Early and long-term outcomes of coronary artery bypass grafting in patients with acute coronary syndrome versus stable angina pectoris

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Objectives: The aim of the present study was to determine the early and long-term outcomes of coronary artery bypass grafting in patients with acute coronary syndrome and stable angina pectoris.

Methods: From September 2004 to September 2011, 382 patients with acute coronary syndrome (unstable angina pectoris and non–ST-segment elevation myocardial infarction) and 851 patients with stable angina pectoris underwent first-time isolated coronary artery bypass grafting at our institute. The early and long-term outcomes were compared between the 2 groups.

Results: Patients with acute coronary syndrome were older, were more likely to be women, had a smaller body surface area, and were more likely to have left main coronary artery disease. In both groups, bilateral internal thoracic artery grafts were used in approximately 89% of the patients, and off-pump techniques in approximately 97% of the patients. The acute coronary syndrome group had a greater operative death rate (2.6% vs 0.1%) and a greater incidence of low output syndrome (3.1% vs 1.2%) and hemodialysis requirement (2.9% vs 1.1%). Multivariate regression analysis demonstrated that age, acute coronary syndrome, lower ejection fraction, and higher creatinine level before surgery were independent predictors of operative death. However, among the hospital survivors, no differences were seen in freedom from all death (85.4% $\pm$ 2.5% vs 87.7% $\pm$ 2.0%), cardiac death (97.4% $\pm$ 0.9% vs 96.5% $\pm$ 0.9%), or major adverse cardiac and cerebrovascular events (78.0% $\pm$ 2.9% vs 78.1% $\pm$ 2.3%) at 7 years between the patients with acute coronary syndrome and stable angina pectoris.

Conclusions: Although acute coronary syndrome is an independent predictor of early mortality in patients undergoing coronary artery bypass grafting, the long-term outcomes after surgery were similar between patients with acute coronary syndrome and stable angina pectoris who survived the early postoperative period. (J Thorac Cardiovasc Surg 2013;145:1577-83)

ACD

Supplemental material is available online.

Acute coronary syndrome (ACS) is one of the leading causes of morbidity and mortality in patients with coronary artery disease. Technological advances have resulted in the widespread use of percutaneous coronary intervention (PCI), which has improved the results of ACS treatment. In patients with ST-segment elevation myocardial infarction (STEMI), primary PCI is recommended, if immediately available.[1] In patients with unstable angina pectoris (UAP) or non-STEMI, either PCI or coronary artery bypass grafting (CABG) could be recommended, depending on the patient characteristics and coronary lesion.[2] Recent trends in patients undergoing CABG have shown an increase in the number of patients with left main coronary artery disease, preoperative use of the intra-aortic balloon pump, and urgent cases,[3] demonstrating that CABG remains the treatment of choice for patients with complex coronary artery disease and high-risk factors.[4]

Although ACS has historically been considered a risk factor in patients undergoing CABG, with several reports of adverse outcomes,[5] recent advances in techniques and technology (eg, arterial grafts, off-pump CABG, and minimally invasive cardiopulmonary bypass) have improved the outcomes of patients with ACS who undergo CABG.[6,7] However, few reports have evaluated the early and long-term outcomes of patients with ACS and stable angina pectoris (SAP) who underwent these contemporary surgical modalities.[8,9]

The aim of the present study was to compare the early and long-term outcomes after contemporary CABG between patients with ACS and those with SAP.

METHODS

Study Patients

From September 2004 to September 2011, 1303 patients underwent first-time isolated CABG at Sakakibara Heart Institute. Of these, 70 patients

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Abbreviations and Acronyms

ACS = acute coronary syndrome
CABG = coronary artery bypass grafting
ITA = internal thoracic artery
MACCE = major adverse cardiac and cerebrovascular events
PCI = percutaneous coronary intervention
SAP = stable angina pectoris
STEMI = ST-segment elevation myocardial infarction
UAP = unstable angina pectoris

with STEMI (see Tables E1 and E2) were excluded from the present study because the treatment strategies for patients with STEMI are complex and differ from those for other patients. The remaining 1233 patients were included in the present study. The preoperative characteristics of the study patients are listed in Table 1. The preoperative diagnosis was ACS in 382 patients (31.0%; UAP in 360 and non-STEMI in 22) and SAP in 851 patients (69.0%). Myocardial infarction was diagnosed from the electrocardiographic findings and serum cardiac enzyme levels, and the location of culprit lesion was confirmed using coronary angiography.

Patients with ACS were initially treated with aspirin, β-blockers, and antithrombin therapy. All patients with ACS underwent angiography early after the start of medication. After angiography, primary PCI was performed when the coronary artery disease was suitable for PCI. Even if the patients had triple-vessel disease, only the culprit lesion was treated with PCI, when possible. Those patients underwent staged CABG after primary PCI. However, those patients were few in the present study (n = 9). Because they were converted from ACS to SAP at CABG, they were included in the SAP group in the present study. The other patients with ACS underwent early CABG. Our CABG strategy for ACS, including STEMI, non-STEMI, and UAP, is shown in Figure E1.

