Percutaneous Treatment With Drug-Eluting Stent vs Bypass Surgery in Patients Suffering From Chronic Stable Angina With Multivessel Disease Involving Significant Proximal Stenosis in Left Anterior Descending Artery

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Background: The aim of the present study was to compare the effects of drug-eluting stents (DES) and coronary artery bypass grafting (CABG) in patients suffering from chronic stable angina with multivessel disease, involving significant proximal stenosis in the left anterior descending artery (LAD).

Methods and Results: All consecutive patients suffering from chronic stable angina with multivessel disease involving significant proximal LAD stenosis underwent DES implantation (n=600) or CABG (n=709) at our institution. At 2 years, the unadjusted mortality was significantly lower in the DES group than in the CABG group (2.2% vs 5.2%, P=0.004), but the adjusted risk of death was similar (odds ratio (OR) 0.74, 95%CI 0.28–1.97, P=0.555). Furthermore, both the adjusted rate of nonfatal myocardial infarction and cerebrovascular events was also comparable. However, the unadjusted and adjusted risk of major adverse cardiac cerebrovascular events in the DES was significantly higher than in the CABG (13.3% vs 9.6%, OR 2.71, 95%CI 1.56–4.74, P<0.001), which is probably attributed to the higher subsequent revascularization rate after DES implantation.

Conclusions: DES showed comparable long-term mortality for the treatment of multivessel disease involving significant proximal stenosis in LAD in comparison with CABG. (Circ J 2009; 73: 1848–1855)

Key Words: Coronary artery bypass grafting; Coronary artery disease; Drug-eluting stent; Percutaneous coronary intervention

Several randomized trials have demonstrated that advantages of the application of percutaneous coronary intervention (PCI) in patients suffering from chronic stable angina with multivessel disease, involving significant proximal stenosis in the left anterior descending artery (LAD), the prognosis when compared with medical therapy.1–6 However, for the subset of patients with multivessel disease involving significant proximal stenosis in left anterior descending artery (LAD), the prognosis when treated by medical therapy was poor.7 Analyses of observational and randomized trial data have revealed that coronary artery bypass grafting (CABG) can lead to a better prognosis than medical treatment in this specific subset of patients.7–9 In several published randomized trials and registry studies, it has been demonstrated that drug-eluting stents (DES) were associated with significant lower rates of restenosis, target lesion revascularization and major adverse cardiac events (MACE) compared with bare metal stents (BMS).10–16 Therefore, DES has been widely used now. Furthermore, results from the Massachusetts stent registry suggested that DES reduces two-year mortality compared with BMS.17

In our present study, the short- and long-term outcome of PCI with DES vs CABG were compared in a cohort of patients with multivessel disease involving significant proximal LAD stenosis.

Methods

Study Population

The study population consisted of consecutive patients suffering from chronic stable angina with multivessel disease involving significant proximal LAD stenosis. These patients underwent DES implantation or isolated CABG at the Beijing Anzhen Hospital (Beijing, China) from July 2003 to December 2005, when DES first was conducted at our institution. Patients with acute coronary syndrome, any previous myocardial revascularization, single-vessel disease, left main stenosis, with concomitant valve surgery and end-stage renal failure (ie, estimated creatinine clearance <15 ml/min or on dialysis) were excluded. The decision to treat each patient using a percutaneous or surgical approach was taken after a consensus between the interventional
cardiologists and cardiac surgeons, taking into account the preference of the patient and the referring cardiologist. All patients were requested to submit written informed consent.

**Myocardial Revascularization**

**PCI** Procedures were performed through implantation of a sirolimus-eluting stent (Cypher, Cordis, Johnson & Johnson, Miami Lakes, FL, USA) or a paclitaxel-eluting stent (Taxus, Boston Scientific Corp, Natick, MA, USA) at the operator’s discretion. All lesions ≥70% by visual estimate in 1 main vessel or side branches with reference diameter ≥2 mm were attempted. Stents were implanted according to current clinical practice. Angiographic success was defined as a final angiographic residual stenosis ≤20% through visual estimation. Procedural success was considered to be angiographic success and the absence of any in-hospital major complications (ie, acute myocardial infarction [MI], need for bypass surgery or repeat PCI, or death). All patients received 325 mg of aspirin and clopidogrel (75 mg/day) before stent deployment, with a loading dose (300 mg of clopidogrel) given to patients not pretreated. All patients received a 70 IU/kg intra-arterial bolus of unfractionated heparin. The use of glycoprotein IIb/IIIa inhibitors was at the operator’s discretion. Cardiac enzymes were not measured routinely unless there was a clinical suspicion of ischemia, and therefore was not a designated outcome of the study.

