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ScienceDirect

Journal of the Chinese Medical Association 79 (2016) 356–362

www.jcma-online.com

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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Received March 26, 2015; accepted November 4, 2015

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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http://dx.doi.org/10.1016/j.jcma.2016.01.005

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 $\geq$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 $\pm$ 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