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Original Article

Long-term results of stenting versus coronary artery bypass surgery for left main coronary artery disease—A single-center experience

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Abstract

Background: Percutaneous coronary intervention (PCI) has emerged as an alternative treatment to coronary artery bypass grafting (CABG) for unprotected left main (LM) coronary artery disease, but the results of both treatments are less clear in real-world practice. We aimed to assess the long-term outcomes of unprotected LM disease treated with CABG or PCI with stenting in high-risk population from a single center.
Methods: We collected 478 consecutive patients with unprotected LM disease (PCI/CABG: 208/270; mean age: 70 ± 11 years; 85% male), and 252 patients were considered to be at high risk (European System for Cardiac Operative Risk Evaluation ≥6). The median follow-up was 4.3 years (interquartile range: 2.7–6.5 years).
Results: All-cause death (PCI/CABG: 27.4%/31.5%; $p = 0.36$) and all-cause death/myocardial infarction (MI)/stroke (PCI/CABG: 30.8%/35.9%; $p = 0.49$) were comparable between the two groups, whereas the repeat revascularization rate was significantly higher in the PCI group (PCI/CABG: 22.6%/11.0%; $p < 0.01$). These results remained similar after adjustment with the propensity score. Notably, CABG tended to be associated with higher periprocedural mortality (adjusted $p = 0.08$) and long-term stroke (adjusted $p = 0.05$), while PCI was associated with higher long-term MI (adjusted $p = 0.09$). Analyses of the diabetic subgroup (PCI/CABG: 98/124) yielded similar results.
Conclusion: PCI was a comparable alternative to CABG for high-risk patients with unprotected LM disease in terms of long-term risks of all-cause death/MI/stroke, but with a significantly higher repeat revascularization rate.

Keywords: coronary artery bypass grafting; coronary stent; left main coronary artery disease; percutaneous coronary intervention

1. Introduction

Although coronary artery bypass grafting (CABG) remains the reference of treatment for unprotected left main (LM) coronary artery disease, percutaneous coronary intervention (PCI) with stenting, especially using the drug-eluting stent (DES), has emerged as an alternative treatment with acceptable short- and long-term clinical outcomes in recent studies.[1–5] Although treatment of LM disease with PCI seemed to have a similar long-term mortality rate to that with CABG, PCI was consistently associated with a higher rate of repeated revascularization than CABG, even with the use of DESs.[6–13] Furthermore, a recent meta-analysis comparing the long-term outcomes of PCI with CABG showed that the patients with LM disease treated with PCI suffered from less strokes, while

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

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patients treated with CABG had less occurrence of nonfatal myocardial infarction (MI).[14] Therefore, considering the surgical risk, the potentially troublesome in-stent restenosis and late/very late stent thrombosis, as well as the patient's and physician's preferences, the choice of treatment in real-world daily practice may sometimes be difficult. In this study, we aimed to assess the long-term clinical outcomes of LM disease treated with PCI with stenting or CABG in a real-world high-risk population from a single center.

2. Methods

This study was a retrospective observational study and included 478 consecutive patients with unprotected LM coronary artery stenosis (>50% narrowing) undergoing PCI or CABG at Taipei Veterans General Hospital, Taipei, Taiwan from January 2004 to December 2010. Unprotected LM disease was defined as significant LM coronary artery stenosis without patent coronary artery bypass graft to the left anterior descending or left circumflex artery. Patients with acute coronary syndrome with cardiogenic shock and acute ST segment elevation MI with totally occluded LM coronary artery as the culprit lesion were excluded. Patients who underwent concomitant valvular or aortic surgery were also excluded. The decision to perform PCI or CABG depended on the patient's or physician's preference or surgical/interventional risk profile. The surgical risk of the patient was evaluated according to the European System for Cardiac Operative Risk Evaluation (EuroSCORE),[15] which was computed by two experienced cardiologists who were unaware of the clinical course of patients. Patients with a EuroSCORE of ≥6 were considered to be at high surgical risk.

