

Myocardial Infarction: Sex Differences in Symptoms Reported to Emergency Dispatch

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Abstract

Background

Emergency management of myocardial infarction (MI) is time critical, because improved patient outcomes are associated with reduced time from symptom onset to definitive care. Previous studies have identified that women are less likely to present with chest pain. We sought to measure the effect of sex on symptoms reported to the ambulance dispatch and ambulance times for MI patients.

Methods

The Western Australia Emergency Department Information System (EDIS) was used to identify patients with emergency department (ED) diagnoses of MI (STEMI and NSTEMI) who arrived by ambulance between Jan 1 2008 and Oct 31 2009. Their emergency telephone calls to the ambulance service were transcribed to identify presenting symptoms. Ambulance operations data were used to examine ambulance times. Sex differences were analysed using univariable and age-adjusted multivariable techniques.

Results

Of 3,329 MI patients who presented to Perth EDs, 2,100 (63.1%) arrived by ambulance. After pre-defined exclusions, 1,681 emergency calls were analysed. Women (n=621, 36.9%) were older than men ($p < 0.001$) and even after age-adjustment were less likely to report chest pain (OR=0.70; 95% CI 0.57, 0.88).

After age-adjustment, ambulance times did not differ between male and female patients with chest pain. Women with chest pain were less likely than men to be allocated a 'priority 1' (lights and sirens) ambulance response (OR=0.39; 95% CI 0.18, 0.87).

Conclusion

Ambulance dispatch officers (and paramedics) need to be aware of potential sex differences in MI presentation in order to ensure appropriate ambulance response.

1. Background

Current guidelines^{1,2} recommend prompt activation of the emergency medical service (EMS) if a person is experiencing symptoms suggestive of a myocardial infarction (MI). The emergency ambulance is usually the quickest mode of transport to hospital, especially in urban areas. In addition, paramedics are trained to initiate treatment and equipped to treat life threatening cardiac arrhythmias should they occur. The time from onset of MI symptoms to treatment in a hospital influences survival, and rapid reperfusion of an obstructed coronary artery is associated with reduced mortality.³ Additionally, current Australian and American College of Cardiology and American Heart Association (ACC/AHA) guidelines for the treatment of ST-segment elevation myocardial infarction (STEMI) recommend the time from first medical contact to percutaneous coronary intervention (PCI) to be less than 90 minutes,^{4,6} with suggestions EMS to PCI time should be less than 90 minutes as well.^{4,5,7} Studies have consistently shown that this rarely occurs,^{8,9} with pre-hospital median delays ranging from 84 to over 400 minutes.⁹

Many studies have investigated reasons for delay in seeking treatment^{9,10} and underuse of emergency ambulances^{11,12} in MI patients. However, no studies were found that have investigated symptoms of MI reported in the telephone call to emergency dispatch as a possible source of delay. Correct recognition of symptoms of an MI is crucial for the ambulance dispatcher to allocate a 'priority 1' (lights and sirens) ambulance response. Most ambulance dispatch systems are primed to rapidly respond to mention of chest pain as a symptom, but not all MI patients experience chest pain as a symptom.¹³ Previous studies have identified women are less likely to present with chest pain^{14,15} and have prolong prehospital delays.^{8,9} Our primary aim was to compare symptoms, in particular chest pain, reported during the emergency telephone call for men and women with MI. We also compared the relationship between symptoms reported and ambulance response in men and women, with adjustment for age.

