Original Article

One-year Outcome of Stenting for Long Coronary Lesions, a Prospective Clinical Trial

Samad Ghaffari MD[1], Mohammad Reza Hasanian MD[1], Leili Pourafkari MD[1*]

1 . Cardiovascular Research Center, Tabriz University of Medical Science Tabriz, Iran.

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Abstract

Background: *Percutaneous coronary intervention (PCI) for long coronary lesions is associated with poor angiographic and clinical outcome compared with focal lesions. Here we describe our experience in PCI of such lesions with bare (BMS) or drug eluting stents (DES).*

Methods: *Between October 2008 and September 2009, One hundred patients with one significant coronary artery stenosis of longer than 20 mm were enrolled in this prospective study. Demographic, clinical and angiographic data were collected and the rate of ischemic events and major adverse cardiac events (MACE) were evaluated in a mean follow up period of about 11.3±3.2 months.*

Results: *Mean age of participants was 58.08±8.97 years. Seventy two (72%) patients were male and the remainders were females. Majority of patients underwent DES implantation [25 (25%) BMS, 75 (75%) DES, P<0.001)].There was no difference in frequency of major risk factors distribution among DES or BMS groups. Mean diameter of implanted stent was 2.8±0.033mm in DES group and 2.9±0.35 in group with BMS (P=0.214). The mean length of implanted stent was 25.8±3.08mm in DES and 23.36±0.mm in BMS groups (P<0.001). In-stent restenosis rate was significantly higher in BMS group [6(24%) in BMS and 5(6.9%) in DES, P=0.02]. MACE were observed in 7(9.3%) of patients with DES and 7 (28%) of patients with BMS (P=0.04).*

Conclusion: *In long coronary lesions implantation of DES was associated with lower MACE compared with BMS in one year follow up. Studies with longer term follow up are needed to further clarify this issue.*

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Corresponding Author: *Leili Pourafkari MD, Cardiovascular Research Center, Madani Heart Hospital, Tabriz University of Medical Sciences, Tabriz, Iran. Tel: +98 411 -335 77 70 Fax: +98 411 -334 40 21 E-mail: leili.p@gmail.com*

Introduction

It is well documented that angiographic and clinical success rate of balloon angioplasty (BA) in long (>20 mm) coronary artery lesions is not as good as those associated with balloon angioplasty of shorter lesions.[1–4] In fact, lesion length is an independent risk factor for early complications of BA.[1,5] Lesion length is an independent risk factor for restenosis following BA [6,7] and restenosis rates of up to 58% have been reported. The implementation of coronary stents has resulted in significant improvement in acute angiographic result, clinical outcome and restenosis rate of long lesions.[8, 9] However, the restenosis rate of such lesions is still high and stenting of long lesions was associated with up to 30% to 63% restenosis rates and stented segment length is an independent predictor of restenosis.[10-12] Recent randomized controlled trials have shown that drug eluting stents (DES) have resulted in a substantial decrease in restenosis rate and need for repeat revascularization compared with the use of bare-metal stents across a wide range of coronary lesions including long lesions.[13,14] This study represents our experience in percutaneous angioplasty and stenting of long coronary lesions.

Methods

This study was conducted in Madani Heart Center, Tabriz, Iran between October 2008 and September 2009. One hundred patients with one significant (≥ 70% diameter stenosis or borderline lesion with objective evidence of ischemia in myocardial scintigraphy, stress echocardiography or exercise tolerance test) coronary artery stenosis of longer than 20 mm were enrolled in this prospective study. Patients who were candidates for rescue PCI or primary angioplasty following acute myocardial infarction were excluded from the study. Our institutional review board and ethics committee approved the performance of this research, and all patients signed a written informed consent. Aspirin and Plavix were administered to all patients and they underwent coronary artery stenting with standard technique. A single bolus dose of 7500 IU IV heparin was injected during the procedure with liberal intraprocedural use of IIb-IIIa inhibitors based on the operator physicians' decision. The choice between the two stent types was left to the discretion of the operational interventionist, which was mostly influenced by the patients' financial situation. Baseline clinical, angiographic, and procedural characteristics and in-hospital outcomes were collected by researcher physicians. Finally, clinical outcomes, most importantly MACE, were obtained through patients visiting in clinic or by formal telephone interviews during the first 6- 9 months of the index procedure and beyond this time all patients were visited in clinic. Symptomatic patients were admitted for control angiography and possible re-intervention and for asymptomatic patients myocardial perfusion imaging or exercise tolerance test was performed with Bruce protocol up to maximal patients' tolerance and those with positive test results were scheduled for control angiography. The rate of restenosis, need for repeat revascularization, MACE and myocardial infarction were collected during the follow up period of about 1 year.