In the CABG group, CABG was performed with the standard bypass procedure. On-pump beating heart surgery was performed in high-risk patients not suitable for aortic clamping. The left internal mammary artery was harvested to bypass the left anterior descending coronary artery in all possible cases. In patients younger than 60 years, radial artery graft was considered. Aspirin or and/or clopidogrel for life-long use was prescribed as soon as possible after the surgery. Complete revascularization was attempted whenever possible using arterial conduits or saphenous vein grafts.

In the PCI group, patients underwent PCI due to either the patient's or the physician's preference, or due to a high surgical risk. PCI and ventriculography were performed by the standard procedure as described before.[16] Predilatation with a balloon catheter was performed in all cases. For most LM lesions involving distal bifurcation, stenting across the bifurcation toward the left anterior descending artery (crossover technique) was attempted, followed by provisional stenting of the left circumflex artery (T-stenting or culotte stenting) if there was residual stenosis or dissection over the orifice of the left circumflex artery. Postdilatation with the kissing balloon technique was attempted except in cases with technique difficulty or small non-dominant left circumflex artery. Debulking by means of a rotablator was used only for highly calcified lesions, and the use of intravascular ultrasound and glycoprotein IIb/IIIa receptor antagonist were at the discretion of the interventional operators. After the procedure, all patients received aspirin (100 mg/d) indefinitely and clopidogrel (300 mg loading dose, then 75 mg/d) or ticlopidine (500 mg loading dose, then 250 mg twice a day) for at least 1 month [bare metal stent (BMS)] or 12 months (DES). Medications for treatment of angina pectoris (calcium channel blockers, beta-blockers, and nitrates) were continued.

All patients were followed up completely without any cases being lost to follow-up. For all patients undergoing PCI or CABG, follow-up angiography was performed only when there were ischemic symptoms or signs and/or noninvasive evidence of ischemia. The clinical follow-up data were collected during scheduled monthly clinic evaluations or through direct telephone contact for all-cause death and first-ever major adverse cardiovascular cerebrovascular event (MACCE), which was defined as all-cause death, MI, stroke, and clinically driven repeat revascularization. MI was defined as the presence of significant new Q waves in at least two electrocardiographic leads or the presence of symptoms compatible with MI associated with an increase in creatine kinase-MB fraction three or more times the upper limit of the reference range. Stroke with neurological deficit was diagnosed by a neurologist on the basis of an imaging study. Stent thrombosis occurrence was classified as definite, probable, or possible according to the Academic Research Consortium criteria,[17] and was considered as acute (within 24 hours), subacute (within 30 days), late (after 30 days and within 12 months), or very late (after 1 year). The study protocol was approved by the Institutional Review Board at Taipei Veterans General Hospital, and informed written consent was obtained from each participant.

All continuous variables were presented as mean ± standard deviation, and categorical variables as numbers and percentages. The differences of continuous data between the PCI and CABG groups were compared by two-sample *t* test. Categorical data between the two groups were compared by means of Chi-square test or Fisher's exact test. Multivariable Cox regression analysis was performed to determine the independent predictors of long-term clinical outcomes. Hazard ratios (HR) and 95% confidence intervals (CI) were calculated. To reduce the effect of treatment selection bias and compensate for potential confounding factors in this observational study, we calculated the propensity score using multiple logistic regression analysis, incorporating all the variables shown in Table 1. Cox regression analysis adjusted with the propensity score was performed in all patients. A p value <0.05 was considered to be statistically significant. SPSS version 17.0 (SPSS Inc., Chicago, IL, USA) software package was used for statistical analysis.

3. Results

3.1. Patient characteristics

From January 2004 to December 2010, we collected 478 consecutive patients with unprotected LM coronary artery

Table 1
Baseline characteristics of patients treated with PCI and CABG.

