Clinical Research

Long-term effect of stenting in unprotected left main coronary artery disease in the elderly

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Objective To evaluate the feasibility, safety and efficacy of percutaneous stent implantation for treating left main coronary artery (LMCA) stenosis. Methods Consecutive patients with unprotected left main coronary artery disease treated by stent-based percutaneous intervention (PCI) at 6 medical centers in China were enrolled. Procedural data and clinical outcomes were obtained from all patients. Results From January 2001 to December 2004, 138 patients (79 males and 59 females; mean age: 69.7 ± 5.8 years) underwent PCI for LMCA stenosis. Bare metal stents (BMS) were implanted in 51 patients with non-bifurcational lesions and in 5 patients with bifurcation lesions from January of 2001 to June of 2003 (BMS group); drug eluting stents (DES) were used unselectively to cover both bifurcational and non-bifurcational lesions in 86 patients from July of 2003 to December of 2004 (DES group). Procedural success rate of the 138 cases was 98% (135/138). One patient (0.7%) with bifurcation lesion who was treated with DES died from severe heart failure 2 weeks after the procedure. During a mean follow up period of 21.3 ± 5.6 months, one patient died from renal failure, one from sudden cardiac death, 4 underwent target lesion revascularization (TLR) in the BMS group, which all occurred in patients with bifurcational lesions; whereas in the DES group no deaths occurred and only one patient with bifurcational lesion had TLR. Conclusions (1) PCI is feasible and relatively safe to treat unprotected left main coronary artery disease in elderly patients at medical centers with experienced professionals. (2) BMS and DES have similar immediate and long-term efficacy in the treatment of ostium and shaft lesions of the LMCA. (3) DES are strongly suggested in the therapy of distal bifurcation lesion of unprotected LMCA. (J Geriatr Cardiol 2005; 2(4):218-222)

Key Words: coronary artery disease; interventional therapy; angioplasty, stent

Unprotected left main coronary artery (LMCA) disease is found in 5% of patients who received selective coronary artery angiography.1,5 It is one of the greatest challenges for interventional cardiologist to treat these high risk patients, especially those at an advanced age. At present, major clinical guidelines list unprotected LMCA disease as contraindication for percutaneous intervention (PCI). Coronary artery bypass graft is often the first choice of treatment.1,5 Interventional therapy is generally contraindicated in unprotected left main coronary disease because of the following reasons: (1) Its procedural risk is much higher, especially for those complicated with multivessel lesions or multiple risk factors. (2) Its procedure technique is complex, especially for distal bifurcation lesion complicated with multivessel disease. (3) Its long-term major adverse cardiac events (MACE) are reported to be much higher and more severe. However, several studies have documented the safety and feasibility of unprotected LMCA intervention using drug eluting stents (DES).6 The purpose of this study was to evaluate the feasibility, safety and efficacy of interventional therapy for different lesions of unprotected LMCA with different stents in elderly patients.

Patients and Methods

Patients
From January 2001 to December 2004, a total of 138 consecutive patients with unprotected LMCA were treated with
balloon pre-dilation and stent implantation in our cooperation group of 6 medical centers in China. The age of the patients was 69.7 ± 5.8 years. Seventy-nine patients were male and 59 were female. From January 2001 to June 2003, patients who selected PCI were contraindicated to coronary artery bypass graft due to the following complicated diseases: (1) chronic obstructive pulmonary disease, (2) serious heart failure, (3) renal dysfunction, (4) peripheral vein thrombosis, and (5) multiorgan dysfunction. From July 2003 to December 2004, patients with unprotected left main stem lesion chose PCI not only due to the above reasons, but also because they were unwilling to undergo a bypass operation.

LMCA disease refers to the atherosclerotic lesion located at the ostium, shaft or distal bifurcation of left main trunk with greater than 50% stenosis. LMCA was considered unprotected if there were no patent coronary artery bypass grafts to the left anterior descending artery or left circumflex artery. Lesions located at the bifurcation involved either the main vessel or major branches were defined as bifurcational. It is usually divided into four types. Baseline clinical characteristics of these patients are shown in Table 1. Informed written consents were obtained from all patients.

