Original Article

Effect of Transfer Delay on Left Ventricular Function after Primary PCI for ST Elevation Myocardial Infarction

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Background: **Primary PCI (PPCI) is superior to thrombolysis for treatment of acute ST Elevation Myocardial Infarction (STEMI). However, transfer to a PCI centre results in a treatment delay compared to those presenting directly to such hospitals. The aim of this study was to investigate the influence of transfer delay on LV function and clinical outcomes in PPCI patients.**

Methods: **Of 113 consecutive PPCI patients, 69 presented directly to the PCI centre and 44 were transferred. Echocardiography was performed at day 1 and after 6 weeks to assess LV function using the Wall Motion Score Index (WMSI). Patients were followed for a mean of 3.51 years.**

Results: **There was no significant difference in WMSI at day 1 between local and transfer patients (1.52 ± 0.36 and 1.48 ± 0.34 respectively, p = ns). After 6 weeks the WMSI improved significantly in both groups (1.33 ± 0.33 and 1.31 ± 0.31 respectively, $p < 0.001$ for both). On multivariate analysis, pain to balloon time > 160 min, LAD stenosis and initial TIMI flow 0–1 were significant independent predictors of LV dysfunction. There was no significant difference in clinical events during long term follow up.**

Conclusions: **Patients transferred for PPCI had similar LV function and clinical outcomes compared to those who presented directly to a PCI hospital.**

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Keywords. STEMI; Coronary angioplasty; Primary PCI; Left ventricular function; Echocardiography

Background

Primary percutaneous coronary intervention (PPCI) has been shown to be superior to thrombolysis in the treatment of acute ST Elevation Myocardial Infarction (STEMI) [1–3] even in patients who required transportation to a hospital with PCI facilities [4–6]. PPCI achieves higher infarct related artery patency rates with lower mortality, reinfarction and stroke [2]. Effective reperfusion can limit myocardial injury and reverse myocardial stunning in the ischaemic territory, preserving left ventricular (LV) function [7,8]. The major limitation of PPCI is its unavailability in most community hospitals. Transfer of patients to a PCI centre results in a delay in treatment compared to those presenting directly to such hospitals. This can potentially result in greater myocardial necrosis, reduced LV function and less favourable clinical outcomes. The aim of this study was to investigate the influence of inter-hospital transfer delay on LV function and long term clinical outcomes in patients undergoing PPCI. We also sought to determine the predictors of poor LV function in these patients.

Methods

Study Population

This single centre prospective observational study was carried out at The Canberra Hospital, ACT, Australia. The study population included 113 consecutive STEMI patients who underwent PPCI between 2004 and 2005. Patients were referred by road ambulance from several community hospitals. The two main referring hospitals are located at a distance of about 15 km. Initial results from the study have been presented previously in abstract form [9].

Patients were accepted for PPCI if they presented within 12 h of the onset of symptoms and had evidence of evolving STEMI on the electrocardiogram (ST-segment elevation $\geq$1 mm in two or more contiguous limb leads or $\geq$2 mm in two or more precordial leads or new left bundle branch

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block). Patients were excluded if they were unwilling to participate in the trial or unable to return for follow up. The study was approved by the Research Ethics Committee of the Australian Capital Territory and written, informed consent was obtained from all subjects.

Treatment Protocol

All patients in the study received aspirin 300 mg, clopidogrel 300 mg and an intravenous bolus of heparin aiming for an activated clotting time of 300 s. Glycoprotein IIb/IIIa inhibitors were used at the discretion of the operator. PCI was performed using six French catheters via the femoral artery using standard techniques including balloon predilatation and stent insertion with a high pressure inflation. Following the procedure the patients were treated with aspirin indefinitely and clopidogrel for a minimum of one month for bare metal stents and six months for drug eluting stents, as well as beta-blockers, ACE inhibitors and statins.

Echocardiography

Transthoracic echocardiograms were performed using standard parasternal, apical and subcostal views within 24 h of the PPCI and six weeks after the procedure. Wall Motion Score Index (WMSI) was determined by blinded visual grading of 16 LV segments [10]. The WMSI has been shown to provide stronger prognostic information than LVEF following acute MI [11].