	PCI (n = 208)	CABG (n = 270)	p	Adjusted p value[a]
Age (y)	70 ± 12	69 ± 11	0.26	0.94
Gender (M/F)	175/33	231/39	0.70	0.99
Hypertension	163 (78)	223 (83)	0.29	0.94
Diabetes	98 (47)	124 (46)	0.85	0.96
Hypercholesterolemia	112 (54)	135 (50)	0.41	0.95
Smoking	104 (50)	180 (67)	<0.01	0.89
Peripheral artery disease	27 (13)	42 (16)	0.44	0.46
Clinical presentation as ACS	103 (50)	146 (54)	0.36	0.96
LVEF (%)	49 ± 12	49 ± 12	0.66	0.99
Creatinine (mg/dL)	1.8 ± 2.0	1.7 ± 2.0	0.75	0.99
eGFR (mL/min/1.73 m^2)	67 ± 32	66 ± 30	0.84	0.89
Chronic kidney disease	84 (40)	101 (37)	0.57	0.38
EuroSCORE	7.1 ± 5.1	6.4 ± 4.0	0.13	0.13
EuroSCORE ≥6	116 (56)	136 (50)	0.27	0.32
Medications				
ACE inhibitors/ARB	121 (58.2)	176 (65.2)	0.13	0.30
Beta-blocker	125 (60.1)	174 (64.4)	0.34	0.57
CCB	110 (52.9)	181 (67.0)	<0.01	<0.01
Statins	129 (62.0)	167 (61.9)	1.00	0.29
Antiplatelets	190 (91.3)	256 (94.8)	0.14	0.11
Diuretic	65 (31.2)	107 (39.6)	0.07	0.41
Angiographic and procedure characteristics				
LM bifurcation involved	146 (70)	207 (77)	0.12	0.94
Right coronary artery involved	117 (56)	230 (85)	<0.01	0.93
Extent of diseased vessel				
LM only	9 (4.3)	5 (1.9)		
LM plus 1-vessel	44 (21)	13 (4.8)		
LM plus 2-vessel	64 (31)	49 (18)		
LM plus 3-vessel	91 (44)	203 (75)	<0.01	0.96
Use of drug eluting stent	131 (63)			
Sirolimus	44 (34)			
Paclitaxel	40 (31)			
Everolimus	25 (19)			
Zotalimus	22 (17)			
Use of intravascular ultrasound	43 (21)			
Use of rotablator	15 (7.2)			

Data are presented as n (%) or mean ± standard deviation, unless otherwise indicated.
ACE = angiotensin-converting enzyme; ACS = acute coronary syndrome; ARB = angiotensin receptor blocker; CABG = coronary artery bypass grafting; CCB = calcium channel blocker; eGFR = estimated glomerular filtration fraction; EuroSCORE = European System for Cardiac Operative Risk Evaluation; F = female; LM = left main; LVEF = left ventricular ejection fraction; M = male; PCI = percutaneous coronary intervention.
[a] Propensity score adjusted.

stenosis, of whom 208 were treated with PCI and 270 with CABG. The mean age of the population was 70 ± 11 years, with male (85%) predominance. More than half of patients (249 patients, 52%) presented with non-ST segment elevation acute coronary syndrome. Furthermore, 222 patients (46%) and 185 patients (39%) suffered from diabetes and chronic kidney disease (estimated glomerular filtration rate <60 mL/min per 1.73 m^2) respectively, and 112 patients (23%) presented with left ventricular ejection fraction <40%. In particular, 252 patients (53%) with an additive EuroSCORE of ≥6 were considered to be at high risk. These features suggested that these study patients belonged to a higher-risk population. The baseline characteristics of the PCI and CABG groups are summarized in Table 1. There were no significant differences in atherosclerotic risk factors between the PCI and CABG groups, except for a higher prevalence of smoking history in patients undergoing CABG. By contrast, the patients undergoing CABG had more complex coronary anatomy, including more triple-vessel disease and more involvement of the right coronary artery (Table 1). Finally, there were no significant differences of medication between both groups except that more CABG patients received calcium channel blockers ($p < 0.01$, Table 1).

