior emergency physicians in Singapore. It explored patient demographic data (age, sex, socio-economic status including education level and type of house, staying alone), CAD risk factors (history of ischaemic heart disease, diabetes mellitus, hypertension, hyperlipidaemia, smoking history, family history of early ischaemic heart disease), prehospital symptomatology (location of chest pain, non-pain symptoms like breathlessness, dizziness, dyspepsia, palpitation, syncope, sweating, nausea/vomiting), time

variables, patient response to chest pain and mode of transport to the hospital.

The interviewers were briefed on the format of the questionnaire. Detailed notes were drawn up to explain each component of the questionnaire including the terminology, and these were given to each interviewer. The questionnaire was pilot-tested at one of the participating EDs over a period of 3 weeks and was found to be easy to administer with no areas of ambiguity.

Time Variables

Four time variables relating to the presenting chest pain were collected:

- the worst episode of chest pain,
- time of consultation with primary care doctor,
- time ambulance was called, and
- time patient reached hospital.

Delay

Delay was defined as the time from onset of worst episode of chest pain to presentation at hospital.

Statistical Methods

Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) software. Student's *t*-test was used to evaluate the difference between groups of continuous variables and chi-square test for categorical variables. Multivariate analysis based on the linear regression model was performed on ranked timing with respect to patient characteristics which were found to be significant factors in bivariate analysis, as well as those characteristics which were previously found to have contributed to delay in presentation in the medical literature.

Results

Demographics

During the period of the study, there were 84,377 attendances at the 5 centres. Three hundred and 2 patients made 307 visits for ACS and satisfied the eligibility criteria during the period. Fifty-eight per cent were diagnosed to have AMI and 42% were diagnosed to have UAP. The subjects' age ranged from 27 to 93 years with a mean age of 61 ± 12.7 years. The majority were men (71.5%).

Close to 7% (6.8%) of subjects lived alone. The educational levels, housing type and CAD risk factors of the cohort are presented in Table I. One third of the patients had no formal education. Slightly less than one third had primary and secondary education, respectively. Only 8% had tertiary education. The majority lived in public housing. With regards to CAD risk factors, about half had past history of ischaemic heart disease and hypertension, respectively, while about one third had past history of

TABLE I: DEMOGRAPHICS OF PATIENTS WITH ACUTE CORONARY SYNDROME

Education (n = 210)	
None	70 (33.3%)
Primary	64 (30.5%)
Secondary	59 (28.1%)
Tertiary	17 (8.1%)
Housing (n = 235)	
1/2/3 room flat	93 (39.6%)
4/5 room flat	110 (46.8%)
Executive apartment	9 (3.8%)
Private residential property	23 (9.8%)
CAD risk factors	
Ischaemic heart disease (n = 301)	141 (46.8%)
Diabetes mellitus (n = 301)	104 (34.6%)
Hypertension (n = 301)	157 (52.2%)
Hyperlipidaemia (n = 283)	82 (29%)
Smoking history (n = 288)	
Present smoker	95 (33%)
Ex-smoker	56 (19.4%)
Non-smoker	137 (47.6%)
Family history (n = 266)	46 (17.3%)

Note:

- 1) CAD: coronary artery disease
- 2) n represents the actual number of respondents for the respective questions

diabetes mellitus and hyperlipidaemia, respectively. More than half were present smokers or ex-smokers. Only 17% had family history of early ischaemic heart disease. No CAD risk factor could be identified in 5.7% of the patients with ACS.

Symptomatology

Figure 1 shows the distribution of patients according to the site of their chest pain. About 18% of the subjects with ACS did not present with typical chest pain (they either had epigastric pain or no pain at all). However, central (57.7%) and left-sided (17.7%) chest pain were most commonly reported. More diabetic as compared to non-diabetic patients reported lack of chest pain (19.2% and 9.1%, respectively; $P = 0.01$).

The commonest non-chest pain symptom was breathlessness (47%) followed by sweating (42%), dizziness (19%), nausea (15%), syncope (8%), dyspepsia (2%) and palpitations (1%). Breathlessness (54%) was the commonest presenting symptom in patients who did not present with chest pain.

