



Original article

Impact of transport pathways on the time from symptom onset of ST-segment elevation myocardial infarction to door of coronary intervention facility



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ABSTRACT

Background: Reducing total ischemic time is important in achieving better outcome in ST-segment elevation myocardial infarction (STEMI). Although the onset-to-door (OTD) time accounts for a large portion of the total ischemic time, factors affecting prolongation of the OTD time are not established.

Purpose: The purpose of this study was to determine the impact of transport pathways on OTD time in patients with STEMI.

Methods and subjects: We retrospectively studied 416 STEMI patients who were divided into 4 groups according to their transport pathways; Group 1 ($n=41$): self-transportation to percutaneous coronary intervention (PCI) facility; Group 2 ($n=215$): emergency medical service (EMS) transportation to PCI facility; Group 3 ($n=103$): self-transportation to non-PCI facility; and Group 4 ($n=57$): EMS transportation to non-PCI facility. OTD time was compared among the 4 groups.

Essential results: Median OTD time for all groups combined was 113 (63–228.8) min [Group 1, 145 (70–256.5); Group 2, 71 (49–108); Group 3, 260 (142–433); and Group 4, 184 (130–256) min]. OTD time for EMS users (Groups 2 and 4) was 138 min shorter than non-EMS users (Groups 1 and 3). Inter-hospital transportation (Groups 3 and 4) prolonged OTD by a median of 132 min compared with direct transportation to PCI facility (Groups 1 and 2). Older age, history of myocardial infarction, prior PCI, shock at onset, high Killip classification, and high GRACE Risk Score were significantly more frequent in EMS users.

Principal conclusions: Self-transportation without EMS and inter-hospital transportation were significant factors causing prolongation of the OTD time. Approximately 35% of STEMI patients did not use EMS and 21% of patients were transported to non-PCI facilities even though they called EMS. Awareness in the community as well as among medical professionals to reduce total ischemic time of STEMI is necessary; this involves educating the general public and EMS crews.

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Introduction

ST-segment elevation myocardial infarction (STEMI) is a life-threatening disease necessitating immediate revascularization, since one third of patients die within the first 24 h after the onset of symptoms. Notably, STEMI has fatal complications within the first 1–2 h of onset [1,2]. Prompt restoration of the coronary flow has a valuable role in reduction of the size of infarcted tissue in

the myocardium and improvement in patient mortality [3–10]. Therefore, primary percutaneous coronary intervention (PCI) in acute coronary syndrome is recommended to be performed within 90 min between entering the door of PCI facilities and balloon inflation (DTB) [2].

The time from symptom onset to door of PCI facility (OTD) is noteworthy since the OTD time accounts for the greatest percentage of total ischemic duration [11,12]. A decrease in OTD time may be key to prevent sudden death in the acute phase or improvement of medium or long-term mortality by shortening the total ischemic time.

STEMI patients who experience acute symptoms visit a PCI facility through various transport pathways. Patients may visit a PCI facility directly by themselves or with an ambulance; alternatively,

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they may arrive at a PCI facility indirectly after first arriving at a non-PCI facility. Differences in the transit time between these routes to a PCI facility have a major impact on OTD [13–16].

In this study we determined the impact of the transport pathways on the OTD time in STEMI patients.

Materials and methods

Study population and study protocol

We retrospectively studied the medical records of 416 consecutive STEMI patients, who visited Tokai University School of Medicine within 24 h of the onset of symptoms from December 2005 to March 2011. Patients who developed onset symptoms of STEMI in the hospital were excluded from this study.

A total of 416 patients were enrolled. Patients were divided into 4 groups according to their transport pathways from onset of symptoms to the PCI facility at Tokai University School of Medicine, a tertiary hospital performing primary PCI: Group 1 (self to PCI), patients who transported themselves to the PCI facility directly; Group 2 (EMS to PCI), patients who were transported to the PCI facility directly by ambulance or helicopter emergency medical service (EMS); Group 3 (self to non-PCI), patients who transported themselves to a referral hospital without a PCI facility, from where they were transported to the PCI facility through inter-hospital transportation; and Group 4 (EMS to non-PCI), patients who were transported to a referral hospital by EMS, and then they were transported to the PCI facility through inter-hospital transportation (Fig. 1). The impact of the time difference in transport pathways, which is derived from EMS use or inter-hospital transportation, on OTD was assessed by comparing OTD and onset to first medical contact (OTF) among the 4 groups.

Definitions

Among patients who visited non-PCI facilities or PCI facilities due to acute onset and presented with electrocardiogram findings

consistent with STEMI, i.e. persistent ST-segment elevation > 1 mm in two contiguous leads, or new or presumed new left bundle branch block. Those with confirmed STEMI by emergency coronary angiography were enrolled [17].