In the PCI group, DES was used in 131 patients (63%), with most patients using first-generation DES (sirolimus-eluting stent and paclitaxel-eluting stent, 64%). The cross-over technique ($n = 166$) was used in 107 patients (73.3%) with distal bifurcation involvement. In patients treated with more than one stent, T-stenting with final kissing balloon post-dilatation (24 patients, 16.4%) was used more often than crush/minicrash (4.1%) and culotte stenting (6.2%). Intravascular ultrasound and rotablation were applied in 43 (20.7%) and 15 (7.2%) patients, respectively (Table 1).

In the CABG group, only 12 patients (4.4%) underwent off-pump surgery, and 220 (81.5%) patients received at least one arterial conduit; the others received vein grafts due to poor quality of LIMA or urgent surgery. The mean numbers of grafts were 0.9 ± 0.5 (arterial grafts) and 2.3 ± 0.8 (venous grafts). Re-do sternotomy was performed in two patients (0.7%). The medication used for both groups is also shown in Table 1.

3.2. Thirty-day and long-term outcomes

Table 2 summarizes 30-day and long-term clinical outcomes after treatment with PCI or CABG. Within the 30-day period after index procedure, CABG appeared to be associated with significantly more deaths and MACCE. By contrast, one case of definite subacute stent thrombosis (14 days after BMS stenting) and two cases of probable acute or subacute stent thrombosis occurred in the PCI group (1 day after DES stenting and 1 week after BMS stenting, respectively) according to the definition of Academic Research Consortium criteria, and all three lead to cardiovascular deaths.

As for the long-term outcomes, the median follow-up period was 4.3 years (25−75%; range: 2.7−6.5 years). During the follow-up period, there were 142 all-cause deaths (29.7%) and 205 cumulative MACCE (42.9%), which also included 35 nonfatal MI (7.3%), 18 stroke (3.8%), and 78 repeat revascularization (16.3%; Table 2). The nonadjusted long-term rates of all-cause death (nonadjusted $p = 0.36$), all-cause death/MI/stroke (nonadjusted $p = 0.49$), and MACCE (nonadjusted $p = 0.71$) were comparable between the PCI and

CABG groups, whereas the rate of repeat revascularization rate was significantly higher in the PCI group (nonadjusted $p < 0.01$; Table 2). There were two cases of probable late stent thrombosis that occurred at 180 days and 266 days after PCI, respectively (cumulative definite/probable stent thrombosis cases: 5, 2.4%). Both patients underwent LM PCI using BMS, and these episodes resulted in sudden death. There was no case with very late stent thrombosis.

We analyzed the long-term clinical outcomes for the diabetic subgroup. Comparing to nondiabetic patients, the patients with diabetes were associated with significantly higher risk for all-cause death, all-cause death/MI/stroke, and MACCE ($p = 0.04$, $p = 0.02$, and $p = 0.005$, respectively) and had a trend toward increased risk of repeat revascularization ($p = 0.07$). Analyses of the diabetic subgroup ($n = 222$; PCI: $n = 98$; CABG: $n = 124$) yielded results similar to those of the overall cohort, with comparable EuroSCORE, all-cause death rate, and MACCE rate between the PCI and CABG groups, and a significantly higher repeat revascularization rate in the PCI group (Table 3).

Table 4 shows the result of multivariate Cox regression analysis of long-term clinical outcomes. The treatment with CABG remained an independent protective factor against repeat revascularization (adjusted HR: 0.40; 95% CI: 0.25−0.63; $p < 0.01$; Table 4).

3.3. Propensity score-adjusted clinical outcomes

There were no significant differences in clinical and angiographic characteristics between the PCI and CABG groups after adjustment with the propensity score (Table 1).

Table 2
Thirty-day and cumulative long-term outcomes.