2. Methods

Study Setting and Cohort

This retrospective cohort study reviewed emergency telephone calls of all adult patients with an emergency department (ED) discharge diagnosis of MI transported by St John Ambulance (SJA) in Western Australia (WA) to one of the seven Perth metropolitan EDs between January 1 2008 and October 31 2009. The Perth metropolitan area covers an area over 5,000 square kilometers¹⁶ and has a population of 1.7 million, with 9.2% aged ≥ 65 years and 3% aged ≥ 75 years.¹⁷ Two and a half per cent of the population are indigenous (Aboriginal and Torres Strait Islander), with the overseas born population largely of Asian (23%) and European (19%) descent.¹⁷ SJA(WA) is the single provider of prehospital emergency care and transport for WA and is staffed by paramedics who attend over 200,000 calls per year.¹⁸ In WA (as for the whole of Australia) the emergency telephone number is 'triple zero' ('000').¹⁸ Calls are answered by an operator who asks whether the emergency requires 'police, fire or ambulance'. Calls requesting 'ambulance' are immediately transferred to the Ambulance Operations Centre located at SJA(WA) headquarters in Perth. All telephone calls are recorded and stored permanently. At the time of the study SJA(WA) ambulance dispatch operators completed a two week in-house course in dispatch and prioritizing ambulances. The dispatch operators were not medically trained. The dispatch operator followed a written in-house protocol asking a series of scripted questions that establish location of the incident, phone number of the caller, chief complaint, and other complaint-specific questions. A Computer Aided Dispatch (CAD) System automatically records time the call was received, time the call was dispatched to the ambulance, and time the ambulance arrived on scene, departed the scene and arrived at the hospital. A priority is allocated to each call: 'Priority 1' (lights and sirens) response represents an emergency; 'Priority 2' response represents an urgent call; 'Priority 3' response represents a non-urgent call.¹⁸ Priority allocation from scene to hospital is determined by the paramedic, based on

patient's clinical status. During the study period, current practice of paramedics did not include 12-lead electrocardiogram acquisition or direct transfer to a percutaneous coronary intervention laboratory.

All adult patients with an ED discharge diagnosis of MI (STEMI and non-STEMI) who were transported to ED by SJA(WA) during the study period were identified from the Perth Emergency Department Information System (EDIS). EDIS is a real-time patient tracking system containing utilization and patient disposition data for each ED in Perth.¹⁹ The principal clinical diagnosis is a mandatory field entered by clinical staff on patient discharge from ED. The clinical diagnosis is electronically mapped to the International Classification of Diseases Version 10 codes (ICD-10-AM).²⁰

Patient details identified from EDIS were used to retrieve the emergency phone call made to SJA(WA), which was saved as a '.wav' file. Patient symptoms, as described by the caller, were transcribed verbatim by one author (LLC). To assess transcription accuracy a random sample of 200 phone calls were reviewed. Of the 200 phone calls, 197 were accurate indicating 98.5% data entry accuracy. Initial lists of possible symptoms of MI were created from an extensive literature search and clinical expertise, with additional symptoms added as required from the telephone transcripts. Symptoms were coded 'yes' if stated in the telephone call or 'no' if declared absent or not stated. Multiple symptoms for individual patients were possible. Additional information pertaining to the call was collected, including sex of the caller and their relationship to the patient, and location of the call.

The SJA(WA) patient database contains computerised records of all cases attended by ambulances in WA from the CAD system and the paramedic completed patient care record (PCR), which includes dispatch priority, clinical problem codes and clinical management. The EDIS data was linked to the SJA(WA) database, together with the transcribed symptoms from the emergency phone call to SJA. Only the index hospital admission was included for patients who subsequently transferred to a second hospital. Patients were excluded if they

arrived by private transport, Royal Flying Doctor Service, helicopter, or other voluntary transport services.

Statistical Methods

Data were presented as frequencies with percentages, or means \pm standard deviations. Ambulance times were described using means, standard deviations, medians and inter-quartile ranges. Comparisons of baseline characteristics between men and women were performed using chi-square tests for categorical variables, the Mann-Whitney test for medians, and Student's *t* tests for continuous variables.

