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Electrocardiogram score for the selection of reperfusion strategy in early latecomers with ST-segment elevation myocardial infarction

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Abstract

Objective: The clinical benefit of percutaneous coronary intervention (PCI) is controversial in ST-segment elevation myocardial infarction (STEMI) patients presenting 12–72 hours after symptom onset. Several studies suggested this conflicting result was associated with myocardial area at risk (MaR) of enrolled patients. MaR could be estimated by the electrocardiogram (ECG) score. Our objective was to evaluate the benefits of PCI in STEMI latecomers with different MaR.

Methods: We constructed a prospective cohort involving 436 patients presenting 12–72 hours after STEMI onset and who met an inclusion criteria. 218 underwent PCI and 218 received the optimal medical therapy (OMT) alone. Individual MaR was quantified by the combined Aldrich ST and Selvester QRS score. The primary endpoint was a composite of cardiovascular death, reinfarction or revascularization within two years.

Results: The 2-year cumulative primary endpoint rate was respectively 9.2% in PCI group and 5.3% in OMT group when MaR < 35% (adjusted hazard ratio for PCI vs. OMT, 1.855; 95% confidence interval [CI], 0.617–5.575; P = 0.271), and was 12.8% in PCI group and 23.1% in OMT group when MaR ≥35% (adjusted hazard ratio for PCI vs. OMT, 0.448; 95% CI, 0.228–0.884; P = 0.021).

Conclusion: The benefit of PCI for the STEMI latecomers was associated with the MaR. PCI, compared with OMT, could significantly reduce the 2-year primary outcomes in patients with MaR ≥ 35%, but not in ones with MaR < 35%.

Keywords: Electrocardiography/electrocardiogram(s); Myocardial infarction; Myocardial area at risk; Percutaneous coronary intervention; Selvester QRS score; Aldrich ST score

Introduction

Primary percutaneous coronary intervention (PCI) is the recommended treatment for patients with ST-segment elevation myocardial infarction (STEMI) within 12 hours after ischemic symptom onset [1]. However, the clinical benefit of PCI vs. optimal medical therapy (OMT) alone is controversial in stable patients presenting over 12 hours timeframe [2–4]. A comprehensive meta-analysis of 10 trials comparing the efficacy of late PCI vs. medical therapy alone in 3560 patients randomized over 12 hours after STEMI indicated this conflicting result could be associated with enrolled patients' ischemia in the infarct-related artery territory [5].

This ischemic myocardial tissue within the vascular territory that is distal to the culprit lesion of the infarct-related artery is usually called myocardial area at risk (MaR) [6]. MaR includes salvageable and infarcted myocardium. For example, following acute coronary occlusion the MaR is entirely ischemic, but over time the MaR gradually becomes a mix of both ischemic and infarcted myocardium. The extent of MaR is typically identified and qualified by single-photoemission computed tomography (SPECT). Although the SPECT analysis of MaR is a promising risk-stratification tool for STEMI, it had very limited clinical applicability due to high cost and uncommon availability [3,4]. In contrast, a standard 12-lead electrocardiogram (ECG) is inexpensive and easily applied before reperfusion treatment has commenced, and several algorithms have been developed to estimate MaR by using the Aldrich ST score and Selvester QRS score [7–10]. The Aldrich ST score estimates the size of ischemic myocardium and Selvester QRS score estimates

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the size of the infarcted myocardium. As time progresses ischemia is replaced by infarction and the primary ECG ST-segment deviation is replaced by QRS complex changes, especially in STEMI latecomers. Thus the combined utilization of Aldrich and Selvester score would be more stable and accurate to estimate the MaR of these patients [11].

This study aimed to evaluate whether the combined ECG score could be applied (1) to quantify the MaR of STEMI latecomers, and (2) to evaluate the clinical benefit of PCI vs. OMT for these patients with different stratification of MaR. It could provide an easy and quick clinical assessment for the selection of reperfusion strategy.

Methods

All STEMI patients at the First Hospital of Jilin University were recorded in a prospective cohort. Data elements included demographic, clinical, angiographic/procedural, and follow-up variables. Each patient had an outpatient visit at 1 month and several follow-up phone calls using a standardized questionnaire at 6 months, 1 year, and then annually by trained personnel to document long-term outcomes. In each contact, details of any readmission during that time period and/or mortality information were collected, including the date, the place, and if the reason for readmission or death was cardiovascular or non-cardiovascular.