**CABG** Surgical techniques were performed with elective off-pump coronary artery bypass (OPCAB), including a left internal mammary artery (LIMA) for revascularization of the LAD whenever possible. For those patients taking aspirin and clopidogrel, surgery was postponed 5 days after discontinuing clopidogrel. Cardiac enzymes were not measured routinely unless there was a clinical suspicion of ischemia.

**Definitions**

Lesions were defined according to the American College of Cardiology/American Heart Association (ACC/AHA) classification.18 Significant proximal LAD stenosis was defined as ≥70% stenosis in the portion of LAD from its origin to the takeoff of the first diagonal branch.7-9 Chronic total occlusion was defined as the presence of total obstruction of the LAD, circumflex artery or right coronary artery believed to be ≥6 months. Coronary anatomy was assessed according to the classification proposed by the AHA.19 Patients were classified into those with 2-vessel coronary artery disease and those with 3-vessel coronary artery disease using methods adapted from the Coronary Artery Surgery study.20 Classification of angina severity was according to the Canadian Cardiovascular Society (CCS) angina class.21 Complete revascularization in PCI was defined as successful revascularization of each major epicardial vessel with ≥50% stenosis.2223 Complete revascularization in CABG was accomplished when at least one graft was placed in each of the three major epicardial vessels distal to a ≥25% stenosis.2425 Major adverse cardiac cerebrovascular events (MACCEs) were defined as death, nonfatal MI, cerebrovascular events (CVEs) and repeat revascularization. Death was defined as any post-procedure death. The diagnosis of MI, MI with PCI and MI with CABG was based on ESC/ACC/AHA/WHF universal definition of MI.26 Repeat revascularization included target vessel revascularization and non-target vessel revascularization, regardless of whether the procedure was clinically or angiographically driven. CVEs was defined as a transient ischemic attack or stroke adjudicated by a neurologist.

**Postprocedure Management and Follow-up**

All patients in the 2 groups were administered aspirin (100 mg/day). Clopidogrel (75 mg/day for at least 6 months) was prescribed to patients in the DES group. Prescription of statins and angiotensin convertingenzyme inhibitors was left to the discretion of the physician. Clinical follow-up was completed via telephone contact or patient visit by experienced personnel. Angiographic follow-up was scheduled in the DES group between 6 and 9 months, or earlier if noninvasive evaluation or clinical presentation suggested ischemia.

Hierarchical study end points were cumulative occurrence during hospitalization, at 2 years of death, nonfatal MI, CVEs, repeat revascularization and the composite MACCEs.

**Statistics**

Continuous variables were presented as mean±standard deviation and compared using the Student’s t-test (when the group distributions were symmetrical and mounded) or Mann-Whitney U test (when the group distributions were skewed). The Satterthwaite adjustment was applied to the t-test when there was evidence against equality of variance. The chi-squared test (when all expected cell counts were ≥5) or Fisher exact test (when any expected cell count was <5) was used to determine the significance of differences in categorical variables. Survival analyses were performed for the first 720 days follow-up. Survival and MACCEs-free survival were analyzed by the Kaplan-Meier method, and proportional hazard Cox regression models were used to adjust for baseline covariates (identified after univariate regression analysis) and expressed as hazard ratio (HR) with 95%CI.s. Adjusted covariates included age, sex, current smoking, previous stroke, hypertension, body mass index, diabetes, peripheral vascular disease, previous MI, total cholesterol, triglyceride, low-density lipoprotein, high-density lipoprotein, creatinine, left ventricular ejection fraction, 3-vessel disease and ACC/AHA lesion type C. Cox proportional-hazards models were also used to test for the significance of the HRs for four subsets of patients: patients with diabetes; patients without diabetes; patients with 2-vessel; or 3-vessel disease. Noncorrelated variables with P<0.05 on univariate analyses and the method of revascularization (DES or CABG), were included in the multivariate analysis. Patients lost to follow-up were considered at risk until the date of last contact, at which point they were censored. Given the nonrandomized nature of the study, in order to minimize any selection bias, a second multivariate analysis was performed using the propensity score as a covariate. The propensity score was determined using a logistic regression model for treatment with CABG vs DES. A full nonparsimonious model was developed, including age, sex, current smoking, previous stroke, hypertension, body mass index, diabetes, peripheral vascular disease, previous MI, total cholesterol, triglycerid, low-density lipo-protein, high-density lipoprotein, creatinine, left ventricular ejection fraction 3-vessel disease and ACC/AHA lesion type C. Results were reported as odds ratio (OR), together with associated exact 95% CI. Statistical analyses were performed using the Statistical Package for Social Sciences for Windows, version 15.0, software (SPSS, Inc, Chicago, IL, USA). P<0.05 were considered statistically significant.
Results