For each symptom of MI, logistic regression was used to estimate the odds ratio (OR) and its 95% confidence interval (CI) for the symptom being reported by women compared to men. Models were subsequently adjusted for age (as a continuous variable) and age/sex interaction was tested. For the symptom chest pain, a stratified analysis that dichotomised age into < 70 years and ≥ 70 years, with men aged < 70 years as the comparison group was also conducted. Age 70 was selected as the cut-off based on previous research which demonstrated that presentation with chest pain is less common in individuals over 70 years of age.^{21,22}

Linear regression was used to model sex differences in ambulance times for 'chest pain' and patients 'without chest pain'. Because model residuals were skewed, time intervals were log transformed. Beta coefficients (and 95% CIs) that estimate the difference in mean log time were reported. For 'chest pain' and patients 'without chest pain' logistic regression was used to compare the odds of women being dispatched as a 'priority 1' (lights and sirens) ambulance response with those of men. Both linear and logistic regression modelling included adjustment for age (as a continuous variable) and testing for age/sex interaction.

All statistical analyses were performed in PASW Release Version 17.0 (IBM SPSS Inc., 2008, Chicago, IL, www.spss.com). Two-sided p-values < 0.05 were considered

significant. Ethics approval was obtained for this study from the University of Western Australia, number RA/4/1/2428.

3. Results

During the study period, January 2008 to October 2009, of the 3,329 (women, n = 1115; men, n = 2214) patients who were discharged from a Perth ED with a diagnosis of MI, 63.1% (women, n = 759; men, n = 1341) arrived by ambulance. More women (68%) than men (60%) arrived by ambulance ($p < 0.001$). Following exclusions, as detailed in Figure 1, 1,681 emergency telephone calls to SJA(WA) were analyzed. Of these, 621 (36.9%) were female patients.

Women were older than men (mean age 77.6 vs. 69.1 years, $p < 0.001$). Differences in the relationship of caller to patient and the location of patient at time of the emergency call were found between men and women (Table 1).

Sex differences in chest pain reported by MI patients in the emergency telephone call

As shown in Table 2, women were less likely than men to report chest pain (54% vs. 69%; OR=0.54; 95% CI 0.44, 0.67; $p < 0.001$), even after age adjustment (OR=0.70; 95% CI 0.57, 0.88; $p = 0.002$). There was no significant interaction between sex and age ($p = 0.10$), however in age-stratified analysis, men ≥ 70 years (OR=0.48; 95% CI 0.37, 0.63; $p < 0.001$) and women ≥ 70 years (OR=0.28; 95% CI 0.22, 0.37; $p < 0.001$) were less likely to have reported chest pain when compared with men < 70 years.

Differences in other symptoms reported by MI patients in the emergency telephone call

As shown in Table 2, women were more likely than men to present with vomiting (7.4% vs. 4.9%; OR=1.55; 95% CI 1.03, 2.34; $p = 0.04$), even after age adjustment (OR=1.57; 95% CI 1.02, 2.41; $p = 0.04$). Greater odds of vomiting in women persisted in subgroup analyzes of chest pain only patients, but not in patients who did not report chest pain.

In a subgroup analysis of patients who did not report chest pain there were no statistically significant differences between other reported symptoms. The most common symptoms in this subgroup included: shortness of breath (38% women vs. 32% men); a fall (17% women vs. 11% men); syncope, collapse or unconsciousness (17% women vs. 18% men); feeling unwell (11% women vs. 8% men); weakness (9% women vs. 7% men); confusion (8% women vs. 5% men); and vomiting (8% women vs. 8% men).

Sex differences in Ambulance times

As shown in Figure 2, compared with men, women had statistically significantly longer median on-scene time (19 vs. 17.7 minutes; $p < 0.001$) and call to hospital time (48 vs. 46.5 minutes; $p = 0.009$). The greatest component of pre-hospital time for both men and women was on-scene time.

As shown in Table 3, there were no sex differences in any component of ambulance times, except for on-scene time for the subgroup of MI patients with chest pain. The mean on-scene time for women was one minute longer than it was for men ($p = 0.001$), but after age-adjustment, mean on-scene time did not differ by sex.

