Comparison of Coronary Artery Bypass Surgery and Percutaneous Drug-Eluting Stent Implantation for Treatment of Left Main Coronary Artery Stenosis

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Objectives The purpose of this study was to compare outcomes for drug-eluting stents (DES) and coronary artery bypass graft (CABG) surgery in patients with unprotected left main coronary artery (ULMCA) stenosis.

Background Expert guidelines recommend coronary artery bypass graft (CABG) surgery for the treatment of significant stenosis of the unprotected left main coronary artery (ULMCA) if the patient is eligible for CABG; however, treatment by percutaneous coronary intervention (PCI) is common.

Methods Details of patients (n = 343, ages 69.9 ± 11.9 years) undergoing coronary revascularization for ULMCA stenosis (April 2003 to January 2007) were recorded. A total of 223 patients were treated with CABG (mean [interquartile range]: follow-up 600 [226 to 977] days) and 120 by PCI (follow-up 362 [192 to 586] days). The hazard ratios (HRs) for death and major adverse cardiovascular and cerebrovascular events (MACCE) were calculated incorporating propensity score adjustment. Survival comparisons were conducted in propensity-matched subjects (n = 134), and in low- and high-risk subjects for CABG.

Results Patients treated by PCI were more likely to be ≥75 years of age (49% vs. 33%; p = 0.005), and of greater surgical risk (Parsonnet score 17.2 ± 11.2 vs. 13.0 ± 9.3; p < 0.001) than patients treated by CABG. Overall, the propensity-adjusted HR for death was not statistically different (HR 1.93, 95% confidence interval [CI] 0.89 to 4.19, p = 0.10), but MACCE was greater in the PCI group (HR 1.83, 95% CI 1.01 to 3.32, p = 0.05). In propensity-matched individuals, neither survival nor MACCE-free survival were different. Survival was equivalent among low-risk candidates, but PCI had a tendency to inferior survival in high-risk candidates (Ellis category IV, log-rank p = 0.05). Interaction testing, however, failed to demonstrate a difference in outcomes of the 2 revascularization techniques as a function of baseline risk assessment.

Conclusions Overall, the propensity-adjusted risk of mortality for treatment of ULMCA disease does not differ between PCI- and CABG-treated groups. There appears to be sufficient equipoise that a randomized clinical trial to compare the techniques would not be ethically contraindicated. (J Am Coll Cardiol Intv 2008;1:236–45) © 2008 by the American College of Cardiology Foundation

Hemodynamically significant left main coronary artery stenosis is found in approximately 4% of diagnostic coronary angiograms (1) and is known as unprotected left main coronary artery (ULMCA) stenosis if the left coronary artery has no previous grafts. Such anatomical pathology compromises perfusion to approximately two-thirds of the myocardium and is thus an intuitively dangerous lesion. Studies by Veteran's Affairs (2,3), CASS (Coronary Artery Surgery Study) (4,5), and European (6) groups in the 1970s

and 1980s confirmed very high mortality rates among such individuals and also demonstrated substantial reductions in mortality when revascularization by coronary artery bypass graft (CABG) surgery was undertaken (7,8). Subsequently, the mortality benefit of CABG compared with medical management for ULMCA disease was also confirmed in a meta-analysis (9).

The beneficial treatment effect of surgery is probably even greater in the current era because of routine use of a mammary graft to the left anterior descending (LAD) coronary artery wherever possible. Current practice guidelines do not recommend percutaneous coronary intervention (PCI) for revascularization for ULMCA stenosis if the patient is a candidate for CABG (10,11) because of the proven benefit of surgery, high rates of restenosis with use of bare-metal stents in the LMCA position (12–14), and concern that restenosis may present with sudden death rather than angina in this anatomic location (13). If a patient with ULMCA stenosis is a candidate for revascularization, but not for CABG, the guidelines consider PCI of the lesion reasonable (Class IIa indication) (10).

Approximately 20% of ULMCA revascularizations in the U.S. are currently performed by PCI (15). Treatment of ULMCA stenosis with PCI is often undertaken in the best interests of individuals, where the risk of CABG would be unacceptably high, or in patients who refuse to undergo a sternotomy. The advent of drug-eluting stents (DES), and nonrandomized data that suggest the long-term outcomes of DES to treat ULMCA stenoses are acceptable (16–19) have led some cardiologists to consider the possibility of a broader role for PCI as a treatment option for ULMCA stenosis.

Randomized procedural and outcomes data that compare CABG and PCI using DES for treatment of ULMCA stenosis would be a great advance in our clinical knowledge but no such dataset exists. With the advent of DES and with increasing appreciation of neuropsychiatric deficits after cardiac surgery (20), such a trial is now considered by many to be not only ethical but in fact highly warranted (21). When completed and published, the SYNTAX trial (Synergy between PCI and Taxus and Cardiac Surgery) of CABG versus DES will have a subset of individuals with ULMCA stenosis available for analysis to shed some light on this question.

In this context, we analyzed the results of ULMCA stenosis revascularization procedures and outcomes from Cedars-Sinai Medical Center, Los Angeles, California, since the introduction of DES. We used propensity scoring, which is a statistical technique that models an individual's propensity (or probability) of belonging to a certain group (for example, treatment by CABG or PCI). The effect of incorporation of the propensity score is to balance subject characteristics in the 2 groups (22,23). In the absence of randomized data, this technique may be the closest we can get to a fair comparison of the 2 revascularization techniques for ULMCA stenosis.

Methods

Study population. Three hundred forty-three patients with ULMCA diameter stenosis who were revascularized at our institution during the time period of April 2003 to January 2007 were included in this observational study. The definition of ULMCA stenosis used for inclusion in this prospective registry was angiographic diameter stenosis of greater than 50% relative to a reference segment of the left main coronary artery. Individuals who had valve replacement surgery concomitantly with revascularization surgery, and individuals who had a bare-metal stent placed in the left main position were excluded from this prospective registry. Choice of revascularization technique was a nonrandomized process that involved evaluation and advice from treating doctors, and discussions with patient and family. Two hundred twenty-three patients underwent CABG, and 120 underwent PCI with DES (Fig. 1). In keeping with published guidelines (10), individuals generally underwent CABG unless their cardiac surgeon or cardiologist advised against CABG on the basis of high surgical risk, or the patient, with their family, had a strong preference not to undergo cardiac surgery.

The primary end points were the hazard ratio (HR) for death and the HR for major adverse cardiovascular and cerebrovascular events (MACCE) using a Cox proportional hazards model that incorporated propensity score as a covariate. This study was approved by the Institutional Review Board of Cedars-Sinai Medical Center.

Abbreviations and Acronyms

CABG = coronary artery bypass graft (surgery)

CI = confidence interval

DES = drug-eluting stent(s)

HR = hazard ratio

IABP = intra-aortic balloon pump

LAD = left anterior descending (coronary artery)

MACCE = major adverse cardiovascular and cerebrovascular event

PCI = percutaneous coronary intervention

ULMCA = unprotected left main coronary artery