

A Study of the Safety and Efficacy of ≥ 36 mm Long Drug Eluting Stents for Diffuse Coronary Disease

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Received: July 14, 2014

Revised: September 16, 2014

Accepted: September 22, 2014

Published online: October 10, 2014

CONCLUSION: The findings show the efficacy of ≥ 36 mm DES for the treatment of complex diffuse disease and with a very low MACE rate.

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Key words: Long stents; Long lesions; Percutaneous coronary intervention

Mohammadi A, Mohajeri GH, Dargahi M, Golmohammadzade SH, Jabbari F, Shabestari M, Akhondzade R, Izanloo A. A Study of the Safety and Efficacy of ≥ 36 mm Long Drug Eluting Stents for Diffuse Coronary Disease. *Journal of Cardiology and Therapy* 2014; 1(8): 196-199 Available from: URL: <http://www.ghrnet.org/index.php/jct/article/view/894>

ABSTRACT

AIM: Diffuse lesion, which is commonly observed in routine clinical practice, often leads to the use of long or overlapping stents. Long stents can increase the risk of restenosis and stent thrombosis. There is a paucity of research on long term efficacy and safety of long drug eluting stents (DES) in these complex lesions.

METHODS: In this prospective study, consecutive patients who had undergone coronary stenting with ≥ 36 mm DES stents were studied. The clinical follow up was performed in the hospital 6 and 12 months after the surgery. The clinical endpoints were major adverse cardiac events (MACE) including cardiac death, myocardial infarction, repeat revascularization and stent thrombosis.

RESULTS: The study population consisted of 121 patients, out of whom 58% were male, with a mean age of 60.3 years old. 23.4% had diabetes and 34% had a history of myocardial infarct. Most of them had undergone post dilated high pressure (≥ 20 atm) with NC balloon. 19.6% of patients underwent overlapping stents. The mean size and length of stent were 2.86 mm and 42 mm respectively. 3.3% of patients suffered from non-Q wave myocardial infarct in the hospital. No other MACE including stent thrombosis, cardiac death and myocardial infarct were detected.

INTRODUCTION

Studies show that the use of DES reduce the threat of restenosis and in-stent restenosis (ISR) in comparison to BMS^[1-6]. In routine clinical practices and in the real-world experience, DES is widely used for percutaneous coronary intervention (PCI) in more complex lesions including diffuse lesions. Long lesions account for approximately 20% of PCI and the use of long or overlapping stents for full lesion coverage is increasingly on rise^[7-9].

However, two important issues, namely restenosis and stent thrombosis, are among risky unfavorable outcomes of long lesion PCI^[10-12].

In this study, the efficacy and safety of long DES such as the second and the third generation of stents in the management of diffuse coronary artery disease are examined CAD.

METHODS

Participants

This study was a prospective single center study which included 121 patients who had undergone PCI with the implantation of at least

36 mm or 38 mm long stent in the period between April 2011 and January 2011.

All patients, who according to the results of angiographic and clinical status needed the implantation of long stents, were studied. Inclusion criteria required that the planted total stents length be greater than 36 mm.

Exclusion criteria were: (1) Contraindication to long dual antiplatelet therapy; (2) Left main (LM) disease; (3) Planned bifurcation stenting in the side branch; (4) Primary PCI in acute myocardial infarction (MI); (5) Cardiogenic shock; (6) Serum creatinine ≥ 2.5 mg/dL

This research proposal was approved by Education and Research Department of Razavi hospital in Mashhad, Iran. Prior to the intervention, all patients participating in the study signed a written consent form.

Procedural data

All patients received at least 80 mg of aspirin and 600 mg of clopidogrel. During the procedure, patients received intravenous weight adjusted heparin to achieve activated clotting time (ACT) (250-350). Stent implantation was performed by modern techniques and post dilation with NC balloon and a minimum of 18 mm Hg was performed for all patients.

