Early and midterm outcome after off-pump coronary artery bypass grafting in patients with poor left ventricular function compared with patients with normal function

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Abstract
Objective. As there are few reports on the clinical results of off-pump coronary artery bypass (OPCAB) in patients with poor left ventricular (LV) function, the safety and efficacy of OPCAB surgery in such patients remains unclear.

Methods. From January 2002 to May 2007, a total of 519 consecutive patients underwent isolated myocardial revascularization via OPCAB. We compared the early and midterm results of 79 patients with poor LV function [ejection fraction (EF) < 40%] with those of 319 patients with normal LV function (EF ≥ 50%). Follow-up was completed in 96.2% of the patients.

Results. There were no significant intergroup differences in the number of grafts per patient or the rate of achievement of complete revascularization. No patient in either group was converted from off-pump to on-pump. The overall 30-day mortality was 1.0%. The mean follow-up was 3.0 ± 1.3 years. Five-year freedom from death from all causes was 57.7% in the low-EF group and 83.6% in the normal-EF group. The rates of freedom from cardiac death were 73.2% and 93.7%, respectively; and the rates of freedom from the combined endpoint of cardiac death, myocardial infarction, repeat coronary intervention, and heart failure requiring treatment were 65.7% and 77.3%, respectively.

Conclusion. OPCAB surgery in patients with poor LV function can be performed safely with the same quality in terms of the number of grafts and rate of complete revascularization as in patients with normal LV function. There are higher mortality and cardiac event rates in patients with poor LV function than those with normal LV function at the midterm evaluation after OPCAB.

Key words Off-pump coronary artery bypass grafting · Midterm results

Introduction

Severe left ventricular (LV) dysfunction has been reported as an independent predictor of operative mortality in patients undergoing coronary artery bypass grafting (CABG). For patients with congestive heart failure, mortality is directly related to the severity of their ventricular systolic dysfunction.

Recently, complete revascularization has been achieved safely with off-pump coronary artery bypass (OPCAB), which provides better early clinical outcomes than conventional CABG with cardiopulmonary bypass (CPB). In OPCAB surgery, the greatest concern is hemodynamic deterioration during displacement of the heart. Poor LV function is sometimes an exclusion criterion for the OPCAB approach because of the technical difficulty of safely displacing the heart under conditions of hemodynamic stability. There is little in the literature on early or midterm clinical outcomes in patients with severe LV dysfunction undergoing OPCAB. In the present study, we compare the early and midterm results of patients with poor LV function and normal LV function to determine whether LV dysfunction should be an exclusion criterion for OPCAB.
Subjects and methods

From January 2002 to May 2007, a total of 519 consecutive patients underwent isolated myocardial revascularization via the OPCAB technique under a single surgeon (A.T.) at Shiga Medical University Hospital. We compared the clinical results of 79 patients with poor LV function (EF < 40%) with those of 319 patients with normal LV function (EF ≥ 50%). The ejection fraction was determined preoperatively from trans-thoracic echocardiography. In all, 93 patients with moderate LV function (EF ≥ 40% but < 50%) and 28 with single-vessel disease were excluded from the study. We performed OPCAB in all CABG cases with no exclusion criteria. Patients with acute myocardial infarction were included, but patients who had undergone a salvage procedure were excluded.

We adopted the “functional definition” to completeness of revascularization in this study. “Functional” completeness was defined as at least one graft to all diseased arterial territories (stenosis ≥ 50%). Postoperative renal failure was defined as a requirement of hemodialysis. Postoperative stroke was defined as a new neurological event that persisted for more than 24 h after onset and was confirmed by computed tomography (CT) of the brain. Atrial fibrillation was defined as sustained atrial arrhythmia requiring treatment.

Follow-up was performed by direct communication with the patient, the patient’s family, or the attending physician.

Anesthetic and surgical techniques

A standard anesthetic technique was used for all patients. Anesthesia induction was achieved with fentanyl citrate (5–10 μg/kg), thiopental (3–5 mg/kg) or propofol infusion (3–4 mg/kg/h), and vecuronium bromide (0.1 mg/kg). Anesthesia was maintained with fentanyl, propofol (2–3 mg/kg), and low concentrations of sevoflurane as necessary. Anticoagulation was achieved with heparin (1 mg/kg) after the conduits were harvested. The activated clotting time was maintained at ≥ 250 s. Heparin was reversed with protamine after completion of the anastomosis. Standard intraoperative monitoring techniques were used. Pulmonary artery flotation catheters were used routinely and provided continuous evaluation of cardiac output. Transesophageal echocardiography was used routinely.

All procedures were performed through a median sternotomy. The conduits—one or both internal thoracic arteries, the right gastroepiploic artery (RGEA), and the saphenous vein—were harvested and skeletonized. We used a suction-type mechanical stabilizer (Octopus 4.3; Medtronic, Minneapolis, MN, USA) to immobilize the target coronary artery but did not use a heart positioner. Two deep pericardial sutures were used to expose the circumflex (Cx) area. An intracoronary shunt tube and CO2 blower were used routinely. The distal anastomosis was constructed with 7-0 polypropylene according to a standard technique. The quality of the anastomosis was checked with a transit-time Doppler flow device (Transit Time Flowmeter; Medi-Stim ASA, Oslo, Norway). A red blood cell-saving device was used in all cases.

Statistical analysis

Data are presented as the mean ± standard deviation. Categorical variables were analyzed using the χ2 or Fisher’s exact test. Constant variables were examined using the t-test, or the Mann-Whitney U-test. Actuarial survival and event-free survival curves were estimated using the Kaplan-Meier method. P < 0.05 was considered significant. Data were analyzed using SPSS 11.5.1 (SPSS, Chicago, IL, USA) for Windows (Microsoft, Redmond, WA, USA).

Results

Early results

The preoperative characteristics of the patients are summarized in Table 1. Compared with patients with a normal EF, those with a low EF were younger and included higher percentages of patients with diabetes, New York Heart Association (NYHA) class III–IV symptoms, chronic heart failure (CHF), chronic renal failure, previous myocardial infarction, unstable angina, three-vessel disease, and/or preoperative intraaortic balloon pump (IABP) use (P < 0.05).

Outcomes after surgery are shown in Table 2. There were no significant differences in the number of grafts per patient (3.54 ± 0.9 in the low-EF group vs. 3.45 ± 0.9 in the normal-EF group), the rate of achieving complete revascularization (94.9% vs. 96.8%), or the duration of the operation (275 ± 67 vs. 271 ± 59 min). No patient in either group was converted from off-pump to on-pump. Bilateral internal thoracic artery use was higher in the normal EF group (50.6% vs. 67.4%, P = 0.0054), whereas more red blood cell transfusions were required in the low-EF group (64.5% vs. 44.2%). Prolonged respiratory support (> 24 h) occurred in 21 patients (26.6%) in the low-EF group and 13 (4.1%) in the normal-EF group (P < 0.00001), and prolonged stay (> 48 h) in an intensive care unit (ICU) was required in 20 (25.3%) and 18