Timing

More patients presented on Mondays compared to other days of the week. However, when this was further analysed according to age groups, it was found that whilst younger patients (less than 60 years old) tend to present on Mondays,

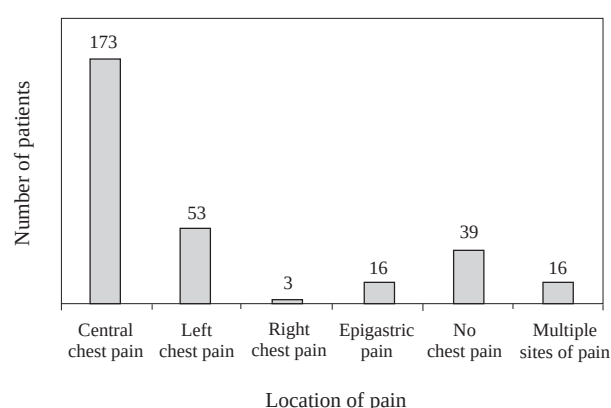


Fig. 1. Number of patients by location of pain.

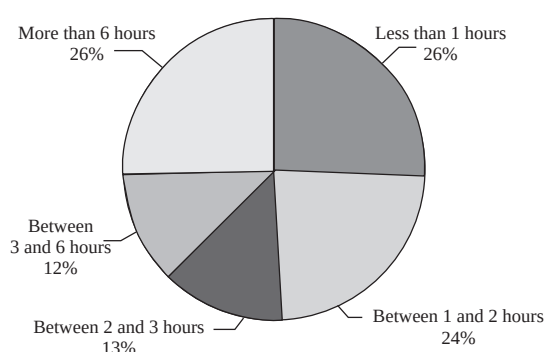


Fig. 2. Time from most severe symptom to arrival at emergency room.

the older patients presented more evenly throughout the week. For the younger patients, the median delay from the worst episode of chest pain to arrival in hospital was 2.9 hours on Mondays and 1.7 hours on the other days of the week. This was found to be not significant ($P = 0.102$).

For subjects with chest pain, the median time from the worst episode of pain to their arrival in hospital was 2.1 hours (mean, 6.3 hours; SD, 12.6 hours). A quarter of patients with chest pain presented within 1 hour from their worst episode of chest pain. Close to 24% presented between 1 and 2 hours whilst 13% presented between 2 and 3 hours from their worst episode of chest pain. About 12% of patients came between 3 and 6 hours and 26% came more than 6 hours from their worst episode of chest pain (Fig. 2).

Singapore Civil Defence Force (SCDF) emergency ambulances were the commonest mode of transportation and were used by about 40% of patients. However, private vehicles (30%) and taxis (22%) were also common modes of transportation. Private ambulances and buses accounted for 3% and 1% of the modes of transport, respectively, while 4% of patients used other modes of transportation. Patients took a median time of 32 minutes (mean, 34

minutes; SD, 13 minutes) to arrive in hospital from the time the ambulance was called.

Multivariate analysis was performed to determine what factors contributed to differences in time between symptom onset and hospital arrival. It showed that past history of diabetes mellitus ($P = 0.029$) and consultation with a primary care doctor ($P = 0.047$) were associated with a longer delay from the worst episode of chest pain while those who lived in executive apartments and private houses tend to present earlier than those who lived in smaller public flats ($P = 0.015$). There was no significant relationship with respect to age, sex, education level, living alone, past history of hypertension, past history of hyperlipidaemia, smoking history, family history of early ischaemic heart disease and having atypical symptoms.

Patients who initially presented to a primary care doctor took a median time of 1.1 hours from consultation with the a primary care doctor to arrival at the ED (mean, 2.7 hours; SD, 6.2 hours).

The patients were asked to determine the possible reasons for the delay from suggested options, in addition to giving their own reasons. They attributed various factors to their delay. The commonest was waiting for their symptoms to resolve spontaneously (33%), followed by waiting for medications to relieve symptoms (21%), waiting for relatives or friends to send them to hospital (15%) and consulting a lay person (3%). Other reasons (4%) included: prior consultation with general practitioner/cardiologist, waiting for a taxi, waiting for own transport, unspecified domestic problems and panic.

Discussion

Prehospital delay encompasses the time required to recognise the presence of symptoms, to attribute the symptoms to a condition that requires medical attention, to make a decision to seek care, to arrange transportation and finally, to make the journey to hospital. Studies have shown that between 20% and 60% of all AMIs go unrecognised due to either lack of chest pain or atypical symptoms.^{11,12} Our study found that 18.3% of patients with ACS did not have chest pain. In this group of patients, the commonest symptom was breathlessness.

The median prehospital delay times in the United States and European studies ranged from 120 to 420 minutes.¹³ Our study showed a median delay time of 126 minutes from the worst episode of chest pain.

