Coronary Heart Disease

Immediate and Long-term Outcomes of Stent Implantation for Procedure-Induced Dissection of Left Main Coronary Artery

Jen-Fu Liu, Shih-Huang Lee, Jun-Jack Cheng and Kou-Gi Shyu

Background: Procedure-induced dissection of the left main coronary artery (LMCA) is a rare complication of coronary catheterization, but it may have fatal results. The outcomes of stent implantation in patients with procedure-induced LMCA dissection are still unclear.

Method: From April 2002 to December 2005, 4852 patients underwent percutaneous coronary intervention (PCI) for coronary artery disease in this institute. During this period, 5 patients (0.1%) developed procedure-induced LMCA dissection during PCI, and they received stent implantation for this complication.

Result: All of the 5 patients developed procedure-induced LMCA dissection during PCI for stenosis of the left anterior descending (LAD) artery. Procedure-induced dissection of the LMCA developed during manipulation of the guiding catheter in 1, after balloon dilatation for LAD stenosis in 1, and after stent implantation for LAD stenosis in 3 patients. Immediate success of stent implantation for LMCA dissection was achieved in all 5 patients. No major complication was noted during LM stenting. At a mean follow-up period of 43 ± 23 months (range 9 to 66 months), four of the 5 patients (80%) underwent repeated coronary angiography due to recurrent angina. One of 4 patients received PCI for restenosis of LMCA. There were no major cardiac events, including requirement of coronary artery bypass graft surgery, myocardial infarction or death during the follow-up period.

Conclusion: LMCA dissection during PCI could be successfully managed by prompt stent implantation, with acceptable immediate and long-term outcomes.

Key Words: Left main coronary artery • Dissection • Stent

INTRODUCTION

Procedure-induced dissection of the left main coronary artery (LMCA) is a rare complication of coronary catheterization, but it may have fatal results.1-3 Emergent coronary artery bypass (CABG) surgery has been reported to treat procedure-induced dissection of LMCA with moderate surgical risks.3-6 Stent implantation has been advocated as an alternative procedure for procedure-induced dissection of LMCA, but the outcomes are still unclear.7-11 The aim of the present study was to evaluate immediate and long-term outcomes of stent implantation for procedure-induced dissection of LMCA.

METHODS

From April 2002 to December 2005, 4852 patients underwent percutaneous coronary intervention (PCI) for coronary artery disease in this institute. After fully informed consent, all patients received the percutaneous transfemoral or transradial approach via an angioplasty...
sheath, and standard angioplasty technique was used in these patients. Each patient was pretreated with intravenous heparin (100 units/kg) at the beginning of the procedure and, if necessary, an additional bolus of heparin was administered to maintain activated clotting time > 300 sec. Five (0.1%) of the 4852 patients had procedure-induced LMCA dissection during PCI, and they received stent implantation for this complication. Post-stent regimens included aspirin (100 mg daily) and clopidogrel (75 mg daily). Clopidogrel therapy was continued for 3 to 9 months, and aspirin was continued indefinitely. Clinical follow-up was obtained by clinic visits, telephone conversation and chart review. The diagnosis of myocardial infarction was based on the appearance of electrocardiographic changes or creatine kinase-MB elevation ≥ 3 times normal value. Angiographic restenosis was defined as a diameter of ≥ 50%.

**RESULTS**

**Patient Characteristics**

Table 1 shows the patient characteristics of the study population. The mean age of the 5 patients was 76 ± 7 years (range 65 to 83 years). Coronary risk factors included current smoking in 3, hypertension in 4, and hyperlipidemia in 2 patients. Two patients had a prior documented myocardial infarction, and 2 had a prior PCI. Mean left ventricular ejection fraction (LVEF) was 64 ± 9% (range 53 to 78%). All of the 5 patients developed procedure-induced LMCA dissection during PCI for stenosis of the left anterior descending artery (LAD). Procedure-induced dissection of the LMCA developed during manipulation of the guiding catheter in 1, after balloon dilatation of LAD stenosis in 1, and after implantation for LAD stenosis in 3 patients (Figure 1). All 5 patients had immediate chest pain when procedure-induced dissection of LMCA happened.

**Immediate Outcomes of LMCA Stenting**

Table 2 shows the immediate outcomes of stent implantation for LMCA dissection. Dissection involved the distal portion of the LMCA and proximal portion of the LAD artery in all the 5 patients. Dissection also involved the middle portion in 4 patients and proximal portion of the LMCA in 1. The mean length of dissection was 18 ± 8 mm.

The stents employed for treatment of LMCA dissections were 1 AVE stent (20%), 1 S7 (20%), 1 Penta (20%), 1 Express (20%), and 1 BX stent (20%). The mean stent size was 3.1 ± 0.2 mm, and the mean stent length was 21 ± 8 mm. Immediate success of stent im-

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DM = diabetes mellitus; LVEF = left ventricular ejection fraction; MI = myocardial infarction; PCI = percutaneous coronary intervention.

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<th>Table 2. Immediate outcomes of stent implantation for left main coronary artery dissection</th>
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D = distal; LMCA = left main coronary artery; M = middle; P = proximal.
planted. Stenting in other vessels was performed in 3 patients. There was no hemodynamic instability such as hypotension and bradycardia during stent implantation for LMCA dissection. No major complication was noted during LM stenting.