Sex differences in priority allocation

As shown in Table 4, women with chest pain were less likely than men to be allocated a 'priority 1' (lights and sirens) ambulance response (98.3% vs. 95.5%; OR=0.36; 95% CI 0.17, 0.78; $p = 0.009$), even after age-adjustment (OR=0.39; 95% CI 0.18, 0.87; $p = 0.02$). Women were less likely than men to be allocated a 'priority 1' ambulance response from the scene to the hospital (17.5% vs. 25.6%; OR 0.62; 95% CI 0.44, 0.86; $p = 0.004$), but after age adjustment this priority response did not differ by sex.

Sex differences in total time from emergency call to hospital for each priority response

As shown in Table 5, there were no sex differences in median total time from emergency call to hospital for each priority response for patients with and without chest pain. There was an increase in total call to hospital time for those patients allocated a 'priority 2 or 3' response compared to a 'priority 1' response.

Discussion

To our knowledge, this is the first study to analyze sex differences in symptoms reported during the emergency telephone calls for (ED confirmed) MI patients. Even after age-adjustment women were much less likely than men to report chest pain. Additionally, on-scene time and total ambulance time was found to be statistically significantly longer for women than men. Women were also less likely to have a 'priority 1' ambulance response compared to men, and median total time from emergency call to hospital for men and women who were allocated a 'priority 2 or 3' ambulance response was longer. Finally, less than 2/3 of MI patients utilized EMS for transport to the hospital. Other studies that have examined emergency telephone calls have either not focused on confirmed MI cases or have not investigated sex differences. We feel these findings add to the literature on sex differences in MI patients transported by EMS and offer an opportunity to improve care provided to female MI patients.

Sex differences in chest pain

The reasons why women with MI experience less chest pain and are more likely to report vomiting than men are not entirely understood. Numerous studies have examined sex differences in symptom presentation of MI, but most have abstracted data from medical records or interviewed patients post MI. Recent studies^{23,15} analysis found women were less likely than men to experience chest pain. Men and women with MI may have different locations of obstructing lesions,^{24,25} and women have been reported to have less obstructive

coronary disease at angiography.²⁶⁻²⁸ This may lead to different combinations of sympathetic and vagal stimulation resulting in differences in the reporting of pain and vomiting.^{29,30} Also, it is well known that women with MI are older^{15,29,26} and have more co-morbid conditions such as diabetes,^{15,29,26} hypertension^{15,26,31} and heart failure,^{15,26,31} and these conditions have been associated with MI without pain.^{29,32,33} For patients who did not report chest pain, there was no sex differences in the symptoms reported, possibly due to insufficient statistical power due to small numbers. The most common non-chest pain symptoms for both men and women were shortness of breath, a fall, or collapse, syncope or unconsciousness. These symptoms are similar to those found in a study¹³ from a large multi-centre prospective trial in 1993 of patients presenting to ED with suspected Acute Coronary Syndrome but without chest pain. The most common symptom at presentation in this study was shortness of breath and syncope.¹³

Sex differences in ambulance times

Although on-scene time and total ambulance time intervals were statistically significantly longer in women compared with men, this is unlikely to be clinically significant. Other studies analysing ambulance times have found the longest component of pre-hospital time is on-scene time.³⁴⁻³⁶

Only one study³⁵ reported sex differences in ambulance times and found women were delivered to hospital 2.3 minutes slower on average than men.

Sex differences in priority allocation

For patients with chest pain, even after age adjustment, women were less likely than men to be allocated a 'priority 1' ambulance response. Other studies have found women with MI were less likely than men to be allocated an Advanced Life Support ambulance (76% vs. 92%)³⁷ or a 'priority 1' ambulance (67% vs. 81%).³⁸ As to be expected irrespective of chest pain status we have shown both men and women with MI who were not allocated a 'priority 1' ambulance response had longer median total time from emergency call to hospital. Further

research is required to investigate strategies to better identify patients who do not present with the classic MI symptoms, otherwise they are unlikely to be allocated to a high priority response and thus will have increased delay to definitive treatment.

