

Percutaneous Coronary Intervention Technique for the Left Main Coronary Artery

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Although balloon angioplasty is now an established treatment for patients with coronary artery disease, the results of balloon angioplasty in the unprotected left main coronary artery (LMCA) have been disappointing due to high mortality rates in both in-hospital and follow-up periods. This has made this procedure controversial, and coronary artery bypass grafting (CABG) has been held up as the only effective therapy for LMCA stenosis. There may be two major reasons for the disappointing results of balloon angioplasty in the unprotected LMCA; one is acute occlusion after the procedure and the other is restenosis, which leads to catastrophic cardiac events such as sudden death, myocardial infarction and heart failure. To overcome these, percutaneous coronary intervention with new procedures and devices such as directional coronary atherectomy (DCA) and stents has been increasingly applied to this form of lesion.

Coronary stenting may improve the results of angioplasty in the unprotected LMCA by both preventing acute elastic recoil and reducing the restenosis rate by attaining a larger final minimal lumen diameter. This procedure is technically easy. Therefore, some single center and multicenter studies have reported promising results for coronary stenting for selected patients with good cardiac function and large-sized LMCAs. However, there are some limitations to this procedure. Although coronary stenting was initially proposed as a way of preventing late restenosis, this effect is limited in selected patient populations. In complex lesions such as long lesions, those in small vessels, ostial lesions, bifurcated lesions and heavily calcified lesions, there are limitations to coronary stenting. For example, when the lesion is located in a distal bifurcated left main trunk, coronary stenting without jailing either of the left coronary arteries is technically very demanding. These lesions are also associated with high restenosis rates. If the lesion in the unprotected LMCA is heavily calcified, incomplete stent dilatation may occur that may lead to acute occlusion or late restenosis. Stent thrombosis is another critical problem with unprotected left main stenting, although the recently available ticlopidine regimen may reduce this possibility. Moreover, coronary stenting has engendered a new troublesome problem, in-stent restenosis; the stent itself will become an obstacle for repeat angioplasty if needed.

In most cases, intravascular ultrasound (IVUS) shows that there is massive atheromatous plaque in unprotected left main stenosis. Therefore some kind of debulking procedure would seem a reasonable and effective way of treating this lesion. This procedure is also effective for lesion in the distal bifurcated LMCA. Although rotational atherectomy is one effective debulking procedure, it does have limitations;

- 1) there may be a risk of slow-flow in the LCA vasculature which may lead to myocardial infarction and/or cardiogenic shock.
- 2) pinpoint debulking is practically impossible and there is often a risk of coronary perforation.
- 3) optimal final minimal lumen diameter cannot be attained by rotational atherectomy alone.

It is certain that DCA is technically more difficult and time-consuming than stenting or rotational atherectomy. However this procedure enables us to debulk massive atheromatous plaque accurately under IVUS guidance. Moreover, there is little risk of thrombotic occlusion or major side branch occlusion. Recent study shows that the restenosis rate after DCA is almost the same as that after stenting in the unprotected LMCA.

The comparison between DCA and stenting is summarized in the table.

	DCA	Stent
Procedure	relatively difficult	easy
Sheath size	8Fr-10Fr	6Fr-8Fr
Approach	femoral	radial, brachial, femoral
IVUS	necessary	not necessary
Antiplatelet	aspirin	ticlopidine
Bifurcation	effective	stent jail ?
Calcification	incomplete debulking ?	incomplete dilatation ?
Thrombotic lesion	terminal delay ?	stent thrombosis ?
Restenosis rate	20-25%	20-25%
Repeat PCI	no limitation	in-stent restenosis

The results of recent studies encourage angioplasty with new devices as an alternative to CABG for the treatment of unprotected left main disease, if the lesion is indicated for angioplasty. New devices have reduced the risk of acute occlusion dramatically. To prevent sudden death by follow-up, scheduled angiography is advisable to detect critical restenosis as early as possible. However, restenosis still remains an important problem. Restenosis is mainly caused by neointimal hyperplasia or negative vessel remodeling. To overcome this phenomenon, there are a number of potential approaches now available. One approach is stenting after debulking which can attain a larger final minimal lumen diameter and may lead to a lower restenosis rate at follow-up. Brachytherapy is another promising avenue for efforts to reduce restenosis, if late thrombosis can be completely protected against. Drug-eluting stents may be another option. In the near future, the restenosis rate after angioplasty for unprotected LMCA disease will be close to zero and catheter-based procedures will be established as treatment-of-choice for these lesions.