Statistical analysis

Variables are expressed as mean ± SD and percentage. Differences in the frequency of characteristics were assessed by independent sample Student's t-test for continuous variables. Chi-square test (or Fisher exact test if applicable) was used for categorical variables. Two-tailed $P < 0.05$ was considered significant. SPSS 13.0 software (SPSS Inc., Chicago, IL, USA) was used for data storage and analysis.

Results

One hundred patients were enrolled in this clinical trial, 72 (72%) male and 28 (28%) females. Drug eluting stents were deployed in 75 (75%) patients and remainders underwent bare metal stent (BMS) implantation for their long lesion. Angiographic success was achieved in all patients. There was no difference in sex, age or coronary risk factors distribution between groups with BMS or DES implantation. The primary diagnosis was unstable

angina in 28 patients [11 (44%) in BMS and 17(22.7%) in DES, P= 0.07], stable angina in 30 patients [12 (48%) in BMS and 18(24%) in DES, P=0.04] and recent myocardial infarction in 42 [2 (8%) in BMS and 40(53.3%) in DES, P<0.001]. Mean diameter of implanted stent was 2.8±0.033 in DES group and 2.9±0.35 in group with BMS (P=0.214). The mean length of implanted stent was 25.8±3.08 in DES and 23.36±0.56 in BMS group (P<0.001) (Table).

Table - Basal characteristics of study groups

	BMS (n=25)	DES (n=75)	P value
Mean age	57.25±8.25	58.36±9.22	0.60
Male gender	20 (80%)	52 (69.3%)	0.30
Hypertension	15 (60%)	39 (52%)	0.48
Hyperlipidemia	10 (40%)	38 (50.7%)	0.35
Diabetes	3 (12%)	28 (37.3%)	0.02
Smoking	10 (40%)	18 (24%)	0.13
Family history of CAD	1 (4%)	7 (9.3%)	0.67
Clinical status			
Myocardial	2(8%)	40 (53.3%)	<0.001
infarction	11 (44%)	17 (22.7)	0.07
Unstable angina	12 (48%)	18 (24%)	0.04
Stable angina			
Coronary			
angiography	11 (44%)	26 (33.3%)	0.47
1- VD	10 (40%)	31 (41.33%)	1
2- VD	4 (16%)	18 (24%)	057
3- VD	2 (8%)	35 (46.7%)	<0.001
Total occlusion			
LVEF <50%	10 (40%)	56 (74.7%)	0.003
Drugs continued			
>6Mo	25 (25%)	75 (75%)	1
Statins	25 (25%)	75 (75%)	1
Aspirin	16 (64%)	56 (74.7%)	0.31
ACEIs	10 (40%)	71 (94.7%)	<0.001
Plavix	25 (25%)	75 (75%)	1
Beta blockers			

BMS: Bare Metal Stent; DES: Drug Eluting Stent; CAD: Coronary Artery Disease; 1-VD, 2-VD, 3-VD: 1,2,3 Vessel Disease, LVEF: Left Ventricular Ejection Fraction.

In a mean follow up period of 11.3±3.2 months myocardial infarction with or without ST elevation was occurred in 2 (2.66%) of DES and 3(12%) in BMS group (P=0.1), among them one case in each group was attributable to a non target lesion and one patient in DES group had stopped Plavix after second month of the procedure. So the mechanism of MI was defined as in-stent thrombosis in all patients of DES group. In 2 of 3 patients with MI in BMS group which occurred after 4th month of intervention restenosis seemed to be the main contributory factor. Among the remaining 95 patients coronary angiography was done in 16 (16.8%) patients, 15 with chest pain syndromes and one asymptomatic patient with positive stress test. In-stent restenosis of long lesion was seen in 9 (9.4%) patients [4(13.6%) in BMS and 5(6.9%) in DES, P=0.2]. However if we consider two cases in BMS group which suffered from AMI the statistical difference becomes significant [6(24%) in BMS and 5(6.9%) in DES, P=0.02]. The mean length of stents with restenosis was 27.72±3.9 and mean diameter was 2.65±0.19 mm. Overall MACE were observed in 7 (9.3%) of patients with DES and 7 (28%) of patients with BMS (P=0.04) (Fig-1).