All enrolled patients were evaluated for the time-points of “Onset”, “FMC”, “Arrival at first-visit-hospital”, and “Arrival at PCI facility door”. “Onset” was defined as the time-point when patients experienced acute symptoms of STEMI. “FMC” was defined as the time of first contact with any medical staff including EMS crews, this being the time of arrival at PCI facility in Group 1, the time of contact with EMS in Groups 2 and 4, and the time of arrival at the referral hospital in Group 3. “Arrival at first-visit-hospital” was defined as the time of arrival at the first-visit-hospital, PCI facility, or non-PCI facility (referral facility). The first-visit-hospital is the PCI facility in Groups 1 and 2, and the non-PCI facility (referral facility) in Groups 3 and 4. “Arrival at PCI facility door” was defined as the time of arrival at the PCI facility. Each of the following time intervals was calculated from the time records. “OTF” is the interval between “onset” and “FMC”. “OTD” is the interval between symptom onset and arrival at the PCI facility door (Fig. 1).

Statistical analysis

Numerical factors with skewed distribution are shown as median (interquartile range). Wilcoxon rank-sum test was used to determine statistically significant differences in clinical parameters between two different groups. Kruskal-Wallis one-way analysis of variance was used to compare more than three groups. If Kruskal-Wallis one-way analysis of variance showed a significant difference, differences between individual groups were estimated using Steel–Dwass multiple comparison. Fisher’s exact test was applied to determine the difference between categorical variables.

Stepwise regression analysis was used in multivariable analysis. For selection of variables, a forward stepwise selection procedure was adopted in stepwise regression analysis to identify factors associated with OTD. The variable entered in the stepwise model was the variable that had the smallest p -value > 0.2. The analysis was stopped when no more variables could be justifiably entered from the stepwise model. Independent variable with multicollinearity for which the variance inflation factor was more than 10 between either variable was excluded. If the variance inflation factor between 2 or more independent variables was more than 10, these were regarded as multicollinear variables, and only one variable among them was used in stepwise regression analysis as the representative variable. OTD with skewed distribution was transformed into normally distributed model by raising to the 0.2th power.

A value of $p < 0.05$ was considered statistically significant. All statistical calculations were performed using JMP version 9 (SAS Institute, Inc., Cary, NC, USA).

Results

The percentage of enrolled patients in each group was as follows: Group 1, 9.9%; Group 2, 51.7%; Group 3, 24.8%; and Group 4, 13.7% (Fig. 2). Usage of EMS (Groups 2 and 4) accounted for 65.4% of the total, and patients who were transported from the referral hospital (Groups 3 and 4) accounted for 38.5%.

Baseline characteristics and clinical status on arrival at PCI facilities of all 416 enrolled patients are shown in Tables 1 and 2, respectively. Median age was 66 (57–76) years and 79.1% of patients were male. The differences between groups were shown in age, dyslipidemia, renal function, and brain natriuretic peptide on arrival. More critical patients with shock, high Killip classification, and high GRACE score were frequent in EMS users (Groups 2 and 4).

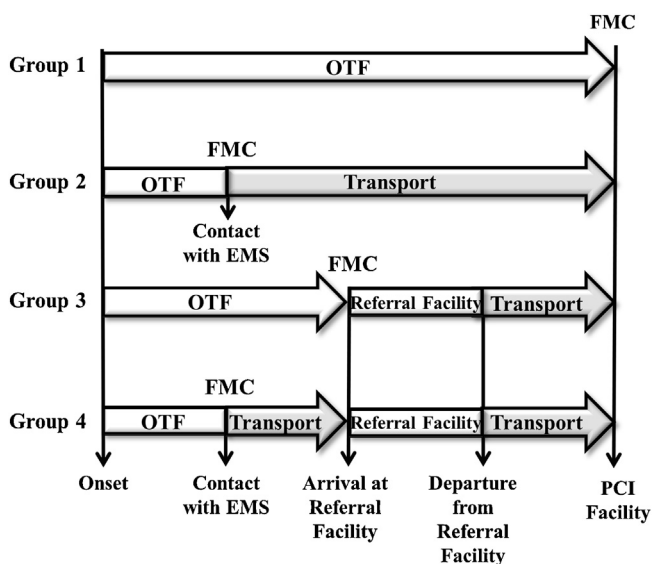


Fig. 1. The pathways to PCI facility. Group 1: Patients who themselves visited a PCI facility directly. Group 2: Patients who called the EMS, and then they were transported to PCI facility directly by EMS. Group 3: Patients who themselves visited a referral hospital by, and then they were transported to PCI facility through the inter-hospital transportation. Group 4: Patients who were transported to a referral hospital by EMS, and then they were transported to a PCI facility through the inter-hospital transportation. PCI, percutaneous coronary intervention; OTF, onset to first medical contact; FMC, first medical contact; EMS, emergency medical service.

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