

STATE-OF-THE-ART PAPER

Unprotected Left Main Intervention

Patient Selection, Operator Technique, and Clinical Outcomes

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In the 1980s, early attempts at balloon angioplasty of the unprotected left main coronary artery (UPLM) were associated with poor early outcomes because of coronary dissection, abrupt closure, and restenosis. Mortality rates as high as 30% at 1 year were reported. In the 1990s, bare-metal stents helped reduce acute complications, but high rates of repeat revascularization (20% to 30%) were observed because of restenosis. In the early 2000s, the introduction of drug-eluting stents (DES), with the promise of vastly reduced rates of restenosis, raised the possibility of improved late outcomes for UPLM patients receiving stents. Although use of DES for UPLM is currently a class III indication in patients who are candidates for coronary artery bypass graft (CABG), many patients are currently undergoing this procedure. Published registries indicate the procedural and in-hospital risks are acceptable and seem to be the same or lower than the procedural risks of CABG. Unprotected left main ostial and midshaft lesions have excellent early and midterm outcomes that will likely (although not yet proven) be similar to those of CABG. Distal left main lesions involving the bifurcation are technically more challenging and associated with a higher rate of late revascularization. Early registry data have not found excess mortality in patients receiving DES for UPLM when compared with historical bypass surgery data, even when the distal bifurcation is stented. However, current follow-up of stented patients is limited to 1 year or less. Over the next few years, the results of randomized trials will expand the evidence base available to clinicians caring for this challenging patient group. (*J Am Coll Cardiol Intv* 2008;1:5-13) © 2008 by the American College of Cardiology Foundation

The left main coronary artery's critical importance to coronary circulation has focused attention on this specific anatomical subgroup for decades. In the early 1970s, coronary artery bypass graft (CABG) was found to improve late survival in patients with significant left main stenosis in comparison with medical therapy (1-3). Once CABG became the standard of care for left main disease, a distinction between protected—by at least 1 patent bypass graft to the left coronary artery—and unprotected left main coronary arteries (UPLM)—no patent bypass graft to the left coronary artery—was

made. This review is confined to the treatment of UPLM disease. In the 1980s, early attempts at balloon angioplasty of the UPLM were associated with poor early outcomes because of coronary dissection, abrupt closure, and restenosis. Mortality rates as high as 30% at 1 year were reported (4-6). In the 1990s, bare-metal stents were introduced and soon were used to treat UPLM disease. Several small registries found a low rate of procedural complications, but rates of repeat revascularization of 20% to 30% because of restenosis were considered unacceptable (7-12). Early bare-metal stent registries for UPLM also found high mortality rates, particularly in high-risk patients, such as patients with acute coronary syndromes and poor left ventricular function. Importantly, high-risk subgroups often presented with late sudden death (11,13). In the early 2000s, the introduction of drug-eluting stents (DES), with the promise of

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Manuscript received November 16, 2007; revised manuscript received November 28, 2007, accepted December 3, 2007.

vastly reduced rates of restenosis (14–17), raised the possibility of improved late outcomes in this challenging patient group.

Early Clinical Results of DES for UPLM Stenosis

Clinical outcomes after treatment of UPLM disease with either the sirolimus-eluting stent (SES) or the paclitaxel-eluting stent (PES) from nearly 20 small registries have been published. Results reported in these registries vary widely (18–40). As depicted in Table 1, cardiac mortality between 6 and 12 months ranges from 0% to 11%. Target lesion revascularization (TLR) or target vessel revascularization (TVR) rates range from 2% to 38%. This wide variation in clinical outcome seems largely attributable to variation in both patient selection and procedural technique.

Although results after UPLM stenting are usually reported as a single, homogeneous subgroup of coronary artery disease, in reality, UPLM encompasses a wide spectrum of disease states. Outcomes will be particularly dependent on lesion location. Left main disease can be confined solely to the left main ostium or to the midshaft, regions technically not difficult to treat with a single stent, where excellent outcomes can be expected. In contradistinction, UPLM disease can be located distally, involving the ostium of the left anterior descending (LAD) and/or circumflex arteries, resulting in a much more technically complex procedure, often requiring double stenting,

with expected less favorable long-term outcomes. Additionally, the UPLM vessel can be large in diameter and free of calcium, which is associated with better outcomes, or small in diameter and contain significant quantities of calcium,

creating a technically demanding procedure that results in less favorable short-term and long-term outcomes.

Another important differentiating patient characteristic is the presence of significant distal disease in the LAD and/or circumflex arteries, requiring multilesion intervention. The presence of multiple downstream lesions will obviously increase procedural complexity and also increase the risk for subsequent revascularization. Finally, any study of UPLM must take patient comorbidity into consideration. Often, patients are refused CABG for UPLM disease because of serious comorbidities (i.e., stenting in the setting of acute myocardial infarction, advanced age, poor left ventricular function, coexisting malignancy, renal failure, and porcelain aorta) that will also impact long-term outcome after coronary stenting. Thus, published studies of UPLM stenting must be viewed in the context of the clinical, angiographic, and procedural (especially, number of stents needed) characteristics of patients enrolled in each specific study.

Figure 1 shows a patient with midshaft UPLM stenosis. This is one of the most straightforward UPLM lesions for stenting, and an excellent outcome was obtained after deployment of a single stent in the shaft of the left main artery. A recent multicenter registry of 147 patients (35) undergoing UPLM stenting of ostial or midshaft lesions with SES (n = 107) or PES (n = 40) found excellent results at midterm clinical follow-up (886 ± 308 days). In this registry, cardiac mortality was 0% in-hospital and 2.7% at follow-up. Cardiac mortality was 0% in 87 patients judged at low risk because of a EuroSCORE ≤6 and/or Parsonnet score ≤13 (41,42), but was 6.7% in 60 patients with high-risk scores. With over a 2-year mean follow-up in the entire group, TVR was only 4.7%. Thus, patients with ostial and midshaft UPLM lesions seem to have excellent outcomes after DES. These outcomes are likely to compare favorably with surgical outcomes, but we await the results of randomized trials before drawing conclusions.

In contradistinction to patients with ostial or midshaft lesions, patients with distal bifurcation lesions are more challenging to treat and have less favorable long-term outcomes. The initial Scripps Clinic UPLM experience

Abbreviations and Acronyms

CABG = coronary artery bypass graft

DES = drug-eluting stent(s)

IVUS = intravascular ultrasound

LAD = left anterior descending artery

PES = paclitaxel-eluting stent(s)

SES = sirolimus-eluting stent(s)

TLR = target lesion revascularization

TVR = target vessel revascularization

UPLM = unprotected left main coronary artery

Table 1. DES for the Unprotected Left Main Coronary Artery

	Park et al. (20)	Chieffo et al. (19)	Valgimigli et al. (37)	Lee et al. (28)	Price et al. (32)	Migliorini et al. (30)	Erglis et al. (38)
Patients, n	102	85	95	50	50	101	53
Distal lesion location (%)	71	81	65	60	94	87	81
Cardiac mortality, 6–12 months (%)	0	3.5	11	4	2	11	2
Angiographic follow-up (%)	84.3	NR	NR	42	98	96	100
Angiographic restenosis (%)	7*	19†	NR	NR	44‡	16*	6*
TLR or TVR (%)	2§	18.8	6.3	13	38§	14	2§

*Follow-up angiography at 6 months. †Follow-up angiography at 4 to 8 months. ‡Follow-up angiography at 3 and 9 months. §Target lesion revascularization (TLR). ||Target vessel revascularization (TVR). Data from Baim et al. (39).

DES = drug-eluting stent; NR = not reported.

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