### Interventional procedure

#### Interventional technique to lesions at the ostium and shaft of left main trunk

If the stenosis of the lumen was between 50% and 70%, stents were implanted directly without balloon pre-dilation. If stenosis was greater than 70%, high pressure pre-dilation with a balloon of 2.5 mm in diameter and 20 mm in length was adapted before stent implantation. The purpose of the pre-dilation was to enlarge the vessel conduit at the lesion, to ensure precise positioning of the stent and to keep enough blood flow during stent positioning. (Figs. 1 and 2)

#### Interventional technique to lesions at the distal part and bifurcation of the left main trunk

T type stenting skill was used to treat these lesions. The first stent was implanted at the main branch and strided over the bifurcation. The second stent was dilated at the ostium and proximal part of the offset branch through the mesh of the main branch stent. After that, kissing dilation with two balloons was conducted to tidy two stents. (Fig. 3)

### Left main trunk disease complicated with multivessel lesions

At first, left main trunk and its distal branches were protected by double wires and pre-dilations was performed. Then, lesions outside the left main trunk were treated with standard technique. Finally, left main trunk lesions were treated by T type stenting and kissing dilation technique.

#### Follow-up

After discharge, the patients were followed up either by telephone calls, letters, e-mails or regular clinical check-ups. Data of major adverse cardiac events and re-hospitalization were collected. Selective coronary angiogram was performed in 40% of patients.

### Definition

Procedural success was defined as Thrombolysis In Myocardial Infarction (TIMI) flow grade 3, and <30% residual diameter stenosis by QCA, without major procedure-related complications such as death, Q-wave myocardial infarction, or emergent bypass surgery. A major adverse cardiac event was defined as the occurrence of cardiac death, acute myocardial infarction, or target lesion revascularization during the follow-up period.

### Statistical analysis

Data were expressed as mean ± SD for continuous variables and as frequencies for categorical variables. Student t test or chi-square statistics were used to compare the differences between groups. P<0.05 was considered to represent a significant difference.

### Results

#### Patient and lesion characteristics

There were no differences between the two groups in patients' age, sex distribution, history of MI, or left ventricular ejection fraction. Fewer patients in the BMS group had history of hypertension, diabetes and hypercholesterolemia compared with patients in the DES group (P<0.05; Table 1). In the BMS group, there were 51 (91.1%) cases of non-bifurcational lesions and 5 (8.9%) bifurcational lesion cases. In the DES group, there were 14 (17.1%) cases with non-bifurcational lesion and 68 (82.9%) with bifurcational lesion. (Table 2)

#### Procedural results

The success rate of PCI procedure in 138 patients was 98% (135/138). During hospitalization, two (1.4%) patients had acute stent thrombosis and one (0.7%) patient died severe
Fig. 1. Stenting treatment at the ostium and shaft of the left main trunk. A. Left main trunk was 10mm long and 4mm in reference diameter. There was 70% stenosis at its ostium and shaft. B. A 4.0 × 8mm bare stainless steel stent was settled and dilated with 16 atmosphere pressures. C. Stent was totally dilated without residual stenosis and dissection.

Fig. 2. Stenting at the shaft of the left main trunk. A. Left main trunk was 12mm long and 4mm in reference diameter. There was 80% stenosis at its shaft. B. A 4.0 × 10 mm bare stainless steel stent was implanted with 16 atmosphere pressure dilation. C. Stent was totally dilated without residual stenosis and dissection.

Fig. 3. T type stenting at the distal bifurcation of left main trunk. A. Left main trunk was 10 mm long and 4 mm in reference diameter. A type I bifurcational lesion involved the proximal part of left anterior descending branch. B. By the support of double wires, type T stenting and kissing dilation technique were taken after sufficient pre-dilation. Two sirolimus eluting stents were used. C. Stents were well dilated without residual stenosis and dissection.

Follow-up results

One hundred thirty-seven patients were discharged free of symptoms. Of them 113 patients were followed up for a mean of 21.3 ± 5.6 months. The follow-up rate was 82.5% (113/137). During the follow-up period, four patients in the BMS group had MACE (8.5%, 4/47), including one cardiac death and three elective bypass operations. In these 4 patients, the lesions were located at the distal bifurcation of left main stem. No MACE occurred during the follow-up in the DES group. (Table 2)

Discussion

Unprotected LMCA disease is still listed in the contraindications of interventional therapy in present clinical guidelines due to the high procedure risks. Based on the experience of long-term follow-up of the bare stent group, we believe that bare stainless steel stents should only be used to treat the pure ostium and/or shaft lesions of unprotected left main stem with more than 4.0mm reference diameter. The bare stents should not be used in the treatment of distal bifurcational lesions of unprotected left main trunk because of their significantly higher long-term MACE rate.

