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## Original Research Article

# Association between clinical parameters and ST-segment resolution after primary percutaneous coronary intervention in patients with acute ST-segment elevation myocardial infarction

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## ARTICLE INFO

## Article history:

Received 8 January 2015

Received in revised form

2 March 2016

Accepted 13 March 2016

Available online 15 April 2016

## Keywords:

ST-segment resolution

ST-elevation myocardial infarction

Percutaneous coronary intervention

## ABSTRACT

**Background and objective:** The aim of this study was to evaluate and compare various parameters between complete and incomplete ST-segment resolution (STR) patients' groups and to identify associates of STR in patients with acute ST-segment elevation myocardial infarction (STEMI) after primary percutaneous coronary intervention (PPCI) (primary outcome).

**Materials and methods:** A total of 203 consecutive patients were divided into two groups according to the degree of STR: <70% (incomplete) and ≥70% (complete resolution) 5–15 min after the PPCI. The cardiovascular risk factors, sex, Killip class, Thrombolysis in Myocardial Infarction (TIMI) flow, symptom-onset-to-balloon time and door-to-balloon time, and adverse cardiovascular events (secondary outcome) were assessed and compared between two groups.

**Results:** There were 147 patients with incomplete STR and 56 patients with complete STR. Patients with complete STR were younger, had lower Killip class, shorter duration of the chest pain and were less likely to have anterior myocardial infarction (AMI). Patients in the incomplete STR group had longer symptom-onset-to-balloon and door-to-balloon intervals. TIMI3 flow after PPCI was more common in the complete STR group. TIMI flow ≤2 after PPCI, AMI and symptom onset-to-balloon time were inversely associated with STR (beta coefficients –28.635, –28.611, and –0.917, respectively). AMI (OR = 29.9), symptom onset-to-balloon time (OR = 1.7) and patient's age (OR = 1.1) were associated with an increased likelihood of having incomplete STR.

**Conclusions:** Patients with complete STR were younger, had lower Killip class, shorter duration of STEMI, were less likely to have AMI, were more likely to recover TIMI3 flow.

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Peer review under the responsibility of the Lithuanian University of Health Sciences.

<http://dx.doi.org/10.1016/j.medici.2016.03.004>

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Age, TIMI-flow grade 2 or less after PPCI, AMI and symptom-onset-to-balloon time were associated with STR.

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## 1. Introduction

Primary percutaneous coronary intervention (PPCI) is the method of choice for patients with acute ST-segment elevation myocardial infarction (STEMI) [1]. The success of PCI (percutaneous coronary intervention) can be determined electrocardiographically by measuring ST-segment resolution (STR) after procedure and angiographically by evaluating Thrombolysis in Myocardial Infarction (TIMI) flow [2]. However, good epicardial blood flow does not necessarily imply adequate perfusion at the myocyte level. That is why monitoring STR after successful primary PCI is probably the most convenient method to assess if appropriate perfusion is achieved in the heart microvessels, because STR reflects the physiology of myocytes, which are the final target of coronary blood flow [3]. Recent studies have shown that STR is an important prognostic indicator for late revascularization, recurrence rate of myocardial infarction, but does not predict long-term mortality in patients with STEMI undergoing PPCI [2–4]. In many studies complete STR is determined by ST-segment drop >70% of ST-segment elevation recorded before PCI [3–5].

The aim of our prospective observational study was to evaluate and compare clinical parameters between complete STR and incomplete STR patients' groups and to identify clinical associates and their impact on STR.

## 2. Materials and methods

### 2.1. Patients

A total of 203 consecutive patients with acute STEMI who underwent PPCI from December 1, 2013, to August 31, 2014, in the Hospital of Lithuanian University of Health Sciences Kauno Klinikos were enrolled in the study.

The inclusion criteria were confirmed diagnosis of STEMI (typical chest pain lasting for more than 20 min and ST-segment elevation of  $\geq 2$  mm in at least two contiguous precordial ECG leads and  $\geq 1$  mm in at least two extremity leads); symptoms of less than 24 h duration and persistent ST-segment elevation; symptoms of ischemia and persistent ST-segment elevation 24–48 h after symptom onset; eligibility for primary PCI.

The exclusion criteria were thrombolytic therapy after the diagnosis of STEMI was made; left bundle branch block on ECG; symptom onset more than 48 h; absence or doubtful culprit lesion; culprit lesion not crossable with PCI guidewire.

Cardiovascular disease risk factors (age, arterial hypertension, diabetes mellitus, dyslipidemia, smoking, prior myocardial infarction), sex, Killip class, symptom onset-to-balloon

time and door-to-balloon time were assessed and compared between complete and incomplete STR groups.

### 2.2. Coronary angiography, primary PCI and concomitant medication

Quantitative coronary angiography was performed according to the standard criteria. The location and number of damaged vessels with significant stenosis ( $\geq 50\%$ ) were assessed. The Thrombolysis in Myocardial Infarction (TIMI) flow grading system was used to evaluate myocardial perfusion in the infarct-related artery before and after PCI: TIMI 0 (no perfusion), absence of any antegrade flow beyond a coronary occlusion; TIMI 1 (penetration without perfusion), faint antegrade coronary flow beyond the occlusion, with incomplete filling of the distal coronary bed; TIMI 2 (partial reperfusion), delayed or sluggish antegrade flow with complete filling of the distal territory; and TIMI 3, normal flow which fills the distal coronary bed completely [6]. Obtained data were compared between complete and incomplete STR groups.

Primary PCI (mostly with stent implantation) and periprocedural care were performed according to the standard criteria.

A loading dose of 500 mg of acetylsalicylic acid was given to all patients just after the diagnosis was confirmed if not taken chronically. Clopidogrel (600 mg) was administered to majority of patients after diagnosis confirmation with the exclusion of a few patients for whom ticagrelor loading dose (180 mg) was prescribed (matter of availability).

The majority of patients received bare-metal or various drug-eluting stents. In some patients stents were not implanted because of big thrombus or remaining TIMI 0 antegrade flow after balloon inflation and thrombus aspiration. Visible thrombus was manually aspirated in some patients using standard aspiration catheters. A usual dose of unfractionated heparin (100 units per kilogram body weight) was administered during PCI procedure. No bivalirudin used. Glycoprotein receptors IIb/IIIa antagonists were used very rarely and only in distal embolization cases.

In absence of contraindications usual further treatment of acute myocardial infarction with angiotensin-converting enzyme inhibitors, beta-blockers, statins and antiplatelets was prescribed.

### 2.3. ST-segment resolution

Technically adequate 12-lead ECGs before and 5–15 min after PPCI was finished were registered using a speed of 25 mm/s and amplitude of 10 mm/mV. The elevation of ST-segment was measured at J point in mm. The arithmetic mean of

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