ORIGINAL ARTICLE

Correlation between Clinical and Educational Factors and Delayed Hospital Arrival in Myocardial Infarction

Andressa Sardá Maiochi Takagui,[1] Daniel Medeiros Moreira,[1,2] Ana Teresa Glaser Carvalho,[1] Thays Fraga Duarte,[1] Roberto Léo da Silva,[1] Tammuz Fattah[1]

Instituto de Cardiologia de Santa Catarina (ICSC),[1] Universidade do Sul de Santa Catarina (UNISUL),[2] Florianópolis, SC – Brazil

Abstract

Background: Acute myocardial infarction is one of the main causes of morbidity and mortality in the world, and one of the factors with the greatest prognostic impact is early specialist care, but there are still many factors that delay patient's arrival at the hospital.

Objective: To correlate social, educational, cognitive and clinical factors with time to hospital arrival after the onset of acute myocardial infarction's first symptoms.

Methods: Time interval to search for medical care was measured by patient's report of the onset of infarction's first symptoms and hospital admission verified through electronic medical data of the emergency service. The correlation between delta-T and other variables was performed through Kendall's correlation. Values of $p < 0.05$ were considered statistically significant.

Results: There was no correlation between delta-T and scholarity, or between delta - T and Mini Mental State Examination performance, as well as no association between the presence of hypertension, diabetes mellitus, dyslipidemia, family history, sedentary lifestyle or smoking with arrival time at the hospital. Comparisons between delta-T and marital status were also not statistically significant. Transfer from another health service and city of origin were the most determinant delay factors in our population's arrival at the hospital.

Conclusion: The present study suggests that, in our population, educational, social and cognitive factors are not directly related to the delay in arriving at the hospital. (Int J Cardiovasc Sci. 2018;31(2)107-113)

Keywords: Myocardial Infarction; Indicators of Morbidity and Mortality; Myocardial Ischemia; Chest Pain; Emergency Medical Services; Risk Factors.

Introduction

Myocardial ischemia and, consequently, acute myocardial infarction (AMI) are mentioned as one of the main causes of worldwide morbimortality. Estimated at around 30% in the 1950s, hospital mortality due to AMI showed a significant decline in the last decades, both in Europe and the United States, as well as in Brazil.[1-3] Currently, with the use of thrombolytics or primary angioplasty, its occurrence is estimated at between 8 and 10%, mainly due to the benefits of early recanalization of the coronary artery related to the event.

The Delta Time (Δ-T) between the onset of the first symptoms and the arrival at the emergency service is directly related to the disease morbimortality, and rapid specialized care is essential. However, it is estimated that only 20% of individuals with chest pain reports reach the emergency unit within 2 hours of symptom onset.[4]

Among the prehospital factors that hinder the early care of AMI are: the patient's lack of awareness of chest pain symptoms as being a sign of infarction; attributing the symptoms to other conditions or to a

Mailing Address: Andressa Sardá Maiochi Takagui
Rua Olívio Domingos Brugnago, 195 – Vila Nova. Postal Code: 89259-260, Jaraguá do Sul, SC – Brazil
E-mail: dessa_maiochi@hotmail.com; andressa.s.maiochi@gmail.com

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common illness (influenza or muscle pain, for instance); lack of knowledge on the benefits of early diagnosis and treatment; and non-availability of standardized extra-hospital emergency care to all.[5]

Previous studies have already shown a correlation between low level of schooling and delay in seeking medical care after chest pain onset.[6] Supposedly, individuals with greater intellectual capacity would be more capable to recognize their symptoms as potentially severe and would seek health care earlier.

This study aims to correlate social, educational, cognitive and clinical factors with the time of arrival at the hospital after the onset of AMI first symptoms.

Methods

This research used the Catherine database Heart Study, a prospective cohort study with registration on ClinicalTrials.gov NCT03015064, which exclusively used its database.

Briefly, this is a prospective cohort in which patients from Instituto de Cardiologia de Santa Catarina (ICSC) with a diagnosis of the first AMI are being evaluated. Data have been collected since July 2016, and the study is expected to be completed by December 2020, also intending to include other public hospitals in the State of Santa Catarina. All patients included in the database until December 2016 participated in the current analysis.

The inclusion criteria were age older than 18 years; AMI diagnosis established by the presence of suggestive precordial pain, associated with electrocardiogram with a new ST-segment elevation at the J point in two contiguous leads, with limits of ≥ 0.1 mV in all leads, except for leads V2 and V3, to which the limits of ≥ 0.2 mV in men ≥ 40 years, ≥ 0.25 mV in men < 40 years and ≥ 0.15 mV in women are applied; or the presence of precordial pain suggestive of AMI associated with elevation in troponin I or creatine kinase MB Isoenzyme (CKMB) levels above the 99th percentile of the upper reference limit. The exclusion criteria considered for the study were the absence of the established criteria for AMI, presence of previous AMI, and disagreement with the Free and Informed Consent Terms.

