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Defining high-risk patients with ST-segment elevation acute myocardial infarction undergoing primary percutaneous coronary intervention: A comparison among different scoring systems and clinical definitions

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ABSTRACT

Background: Identification of high-risk patients with ST-segment elevation acute myocardial infarction (STEMI) is of the utmost importance for adequate patient stratification and evaluation of additive treatments. However, there is no consensus on the optimal definition of high-risk patients.
Methods: We therefore compared 5 scoring systems in the assessment of the risk of 30-day mortality in 3214 patients with STEMI treated with primary percutaneous coronary intervention (PCI).
Results: Clinical scores showed a large variability in risk stratifying patients. Identification of high-risk patients ranged from 15% (PAMI score ≥ 9) to 66% (McNamara definition). McNamara, Antoniucci and Brodie definitions had the best sensitivity (0.87–0.88 and 95% confidence intervals (CI) ranging from 0.82–0.93) while PAMI ≥ 9 had the best specificity (0.87 with 95% CI of 0.86–0.88), while its sensitivity was quite low (0.42). In a sample size simulation of a trial aimed at demonstrating a 33% difference in 30-day mortality between two hypothetical treatments, the number of STEMI patients needed to be screened varied from 4712 for the Brodie definition to 9038 for the PAMI ≥ 9 score.
Conclusions: There is a large variability in risk stratification, sensitivity, specificity and predictive values among different scoring systems. These considerations should be taken into account when designing randomised trials.

1. Introduction

Significant changes have recently occurred in the field of reperfusion therapy in patients with ST-segment elevation acute myocardial infarction (STEMI) which include a broader use of primary

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percutaneous coronary intervention (PCI) and a more liberal use of glycoprotein IIb–IIIa inhibitors [1–3]. Although primary PCI has significantly reduced the incidence of adverse cardiac events compared to thrombolytic therapy [4–6], mortality is still considerable in high-risk patients [7]. However, a specific definition of high-risk patients is still lacking. Different studies have used various definitions of high-risk patients [8–11] and there is no unanimity on which definition or score should be used to identify this category of patients. Furthermore, there are scant data comparing the predictive value with respect to 30-day mortality of different high-risk clinical definitions and scoring systems [12]. Since identification of high-risk patients is of the utmost importance in order to design appropriate trials aimed at evaluating the effects of additive therapeutic strategies on clinical outcome, we compared the performance of various definitions and scoring systems with respect to 30-day mortality in a large cohort of patients with STEMI treated with PCI and enrolled in a real world registry. For this purpose only those high-risk definitions and scoring systems including variables that could be immediately available at patient admission were considered for this analysis.

2. Methods

The Lombardima group is a regional branch of the Italian Society of Invasive Cardiology. The Lombardima Registry was implemented in the year 2005 to monitor the outcome of patients undergoing PCI in Lombardy, a Northern Italian region with a population of nearly 9.5 million inhabitants, the 15% of the Italian population. The network includes 67% of the PCI centers in the region. Hospitals in which fewer than 10 primary PCI procedures were performed in the previous year were not invited to participate in the registry. All patients with characteristic symptoms of acute STEMI presenting at the first medical contact within 12 h from symptom onset with at least 1 mm ST-segment elevation in 2 or more contiguous leads or at least 2 mm in leads V1–V4 or left bundle branch block and who underwent PCI were included in the registry. Clinical characteristics, risk markers, electrocardiogram (ECG) parameters, time intervals, angiographic and procedural data were prospectively entered into a web-based database with a pre-specified dataset. The registry enrolled patients treated with rescue PCI, facilitated PCI and primary PCI over an 18-month period. For the purpose of this study we included only patients treated with primary PCI. The use of the registry was approved by local Ethic Committees and patients provided informed consent to participate in the study.

After undergoing 12-lead ECG and hemodynamic assessment, all patients underwent coronary angiography and subsequent PCI. Interventional strategies, including the use of thrombus aspiration devices, coronary stents (either bare-metal stents or drug-eluting stents) were left at the discretion of the various interventional cardiologists. Moreover, antithrombotic drugs before, during and after PCI as well as the use of glycoprotein IIb–IIIa inhibitors were left to the operator's discretion. Antiplatelet treatment including aspirin and clopidogrel (loading dose of 300 or 600 mg followed by 75 mg daily) was prescribed according to current standards of treatment.

ST-segment resolution after PCI was quantified as the percentage of the value obtained from the basal ECG, and was considered significant when a >50% reduction of the initial value was observed 60 min after PCI [13,14].

Thirty-day follow-up was available in all patients. External audit of the files was held in order to ensure completeness and reliability of data. Data were regularly checked by cardiologists appointed by the committee in charge for the Lombardima group and specific queries were asked to the participants who had entered incomplete data.

