

PCI of the Unprotected Left Main Trunk

Technical considerations for LMT intervention.

BY MASAHIKO OCHIAI, MD, FACC, FSCAI

As a rule, left main trunk (LMT) lesions are presently an indication for coronary artery bypass graft (CABG) surgery because of the risk of acute coronary occlusion during percutaneous coronary intervention (PCI), which is potentially fatal due to the large myocardial territory affected. However, the advent of bare-metal stents (BMSs) made it possible to prevent acute coronary occlusion during PCI, which led to a significant improvement in the safety of this procedure. Therefore, since the latter half of the 1990s, PCI has been performed at some institutions for patients with LMT lesions who have a high risk of developing complications related to CABG.¹ Because of the large diameter of the LMT, PCI is a suitable procedure for the treatment of lesions at this site under normal conditions, but sophisticated procedures are required when stenosis involves the origin of the left circumflex artery (LCx) and the left anterior descending (LAD) artery. In addition, if restenosis occurs, it is not only associated with the recurrence of angina but also with the risk of acute left heart failure or sudden death. The restenosis rate after PCI has been significantly reduced through development of the drug-eluting stent (DES). To prevent restenosis after stenting using a BMS, the target final lumen area of the LMT should be at least 12 mm² on intravascular ultrasound (IVUS), but this target tends to be associated with stent overexpansion. When a DES is used, the target final lumen area becomes smaller, and 10 mm² is considered to be sufficient,²⁻⁴ meaning that the procedure becomes both safer and technically easier. At present, procedures to cope with bifurcation lesions are being established, and in Japan, several patients have been treated with PCI rather than CABG as first-line therapy. My PCI strategy for LMT lesions is discussed in this article.

COMPLICATIONS AND THEIR PREVENTION

Placement of a DES in the LMT is not difficult unless the lesion contains severely calcified plaque. I pay special attention to the following three possible complications. For prevention of complications and for complete apposition of the stent, the use of IVUS is essential.

Slow Flow/No Flow

Slow flow/no flow in the LMT after placement of the stent leads to hemodynamic collapse that represents an extremely serious outcome for the patient. I have experienced two such cases, and fortunately both patients were saved by using a suction device and approximately 20 minutes of cardiopulmonary resuscitation. I consider slow flow/no flow to be the most dangerous complication of LMT intervention. Detection of vulnerable plaque by IVUS is a useful method of preventing such complications, but it is necessary to pass the guidewire and IVUS probe across the lesion first. Once such devices have crossed the lesion and the vulnerable plaque has been detected, it becomes difficult to perform CABG after the guidewire is withdrawn because of the high risk of acute coronary occlusion. At present, I consider 64-slice multislice computed tomography (MSCT) to be the most promising method for pre-PCI assessment of plaque characteristics because it allows various plaque characteristics to be determined in a completely noninvasive way.⁵ I consider that CABG is indicated for patients who have LMT plaque with a low CT score and marked positive remodeling, even if PCI appears possible based on lesion morphology. Under the opposite circumstances, I can perform PCI with full confidence. There is a big difference between doing something in a tentative manner and doing the same thing with confidence.

Dissection at the Ostium of the LCx

When placing a DES at a bifurcation of the LMT, kissing-balloon inflation eventually becomes essential. Bifurcation lesions should be managed by completing the procedure with a single stent whenever possible. It is not uncommon for plaque to extend through the LMT as far as the ostium of the LCx, and causing the dissection of such plaque by overdistension during the kissing-balloon procedure must be avoided. To avoid this complication, I always perform pre-PCI IVUS from the LCx, as well as from the LAD. Detailed assessment is required, especially at the ostium of the LCx,