After the procedure, all patients received 80 mg/d of aspirin indefinitely, 150 mg/d of clopidogrel for one week and 75 mg/d for one year. Longer consumption of clopidogrel was at the discretion of the physician. A 12 lead ECG was obtained after the procedure and before the discharge. Serum levels of Creatine Kinase test (CKMB) and T n I were measured 6 and 12 hours after the procedure, and thereafter if necessary.

Clinical follow up

Clinical follow-ups were performed at 1, 3, 6 and 12-month interval for all patients. Based on the clinical status, re-hospitalization, re-catheterization and recurrence of adverse events were carried out.

All data was stored in a computer database.

Study outcomes

Clinical outcome comprised of major adverse cardiac events (MACE) including death, myocardial infarction, revascularization (TLR) and stent thrombosis.

Peri procedural MI was defined as an increase of CKMB or TNI greater than three times of the normal upper limits or the persistent ST elevation of greater than 1 mm in two contiguous limb leads or greater than 2 mm in two contiguous pericardial leads.

Target vessel revascularization (TVR) was used if symptoms or signs of myocardial ischemia were observed.

Stent thrombosis or probable thrombosis was defined according to the definition of academic research consortium (ARC). Stent overlap was defined as the presence of ≥ 2 stent within a single lesion with an overlapping zone of at least 1 mm.

Statistical analysis

The data was entered in SPSS version 19 for the analysis. Quantitative data were analyzed by computing indices of central tendency and dispersion as well as frequency distributions.

RESULTS

Of the 121 patients enrolled in the study, 58% were male with a mean age 60.3 ± 10 years. All patients underwent coronary artery stenting

with at least 36 mm or 38 mm of long drug eluting stent.

The patient demographics are shown in table 1.

The majority of patients had stable angina pectoris (78%). 60.6% of patients had multi vessel disease and right coronary artery (RCA) (45.5%) and 1 anterior descending (LAD) (50%) were the most common target vessels.

19.6% of patients underwent two overlapping stents (at least one of stents were long) with a mean stent size of 2.86 ± 0.31 mm and the mean stent length of 42 mm. Angiographic and procedural data is shown in table 2.

Four patients (3.3%) suffered from a peri procedural non Q- wave myocardial infarction. There was not any case of Q-wave MI, death or stent thrombosis during the hospitalization. The mean follow-up duration was 12 ± 2 months.

There was not any cardiac death, stent thrombosis or MI. Only one patient (0.9%) with ISR underwent target lesion revascularization (TLR) (Table 3).

Table 1 Baseline clinical characteristics.

Age (y)	60.3 \pm 9.9
Male (%)	58
Hypertension (%)	56
Dyslipidemia (%)	59.1
Smoker (%)	18.2
Diabetes mellitus (%)	23.4
Prior MI (%)	33.9
Mean LV EF(%)	51

Table 2 Angiographic and procedural characteristics.

Target vessel	No.	%
LAD	60	49.5
RCA	55	45.4
LCX /OM	6	4.9
Stent type		
36 mm biomatrix	45	37.2
38mm promus element	58	47.9
38mm xience	18	14.8
Overlapping stenting	24	19.8
Mean stent diameter	2.86 mm	
Mean stent length	42 mm	

Table 3 Major adverse cardiac events in the hospital in a 12- month follow up.

Major adverse cardiac events in the hospital		
	No.	%
Death	0	0
Non Q-were MI	4	3.3
Q-were M	0	0
Stent thrombosis	0	0
CABG	0	0
Repeat PCI	0	0
12-month follow-up		
Death	0	0
MI	0	0
TLR	1	0.9
Stent thrombosis	0	0

DISCUSSION

Today, drug eluting stents (DES) are used increasingly, particularly in complex coronary disease. According to the guidelines, the use of DSE in long lesions has become the standard clinical practice^[13-16].