Due to the technical improvement, equipment revolution and experience gained, the attitude toward and concept of PCI to unprotected left main stem lesions is changing. Along
with the widespread use of effective anti-platelet agents and DES, it is feasible to treat unprotected left main trunk lesions with interventional procedure regularly in experienced medical centers. In this study, lesions located at all parts of the left main stem have been treated non-selectively with DES with a technical success rate of 100% and an excellent immediate and long-term result/death. Although the mean age of the patients in our study was older, the immediate and long-term effects were at least comparable to those reported by others.

It reflects the further improvement of technique, equipment, experience and adjunctive medical treatment in recent years. Therefore the results of the study suggest that in the era of DES, it is feasible and safe to treat all lesions of the unprotected left main stem regularly using DES in well-equipped medical centers with experienced staff.

The basic interventional procedure of lesions at the ostium and shaft of unprotected left main stem in the elderly was similar to those used for other coronary arteries. But the following steps need to have more attention paid to them: (1) The guiding catheter should be selected more rationally. For individuals with serious stenosis, it is advisable to choose a guiding catheter with a short tip and side holes. The purpose is to avoid injury of the ostium or shaft lesion with the guiding catheter tip, to provide sufficient blood flow when the tip of the guiding catheter is located at the ostium of the left main stem, as well as to withdraw the guiding catheter easily and precisely after the stent is put in site. (2) A pre-dilation balloon closely follows the guide wire. Especially for patients with a high degree stenosis, the pre-dilation balloon should follow the guide wire tightly once the wire is passed through the lesion and has arrived at the distal of the branch vessel. (3) A pre-dilation balloon larger than 2.5 mm in diameter and with high dilation pressure is recommended so as to ensure sufficient blood flow during the stent passing through the exact position. (4) The proximal mark of the stent should be accurately positioned. The stent at the lesion is usually placed dynamically along with the cardiac construction before its full dilation. The stent shortening after dilation should be considered. (5) Stent parameters should be selected to match the reference diameters of the left main stem exactly. The opening of the left main stem should be dilated finally with higher dilation pressure to form a trunk. (6) Before withdrawing the stent balloon back into the guiding catheter, the proximal end of the dilated stent should be protected by advancing the tip of the guiding catheter into the stent. The distal bifurcational lesion of the unprotected left main stem is one of the most challenging fields in geriatric interventional cardiology. The following practical procedures should be considered: (1) Just one stent is implanted between distal main vessel and one major branch when kissing dilation is conducted with two balloons. (2) One stent is implanted between the distal main vessel and one major branch. Another stent is dilated just at the opening of the other equal branch (type T stenting) before kissing dilation with two balloons. (3) Type Y or trousers stenting is less used at present because of the high risk of intrastent restenosis with both BMS and DES. Although these procedures can be completed successfully without any technical limitation, the long-term intrastent restenosis rate of type Y stenting is significantly higher than type T or one stent procedures. Therefore type Y stenting procedure is almost no longer used in clinical practice.

Synthesizing the above data, this study keeps to the following basic principles in stenting of unprotected left main stem bifurcational lesions in the elderly: (1) If one of the branches is obviously smaller than the other branch, just one stent is implanted between the distal main vessel and the major branch. Then kissing dilation is determined according to the stenosis degree of the opening of the smaller branch. (2) If one branch is small and the residual stenosis of its opening is less than 50%, it is not necessary to dilate the opening or to adapt kissing dilation. (3) For type I bifurcational lesion at the distal left main stem, type T stenting and kissing dilation should be conducted. (4) For any clinical lesion located at the left main stem, DESs are strongly recommended, especially for distal type I bifurcational lesions. The satisfactory immediate and long-term effects of this study support the practical significance of the above principles.

Relationship of stent selection and clinical efficacy in the PCI of unprotected left main stem in the elderly

From the data of this study, it was found that in the elderly there are similar immediate and long-term effects for the ostial and shaft lesions of unprotected left main stem with reference diameter larger than 3.5 mm using both BMS and DES. The reasons may be that the two kinds of lesions are short, the reference diameters of the left main stem are large and there are minimal residual stenosis after high pressure dilations. The acceptable long-term MACE rate supports the use of ei-
ther BMS or DES in the treatment of ostial and shaft lesions of
the unprotected left main stem in the elderly. In summary, our
results showed that in elderly patients with unprotected LMCA
disease, percutaneous stent implantation is feasible and rela-
tively safe; For non-bifurcational lesions, BMS and DES seems
to have similar immediate and long-term efficacy; However,
for bifurcation lesion, DES should be a priority.

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