	PCI ($n = 208$)	CABG ($n = 270$)	p	Adjusted p value[a]
30-d outcomes				
All-cause death	3 (1.4)	14 (5.2)	0.04	0.08
MI	1 (0.5)	1 (0.4)	0.85	0.49
Repeat revascularization	0 (0.0)	1 (0.4)	1.0	1.0
Stroke	1 (0.5)	5 (1.9)	0.22	0.34
All-cause death/MI/stroke	4 (1.9)	18 (6.7)	0.02	0.05
MACCE	4 (1.9)	18 (6.7)	0.02	0.05
Definite/probable stent thrombosis	3 (1.4)			
Long-term outcomes				
All-cause death	57 (27.4)	85 (31.5)	0.36	0.80
MI	17 (8.2)	18 (6.7)	0.45	0.09
Repeat revascularization	47 (22.6)	31 (11.0)	<0.01	<0.01
Stroke	4 (1.9)	14 (5.2)	0.09	0.05
All-cause death/MI/stroke	64 (30.8)	97 (35.9)	0.49	0.88
MACCE	91 (43.8)	114 (42.2)	0.71	0.13
Definite/probable stent thrombosis	5 (2.4)			

Data are presented as n (%).
CABG = coronary artery bypass grafting; MACCE = major adverse cardiac and cerebrovascular event, including all-cause death, myocardial infarction, stroke and repeat revascularization; MI = myocardial infarction; PCI = percutaneous coronary intervention.
[a] Propensity score adjusted.

After adjustment with the propensity score, Fig. 1 shows the adjusted cumulative incidence curves of all-cause death, all-cause death/MI/stroke, MACCE, and repeat revascularization based on the revascularization procedure. There were no significant differences in the adjusted rate of long-term all-cause death, all-cause death/MI/stroke, and MACCE between the PCI and CABG groups, whereas the rate of adjusted repeat revascularization remained significantly higher in the PCI group (adjusted $p < 0.01$). Notably, CABG tended to be associated with higher periprocedural mortality (adjusted $p = 0.08$) and long-term stroke (adjusted $p = 0.05$), while PCI tended to be associated with a higher risk of long-term MI (adjusted $p = 0.09$).

4. Discussion

The results of this study showed that, in a cohort with unprotected LM disease, the long-term risks of all-cause death/MI/stroke and MACCE were similar in the PCI and CABG groups during a median follow-up period of 4.3 years. By contrast, the rate of long-term repeat revascularization was significantly higher in the PCI group than in the CABG group. Subgroup analysis of diabetic patients yielded results similar to those of the overall cohort.

As CABG may be associated with a higher rate of periprocedural MI and stroke and potential long-term advantage, studies with limited follow-up periods may not be appropriate to compare the clinical outcomes of CABG and PCI. Park et al[10] have reported a single-center experience in a 10-year follow-up cohort of patients with LM disease treated with BMS and CABG, and a 5-year follow-up cohort of patients with LM disease treated with DES and CABG. They found that there were no significant differences in the adjusted risk of death and the composite of death, MI, or stroke between BMS and CABG or between DES and CABG. By contrast, the rate of TVR was consistently higher in the BMS or DES group

Table 3
Cumulative long-term outcomes in LM patients with and without diabetes.

	With diabetes			Without diabetes		
	PCI ($n = 98$)	CABG ($n = 124$)	p[a]	PCI ($n = 110$)	CABG ($n = 146$)	p[a]
EuroSCORE	7.5 ± 5.3	6.9 ± 4.3	0.32	6.7 ± 4.8	6.1 ± 3.7	0.26
All-cause death	31 (31.6)	45 (36.3)	0.59	26 (23.6)	40 (27.4)	0.87
MI	9 (9.2)	8 (6.5)	0.16	8 (7.3)	10 (6.8)	0.14
Repeat revascularization	25 (25.5)	17 (13.7)	0.01	22 (20.0)	14 (9.6)	<0.01
Stroke	3 (3.1)	8 (6.5)	0.26	1 (0.9)	6 (4.1)	0.10
All-cause death/MI/stroke	35 (35.7)	51 (41.1)	0.80	29 (26.4)	46 (31.5)	0.99
MACCE	48 (49.0)	62 (50.0)	0.53	43 (39.1)	52 (35.6)	0.14

Data are presented as n (%) or mean ± standard deviation.
CABG = coronary artery bypass grafting; EuroSCORE = European System for Cardiac Operative Risk Evaluation; LM = left main coronary artery disease; MACCE = major adverse cardiac and cerebrovascular event, included all-cause death, myocardial infarction, stroke and repeat revascularization; MI = myocardial infarction; PCI = percutaneous coronary intervention.
[a] Propensity score adjusted.