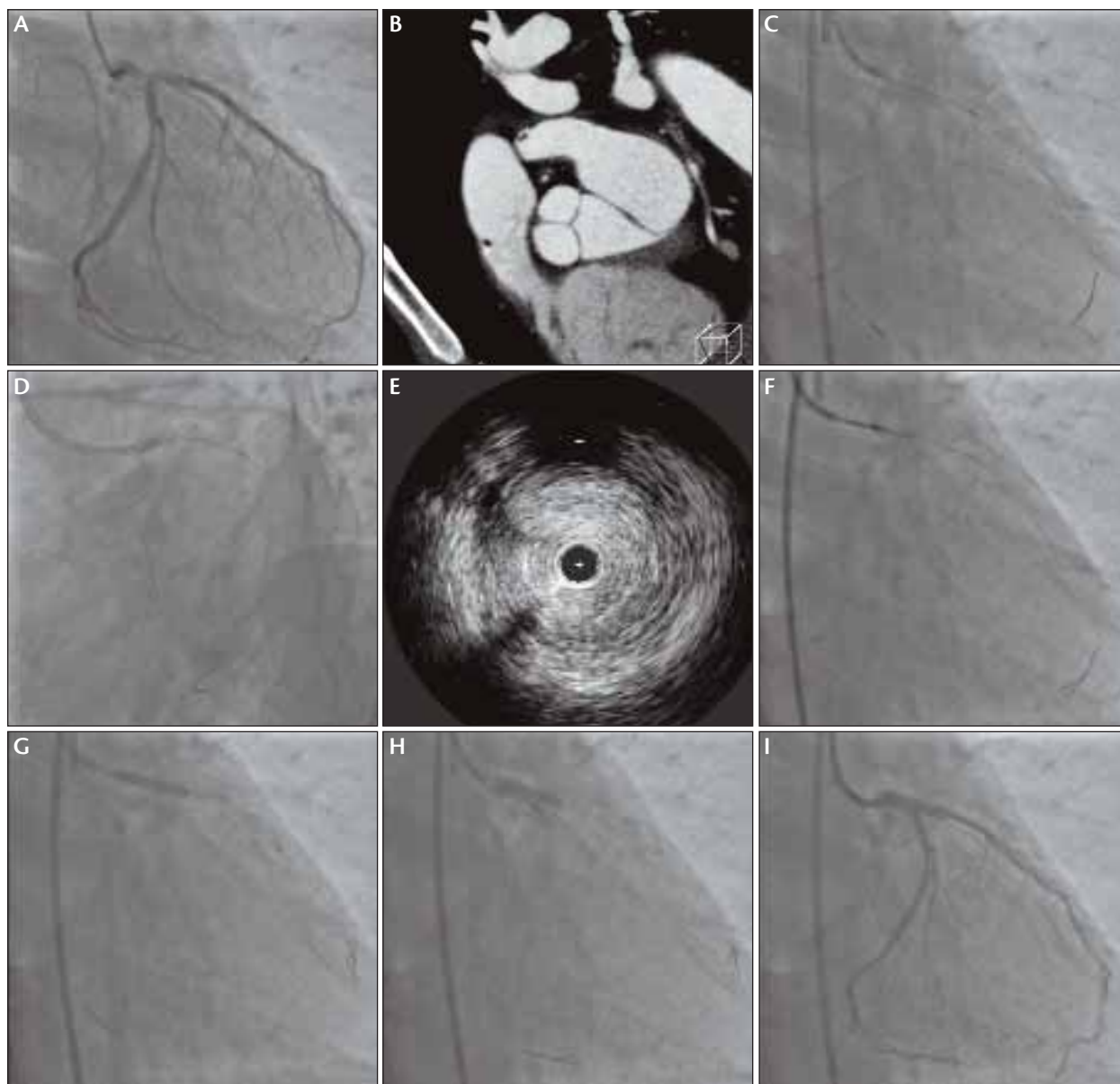


Figure 1. Implantation of a Cypher stent for an unprotected LMT lesion. The patient was a 50-year-old man with effort angina. A bifurcation lesion of the LMT was found by coronary angiography (A). A 64-slice MSCT scan revealed no obvious positive remodeling, and the CT score was 40 (B). The patient was considered to have a low risk of slow flow/no flow after PCI, and intervention was indicated. Due to the extremely large myocardial territory supplied by the LCx, PCI was performed using an 8-F guide catheter after insertion of an intra-aortic balloon pump (C). IVUS was done via both the LAD and the LCx (D,E). Abundant plaque was observed in the LMT (F), but no vulnerable plaque was found. After debulking the plaque by directional coronary atherectomy, the wire was secured in the LCx, and a 3.5-mm X 23-mm Cypher stent (Cordis Endovascular, a Johnson & Johnson company, Miami, FL) was implanted (G). Kissing-balloon inflation was performed (H), and a good result was obtained (I).

to determine both the exact vessel diameter and the luminal diameter. The possibility of causing dangerous dissection is quite limited when a balloon with a diameter smaller than the luminal diameter is placed in the LCx for kissing-balloon inflation.