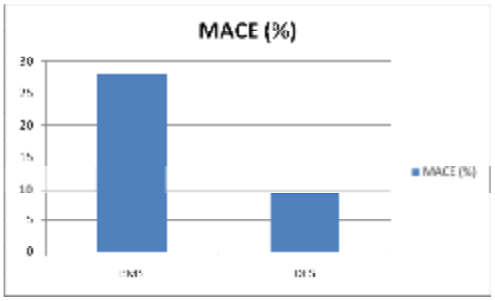

Fig- Frequency of one- year MACE among study groups

Discussion

The clinical and angiographic outcomes of long lesion angioplasty are not as good as focal lesions. [1–4, 13,14] The implantation of stents may improve the outcome of these procedures.[13-17] The superiority of coronary stent deployment to simple BA is well documented.[8, 9] Previously higher cost and higher rate of stent thrombosis and restenosis [18-20] with multiple stents[20, 21] were major drawbacks of long lesion stenting. During the past decade the introduction of longer flexible stents, high support guiding catheters and extra support guide wires and the optimalization of the antithrombotic protocol has expanded the long lesions percutaneous treatment[17] and finally the implementation of DES was a major advance to counterpart the restenosis which traditionally is the achilles heel of the coronary angioplasty. The

feasibility, safety and efficacy of elective stenting as compared with BA were established in the first series of stent trials and bail-out stenting (preventing emergency bypass surgery or worse) was allowed in the BA strategy.[15] However, the long-term outcome of stents in long lesions could not compete with the results of stenting in focal lesions as was reported in the BElgian NEtherlands STENT (BENESTENT) trial and the Stent Restenosis Study (STRESS).[15] The Additional Value of NIR Stents for Treatment of Long Coronary Lesions (ADVANCE) trial was the first study which evaluated the impact of provisional stenting in long lesions. A total of 437 patients with a single native lesion 20 to 50 mm in length were included and underwent BA to achieve a diameter stenosis (DS) of less than 30% by on-line quantitative coronary angiography (QCA). "Bail-out stenting" was performed for flow-limiting dissections or >50% DS. Patients in whom an optimal BA result was achieved were randomized to additional stenting (using NIR stents) or no stenting. In this study a strategy of provisional stenting for long coronary lesions led to bailout stenting in one-third of patients, with a threefold increase in peri-procedural infarction. Additional stenting was associated with lower angiographic restenosis rate, but no reduction in MACE at nine months.[15] Another important factor is the lumen cross sectional area of the vessel. Using Intra Vascular Ultra Sound (IVUS) Hong et al showed a similar angiographic restenosis rate between long and short coronary lesions with a stent lumen cross sectional area (CSA) of ≥7.0 mm2. They concluded that regardless of the stent length, the most important factor determining the angiographic restenosis is the IVUS stent lumen CSA in relatively large coronary artery lesions.[22] A large list of studies have documented the reduced rate of restenosis with drug-eluting stents which provide local drug delivery and reduces the need for reintervention, compared with bare metal stents.[10, 11, 15, 19, 23] Thereafter numerous studies have focused on the clinical use of paclitaxel- (PES) and sirolimus-eluting stents (SES) beyond the simple lesions and in more complex lesions and procedures.[13, 14, 16, 22] Schofer et al compared the binary restenosis rate and clinical major adverse cardiac events (MACE) of SES versus BMS in lesions longer than 15 mm length with a reference vessel diameter of about 2.5-3 mm and found a significantly lower restenosis rate (5·9 vs 42.3%, p=0·0001) and fewer MACE at 9 months follow up (8·0 vs 22.6%, p=0·0002), due mainly to a lower need for target lesion revascularisations (4·0 vs 20·9%, p<0·0001).[14] Some studies have shown better results with SES compared with PES in complex lesions and high risk patients[16, 24-29] and some other studies have proved vice versa.[30,31] For example, Kim et al in the Long-DES Registry Study showed that SES was associated with a lower angiographic restenosis rate than PES in patients with lesions >24 mm in length,[27] this was a non randomized study, however in another randomized study they showed similar results and stated on the superiority of SES over PES regarding the restenosis rate and need for revascularization.[16] Our study was a non randomized study enrolling high risk patients among whom 31% were diabetics, 70% had been admitted with acute coronary syndromes and 63% had more than one stenotic coronary artery. There was significantly lower MACE rate with DES implantation mostly due to higher need for repeat revascularization in those with BMS. Studies with long term follow up are needed to confirm the safety of long drug eluting stents.

Limitations

Our study was a nonrandomized single center study with limited sample volume. We couldn't randomize patients for DES or BMS mostly because of the financial concerns. Due to some logistic problems we used different type of bare or drug eluting stents and also we did not perform IVUS routinely for all patients.

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