This study found that patients with diabetes tend to present later and may not have chest pain as the presenting complaint. Hence, there is compelling evidence to target this group in creating greater awareness about the other symptoms of a coronary event.

Consultation with the patient's physician was found in other studies to be associated with a longer delay.¹⁴ In our study, consultation with a primary care doctor was also associated with a later presentation. A median time of 1.1 hours was taken from consultation with the primary care doctor to actual arrival in hospital. This has added to the time taken between the first onset of symptoms and presentation at the ED. Family physicians should be made aware in future education campaigns of the importance of early intervention in those with symptoms of ACS. They should be reminded that those who present with symptoms of ACS at the clinic should be given priority and attended to as soon as possible.

We found that those who lived in executive apartments and private houses, namely those from a higher socio-economic group, presented significantly earlier at the ED. This is in keeping with the finding from previous studies in the United States that socio-economic status affects the patients' threshold in seeking medical help.

Previous studies performed in the United States have identified older age, being female, being of lower socio-economic status, having diabetes, having symptoms at home, having mild or atypical symptoms and telephone consultation with patients' physician as factors associated with a longer delay in presenting at the ED.^{15,16} On the contrary, our study did not find age, sex, education level and having atypical symptoms to be associated with a significant delay. This can be attributed to behavioural differences among different cultures.

Many patients attributed the delay to the wait for their symptoms to resolve spontaneously or to be relieved by self-medication. Future health education campaigns should emphasise that patients with symptoms of ACS should not wait longer than 15 minutes for their symptoms to resolve before seeking medical help or calling for an ambulance. Also, they should call for an ambulance instead of waiting for their relatives or friends to send them to hospital.

Knowledge of the other symptoms of AMI was found to be deficient in the study population in the REACT trial and contributed to prehospital delay.¹⁷ Hence, the public education campaigns in the REACT trial incorporated public messages which emphasised the other symptoms of AMI as well as chest pain. Although no significant reduction in delay was found in the intervention group in the REACT trial,¹⁸ a similar public education programme in Singapore may be more successful since this is a more contained community with a less competitive media environment. The public should therefore be informed to look out for "angina-equivalent symptoms" in future public education campaigns. They should be told specifically that symptoms like breathlessness, especially when associated with sweatiness, should be taken seriously.

We found 52% of patients coming to hospital by private vehicles or taxis, underscoring the perception that these modes of transportation were the quickest way to the hospital. These modes of transportation, though at times the fastest, are certainly not the safest ways to the ED, since those with ACS are at risk of developing complications during the journey to hospital. Here again, public education, especially on how to recognise a cardiac emergency and thus, to call for an ambulance, has an important role to play. The public should be informed in future campaigns that SCDF ambulances are best equipped and staffed to handle emergencies such as these.

An interesting observation from this study is that more patients presented on Mondays than the other days of the week but this did not apply to older patients. This finding is in keeping with various other studies^{19,20} and is attributable to the stress of going to work on Mondays, when a heavier work load is anticipated and when one has to contend with the heavier rush-hour traffic. It is also postulated that patients tend to postpone seeking help on weekends when medical help is less readily available. However, this is not supported by our data which found that the delay on Mondays was not significantly longer than the other days of the week, implying that the patients did not postpone seeking help on weekends.

We wish to highlight a few limitations in our study. As in all interview-based studies, there might be recall bias and inaccuracy in recall of timing of events by the patients. Only patients who were able to give a history at the ED were interviewed. Patients who were unconscious, intubated, moribund or had collapsed and died outside the hospital from an AMI were excluded from this study. Thus, the characteristic of this latter group could not be determined. The study was carried out in public hospitals, hence, the characteristics of the patients may not be reflective of the general population. Our findings were based on ED attendance and hence, not directly comparable to population-based studies. We did not ascertain the time of symptom onset in patients without chest pain and their delay in presentation could not be analysed.

Conclusion

This study found that there was still a long delay in presentation of patients with ACS at the ED. Much of the delay can be rectified by way of inculcating a greater awareness of the signs and symptoms of ACS among members of the public. Certain groups, such as diabetics and those with CAD risk factors, should be specifically targeted. The processes involved from the time of first symptoms to the time of presentation at the ED can also be improved. Factors for the delay at the general practitioners' clinic should be identified and studied and the transport

mechanism be further improved by way of educating the public on the importance of the ambulance services.

To conclude, we recommend that health campaigns be carried out more vigorously to educate the public on how to recognise the symptoms of ACS, the importance of presenting early at the hospitals and to use the ambulances when they have such symptoms. These campaigns can be in the form of public cardio-pulmonary resuscitation programmes, mass media campaigns, or even a national health education programme. The impact of such public education programmes can be a future topic of research.