Data collection was performed through an individual interview and complemented with data obtained from the Micromed® electronic medical record. The questionnaire included different clinical and social variables, as well as a specific test for cognitive assessment, the Mini-Mental State Examination (MMSE), which was applied to all study patients during the length of stay at the institution, usually between the second and the fifth days. Among the social variables, gender, age, marital status, origin and level of schooling were assessed. The clinical variables included the presence of classic risk factors, physical activity, drug and alcohol consumption, and time of symptom onset, among others. Additionally, all study participants are being followed up at 30 days and 1 year, through medical records or by telephone contact, when the records are not available, to assess relevant clinical events such as acute intrastent thrombosis, restenosis, AMI, unstable angina, cerebrovascular accident, bleeding, rehospitalization and death. Such assessments, however, will be addressed in a future study of the Catarina Heart Study.

The primary outcome of this study was the correlation between years of schooling with the Δ-T, characterized by the interval between the onset of the first ischemic symptoms and the time of admission at the referral hospital emergency unit, as documented in the electronic medical record. The secondary outcomes were the correlation between Δ-T and MMSE performance, as well as the association between Δ-T and marital status and Δ-T and the presence of classic risk factors for coronary artery disease (systemic arterial hypertension, diabetes mellitus, dyslipidemia, smoking, sedentary lifestyle and family history).

Statistical analysis

For the analytical evaluations, a sample of 92 patients was calculated to find a correlation of 0.3, with 90% power and alpha of 0.05. The obtained data were tabulated and analyzed through the Statistical Package for Social Science (SPSS), version 13.0 for Windows. Continuous variables were expressed as mean and standard deviation, or median and interquartile range, and evaluated by the two-tailed Mann-Whitney U test. Normality was assessed by the Kolmogorov-Smirnov test. Age was the only variable that showed a normal distribution and, thus, it was expressed as mean and standard deviation. Variables such as level of schooling, Δ-T and MMSE performance did not show a normal distribution, being expressed as median and interquartile range. Associations between quantitative variables were evaluated by the Kendall correlation, since the correlated variables did not have a parametric distribution. Categorical variables were expressed

as numeric values with the respective percentages, and analyzed by the chi-square test or Fisher's test. Values of $p < 0.05$ were considered significant, and confidence intervals were set at 95%.

The study was carried out in accordance with Resolution 466/2012 of the National Health Council and was approved by the institution's ethics committee. All participants signed the Free and Informed Consent form.

Results

We evaluated 107 patients who were admitted to the ICSC from July to December 2016, in addition to a single patient admitted to another public hospital in the city of Florianópolis, Santa Catarina, Brazil. The sample consisted of 75 men (69.4%), and the mean age was 59.32 ± 11.57 years. Most of them were married/in a stable relationship (69.4%) and self-reported their ethnicity as White (88.9%). Regarding the origin, 29 patients (26.9%) came from São José (SC), where the institution is located, while 79 (73.1%) came from other municipalities. These and other characteristics of the studied population are shown in table 1.

The median duration of schooling was 5 years, with an Interquartile Range (IQR) of 3 to 8 years. The median score in the MMSE was 25 (IQR: 22 to 27).

The median Δ-T was 4 hours and 51 minutes (IQR: 2 hours and 11 minutes - 13 hours and 45 minutes), with a minimum Δ-T of 26 minutes, and a maximum of 90 hours and 39 minutes. These values were significantly lower when only ST-elevation myocardial infarctions were considered, with a median of 3 hours and 49 minutes (IQR: 1 hour and 56 minutes - 11 hours and 46 minutes), when compared to 9 hours and 40 minutes (IQR: 2 hours and 40 minutes - 18 hours and 01 minute) for non-ST elevation MI (NSTEMI) ($p = 0.04$). Additionally, patients from São José took less time to arrive at the hospital, with a median of 2 hours and 17 minutes (IQR: 1 hour and 21 minutes - 12 hours and 19 minutes), when compared with the median of 6 hours and 17 minutes (IQR: 2 hours and 42 minutes - 14 hours and 03 minutes) from other municipalities ($p = 0.02$); patients who were transferred from other health services had a greater median time (9 hours and 04 minutes; IQR: 3 hours and 19 minutes - 16 hours and 33 minutes) compared to those who spontaneously came to the hospital (2 hours and 57 minutes ; IQR: 1 hour and 45 minutes - 6 hours and 07 minutes), with $p = 0.007$.