Clinical and Demographic Characteristics
Between July 2003 and December 2005, 1309 patients suffering from chronic stable angina with multivessel disease involving significant proximal LAD stenosis were treated with DES implantation (n=600) or CABG (n=709) at our institution. Clinical and demographic characteristics are summarized in Table 1. Compared with patients in the CABG group, patients in the DES group were more prone to CCS I angina and had a significantly higher incidences of hypertension. Moreover, patients treated with DES had higher body mass index, low-density lipoprotein and left ventricular ejection fractions. In contrast, patients with CABG were more likely to undergo CCS II–III angina and have a history of MI.

Angiographic and Procedural Characteristics
Angiographic and procedural characteristics are listed in Table 2. Patients with CABG significantly had a higher

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Table 1. Clinical and Demographic Characteristics

<table>
<thead>
<tr>
<th></th>
<th>DES (n=600)</th>
<th>CABG (n=709)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years ± SD)</td>
<td>61.43±10.30</td>
<td>61.37±9.62</td>
<td>0.920</td>
</tr>
<tr>
<td>Male (%)</td>
<td>75.8</td>
<td>78.7</td>
<td>0.216</td>
</tr>
<tr>
<td>Current smoking (%)</td>
<td>32.8</td>
<td>31.9</td>
<td>0.073</td>
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<tr>
<td>Previous stroke (%)</td>
<td>10.2</td>
<td>10.3</td>
<td>0.939</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>68.7</td>
<td>58.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BMI</td>
<td>26.10±2.89</td>
<td>25.72±3.25</td>
<td>0.043</td>
</tr>
<tr>
<td>Diabetes mellitus (%)</td>
<td>28.8</td>
<td>30.3</td>
<td>0.560</td>
</tr>
<tr>
<td>Peripheral vascular disease (%)</td>
<td>2.7</td>
<td>2.5</td>
<td>0.885</td>
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</table>

Table 2. Angiographic and Procedural Characteristics

<table>
<thead>
<tr>
<th></th>
<th>DES (n=600)</th>
<th>CABG (n=709)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of diseased vessels</td>
<td>2 (%)</td>
<td>26.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ACC/AHA lesion type C (%)</td>
<td>26.9</td>
<td>43.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Treated vessel/patient</td>
<td>2.44±0.50</td>
<td>2.73±0.44</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Complete revascularization (%)</td>
<td>68.5</td>
<td>79.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hemodynamic support with IABP (%)</td>
<td>0.5</td>
<td>3.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Stents or conduit/patient</td>
<td>2.79±1.34</td>
<td>2.73±0.44</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>DES type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sirolimus-eluting stent (%)</td>
<td>79.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paclitaxel-eluting stent (%)</td>
<td>20.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPCAB (%)</td>
<td>–</td>
<td>97.5</td>
<td></td>
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<tr>
<td>LIMA-to-LAD graft (%)</td>
<td>–</td>
<td>100</td>
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Table 3. In-Hospital Outcomes

<table>
<thead>
<tr>
<th></th>
<th>DES (n=600)</th>
<th>CABG (n=709)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>5 (0.8%)</td>
<td>24 (3.4%)</td>
<td>0.003</td>
</tr>
<tr>
<td>Nonfatal MI</td>
<td>7 (1.2%)</td>
<td>10 (1.4%)</td>
<td>0.886</td>
</tr>
<tr>
<td>CVEs</td>
<td>0</td>
<td>3 (0.4%)</td>
<td>0.310</td>
</tr>
<tr>
<td>Repeat revascularization</td>
<td>1 (0.2%)</td>
<td>1 (0.1%)</td>
<td>1.000</td>
</tr>
<tr>
<td>MACCEs</td>
<td>13 (2.2%)</td>
<td>38 (5.4%)</td>
<td>0.003</td>
</tr>
</tbody>
</table>

CVEs, cerebrovascular events; MACCEs, major adverse cardiac cerebrovascular events. Other abbreviations see in Table 1.
Revascularization Strategy for CADs

In-Hospital Outcomes
In-hospital outcomes are presented in Table 3. The occurrence of death (0.9% vs 3.4%, P=0.003) and MACCEs (2.2% vs 5.4%, P=0.003) were significantly lower in the DES group than in the CABG group. The rate of nonfatal MI, CVEs and repeat revascularization were 1.2%, 0 and 0.2% in the DES group, respectively, and 1.4%, 0.4%, and 0.1%, respectively, in the CABG group (P=NS for these comparisons).