Acknowledgements

We would like to thank Dr K Y Tham of Tan Tock Seng Hospital and Dr Y Y Ng of Alexandra Hospital for their input in study design and data collection.

REFERENCES

1. Saw H S, Koo C C, Yan P. Coronary artery disease: the Singapore perspective. Singapore: Singapore Cardiac Society, 2000.
2. McGovern P G, Pankow J S, Shahar E, Doliszny K M, Folsom A R, Blackburn H, et al. Recent trends in acute coronary heart disease—mortality, morbidity, medical care, and risk factors. The Minnesota Heart Survey Investigators. *N Engl J Med* 1996; 334:884-90.
3. Newby L K, Rutsch W R, Califf R M, Simoons M L, Aylward P E, Armstrong P W, et al. Time from symptom onset to treatment and outcomes after thrombolytic therapy. GUSTO-1 Investigators. *J Am Coll Cardiol* 1996; 27:1646-55.
4. Ng T P, Mak K H, Phua K H, Tan C H. Trends in mortality, incidence, hospitalization, cardiac procedures and outcomes of care for coronary heart disease in Singapore. *Ann Acad Med Singapore* 1999; 28:395-401.
5. Singapore Department of Statistics. Singapore 1999, Statistical Highlights. Singapore: Department of Statistics, 2000.
6. Anantharaman V. Early response to heart attacks. *Heartline* 1999 July; Issue No. 6.
7. Cummins R, editor. ACLS. Dallas, Texas: American Heart Association, 1997.
8. Goldberg R J, Gurwitz J, Yarzebski J, Landon J, Gore J M, Alpert J S, et al. Patient delay and receipt of thrombolytic therapy among patients with acute myocardial infarction from a community-wide perspective. *Am J Cardiol* 1992; 70:421-5.
9. Dracup K, McKinley S M, Moser D K. Australian patients' delay in response to heart attack symptoms. *Med J Aust* 1997; 166:228-9.
10. Ell K, Haywood L J, Sobel E, deGuzman M, Blumfield D, Ning J-P, et al. Acute chest pain in African Americans: factors in the delay in seeking emergency care. *Am J Public Health* 1994; 84:965-70.
11. Kannel W B, Abbott R D. Incidence and prognosis of unrecognised myocardial infarction. An update on the Framingham Study. *N Engl J Med* 1984; 311:1144-7.
12. Sigurdsson E, Thorgeirsson G, Sigvaldason H, Sigfusson N. Unrecognised myocardial infarction: epidemiology, clinical characteristics, and the prognostic role of angina pectoris. The Reykjavik Study. *Ann Intern Med* 1995; 122:96-102.
13. Bolte H D. Coronary heart disease: new therapeutic developments. *Heartbeat* 1987; 4:4-5.

14. Hedges J R, Mann N C, Meischke H, Robbins M, Goldberg R, Zapka J. Assessment of chest pain onset and out-of-hospital delay using standardized interview questions: the REACT Pilot Study. Rapid Early Action for Coronary Treatment (REACT) Study Group. *Acad Emerg Med* 1998; 5:773-80.
15. Simons-Morton D G, Goff D C, Osganian S, Goldberg R J, Raczynski J M, Finnegan J R, et al. Rapid early action for coronary treatment: rationale, design, and baseline characteristics. *Acad Emerg Med* 1998; 5:726-38.
16. Dracup K, Moser D K. Beyond sociodemographics: factors influencing the decision to seek treatment for symptoms of acute myocardial infarction. *Heart Lung* 1997; 26:253-62.
17. Goff D C Jr, Sellers D E, McGovern P G, Meischke H, Goldberg R J, Bittner V, et al. Knowledge of heart attack symptoms in a population survey in the United States. The REACT Trial. *Arch Intern Med* 1998; 158:2329-38.
18. Luepker R V, Raczynski J M, Osganian S, Goldberg R J, Finnegan J R, Hedges J R, 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.
19. Gneccchi-Ruscone T, Piccaluga E, Guzzetti S, Contini M, Montano N, Nicolis E. Morning and Monday: critical periods for the onset of acute myocardial infarction. The GISSI 2 Study experience. *Eur Heart J* 1994; 15:882-7.
20. Willich S N, Lowel H, Lewis M, Hormann A, Arntz H R, Keil U. Weekly variation of acute myocardial infarction. Increased Monday risk in the working population. *Circulation* 1994; 90:87-93.