On closer analysis of specific phone calls the reason why some of the patients with chest pain were not allocated a 'priority 1' ambulance response was they were not experiencing chest pain at time of the emergency call. Some had experienced chest pain, taken sublingual nitrate, and their chest pain had resolved. Several had experienced chest pain earlier and consulted their general practitioner, who identified changes on the electrocardiogram or a positive test for troponin. While telephone dispatchers were instructed to ask if the patient was experiencing chest pain at time of the call, some dispatchers allocated a 'priority 2' response to patients if their chest pain had resolved, contrary to existing SJA(WA) policy. Even though allocating a 'priority 2' response was incorrect, after these 19 calls were removed from the analysis, we found no difference in 'priority 1' response between men and women. Recently, SJA(WA) has introduced dispatch protocols (Medical Priority Dispatch System³⁹ – Version 12 AUE-std) with specific scripted dispatcher-asked questions, which ensures all patients who have had chest pain are allocated a 'priority 1' response. Finally, this study found a persistent underuse of emergency ambulance for the whole cohort (63%), with significantly more women (68%) than men (60%) using an ambulance. This finding is comparable to the 53% to 70% of MI patients transported by emergency ambulances in other studies.^{11,12} Also, consistent with other studies, women were more often transported by ambulance than men, possibly a reflection of the fact women tended to be older.^{12,40} Nonetheless, reasons why more than 35% of all MI patients in Perth chose not to call an ambulance is of concern and warrants further exploration. It is recommended that all patients experiencing symptoms of an MI call the emergency ambulance.^{1,2}

Limitations

The strength of our study is that it is a population-based cohort of patients with ED-confirmed MI (STEMI / nonSTEMI), drawn from all public hospital EDs in the Perth metropolitan area. Whilst we are confident in sex differences found in MI patients experiencing chest pain, some caution is required in the interpretation of sex differences in other symptoms, including vomiting. It is important to note that the ambulance dispatch officer did not attempt to elicit the full spectrum of symptoms experienced by the patient. If chest pain was mentioned, the need for a 'priority 1' response was established and further questioning about other symptoms was unlikely. As such, patients without chest pain were likely to report more of the other symptoms.

Also, SJA(WA) had no formalised or routine call taker quality assurance program undertaken during the study period. Variations may have been caused by different subjective interpretations of the symptoms reported between dispatch operators. We also need to highlight 'the caller' was often not a first party caller (self) and the majority of calls were from a second or third party caller. In three other studies⁴¹⁻⁴³ the first party caller was between 5 – 11%, as such we would suggest our data is similar. Another limitation is that we did not include MI patients for whom an ambulance was called, but were pronounced dead by the paramedics and not admitted to ED. Whilst unlikely, it is possible that such patients may have reported a different pattern of symptoms. Also the ambulance record (n=26) and the emergency telephone call (n=198) were missing for a number of patients and could not be analyzed.

We were also unable to identify patient co-morbid conditions or location of the obstructed coronary artery that may be associated with atypical symptom presentation of MI. However, our primary research question was to determine sex differences in symptoms (particularly chest pain) during the emergency telephone in MI patients and examine the effect of such differences on ambulance response.

4. Conclusion

During the emergency telephone call for an ambulance, women with an ED confirmed diagnosis of MI were less likely than men to report chest pain as a symptom. Women with chest pain were also less likely to be allocated a 'priority 1' (lights and sirens) ambulance response. Overall ambulance times did not differ between men and women, although women had a marginally longer on-scene time. Ambulance dispatch officers and paramedics need to be aware of the potential sex differences in MI presentation, in order to ensure appropriate ambulance response.

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Declaration of interest

Linda Coventry and Alexandra Bremner have no conflict of interest to disclose.

This study was undertaken as part of Linda Coventry's PhD programme of research, supervised by Judith Finn, Alexandra Bremner and Ian Jacobs.

Ian Jacobs has the following conflict to disclose:

Ian is the Clinical Services Director, St John Ambulance (Western Australia).

Judith Finn has the following conflict to disclose:

Judith receives partial salary support from St John Ambulance (WA) for the purpose of conducting pre-hospital research, however SJA(WA) played no role in the study design, conduct, or interpretation of results.

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