Table 1 – Characteristics of the studied population

Variables	Values
Age, mean ± SD	59.32 ± 11.57
Male, n (%)	75 (69.4)
Ethnicity n (%)	
White	96 (88.9)
Black	3 (2.8)
Mixed-race	9 (8.3)
Marital status, n (%)	
Single	7 (6.5)
Married/in a stable relationship	75 (69.4)
Divorced	14 (13.0)
Widowed	12 (11.1)
STEMI, n (%)	51 (47.2)
Origin, n (%)	
São José	29 (26.9)
Other municipalities	79 (73.1)
Referred, n (%)	57 (52.8)
Risk factors, n (%)	
Systemic arterial hypertension	62 (57.4)
Diabetes Mellitus	24 (22.2)
Dyslipidemia	35 (32.4)
Family history, n (%)	44 (40.7)
Smoker	34 (31.5)
Ex-smoker	31 (28.7)
Sedentary lifestyle	59 (54.6)

SD: standard deviation; STEMI: ST-elevation myocardial infarction

There was no correlation between years of schooling and Δ-T ($r = -0.032$, $p = 0.645$), or between MMSE performance and Δ-T ($r = -0.073$; $p = 0.283$), even when infarctions with and without ST-elevation were evaluated separately (Table 2). When the risk factors were analyzed, there was no association between the presence of systemic arterial hypertension, diabetes mellitus, dyslipidemia, family history, smoking or sedentary lifestyle with time of arrival at the hospital (Table 3). Comparisons between Δ-T and marital status

Table 2 – Correlations between arrival time, schooling and Mini-Mental State Examination (MMSE) *

Type of AMI	Δ-T					
	STEMI		NSTEMI		All	
	Value of r	Value of p	Value of r	Value of p	Value of r	Value of p
Schooling level	- 0.009	0.933	- 0.067	0.495	-0.032	0.645
MMSE	- 0.061	0.545	- 0.140	0.146	- 0.073	0.283

** Evaluated by Kendall's correlation. STEMI: ST-elevation myocardial infarction; NSTEMI: non-ST-elevation myocardial infarction*

Table 3 – Comparisons between the presence of risk factors and time of arrival

Risk Factor	Δ-T*		
	Yes	No	p value†
Systemic arterial hypertension	5h10min (2h13min - 12h44min)	4h20min (2h10min - 16h41min)	0.805
Diabetes Mellitus	3h53min (1h54min - 16h30min)	5h03min (2h15min - 13h19min)	0.979
Dyslipidemia	7h02min (2h08min - 17h12min)	4h20min (2h17min - 12h19min)	0.413
Family history	4h00min (1h46min - 9h58min)	6h17min (2h24min - 18h22min)	0.093
Smoking	5h20min (2h44min - 13h39min)	4h47min (2h07min - 14h05min)	0.843
Sedentary lifestyle	4h49min (2h07min - 12h44min)	6h43min (2h37min - 16h32min)	0.359

** Values are shown as median (interquartile range); †assessed by the two-tailed Mann-Whitney test. h: hours; min: minutes*

were also not statistically significant, with married individuals showing a median time of 4 hours and 49 minutes (IQR: 2 hours and 07 minutes - 12 hours and 9 minutes), whereas the single, divorced and widowed individuals showed a median time of 5 hours and 20 minutes (IQR: 2 hours and 47 minutes - 17 hours and 59 minutes), with p = 0.335.

There was, however, a statistically significant association between the presence of systemic arterial hypertension and a worse performance in the MMSE, with the patients with systemic arterial hypertension obtaining a median score of 23 (IQR: 20.75 - 26.00), whereas those without systemic arterial hypertension had a median score of 27 (IQR: 25-28), with p < 0.001. The hypertensive group also had lower educational levels, with patients with systemic arterial hypertension showing a median of 4 years of schooling (IQR: 2 - 8), whereas those without systemic arterial hypertension had 8 years (IQR: 4 - 11), p = 0.002. Moreover, the women in our sample had fewer years of schooling, with a median of 4 years (IQR: 2.5 - 7.5), compared to men, who had a median of 7 years (IQR: 4-8), with p = 0.04. The MMSE score was 23 (IQR: 21-26) for women and 26 (IQR: 23-28) for men (p = 0.04).

Discussion

This study showed no correlation between the time of arrival at the hospital and the level of schooling or performance in the MMSE, as well as no association between Δ-T and marital status, or between Δ-T and the presence of risk factors for coronary disease.

These data are different from those reported by Franco et al.,[7] who assessed 112 patients with STEMI, with baseline characteristics similar to ours and showed a weak to moderate correlation (r = 0.24) between Δ-T and level of schooling. The comparison of marital status by the same authors showed that married, divorced and widowed patients had a higher Δ-T than the single individuals, but also without statistical significance (p = 0.06).

