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Factors associated with longer delays in reperfusion in ST-segment elevation myocardial infarction

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ABSTRACT

Background/objectives: The goal of this paper is to identify the predictors of delay in total ischemia time that would be the focus of improvement efforts in patients with ST-segment elevation myocardial infarction.
Methods: Data was collected retrospectively through the patient's clinical records and by direct telephone interview.
Total ischemic time was categorized in two classes according to the elapsed time since symptom presentation until restored flow, less than 6 h and 6 h or less. Logistic regression analysis was applied to evaluate the relationship between total ischemic time and a set of variables. Discrimination ability of the model was also assessed, as well as sensitivity and specificity, through ROC curves.
Results: Data from 128 patients, 74.22% males and 25.78% females, were analyzed. The average age was approximately 62 years (±13.6).
Six variables associated with total ischemia were selected in the final model: the patient age, the level of pain intensity, the region of origin, the socioeconomic status, the activity that the patient was performing at the time of symptoms onset, and the fact that the patient has been transferred from another hospital.
Conclusion: The identification of variables associated with the total ischemia time allows the recognition of patients with possibility of worse prognosis, for which should be directed educational efforts and also the identification of variables that can be modified to optimize the therapy.

1. Introduction

CHD by itself is the single most common cause of death in Europe: accounting for 1.8 million deaths in Europe each year. CHD is also the single most common cause of death in the EU, accounting for over 681,000 deaths in the EU each year [1].

The sense of urgency to attain early reperfusion flows to avoid the inexorable 'wavefront' of ischemic cell death that follows acute myocardial infarction (AMI) is essential, modern reperfusion techniques with thrombolysis and angioplasty have made the attainment of early coronary patency practical. This early restoration of flow aborts the infarct process, salvages threatened myocardium, reduces infarct size, and lowers morbidity and mortality in the months and years to follow [2].

Some studies have clearly demonstrate improved clinical outcomes for patients who present with early primary percutaneous coronary intervention (PPCI) in AMI with ST elevation patients [3], since the benefits that can be obtained are still "time dependent". PPCI should be performed in character emergence in the early hours of infarction [4]. Unfortunately, a significant proportion of patients are unable to receive medical care within the first 2 h [3].

Currently accepted standards for gauging quality of care in the treatment of ST-segment elevation myocardial infarction (STEMI) mainly focus on shortening the time to treatment after the patient arrives at the hospital. But this narrow focus fails to consider the substantial duration of myocardial ischemia that exists prior to hospital arrival, and the large number of deaths that occur during the prehospital period. The time from symptom onset until reperfusion occurs is one estimate of total ischemic time. The shorter the delay in total ischemic, the better the clinical outcomes, including decreased rates of cardiogenic shock, left ventricular dysfunction, congestive heart failure, and death [5].

Clearly, any benefit of reperfusion is time-dependent from the first moment of occlusion. In a recent study, was demonstrated that time from symptom onset to balloon inflation, but not door-to-balloon time, is strongly related to 1-year mortality in patients treated by primary angioplasty [6,7].

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The identification of the variables associated with longer total ischemia time is important since it is essential to understand how different patients react, to symptoms and to identify high-risk groups needing educational and clinical interventions [8].

The current American and European guidelines have mainly focused on the door-to-balloon or door-to-needle time as indicators of the quality of care and predictors of mortality. These intervals, however, are short compared to the cumulated time from symptom onset to the initiation of reperfusion therapy (i.e., treatment delay) and do not reflect the entire interval that can be modified by the healthcare system.

When the time from symptom onset to restoration of flow is less than 6 h the AMI can be defined as "developing", studies have shown that the survival rate drops dramatically after 6 h, however up to 25% of the patients spent more than 6 h before they even presented to the hospital [2,3,9].

The goal of this analysis was to identify predictors of delay in total ischemia time that shall be the focus of improvement efforts.

2. Material and methods

Data from this study were collected in the Cardiology Department of Hospital Santa Maria (HSM) in Lisbon, Portugal, and had a target population of patients with confirmed AMI with ST elevation. The study protocol was submitted to the Ethics Committee of the HSM, on June 30, 2011 and received approval on 25 October 2011.

Inclusion criteria included patients who resorted to the Emergency Department (ED) of the HSM with confirmed AMI with ST elevation in which coronary flow was restored by PPCI between January 1, 2010 and December 31, 2010.

