Previous coronary stents do not increase early and long-term adverse outcomes in patients undergoing off-pump coronary artery bypass grafting: A propensity-matched comparison

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Objective: The aim of our study was to compare the early and long-term outcomes of patients undergoing off-pump coronary artery bypass grafting (CABG) with and without previous coronary stents.

Methods: Between September 2004 and September 2011, 269 patients with previous stents underwent first-time isolated off-pump CABG. These patients were compared with 897 patients without previous stent. A propensity score-matching analysis was performed to compare early and late outcomes between the groups. Mean follow-up time was 43.4 months after surgery.

Results: Patients with previous stents were more likely to be men (85.9% in the stent group vs 79.4% in the no-stent group; $P = .022$) and more likely to have prior myocardial infarction (60.2% vs 36.8%; $P < .001$). Mean number of anastomoses was lower in patients with previous stents than in patients without previous stents (4.0 vs 4.2; $P = .037$). There was no difference in the use of bilateral internal thoracic artery graft between the groups (88.8% vs 89.1%; $P > .999$). After propensity adjustment for preoperative characteristics, both operative death (0.7% vs 1.5%; $P = .414$) and the major complications rates (7.8% vs 7.5%; $P = .869$) were similar between the groups. The actuarial survival rate at 7 years was not different between the groups (87.2% $\pm$ 3.2% vs 84.8% $\pm$ 2.9%; $P = .470$). Furthermore, freedom from major adverse cardiac and cerebrovascular events at 7 years were similar between the groups (78.9% $\pm$ 3.8% vs 77.6% $\pm$ 3.3%; $P = .811$).

Conclusions: Previous coronary stents do not increase early and long-term morbidity or mortality in patients undergoing off-pump CABG. (J Thorac Cardiovasc Surg 2014;148:1843-9)

The use of stents during percutaneous coronary intervention (PCI) for the treatment of coronary artery disease has been increasing. However, restenosis is still a major problem after stent implantation. Therefore, the number of patients undergoing coronary artery bypass grafting (CABG) in whom previous PCI procedures have been performed is also increasing. Several investigators have demonstrated that previous PCI with stent is a risk factor of CABG.[1-4] Massoudy and colleagues[3] showed in a multicenter analysis that a history of multiple PCIs was an independent predictor for in-hospital deaths and major adverse cardiac events.[3] In an another multicenter study, Mannacio and colleagues[4] demonstrated that a history of PCI before CABG increased risk for both operative death and perioperative complications and decreased survival at 5 years' follow-up. Possible reasons for the worse outcome after CABG in patients with previous stent compared with those without stent include local and systemic inflammatory reactions.[5,6] Previous studies comparing outcomes in patients with and without previous PCI with stent included CABG using cardiopulmonary bypass, which accelerates systemic inflammatory responses.[7] Thus we hypothesized that the elimination of cardiopulmonary bypass may diminish the difference in in-hospital and long-term outcomes among patients undergoing CABG with and without previous stent.

The aim of our study was to compare the early and long-term outcomes of patients undergoing off-pump CABG with and without previous coronary stents.

PATIENTS AND METHODS

Study Patients

Between September 2004 and September 2011, 1166 patients underwent first-time isolated off-pump CABG at the Sakakibara Heart Institute. Of those, 269 patients (23.1%; stent group) had at least 1 previous PCI with stent, whereas 897 patients (76.9%; no-stent group) underwent Off-pump CABG as the first-time intervention for the treatment of coronary artery disease. In the stent group, the mean number of PCI procedures with stent per patient was 1.7 $\pm$ 1.2 in the stent group (single PCI procedure with stent in 162 patients and multiple PCI procedures with stents in 107 patients). Furthermore, the median interval from the last PCI procedure to the CABG operation was 12 months (range, 1 day-254 months). The mean number of implanted stents was 1.8 $\pm$ 1.3 per patient. Implanted stent material included bare-metal stents in 174 patients, drug-eluting stents in 71patients, and both in 24 patients.

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Abbreviations and Acronyms

CABG = coronary artery bypass grafting
ITA = internal thoracic artery
MACCE = major adverse cardiac and cerebrovascular event
PCI = percutaneous coronary intervention

The institutional review board of our institution approved this retrospective study and waived the need for written consent. All data were collected prospectively and reviewed retrospectively. Follow-up involved direct communication with the patient, the patient's family, the attending physician, or a combination of these.

The primary end point of our study was long-term all-cause mortality, including early deaths. The secondary end points were operative death, early major complications, and late major adverse cardiac and cerebrovascular event (MACCE).