Coronary Artery Rupture

Balloon overdilation is certainly associated with the risk of coronary artery rupture. I have experienced this complication in one of our own patients and have witnessed a second case at another hospital. Both patients immediately developed

cardiogenic shock. Bleeding was slowed by balloon dilatation already present in the coronary artery, and pericardial drainage was performed immediately. Because the LMT is surrounded by connective tissue, hemostasis could eventually be achieved in both cases by moderate neutralization of heparin and inflation of a perfusion balloon without using a covered stent. I usually neutralize heparin partially and keep activated clotting time at approximately 180 to 200 seconds.

APPROACH AND SUPPORT DEVICES

A procedure to cope with emergencies is essential in case dissection extends from the LMT into both the LAD and LCx during the dilation procedure. Apart from countermeasures for late restenosis and new lesions, such emergency situations are best handled in the cardiac catheter room by a bailout procedure using simultaneous kissing stents (V-stenting) for both the LAD and LCx. In Japan, Cypher and Taxus Express 2 stents (Boston Scientific Corporation, Natick, MA) are available for such a procedure. Considering their specifications, an 8-F guide catheter is needed for the Cypher stent, and a 7-F guide catheter is required for the Taxus Express 2 stent. Both the femoral and radial approaches may be used provided that catheters of the above-mentioned sizes can be introduced.

As a support device, I use an intra-aortic balloon pump in patients who are LCA dominant and have an extremely large myocardial territory supplied by the LCx, have chronic total occlusion of the RCA, or have a history of inferior infarction (regardless of whether they received reperfusion therapy during acute infarction). When rotational atherectomy is performed under these conditions, it is advisable to place a temporary pacemaker in advance.

SITE-SPECIFIC STRATEGIES

Lesions of the LMT Ostium and Body

IVUS is performed to assess plaque from the bifurcation of the LMT to the ostial region, and the exact length of the plaque is measured by using the auto-pullback system. If it is possible to introduce a short DES without covering the bifurcation, it is placed from the LMT ostium, after which postdilatation is performed if it is considered necessary based on the IVUS findings. A steep AP cranial view is best suited for assessing plaque in the ostial area of the LMT. If there is severe calcification, rotational atherectomy is performed using two burr sizes (ie, 1.75 mm and 2.15 mm) before the DES is implanted.

LMT Bifurcation Lesions

If there is no significant stenosis at the LCx ostium, a DES is implanted from the LAD so that it crosses over the LCx ostium, and kissing-balloon inflation is performed. Because it is impossible to precisely predict plaque shift in associa-

tion with stent implantation, it is important to leave a jailed wire in the LCx. If serious stenosis subsequently occurs at the LCx ostium due to plaque shift, the stent strut is recrossed and dilated to allow insertion of a second DES so that the two stents form a modified T shape. If there is abundant plaque in the LMT extending to the LAD ostium, directional coronary atherectomy is done to debulk the lesion with the expectation of preventing plaque shift.

When significant stenosis is detected at the LCx ostium, modified T-stenting is employed in most cases because the results of crush stenting have not been as good as expected. A strategy employed by some institutions, however, is to debulk the plaque at the LCx ostium with directional coronary atherectomy, implant the DES in the LMT-LAD direction, and complete the procedure with kissing-balloon inflation.

To perform kissing-balloon inflation, it is essential to recross the stent strut toward the LCx. With a jailed wire, the procedure itself can be facilitated in many cases. However, due to the large diameter of the LMT, apposition of the first DES is often incomplete, and the wire for recrossing (which comes out of the guide catheter) sometimes enters the space between the stent and the LMT wall, recrosses the struts into the LMT, and thereafter recrosses the struts from there into the LCx. To prevent this phenomenon, I always use special microcatheters, such as the Multifunction Probing Catheter (Boston Scientific Corporation) or the Crusade (Kaneka Medics, Osaka, Japan) for recrossing the stent strut with a wire. After the wire has recrossed the struts toward the LCx, I perform IVUS examination from the LAD again to confirm the position of the wire in the LMT whenever possible (Figure 1).

CONCLUSIONS

PCI for LMT disease is not yet a fully established procedure, and we lack sufficient evidence to define its indications. Thus, this article presents my personal PCI strategies, which I hope may be useful for other physicians. ■

Masahiko Ochiai, MD, FACC, FSCAI, is from the Division of Cardiology and Cardiovascular Surgery, Showa University Northern Yokohama Hospital, Yokohama, Japan. He has disclosed that he is a paid consultant to Boston Scientific. Dr. Ochiai may be reached at mochiai@ga3.so-net.ne.jp.

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