Outcomes at 24 Months
In a preliminary analysis, the cumulative mortality at 24 months was significantly lower in the DES group than in the CABG group (24-month unadjusted mortality rate, 2.2% vs 5.2%, P=0.004). However, in the propensity score-adjusted analyses, the risk of death did not show significant differences in the 2 groups (OR 0.74, 95% CI 0.28–1.97, P=0.555) (Table 4). After multivariable adjusted Cox regression analysis, survival was also not significantly different in the 2 groups (98.4% vs 97.4%, HR 0.62, 95% CI 0.22–1.73, P=0.364) (Figure 1).

During the study period, 14 patients in the CABG group underwent angiographic examination as clinically indicated. In the DES group, 213 patients (57.8%) underwent scheduled or clinically indicated follow-up coronary angiography after the index procedure. The unadjusted and adjusted risks of repeat revascularization were significantly higher in patients treated with DES than those treated with CABG (unadjusted rate 10.2% vs 2.0%, P<0.001; adjusted risk OR 7.37, 95% CI 2.98–15.21, P=0.001). 61 patients (repeat PCI in 55, CABG in 6) in the DES group underwent repeat revascularization (47 for angina recurring, 14 driven by angiography), of which 48 patients experienced target vessel revascularizations (38 patients for additional procedures on the proximal LAD). However, only 14 patients (repeat PCI in 14) in the CABG group underwent repeat revascularization and all repeat revascularizations were performed on the index procedure treating vessels (2 patients undergoing additional procedures for LIMA-LAD anastomotic stenosis) for the recurrent angina. As mentioned above, the rate of repeat revascularization driven by recurrent angina in the DES group also was significantly higher than in the CABG group (7.8% vs 2.0%). There was no significant difference in the risk of CVEs and nonfatal MI at 24 months (Table 4).

MACCEs occurred in 80 cases in the DES group and 68 cases in the CABG group, and the unadjusted rate of MACCEs at 24 months was 13.3% vs 9.6% (P=0.033). This statistical trend was confirmed in the propensity score adjusted analysis (OR 2.71, 95% CI 1.56–4.74, P<0.001) (Table 4). In addition, the adjusted MACCEs-free survival with Cox regression was lower in the DES group than that

<table>
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<th>(%)</th>
<th>Unadjusted</th>
<th>Adjusted</th>
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<tr>
<td></td>
<td>DES</td>
<td>CABG</td>
</tr>
<tr>
<td>Death</td>
<td>2.2</td>
<td>5.2</td>
</tr>
<tr>
<td>Nonfatal MI</td>
<td>1.6</td>
<td>1.9</td>
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<tr>
<td>Repeat revascularization</td>
<td>10.2</td>
<td>2.0</td>
</tr>
<tr>
<td>CVEs</td>
<td>1.8</td>
<td>1.7</td>
</tr>
<tr>
<td>MACCEs</td>
<td>13.3</td>
<td>9.6</td>
</tr>
</tbody>
</table>

OR, odd ratios; CI, confidence interval. Other abbreviations see in Tables 1, 3.

Figure 1. Adjusted survival (A) and MACCEs-free survival (B) curves for all study patients. Proportional hazard Cox regression models were used to adjust for baseline covariates and adjusted covariates included age, sex, current smoking, previous stroke, hypertension, body mass index, diabetes, peripheral vascular disease, previous MI, total cholesterol, triglyceride, low-density lipoprotein, high-density lipoprotein, creatinine, left ventricular ejection fraction, 3-vessel disease and ACC/AHA lesion type C. Abbreviations see in text.
in the CABG group (81.1% vs 92.3%, HR 2.63, 95%CI 1.55–4.48, P<0.001) (Figure 1). The difference was mainly due to the higher rate of repeat revascularization, as shown above.