The MMSE median score found in our population was of 25, noting that it is considered a normal score when ≥ 27, and cognitive dysfunction (dementia) when ≤ 24 or ≤ 17 for illiterate or time of schooling less than 4 years.[8] This result reflected the low educational levels in our sample, which were even lower in the group of women.

The Δ-T medians found in our study were 4 hours 51 minutes for the general population and 3 hours and 49 minutes, considering only patients with STEMI, similar to that reported by other national studies, such as the one by Bastos et al.[4] in São José do Rio Preto (4 hours and 08 minutes) and by Franco et al.[7] in Porto Alegre (3 hours and 11 minutes). Our result is also similar to that found in an international study, which found a median Δ-T of 3 hours and 30 minutes in the United States, 4 hours and 24 minutes in South Korea, 4 hours and 30 minutes in Japan and 30 minutes in England.[9] However, our Δ-T is still much higher than that recommended by the American Heart Association guidelines.[10] When available in a timely fashion (< 2 hours), primary angioplasty results in a benefit regarding mortality of 25 to 30%. The benefit of thrombolysis is maximal when administered within 2 hours of symptom onset, especially within the first 70 minutes, since resistance to thrombolysis is time-dependent.[11]

The GRACE study found that individuals with a previous history of AMI had arrived earlier at the hospital when compared to those without a history of angina, diabetes, heart failure, or hypertension.[12] Our study did not include patients with prior AMI, but most individuals were aware of at least one risk factor for coronary heart disease and it was expected that they would seek care faster because they associated their symptoms with the heart; however, this was not confirmed in this study. Nevertheless, it was observed that the patients with arterial hypertension had a worse performance in the MMSE. This result may be simply related to the lower level of schooling observed in this group, or even suggest that hypertension is a factor associated with the identified cognitive decline. The role of systemic arterial hypertension in determining loss of cognitive function, in the absence of a previous cerebral vascular accident, is still not a consensus in the literature. Some clinical studies have shown that hypertensive individuals show a poor performance in neuropsychological tests.[13] Reports from the Framingham study observed an inverse association between blood pressure and cognition, concluding that elevated blood pressure might be related to the presence of cognitive decline.[14] Other investigations found the inverse, that is, systemic arterial hypertension was associated with better cognitive function in the elderly.[15] Finally, other studies did not demonstrate this association.[16]

The results of our study suggest that factors such as level of schooling, cognitive performance and marital status were not determinant for the delay in hospital arrival, similar to the data reported by Dracup and Moser.[17]

It is known that other prehospital factors influence the patient's time of arrival, such as the region of origin, the availability of their own means of transportation or ambulance availability for transportation to the hospital, and the search or transfer to the closest health service, which, in most cases is not a specialized one and does not have the recommended resources for the care of infarction victims.[18,19] Our study reflected the logistical and operational obstacles faced in the care of infarction in the public health system, since the factors that most often determined the delay in the specialized treatment of our population were the transfer from another health service and the region of origin.

Among this study limitations, the fact that we exclusively evaluated patients treated by the Brazilian Unified Health System and mostly in a single institution (only one patient was treated in another public hospital in Florianópolis), may have disregarded a portion of the population that, supposedly, could have better socioeconomic conditions and higher levels of schooling. Additionally, the small sample size may have influenced the lack of statistically significant associations, although there was enough power to evaluate the suggested correlations. Also, according to Bonnet and Wright,[20] perhaps the data would be more accurate if the correlation had been calculated with a confidence interval, which was not used in the present study. However, these biases do not invalidate our study, because even if the sample were larger, it is possible that any found correlation would be weak and without clinical significance.

Conclusion

The present study suggests that, in our population, educational, social and cognitive factors were not directly related to the delay at hospital arrival. The factors that most often determined the delay were the transfer from another health service and the region of origin. A prolonged Δ-T, mainly due to prehospital delay, remains a challenging issue so that we can attain the maximum benefits from modern reperfusion therapies.

Author contributions

Conception and design of the research: Moreira DM. Acquisition of data: Takagui ASM, Carvalho ATG, Duarte TF. Analysis and interpretation of the data: Takagui ASM, Silva RL, Fattah T. Statistical analysis: Moreira DM. Writing of the manuscript: Takagui ASM. Critical revision of the manuscript for intellectual content: Moreira DM.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This article is part of completion work submitted by Andressa Sardá Maiochi Takagui, from Instituto de Cardiologia de Santa Catarina (ICSC).

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Instituto de Cardiologia de Santa Catarina under the protocol number 55450816.0.1001.0113. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

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