2.1. Highrisk clinical definitions, score systems and statistical analysis

High-risk clinical definitions and score systems were identified through a Medline search using the words ST-segment elevation acute myocardial infarction, coronary angioplasty and score. They were then quoted with the name provided by the literature or with the name of the first author of the relative publication. The objective of this study was to evaluate different scoring systems in relation to the risk of 30-day all-cause mortality. Since we were interested only in those clinical definitions and scoring systems providing a preliminary risk assessment at the first medical contact, those definitions and scores which included variables not available at that time were not considered. To make comparisons among scores they were dichotomised in relation to their ability to define high- and low-risk patients. To dichotomise continuous scoring systems we used cut-off points provided by the literature. We estimated the sample size of a hypothetical trial including high-risk STEMI patients according to the various definitions and scores, assuming that a treatment would have reduced mortality by 33% with $\alpha = 0.05$ and a power of 80% . This percent of reduction in mortality was chosen according to the results of the HORIZONS-AMI trial [15]. Number of patients to be screened was obtained by adding to the number of high-risk STEMI patients (those meeting the specific high-risk definitions or scores) that of patients not meeting those specific definitions or scores (being therefore to be considered as "not high-risk STEMI patients").

Data are presented as mean ± Standard Deviation or median and range, as appropriate. Each score was characterised according to its sensitivity, specificity, predictive values and accuracy. Comparisons among scores in terms of sensitivity, specificity, accuracy and predictive values were performed considering 95% confidence of intervals (CI). Scores were considered to be significantly different if there was no overlap between their 95% CI. Statistical analyses were performed using the R software package, version 2.9 (available at http://www.r-project.org).

3. Results

In the Lombardima Registry 3214 patients were treated with primary PCI over an 18-month period. Clinical characteristics of these patients are shown in Tables 1 and 2. Median age was 63 years and 5% of patients presented with cardiogenic shock. TIMI III flow at the end of the procedure was achieved in 87% of patients and ST-segment resolution in 72%. Mortality at 30-day follow-up was 4.8%.

Seven scores were identified through a Medline search[8–11,16–18]. Two of them, the CADILLAC score [18] and the GRACE score [17], were not considered because they included variables that couldn't be available in all patients when they entered the Cath Lab, such as renal insufficiency or increased cardiac markers. Therefore, 5 high-risk clinical definitions and scoring systems were evaluated in this study.

3.1. Comparison between STEMI high-risk definitions and scoring systems

The characteristics of these definitions and scoring systems are reported in Table 3. In order to dichotomise patient population into high- and low-risk patients with the PAMI and TIMI scores, which are continuous scoring systems, we used 2 different cut-off points provided by the literature [11,16,19]. Therefore 7 scoring systems were finally evaluated.

Table 1
Clinical characteristics of patients enrolled in the registry.

	Availability *n* (%)	Patients *n* 3214
Age, median (25%–75%)	3214 (100)	63 (54–72)
Male, *n* (%)	3214 (100)	2452 (76)
Systemic hypertension, *n* (%)	3214 (100)	1507 (47)
Diabetes mellitus, *n* (%)	3214 (100)	538 (17)
Hypercolesterolemia, *n* (%)	3214 (100)	1199 (37)
Smoking, *n* (%)	3214 (100)	1477 (46)
Familiar history of coronary disease, *n* (%)	3214 (100)	952 (30)
Renal dysfunction, *n* (%)	3214 (100)	72 (2)
Prior myocardial infarction, *n* (%)	3214 (100)	382 (12)
Prior coronary angioplasty, *n* (%)	3214 (100)	305 (9)
Prior coronary bypass, *n* (%)	3214 (100)	83 (3)
LVEF[a]	2675 (83)	
>50%, *n* (%)		1343 (50)
41–50%, *n* (%)		939 (35)
30–40%, *n* (%)		304 (11)
< 30%, *n* (%)		89 (4)
Killip class	3185 (99)	
I, *n* (%)		2474 (78)
II, *n* (%)		441 (14)
III, *n* (%)		115 (3)
IV, *n* (%)		155 (5)
Number of leads with ST-segment elevation	3136 (98)	
<3, *n* (%)		809 (26)
3–5, *n* (%)		1579 (50)
>5, *n* (%)		748 (24)
Total Ischemic time[b], median (25%–75%)	2507 (78)	
ST-segment resolution, *n* (%)	3055 (95)	168 (110–255)
Infarct location	3176 (99)	2206 (72)
Anterior, *n* (%)		1491 (47)
Non anterior, *n* (%)		1685 (53)

[a] LVEF: left ventricular ejection fraction at hospital discharge.
[b] Time from symptom onset to balloon dilatation.