End Points and Follow Up

We defined pain to door time as time from onset of pain to the first hospital contact and door to balloon time as the time from arrival at the first hospital to the first balloon inflation. Transfer time was recorded as time from arrival at the first hospital to arrival at the PCI hospital. The primary endpoint was LV function as assessed by WMSI at one day and six weeks. Poor LV function was defined as a WMSI > 1.4. Secondary endpoints included Major Adverse Cardiovascular Events (MACE) consisting of death, MI, cerebrovascular accident or target vessel revascularisation.

Information regarding patient outcomes was obtained during their initial stay in hospital and at six weeks. Long-term follow up was carried out by mail and phone and review of hospital records to determine end points.

Statistical Analysis

Statistical analysis was performed using SPSS version 18. Categorical data were analysed with the Chi square test or Fisher's test whenever appropriate. Continuous data were analysed using Student's *t*-test or ANOVA if normally distributed and with the Mann–Whitney or Kruskall–Wallis test if this were not the case. Logistic regression analysis was used to assess the relationship between patient characteristics and WMSI. All tests were two-sided and a *p*-value of 0.05 was considered significant. A multivariate logistic regression using a forward stepwise likelihood ratio method was undertaken to produce a parsimonious model of characteristics that significantly contribute to predicting WMSI. The model had an entry probability of 0.05 and a removal probability of 0.1. The results are expressed as odds ratios and 95% confidence intervals (95% CI).

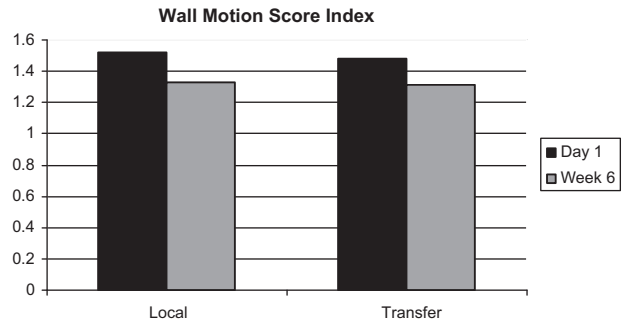

Figure 1. *Wall Motion Score Index for local and transfer patients at day 1 and week 6 ($p < 0.001$ for both groups).*

Results

There were 113 patients in the study, 69 presenting to the PCI hospital and 44 who were transferred to undergo PPCI. Mean age was 60.1 ± 11.3 years and 75% were males. Patient characteristics and treatment times are summarised in Table 1. There were no significant differences between local and transferred patients with regards to clinical characteristics except for a higher proportion of females in the transferred group. There was no significant difference in pain to door time between local and transferred patients. For transferred patients the median transfer time was 114 min and the median door to balloon time was significantly longer than for local patients (197 min vs 81 min respectively, $p = 0.0001$).

There were no significant differences between local and transferred patients with regards to the severity of coronary artery disease, use of stents, glycoprotein IIb/IIIa inhibitors and other evidence-based medications.

Echocardiographic findings at day 1 and week 6 are summarised in Table 2. Six patients were excluded from the echo analysis as they did not have a follow up echocardiogram, including two patients (one local and one transfer) who died in hospital. There was no significant difference in WMSI at day 1 for local and transfer patients (1.52 ± 0.36 and 1.48 ± 0.34 respectively, p = ns) (see Fig. 1). At the time of the echo at week 6 post infarct, the WMSI had improved significantly (by approximately 12%) in both groups (1.33 ± 0.33 and 1.31 ± 0.31 respectively, $p < 0.001$ for both groups compared to baseline). There was no significant difference in the magnitude of LV function recovery between the two groups. The ejection fraction measurements mirrored these results.

Long term follow up was available for all patients except four who could not be contacted (Table 3). Median length of follow up was 3.98 years (mean = 3.51 years). Mortality over this period was 7.5% in both groups (p = ns). There was a trend for higher repeat PCI in the transferred group, but this was not statistically significant. MACE occurred