However, long lesions are associated with more adverse side effects including higher rates of restenosis, peri procedural MI and stent thrombosis. Technically, long lesion stenting is associated with difficulties such as stent deliverability, stent overlap, geographical

miss and prolonged intracoronary manipulation due to the multiple and overlapping stent placement which may damage the vessel wall integrity^[17].

New generations of DSE have specific design characteristics including low loss rate to minimize restenosis risks, thin struts to enhance deliverability and minimize the risk of peri procedural infarction and availability of long lengths to minimize overlap and avoid geographical miss^[17].

These opportunities can help interventionists treat long lesions.

Stent overlapping, which is often unavoidable, can be a source of neointimal hyperplasia and the incomplete endothelial coverage of stent struts can be a predictor of late stent thrombosis^[18].

Pooled analysis of five sirolimus-eluting stents (SES) clinical trials showed that stent overlap was associated with greater lumen loss and restenosis in both BMS and SES. However, TLR increased only with BMS not SES. Thus, the avoidance of stent overlap by available long stents may enhance long term stent patency^[19].

This study shows that the use of ≥ 36 mm of DES implantation is associated with a low rate of MACE, mainly due to reduced risk of target lesion revascularization. The annual cumulative rate of MACE was 0.9%.

Lee *et al* reported the safety and effectiveness of full metal jacket DES in the treatment of diffuse lesions with restenosis rates of 11% and 22.2% for SES and PES respectively, suggesting that the risk of restenosis is influenced by the type of DES.

The long DES II study compared SES with PES in patients with coronary lesions >25 mm. The study showed that SES was associated with a significant reduction in TLR (2.4% to 7.2%, $p=0.012$) in stent binary restenosis (2.9% to 11.8%, $p=0.001$).

The EVERLONG registry examined the clinical results of overlapping EES stents in long lesion (a mean length of 42.7 mm), showing low TLR (0.4) and MACE rate (5.4%) in a nine month interval after the study^[20].

In this study, the use of the second (EES) and the third (BES) generation of long stents was associated with low incidence of MACE in a 12-month interval after the study. There was not any case of stent thrombosis in the follow up and TLR was only about 0.9%.

Colombo *et al* examined the midterm clinical outcomes of 38 mm long DES (Taxus liberte, Endeavor Resolute, Xience) in 68 patients. There was not any case of MACE or TLR but two non-cardiac deaths (2.9%) were reported. OCT analysis in this study revealed that the second generation of stents was safer than the first generation^[23].

Also, Loutfi *et al* studied clinical outcomes of 129 patients with diffuse CAD in a 2-year period, finding that the use of DES (with a mean length of 54.5 mm) was associated with TLR (5.4%), but no cardiac death was detected and only one case of late stent thrombosis was reported^[17].

In this study, the independent predictors of repeated revascularization were insulin treated type 2 DM, reference diameter (RVD) of less than 2.75 mm and overlapping DES longer than 60 mm.

Stent thrombosis is an important complication in patients treated with long DES.

Jon Suh showed the stent length to lesion was an important predictor of stent thrombosis. Stent length ≥ 31.5 mm was associated with higher rates of sent thrombosis (4% to 0.7%) in a 3-year interval^[24].

Ruchin *et al* reported a 9-month late stent thrombosis of 1.25% for a mean stent length of ≥ 55 mm^[25].

In the present study, all patients were on dual antiplatelet medication (ASA+Clopidogrel) at least for one year and no case of stent

thrombosis was reported.

The main limitation of this research was that it was a single center study. Moreover, the technique of stenting and patient selection may have influenced the results. Another limitation was the lack of angiographic follow up and IVUS assessment As well as midterm follow up (12 months) for the evaluation of TLR.

CONCLUSION

The results indicated that the use of ≥ 36 mm DES for the treatment of complex diffuse was safe and effective with a low MACE rate in one-year interval and yielded favorable clinical outcomes

Our findings suggested that new generation of DES were highly effective in the treatment of diffuse CAD in the real-world experience.

CONFLICT OF INTERESTS

There are no conflicts of interest with regard to the present study.

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