**Long-term Outcomes of LMCA Stenting**

Table 3 shows the long-term outcomes of stent implantation for LMCA dissection. At a mean follow-up period of $43 \pm 23$ months (range 9 to 66 months), four of 5 patients (80%) underwent repeated coronary angiography due to recurrent angina. One of 4 patient received PCI for restenosis of LMCA 5 months after stent implantation, and 3 patients received PCI for stenosis of other coronary vessels. There were no major cardiac events, including requirement of CABG, myocardial infarction or death during the follow-up period.

**DISCUSSION**

**Major Findings**

LMCA dissection during PCI could be successfully managed by prompt stent implantation, with acceptable immediate and long-term outcomes.

**Procedure-induced Dissection of LMCA**

Procedure-induced LMCA dissection is a rare complication, but it may impair coronary flow and consequently lead to death. Some studies have shown that risk factors of LMCA dissection may include the presence of LMCA stenosis and an unusual anatomy of the LMCA orifice that necessitates extensive manipulation of the catheter for engagement of the LMCA. In the present study, none of the patients had LMCA stenosis or unusual anatomy of the LMCA orifice. However, coronary angiography showed atherosclerotic disease of the proximal LAD artery in all patients. It is possible that intravascular ultrasound examination might show diffuse atherosclerotic disease of the LMCA in our patients. The present study indicated that special care should be taken to avoid dissection of LMCA in patients receiving PCI for proximal LAD stenosis.

**Stent Implantation for Procedure-induced LMCA Dissection**

Therapeutic options for catheter-induced LMCA dis-
section include emergent CABG and stent implantation. Previous studies showed that CABG could be successfully performed for this complication. Kovac et al. showed that 74% of their 42 patients were alive within one month after urgent CABG for procedure-induced dissection of LMCA.3 Our institute had 2 patients who received emergent CABG surgery for catheter-induced LMCA dissection. Unfortunately, they died during CABG surgery. It is possible that prolonged period of myocardial ischemia might result in exacerbation of left ventricular function and death.6 Garcia-Robles et al. reported that stent implantation was useful to restore the coronary flow in a patient with catheter-induced occlusive dissection of the LMCA.7 Al-Saif et al. reported that catheter-induced LMCA dissection with retrograde progression into aortic wall could be effectively managed by stent implantation.9 Lee et al. showed that stent implantation had good results of acute and long-term outcomes in 10 patients with catheter-induced LMCA dissection.11 In the present study, none of the patients had complication, including hypotension and bradycardia. This finding supported that prompt stent implantation may be a safe and effective therapy option in patients with procedure-induced dissection of the LMCA.

**Clinical Implications**

Patients with procedure-induced dissection of the LMCA might die because of rapid deterioration of hemodynamics before CABG can be performed. LMCA flow should be restored as soon as possible. The present study showed that prompt stent implantation had the benefits of repairing dissection with restoration of flow and resulted in acceptable immediate and long-term outcomes in patients with procedure-induced dissection of the LMCA.

**Study Limitations**

Due to the small patient number in the present study, we could not accurately comment on the risk of acute closure of LMCA after stenting for procedure-induced LMCA dissection. However, the rare incidence of this complication makes a larger study impossible. It is still possible that CABG has comparable results.

**CONCLUSIONS**

LMCA dissection during PCI could be successfully treated with proper stent implantation with acceptable immediate and long-term outcomes.

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支架置放對於心導管手術引起左主冠狀動脈剝離的立即效果和長期預後

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背景 左主冠狀動脈剝離是經皮冠狀動脈介入性治療手術很少見的併發症，然而一旦發生會有致命的危險。在治療方面除了進行緊急冠狀動脈繞道手術外，立即的血管內支架置放也不失為一種方法，但其療效仍然不是非常確定。

方法 在 2002 年四月到 2005 年十二月，4852 位有冠狀動脈疾病的病人在本院接受經皮冠狀動脈介入性治療，其中有 5 位 (0.1%) 發生左主冠狀動脈剝離，他們接受支架置放來治療左主冠狀動脈剝離的併發症。

結果 這 5 位病人都由於左前降支冠狀動脈狹窄接受經皮冠狀動脈介入性治療時引起左主冠狀動脈剝離，其中 1 位發生在引導導管置放時，1 位發生在鋼球擴張時，3 位發生在支架置放時。在這 5 位病患，支架置放手術成功地治療左主冠狀動脈剝離的情況，手術中沒有產生任何併發症。在平均 43±23 月 (9 至 66 月) 的長期後續追蹤，當中 4 位病人臨床上有心絞痛情形，再次接受經皮冠狀動脈介入性治療，4 位之中只有 1 位發生左主冠狀動脈再狹窄需要再次做鋼球擴張及支架置放，這 5 位病患都沒有發生需要立即冠狀動脈繞道手術、心肌梗塞或者死亡的情形。

結論 經皮冠狀動脈介入性治療手術中併發左主冠狀動脈剝離，立即地置放支架有可以接受的立即效果和長期預後。

關鍵詞：左主冠狀動脈、剝離、支架。