Operative Method

Our operative technique for off-pump CABG has been described previously.[8] All arterial grafts were harvested in a skeletonized fashion using an ultrasonic scalpel (Harmonic Scalpel, Ethicon Endosurgery, Cincinnati, Ohio). We bypassed all significantly diseased coronary vessels (≥50% diameter reduction) which were >1 mm in diameter. Deep pericardial stay sutures were not used, and a commercially available heart positioner and stabilizer were applied in all cases. We performed extensive reconstruction when the left anterior descending artery was diffusely diseased, and branches such as the septal and diagonal arteries were affected by severe atheromatous plaque. The detailed indications, techniques, and outcomes of extensive reconstruction of the left anterior descending artery have been described previously.[9]

During the operation, graft patency was assessed with a Doppler flow meter in all patients. Furthermore, intraoperative fluorescence imaging has been additionally used since April 2007.

We routinely prescribed low-dose aspirin to all patients postoperatively, continued indefinitely. Clopidogrel was given only in patients with a drug-eluting stent.

Definitions

Nonelective operations included both emergency and urgent cases, according to the definitions in the Society of Thoracic Surgeons database. Operative death was defined as death occurring during the same hospitalization, or after discharge but within 30 days after surgery. Low-output syndrome was defined as the postoperative need for intra-aortic balloon pumping, or any dose of adrenaline, or >5 μg/kg/min dopamine or dobutamine. Perioperative myocardial infarction was defined as new Q waves on electrocardiography or a peak creatine kinase MB level of ≥5 times 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 a new neurological deficit that was detected on computed tomography. In patients with preoperative stroke, postoperative stroke was defined as a worsening of the neurologic deficit with new radiologic findings. The major complications included low-output syndrome, perioperative myocardial infarction, respiratory failure, stroke, new requirement of hemodialysis, mediastinitis, and reexploration due to bleeding. MACCE was defined as death from any cause, stroke, myocardial infarction, or repeat revascularization.

Statistical Analysis

All statistical analyses were performed using the StatView 5.0 software package or the SAS program for Windows, release 9.2 (SAS Institute Inc, Cary, NC). Continuous variables are reported as the mean ± standard deviation. Continuous variables were compared by Student t test, whereas discrete variables were compared by the χ^2 test or Fischer exact test.

Actuarial survival curves were estimated using the Kaplan-Meier method. The log-rank test was used to assess differences in survival between groups. Multivariate Cox proportional hazards analysis was performed to identify significant predictors of late mortality and late MACCE, using the clinical variables listed in Table 1 and the history of previous stent. Variables with $P < .1$ in univariate analyses were included in the multivariate model.

A propensity score of having previous stent was calculated for each patient using a logistic regression model that included all preoperative variables listed in Table 1. Patients were matched 1:1 on propensity scores with greedy matching techniques. Outcomes of interest between the matched groups were compared using the paired t test for continuous variables, and the McNemar test for discrete variables.

Power analysis for log-rank test indicated that this study has adequate power to detect significant differences for the late death (1-β: 0.94; survival proportion of 7 years of the no-stent group: 0.84; hazard ratio [HR], 0.27) for an α value of 0.05.

RESULTS

Preoperative Characteristics and In-Hospital Outcomes

Preoperative characteristics of both groups are shown in Table 1. The stent group had higher proportions of men ($P = .022$) and prior myocardial infarction ($P < .001$). The mean number of diseased vessels was higher in the no-stent group than in the stent group ($P = .006$).

The intraoperative and postoperative data are listed in Table 2. The mean number of anastomoses per patient was significantly higher in the stent group than in the no-stent group ($P = .037$). The incidence of performing extensive reconstruction of the left anterior descending artery was higher in the stent group than in the no-stent group ($P = .003$).

The operative death rates did not differ between these groups ($P > .999$) and neither did the major complication ($P > .999$). The causes of death were mediastinitis in 1 patient and congestive heart failure in the other patient in the stent group and pneumonia in 6 patients, congestive heart failure in 1 patient, and a rupture of aortic aneurysm in 1 patient in the non-stent group.

Long-Term Outcomes

Follow-up was complete in 1158 of 1166 patients (99.3%). During the follow-up period (43.4 ± 24.5 months), there were 19 deaths in the stent group and 81 deaths in the no-stent group. The actuarial survival rate at 7 years was 87.3% ± 3.2% in the stent group and 84.4% ± 3.8% in the no-stent group ($P = .381$) (Figure 1, *A*). Univariate analyses identified that age, smaller body surface area, acute coronary syndrome, Canadian Cardiovascular Society class III or IV, lower ejection fraction, number of diseased vessel, higher creatinine level, a history of congestive heart failure, peripheral vascular disease, chronic obstructive pulmonary disease, nonelective surgery, and