Study population

Patients (1) who were over 18 years-old, (2) hospitalized with a definitive diagnosis of new-onset STEMI through January, 2010 to January, 2012 and (3) presented to our department 12–72 hours after symptom onset were included in this study. This hospitalization was defined as the index hospitalization. The exclusion criteria included patients with (1) cardiogenic shock, electrical instability and severe congestive heart failure (New York Heart Association III or IV) on admission; (2) electrocardiogram presenting with complete left or right bundle branch block, Wolff-Parkinson-White syndrome and left ventricular hypertrophy; (3) receiving coronary artery bypass grafting, and (4) in-hospital mortality during the index hospitalization. In addition, (5) patients without angiographic or complete clinical data were also excluded. Then, patients were divided into two groups according to their treatments: receiving PCI and OMT (PCI group) or OMT alone (OMT group). We calculated a propensity score for each patient and matched each PCI case to one OMT case (Fig. 1). The study was approved by the Ethics Committee of the First Hospital of Jilin University.

Treatments

All patients received optimal medical therapy, including aspirin, anticoagulation if indicated, angiotensin-converting-enzyme inhibition (ACEI)/angiotensin receptor blocker (ARB), beta-blockade, and lipid-lowering therapy/plaque stabilization, unless contraindicated. Patients were assigned to perform coronary angiography/PCI within a few hours after decision if the condition was permitted, and each patient's angiography record was collected.

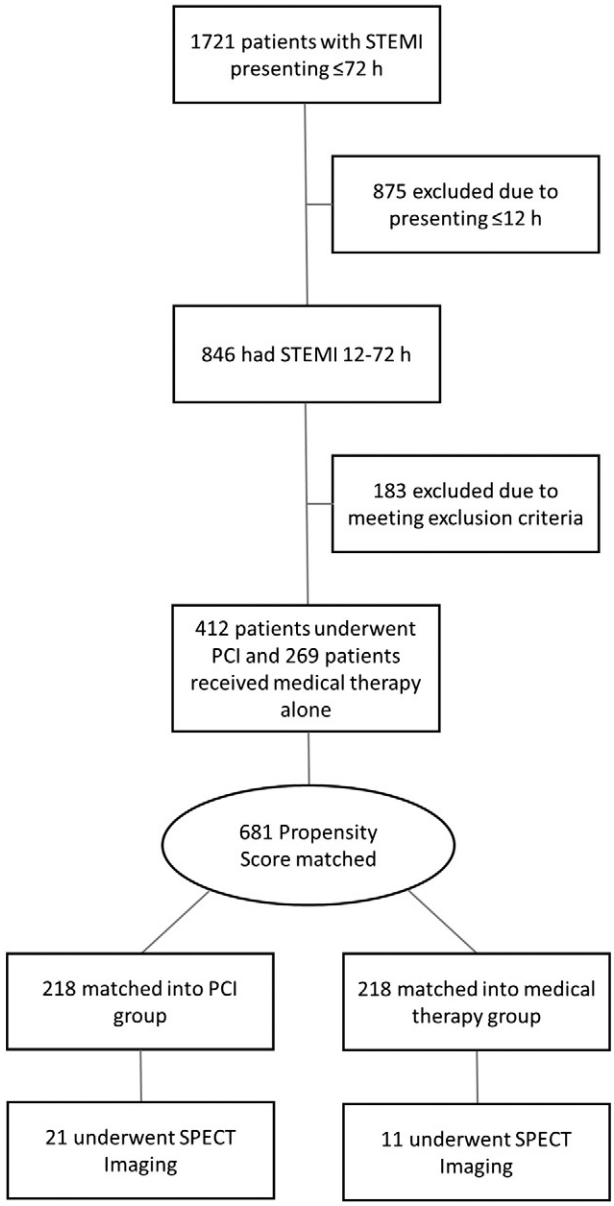

Fig. 1. Flowchart of study population. STEMI indicates ST-segment elevation myocardial infarction; SPECT, single-photon emission computed tomography. Propensity score matching was used to ensure similarity of patients in two groups, matching each PCI case to one medical therapy case.

ECG acquisition and evaluation

The standard 12-lead ECGs on admission from each patient were collected within 10 minutes and transferred to a personal computer for post-processing. Standard ECG amplitude and duration measurements were performed automatically using the algorithm provided with the ECG Research Workstation Software (GE Healthcare, Milwaukee, WI, USA). The results by computer measurements were then compared with those by manual measurements which were used to increase reproducibility and decrease the inter observer variability.

The Aldrich score in present study was based on the rule set recommended by Bacharova et al. [12]. This scoring system was calculated to estimate the magnitude of ST segment elevation, which was measured at the J point in all recordings. ST elevation was defined as an elevation of more