Off-Pump Coronary Artery Bypass Grafting for Acute Myocardial Infarction

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Background The aim of this study was to evaluate the surgical results of off-pump coronary artery bypass grafting (OPCAB) for patients with acute myocardial infarction (AMI) within 14 days of the infarction.

Methods and Results From April 2000 to January 2005 among 841 patients who underwent OPCAB, 43 consecutive patients (5.1%) were examined. Mean age at operation was 69.5 years and mean time from the onset of AMI to surgery was 4.6 days. Seventeen patients (39.5%) had left main trunk disease. Three patients (7.0%) underwent OPCAB following unsuccessful percutaneous coronary intervention, and 1 patient (2.3%) underwent redo procedure 9 years after previous coronary artery bypass grafting (CABG). Six patients (14%) were admitted in cardiogenic shock. Intraaortic balloon pumping was inserted preoperatively in 20 patients (46.5%). The average maximum creatine kinase-myocardial band was 139±181 (U/L). The mean number of grafts was 3.2 and the rate of complete revascularization was 91%. Two of six patients with preoperative cardiogenic shock were converted to on-pump beating CABG due to ventricular arrhythmia. The early graft patency rate was 98%. All patients survived except 2 with preoperative cardiogenic shock.

Conclusions OPCAB can be performed after AMI as a relatively low-risk procedure with an acceptable mortality rate, even within 14 days of the infarction. (Circ J 2006; 70: 1303–1306)

Key Words: Acute myocardial infarction (AMI); Coronary artery bypass grafting; Off-pump coronary artery bypass (OPCAB)

Surgical revascularization for ischemic heart disease has been an innovation of the past decade and now off-pump coronary artery bypass grafting (OPCAB) is widely accepted and considered to be safe and effective for myocardial revascularization! In addition OPCAB is considered to be safe for high-risk patients²⁻⁵ Several authors have reported an approximately 20% mortality rate in patients with acute myocardial infarction (AMI) undergoing conventional coronary artery bypass grafting (CABG) with cardiopulmonary bypass (CPB)⁶⁻¹¹ The purpose of this study was to evaluate OPCAB for patients with AMI within 14 days of infarction.

Methods

The diagnosis of AMI was based on continuous chest pain and changes in the conventional ECG and enzyme criteria (creatine kinase-myocardial band more than twice the normal value, which is <11IU/L), and confirmed by coronary angiography that showed an occluded vessel. The therapeutic strategy for AMI is firstly catheter intervention, followed up medically with intraaortic balloon pumping (IABP). The sustained elevation of enzymes, ST segment on ECG, sustained chest pain and hemodynamic instability (including cardiogenic shock) were indicators for surgery.

The strategy of OPCAB at the National Cardiovascular Center was described in 2002¹² and 2004¹³ Briefly, we usually use a radial artery (RA) composite graft in combination with 1 or both internal thoracic arteries (ITA) for revascularization of the total coronary system. In particular, single ITA and the RA as a composite graft are used for elderly patients with poor risks.

The left ITA (LITA) is generally used for revascularization of the left anterior descending branch (LAD) or the blood source of the RA as various configurations of the composite graft¹³ From April 2000 through January 2005 of the 841 patients who underwent OPCAB, we examined 43 consecutive patients (5.1%), 33 of whom were male (Table 1). Three patients underwent OPCAB following unsuccessful percutaneous coronary intervention (PCI), and 1 underwent a re-do procedure 9 years after conventional CABG. Six patients (14%) were admitted to surgery in cardiogenic shock, 20 (47%) required preoperative IABP, and 18 (42%) required emergency operation.

Statistical Analysis

All values are expressed as the mean±standard deviation. The discrete variables were analyzed with chi-square test and Mann-Whitney U-test. All statistical analyses were performed using SPSS 10.0 for Windows (Chicago, IL, USA). The differences were considered statistically significant when the p-value was less than 0.05.
Results

Of the 43 patients, 41 (95%) underwent OPCAB without subsequent conversion to on-pump bypass surgery. Two patients were converted to beating heart bypass under CPB because of ventricular tachy-arrhythmia after LITA to LAD anastomosis. The mean time of operation was 291±84 min, the mean number of grafts per patients was 3.2±1.1, and the rate of complete revascularization was 91% (n=39). Postoperative coronary angiography was performed in 32 patients (74%): there were 2 cases of significant stenosis in LAD anastomosis and a posterolateral anastomosis. The early graft patency rate was 98% (105/107 anastomosis). There was 1 case of left ventricular rupture which occurred in day after the operation.

All patients without cardiogenic shock survived, but 2 of 6 patients with cardiogenic shock died from MRSA mediastinitis (Table 6).

Discussion

In the clinical setting, AMI patients who develop sus-
CPB, global myocardial ischemia during cardiopreoperative arrest and reperfusion injury just after the release of aortic cross-clamping have been described as devastating effects.\(^\text{14-20}\) The advent of OPCAB has entirely changed the surgical treatment of ischemic heart disease because it eliminates the systemic inflammatory reaction to CPB, cardiopreoperative arrest, global myocardial ischemia during aortic cross-clamping and postoperative neurologic complications.\(^\text{21-23}\)

We report an acceptable outcome for 43 OPCAB patients within 14 days of AMI. In this study there was no operative mortality and 2 cases of (4.7\%) hospital mortality. The 2 patients who died in hospital had developed preoperative cardiogenic shock and underwent emergency CABG. Cardiogenic shock is a very strong predictors of operative mortality. Successful primary PCI for AMI with cardiogenic shock had a high mortality reported as 18\% at 1 year after AME.\(^\text{24}\) Nunley et al reported that AMI patients with preoperative cardiogenic shock have very high rates of operative mortality (14.3\%)\(^\text{25}\) and preoperative cardiogenic shock has been reported as a predictor of operative mortality.\(^\text{26}\) In the present study the mortality of patients who developed preoperative cardiogenic shock was significantly higher than patients without it (shock 2/6: 33\%; non-shock: 0/37: 0\%; \(p=0.016\)).

Two of 6 patients with preoperative cardiogenic shock developed intraoperative circulatory collapse due to ventricular arrhythmia, and they were converted to on-pump beating CABG; one of these died in hospital. They developed ventricular fibrillation subsequent to ventricular tachycardia just after or during anastomosis to LAD. The initiating events are considered to be myocardial ischemia and reperfusion injury. As previously described, on conversion to on-pump beating CABG, the number of patients with preoperative cardiogenic shock was significantly larger (\(p=0.016\)) than without it.\(^\text{27}\) We consider that operative mortality depends on the presence of cardiogenic shock. In order to prevent the neurologic damage and organ dysfunction triggered by shock, we convert to on-pump beating CABG, instead of persisting with OPCAB. In addition, early conversion to on-pump beating CABG will ensure stable systemic circulation and prevent progressive organ dysfunction in patients with cardiogenic shock. On-pump beating CABG minimizes the deleterious effects of CPB by using a closed circuit and avoiding cardiopreoperative arrest. The avoidance of aortic cross-clamping and cardiac arrest can contribute to myocardial protection and eliminate intraoperative global myocardial ischemia.\(^\text{28}\) The better outcome of CABG for AMI patients with preoperative cardiogenic shock was expected, even in on-pump beating CABG.

In conclusion, OPCAB after AMI can be performed safely and efficiently with low mortality, but on-pump beating CABG may have a better outcome, even in patients with preoperative cardiogenic shock.

Further studies are necessary and needed for precise elucidation of risk factors and the key points for conversion to on-pump beating CABG in OPCAB after AMI. The long term efficacy of OPCAB after AMI within 14 days of infarction remains to be answered.

References