Subgroup Analysis
After multivariable adjusted Cox regression analysis, the mortality was comparable between DES and CABG in the subgroup of with diabetic patients, nondiabetic patients, patients with 2-vessel disease and patients with 3-vessel disease (Figure 2). The adjusted risk of MACCEs was also similar between DES and CABG in the diabetic patients. However, patients treated with DES had a significantly higher risk of MACCEs than those treated with CABG in the subgroup of patients without diabetes, patients with 2-vessel disease and patients with 3-vessel disease (Figure 2).

Discussion
To our knowledge, this is the first study to compare surgical revascularization with PCI with DES implantation in the treatment of patients suffering from chronic stable angina with multivessel disease involving significant proximal stenosis in LAD. Because of the nonrandomized nature of the study, an adjusted analysis using the propensity score was performed to evaluate the differences in baseline clinical characteristics between the study groups.27

In this single-center retrospective study, the main finding was that the adjusted long-term mortality risk was similar in patients who underwent PCI with DES implantation or CABG, although a significant decrease in-hospital mortality was related to DES. This balance was maintained among all subgroups, including nondiabetics, diabetics and patients with either 2- or 3-vessel disease. Furthermore, the adjusted rate of nonfatal MI and CVEs was also comparable between the two strategies. However, the MACCEs risk of the DES group was significantly higher than the CABG group, mainly owing to the higher subsequent revascularization rate after DES implantation.

A variety of factors, including unfavorable anatomy, must be taken into consideration when determining an appropriate treatment strategy for a patient with multivessel disease.28 It has been demonstrated that multivessel disease involving significant proximal stenosis in the LAD was related to poor prognosis, and the 5-year mortality was up to 17–41%.8 Analyses of observational studies and randomized trial data have revealed that surgery is associated with a better prognosis than medical treatment.8,9 However,
there were no substantial data to compare surgery with PCI in this regard, despite of the widespread availability of DES.

Several previous studies have documented that CABG had better survival rates than PTCA, and suggested that CABG be the first choice of procedure in these cases. However, these studies were conducted in the era preceding the widespread use of coronary stenting. Furthermore, there is no evidence from randomized trials to support this recommendation.

Of several published randomized clinical trials comparing CABG with BMS, the ARTS I trial and ERACI II trial seem particularly relevant. In a subanalysis of the ARTS I trial, the 3-year outcome in patients with multivessel disease involving significant proximal stenosis in LAD showed no significant differences in mortality (4.5% vs 4.3%), CVEs (2.0% vs 2.8%) or MI (6.9% vs 6.3%) rates between BMS and CABG. However, the overall MACCEs rate (28% vs 14.6%) was significantly higher in patients treated with BMS, a difference largely attributable to the higher need for further revascularization (22.0% vs 4.8%). The data from the ERACI II trial was similar to the ARTS I trial. In the subgroup analysis, there were no significant differences in survival (PCI 96.4% vs CABG 95%) and survival with freedom from MI (PCI 92% vs CABG 89%) at 41.5-months’ follow up, while freedom from new revascularization procedures was significantly different (CABG 96.6% vs PCI 75%, P=0.0002). As a result, event-free survival was better with CABG than with PCI (86.5% vs 65%, P=0.005). In conclusion, the use of coronary stenting has a comparable survival benefit with CABG, although the rate of MACCEs was higher than CABG mainly owing to more frequent repeat revascularization.

Several published pivotal trials have demonstrated that DES was associated with a significant lower rate of restenosis, target lesion revascularization and MACE compared with BMS. Accordingly, DES has been routinely used. Recent published registry studies compared DES with CABG for the treatment of multivessel disease. In terms of multivessel disease involving proximal LAD, one Korean study showed that DES did not increase the risk of death for patients with 2-vessel disease (adjusted HR 0.66, 95%CI 0.23–1.89, P=0.64) or 3-vessel disease (adjusted HR 1.11, 95%CI 0.55–2.22, P=0.44) involving proximal LAD, as compared with CABG at 3 years. The outcomes are further supported by our present study. Our study also shows that the adjusted mortality risk at 2 years was similar between the two modalities, including the subgroups of nondiabetics, diabetics and patients with either 2- or 3-vessel disease, although CABG is related to higher unadjusted mortality.