Table 4
Multivariate Cox regression analysis for all-cause death and all-cause death/MI/stroke, and for MACCE and repeat revascularization.

Variables	All-cause death		All cause death/MI/stroke	
	HR (95% CI)	*p*	HR (95% CI)	*p*
Age	1.04 (1.02−1.05)	<0.01	1.04 (1.02−1.06)	<0.01
ACS	1.53 (1.06−2.20)	0.02	1.79 (1.27−2.54)	<0.01
LVEF	0.98 (0.97−0.99)	<0.01	0.98 (0.97−1.00)	<0.01
DM	—	—	1.40 (1.02−1.92)	0.04
Cr	1.21 (1.41−1.28)	<0.01	1.17 (1.10−1.24)	<0.01
CCB	0.57 (0.41−0.80)	<0.01	0.59 (0.43−0.80)	<0.01
	MACCE		Repeat revascularization	
	HR (95% CI)	*p*	HR (95% CI)	*p*
Age	1.02 (1.01−1.03)	<0.01	—	—
ACS	1.60 (1.19−2.16)	<0.01	1.96 (1.24−3.12)	<0.01
LVEF	0.99 (0.98−1.00)	0.01	—	—
DM	1.44 (1.09−1.91)	0.01	—	—
Cr	1.13 (1.07−1.20)	<0.01	—	—
CCB	0.61 (0.47−0.81)	<0.01	—	—
PCI/CABG	—	—	0.40 (0.25−0.63)	<0.01

ACS = acute coronary syndrome; CABG = coronary artery bypass grafting; CCB = calcium channel blocker; CI = confidence interval; Cr = creatinine; DM = diabetes mellitus; HR = hazard ratio; LVEF = left ventricular ejection fraction; MACCE = major adverse cardiac and cerebrovascular event, included all-cause death, myocardial infarction, stroke and repeat revascularization; MI = myocardial infarction; PCI = percutaneous coronary intervention.

compared with the CABG group. In the recently published 5-year result of the LM subgroup in the Synergy between Percutaneous Coronary Intervention with Taxus and Cardiac Surgery (SYNTAX) trial, no differences in overall mortality and MACCE were found between the PCI and CABG groups. Nevertheless, LM patients receiving PCI had a lower stroke rate and higher revascularization rate compared with those receiving CABG.[18] Although our study patients were enrolled from daily practice of a single center and were at higher surgical risk compared with previous studies (mean age ~70 years, nearly half of the patients had diabetes, EuroSCORE $\geq$ 6, and clinical presentation as acute coronary syndrome), our study's results remained consistent with those of the previous studies, although with higher rates of adverse clinical outcomes (e.g., PCI vs. CABG: all-cause death: 27.4% vs. 31.5%; MACCE: 43.8% vs. 42.2%, compared with those of the SYNTAX 5-year results: all-cause death: 12.8% vs. 14.6%; MACCE: 36.9% vs. 31.0%). Thus, our study might expand the findings of the previous randomized trial to the real-world high-risk population with unprotected LM disease and might be beneficial in the choice of treatment.