The institutional review board approved the present retrospective study and waived the need for written consent. We compared the preoperative, intraoperative, and postoperative variables between the patients with ACS and SAP. Multivariate logistic regression analysis was performed to determine the significant predictors of operative death and major complications. The long-term outcomes were compared between the 2 groups. All data were collected prospectively and reviewed retrospectively.

The primary endpoint of the present study was early all-cause mortality. The secondary endpoints were (1) early morbidity, including re-exploration because of bleeding, low output syndrome, perioperative myocardial infarction, severe ventricular arrhythmia, requirement of hemodialysis, stroke, or mediastinitis; (2) long-term all-cause mortality, excluding early deaths; (3) late cardiac death; and (4) late major adverse cardiac and cerebrovascular events (MACCE).

Surgery

Our strategy for isolated CABG was directed at achieving complete myocardial revascularization with an off-pump technique, whenever feasible. Complete revascularization was defined as "traditional" completeness, indicating that all diseased arterial systems (stenosis >50%) received at least 1 graft. The off-pump CABG technique has been previously described.[10] We bypassed all significantly diseased coronary arteries (stenosis ≥50%) that were greater than 1 mm in diameter. If necessary, concomitant extensive reconstruction (length, ≥4.0 cm) with or without endarterectomy was performed in patients with a diffusely diseased left anterior descending artery.[11] Deep pericardial stay sutures were not used, and a commercially available heart positioner and stabilizer were applied in all cases. Cardiopulmonary bypass with or without cardiac arrest was used in patients who were not suitable for the off-pump technique, including patients with severely impaired left ventricular function or intramyocardial coronary arteries.

Bypass grafts were prepared after heparinization (300 IU/kg). Arterial grafts (internal thoracic artery [ITA], radial artery, and gastroepiploic artery) were harvested in a skeletonized fashion. Anastomoses between the coronary arteries and grafts were performed with 8-0 polypropylene running sutures using the parachute technique.

We routinely prescribed low-dose aspirin for all postoperative patients, continued indefinitely. Warfarin (maintained with a target international normalized ratio of 2.0) was administered for 3 months for patients with saphenous vein grafts, in addition to low-dose aspirin.

Follow-up was achieved by outpatient office visits, direct communication with the patient or family, and/or reports from the family physicians. The last follow-up examination was completed in all patients during a 1-month closing interval ending in December 2011.

Definitions

UAP was defined as chest pain at rest that was of new onset or that was increasing in frequency and severity. SAP was defined as chest pain on exertion that was relieved by rest or medication. Left main coronary artery disease was defined as the presence of 50% or greater stenosis on any angiographic view, according to the Society of Thoracic Surgeons database.

Operative death was defined as death within the same hospitalization or within 30 days of surgery. Cardiac death included all deaths from any cardiac cause (acute myocardial infarction, heart failure, or arrhythmia) and sudden unexplained deaths. Low-output syndrome was defined as the need for adrenaline, more than 5 μg/kg/min dopamine or dobutamine, or intra-aortic balloon pumping. Perioperative myocardial infarction was defined as new Q waves on the electrocardiogram or a peak creatine kinase-MB level 5 times or more the upper limit of normal (25 IU/L). Respiratory failure was defined as a requirement for prolonged ventilation (>48 hours) or the occurrence of pneumonia. Postoperative stroke was defined as the occurrence of a new stroke confirmed by computed tomography. In patients with preoperative stroke, postoperative stroke was defined as a worsening of the neurologic deficit with new radiologic findings. MACCE was defined as death from any cause, stroke, myocardial infarction, or repeat revascularization.

Statistical Analysis

All statistical analyses were performed using the StatView, version 5.0, software package or the SAS program for Windows, release 9.2 (SAS Institute, Cary, NC). Continuous variables are reported as the mean ± standard deviation. Continuous variables were compared using the Student t test, and discrete variables were compared using the chi-square or Fischer exact test.

Univariate and multivariate logistic regression analyses were performed to determine the significant predictors of operative death and major morbidity. The variables used for univariate analysis were the clinical variables listed in Table 1, in addition to ACS and SAP and bilateral ITA use. Variables with $P < .1$ on univariate analyses were included in the multivariate model.

Actuarial event-free survival curves were estimated using the Kaplan-Meier method. The log-rank test was used to assess the differences in survival between the 2 groups.

Univariate and multivariate Cox proportional hazard analyses were performed to investigate the significant predictors of late mortality, late cardiac mortality, and late MACCE. The variables used for univariate analysis were the clinical variables listed in Table 1 plus ACS, SAP, and bilateral ITA use. Variables with $P < .1$ on univariate analyses were included in the multivariate model.

A propensity score of having ACS was calculated for each patient using a logistic regression model that included all the preoperative variables listed in Table 1. Patients were matched 1 to 1 by the propensity scores