Data were retrospectively collected through two questionnaires, after obtaining oral consent for each patient. The first questionnaire contained demographic data, collected through patients clinical records and also data such as presence of risk factors, history of ACS, region of the patient location's at the symptoms onset, rural or urban, being transferred from another hospital or not, the day of the occurrence of the AMI and the compute total ischemia time.

All the variables were then transformed in categorical variables. Dichotomous variables were simply categorized as 0 and 1. For variables like age, 3 categories were established, less than 55 years between 55 and 75 years and older than 75 years, also day of the week was categorized in working day (from Monday to Friday) and weekends and/or holiday (Table 1).

Table 1
Demographic description.

	n(number of individuals with total time ≥6 h)
Age (years)	
Age < 55	42(10)
Age 55–75	64(30)
Age > 75	22(14)
Sex	
Female	33(14)
Male	95(40)
Race	
Caucasian	123(51)
Others	5(3)
Socioeconomic level	
High	13(3)
Medium–high	28(7)
Medium	33(12)
Low	54(32)
Scholarship level	
Primary school/no scholarship	73(39)
High school level	27(9)
College education	28(6)

A second questionnaire was also administered by direct telephone interview with the patient and consisted in a socioeconomic scale (Graffar scale) which attributes points, 1 to 5, to each factor of the scale (profession, scholarship level, source of income, housing quality and type of residential area).

The scale classifies a population in five-economic strata: (1) high; (2) medium-high; (3) medium; (4) medium-low and (5) low. In the present study, as the two last categories had few subjects, they were joined in one only category (low).

In the second questionnaire the level of pain experienced by each individual through the application of the numerical scale of pain intensity was also recorded divided in eleven equal parts successively numbered from 0 to 10. It is intended that the patient make the equivalence between the intensity of their pain and a numerical rating, where 0 corresponds to "no pain" and 10 correspond to "maximum pain" [10]. Variables such as level of education, categorized in primary school/no education, high school and college education were also recorded. Being with a companion at the onset of symptoms or not was also addressed. Companion could be a family member, friend or coworker. At last patient's performed activities at symptom onset were recorded and categorized in: leisure, work and physical exercise (Table 1).

3. Statistical analysis

Total ischemic time was categorized in two classes: less than 6 h and more or equal to 6 h from symptom presentation to restored flow. A logistic regression analysis was performed to evaluate the relationship between the categorized total ischemic time and the variables obtained from the questionnaires. The variable race could not be introduced in the model since it had very few subjects in the non-Caucasian category.

A stepwise both-selection technique was used to generate a multiple logistic regression model to determine the predictors of delay. All the variables included in the model were categorical (Tables 1 and 2).

To assess discrimination utility of the model the receiver operating characteristic (ROC) curve was applied and assessed the area under the curve. Sensitivity and specificity was also addressed through the ROC curve.

In order to assess prediction errors a classification table was constructed crossing the observed values for the dependent variable with adjusted values above and below a cut point of 0.5 [11].

Values of $p \leq 0.05$ were considered statistically significant. Variables considered clinically relevant were also kept in the model. All statistical analyses were performed in R software (version 2.13).

4. Results

Total ischemic time according to patients' demographic and clinical characteristics is reported in the Table 1.

The sample consisted of 128 patients, 74.22% male and mostly Caucasians, 123 individuals. The average age was approximately 62 years (±13.6). More than half of the subjects, 57.03%, had only primary education or were illiterate, and most of the subjects were from lower middle class, 35.16%.

The percentage of individuals in the sample that had a total ischemic time exceeding the 6 h was 42.19% (54) with mean age of 65 (±12.9). For those who arrived within the 6 h the mean age was 59 (±13.6).

For the pain scale there were no records of pain levels corresponding to 0, 1 or 2 the lower pain intensity found in the sample was level 3.

Variables significantly related to total ischemic time were: age (p-value: 0.048), pain level (p-value: 0.003), transfer from another hospital (p-value: 0.1052), region (p-value: 0.026), socioeconomic level (p-value: 0.009), activities performed at the onset of symptoms (p-value: 0.026) (Table 2).

Although a non significant p-value was found for the variable transfer (p-value: 0.105) we decided to keep it in the model once it reflected the hospital structure.