The repeat revascularization rate in our PCI patients remained significantly higher than that in the CABG group, even with propensity score adjustment, which is in accordance with those previous studies,[6−13] although the overall revascularization rate was higher in our studies. In particular, the revascularization rate was much higher in our CABG patients in comparison with previous studies,[6−13] but it was comparable with that of the SYNTAX trial 5-year result.[18] Both a higher surgical risk profile and reduced use of arterial conduits in our patients (81.5%) compared to previous studies might be the contributing factors.[10,11] By contrast, as the follow-up angiography was done only by clinical indications and the angiographic follow-up rate was relatively low, especially in the CABG group, the restenosis rate in the PCI group and asymptomatic graft failure might be underestimated.

A recent meta-analysis compared the long-term clinical outcomes of PCI versus CABG for unprotected LM disease, and found that the CABG patients had fewer occurrences of MI but a higher risk of stroke.[14] Although the significantly increased risk of stroke with CABG at 1 year in the global SYNTAX cohort did not become more significant at 5 years, probably due to a late catch-up of stroke in the PCI arm,[19] the stroke risk remained significantly higher in the LM subgroup of the CABG group at 5 years ($p = 0.03$).[18] Our results were similar, showing that there was a trend toward less strokes and a higher MI rate (propensity score-adjusted $p = 0.05$ and $p = 0.09$, respectively) in the PCI group. Nevertheless, our findings must be interpreted with caution due to the limited patient number and observational nature of our study, and further large studies may be needed to elucidate these important issues.

Percutaneous revascularization intervention in diabetic patients remains challenging, and the large Future Revascularization Evaluation in Patients with Diabetes Mellitus: Optimal Management of Multivessel Disease (FREEDOM) trial demonstrated that long-term all-cause/cardiovascular death and MI occurred more frequently in patients treated with PCI.[20] However, LM patients were excluded from the FREEDOM trial. Although diabetic patients in our study had overall worse outcomes compared with nondiabetic patients, all-cause mortality and MACCE rates were comparable, and repeat revascularization was higher in diabetic patients undergoing CABG or PCI, which was similar to the results for the overall study population. These findings were in line with the diabetic subgroup analyses in the Revascularization for Unprotected Left Main Coronary Artery Stenosis: Comparison of Percutaneous Coronary Angioplasty Versus Surgical Revascularization registry and the SYNTAX 5-year result, but were different from those of other observational studies.[18,21,22] Different demographic/surgical risk profiles and follow-up periods might be possible explanations, and further large-scale studies may be warranted for diabetic patients with unprotected LM disease.

This study has several limitations. First, this study was retrospective and observational, with a relatively small cohort. Furthermore, our study findings were derived mainly from a single-center high-surgical-risk cohort. Although we used a propensity score-adjusted analysis to minimize the selection bias, potential confounding bias might have remained in our study results. Second, due to the long period of study enrollment from 2004 to 2010, a significant heterogeneity in treatment/stenting/surgical strategy could exist. Third, the preference of medication prescribed for patients is different between cardiologists and cardiac surgeons, which might make interpretation of the results more difficult. Furthermore, nearly half of the patients in the present study received BMS stenting, and most of the DESs used were the first-generation DESs. Our