Only a slight difference was found between our study and the New York State registry. The New York State registry report documented that CABG did not decrease mortality in patients with 3-vessel disease (adjusted HR 0.79, 95%CI 0.61–1.02, P=0.07), while the survival benefits only existed in 2-vessel disease (adjusted HR 0.71, 95%CI 0.53–0.96, P=0.02) at 18 months. Previous studies have demonstrated that CABG provided survival benefits compared with PCI in patients with renal failure who were excluded from our study. In a retrospective study, dialysis patients had better long-term survival after CABG surgery than after PCI. Likewise, the APPROACH study also showed that CABG was associated with better survival in all categories of kidney function. Furthermore, the New York State registry included more cases of left ventricular dysfunction than our study (15.4% vs 4.3%), and a previous large registry study demonstrated that for patients with an EF <40% and with 2- or 3-vessel disease involving proximal left anterior descending coronary artery, the HRs strongly favored CABG over PCI. All these factors mentioned above may contribute to the differing results between New York State registry and our study.

Our study included more patients with diabetes mellitus than the previous study (30.3% vs 15.4% or 19%), and the prevalence of 3-vessel disease was also higher (73.1% vs 41.5% or 36%). Both diabetes mellitus and 3-vessel disease have been proven to increase the risk of inhospital mortality and morbidity following contemporary CABG. As a result, the in-hospital mortality with CABG (3.4%) in our study is much higher than previous studies (2.0–2.5%), which mainly contributes to the higher unadjusted mortality at 2 years. Nevertheless, the marked difference no longer exists after adjusting for various risk factors.

Compared with that in the CABG group, the rate of MACCEs in the DES group is still higher mainly owing to the higher rate of repeat revascularization in our study, although DES has significantly decreased the risk of restenosis in published studies. Several published studies demonstrated that late patency of the internal mammary artery grafts was superior to DES when it comes to treating the proximal lesion in LAD. In addition, each patient treated with CABG in our study has a LIMA to LAD graft. The factors mentioned above principally account for the lower rate of repeat revascularization in the CABG group. Moreover, the complete revascularization rate of the CABG group is significantly higher than that of the DES group (79.7% vs 68.5%), which also plays an important role in the high rate of revascularization in DES group. In ART I study, complete revascularization was more frequently achieved in CABG-treated patients than in stented patients (84.1% vs 70.5%, P=0.001). Although no differences in mortality or the combined end point of death/stroke/MI were seen in the comparison among the 4 groups, overall MACCE rates were significantly higher in the incompletely revascularized stenting group, driven by an increased need for CABG within the first year follow-up. In the most recent publication on this topic, the investigators of the APPROACH study reported that 1,308 patients completely revascularized after PCI compared with 648 patients with incomplete revascularization after PCI. That study demonstrated that complete multivessel PCI was associated with a reduced need for future PCI and a trend toward better survival. Therefore, all the factors mentioned above may contribute the MACCE rate gap between DES and CABG treated patients.

Our study showed that the incidence of MACCE in the DES group was similar to that of the CABG group among diabetic patients. These outcomes were consistent with the recent studies. The 3-year results of the ARTS-II diabetic patients were compared with both arms of the randomized ARTS-I trial. The MACCE rate in ARTS-II was similar to that in the ARTS-I CABG arm (OR 1.56, 95%CI 0.95–2.57, P=0.09). Moreover, the CARDia trial randomized 510 diabetic patients with multivessel disease or complex single vessel disease to receive either CABG (n=254) or PCI (n=256; 71% DES). In the DES subanalysis, the MACCE rate at 1 year indicated no difference between CABG and DES (11.0% vs 15.1%, P=0.21). However, other subgroup
analysis revealed that patients treated with DES had a significant higher risk of MACCEs than those patients without diabetes, with 2- vessel disease or 3-vessel disease treated with CABG.

**Study Limitations**

Several pitfalls in our present study still remain. This study was a single-center prospective, nonrandomized registry study. A selection bias represents a major limitation owing to the choice of percutaneous or surgical treatment according to physician preferences. Patients treated by CABG may be more prone to severe coronary artery diseases. To minimize the selection bias, we used propensity score methods. Nevertheless, there are still inherent limitations on using an observational population because of unmeasured confounding factors. Moreover, since the two-year follow-up method is not potent enough to evaluate the survival benefit, a longer-term clinical follow-up is needed to assess the clinical effect.

**Conclusion**

In conclusion, our study suggests that percutaneous revascularization with DES showed comparable long-term mortality for the treatment of multivessel disease involving significant proximal stenosis in LAD in comparison with CABG. However, CABG was associated with less MACCEs, primarily due to lower repeat revascularization rate compared with DES.

**References**