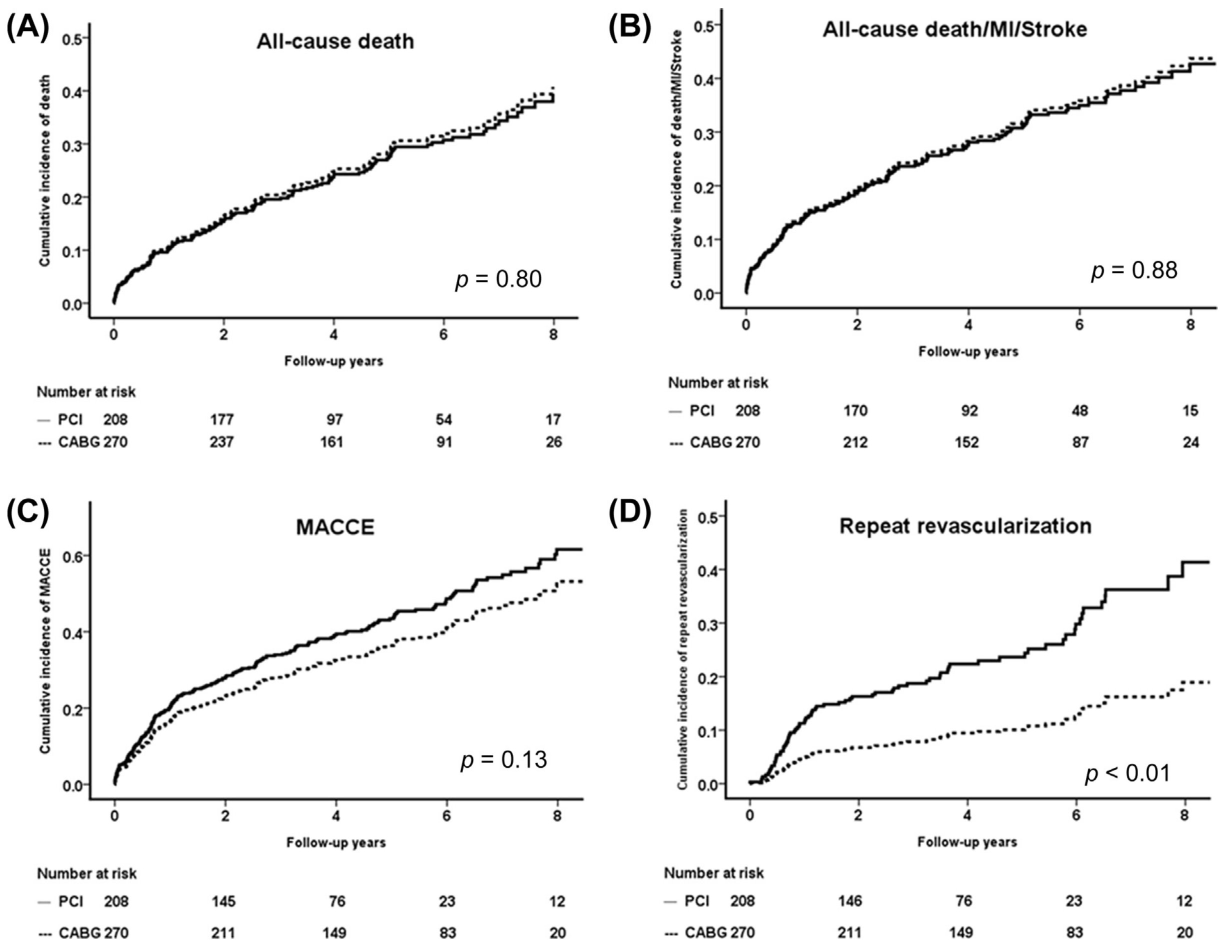

Fig. 1. Cumulative incidence of (A) all-cause death, (B) all-cause death/MI/stroke, (C) MACCE, and (D) repeat revascularization in the PCI and CABG groups. The curves were constructed with Cox regression analyses adjusted for propensity score. CABG = coronary artery bypass grafting; MACCE = major adverse cardiac and cerebrovascular event, included all-cause death, myocardial infarction, stroke and repeat revascularization; MI = myocardial infarction; PCI = percutaneous coronary intervention.

study results may not be applicable to patients undergoing PCI with newer-generation DESs; the EXCEL trial, which compared the safety and efficacy of everolimus-eluting stent with CABG in selected patients with unprotected LM disease, may be expected to give more information. Fourth, as mentioned above, the angiographic follow-up rate of our population was relatively low, so incomplete angiographic follow-up-related potential bias might have a substantial impact on the long-term clinical outcomes in both groups.

In conclusion, in the real-world practice of patients with unprotected LM disease in a single center, we found that PCI was a comparable alternative to CABG in terms of long-term risks of all-cause death/MI/stroke and MACCE. In contrast, the rate of long-term repeat revascularization remained significantly higher in the PCI group than in the CABG group. Diabetic subgroup analysis yielded similar results.

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