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Original Article

Late clinical events of drug eluting versus bare metal stenting; OPCES' ancillary study

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ABSTRACT

Objective: To compare one year clinical outcomes of patients with chronic stable angina who underwent implantation of bare metal stent (BMS) or drug eluting stent (DES).

Methodology: Four hundred forty two (442) participants of OPCES study (Osvix versus Plavix in Cardiovascular Events after Stenting) were included in this sub-study. After evaluation of exclusion criteria (combined DES and BMS stenting (n=31) and incomplete data (n=48) patients were divided in two groups according to selected stent(DES or BMS). Follow-up was conducted by a structured telephone interview after 6 and 12 months. The patients' documents were reviewed by the Study Event Committee in the Isfahan Cardiovascular Research Center to evaluate the occurrence of study endpoints which consisted of clinical success rate and major adverse cardiac events (Major Adverse Cardiac Events (MACE), cardiac death, non-fatal MI, target vessel revascularization and stroke) in hospital, after 6 and 12 months.

Results: One hundred sixty six (45.7%) patients were in the DES and 197(54.3%) were in the BMS group. Procedural complications were seen more frequently in the DES group (1.0% vs. 4.8%, P=0.027), the prevalence of the in-hospital MACE, angiographic and clinical success rate were the same between both the groups. There was no significant difference regarding 6 and 12 months MACE rate in patients treated by BMS or DES (6 months: 1.1% vs. 0.6%, p>0.999 12 month: 3.4% vs 2.6%, P = 0.755).

Conclusion: Considering the same clinical outcome and the economical parameters, use of the BMS after proper patient selection are recommended.

KEY WORD: Coronary artery disease, Angioplasty, Drug eluting stents, Bare metal stents, Major adverse cardiac events.

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INTRODUCTION

Coronary stenting is an established form of the treatment for the majority of patients with symptomatic coronary artery disease (CAD). Stents innovation made a revolution in the treatment of CAD but in stent restenosis remain as a major limitation of coronary artery stenting in daily clinical practice not least in high-risk patients such as those with diabetes or longer lesions.[1-3]

Randomized controlled trials have shown that drug-eluting stents (DES) have resulted in a substantial decrease in restenosis across a wide range of coronary lesions and patient subsets compared to bare metal stents (BMS).[3,4] Also DESs could effectively improve 1-year clinical outcome in 'real world' practice.[5,6] However, recently, late thrombosis, as a complication of DES, arouse many

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questions about the safety and efficacy of these stents.[7-10] Recent studies suggest a 0.5% increased long-term thrombosis risk with DES; however, the clinical significance of these events remains under debate[11] and in a real-world setting, use of DES in all patients is less cost effective than in studies with selected patients.[12]

In Iran, long-term clinical outcome of stenting by DES versus BMS were compared in a few studies but all of them were based on single center registries or trials. In present study we aimed at comparing the 1-year clinical outcomes of the patients who underwent BMS or DES placement in the Iranian patients' subsets participating in the multicentric study.

METHODOLOGY

The present study was a case-cohort ancillary study included in the Osvix versus Plavix in Cardiovascular Events after Stenting (OPCES) study.[13] Briefly, OPCES is a randomized, double blind, multi-centric clinical trial which compared the early and late cardiovascular events as well as side effects of Osvix versus Plavix, two generic form of Clopidogrel, regimens in patients with chronic stable angina who underwent Drug eluting or bare metal stenting. The study was approved by the ethical committee of the Isfahan Cardiovascular Research Center, a WHO collaborating center, and all patients provided written informed consents for participation. OPCES study was registered in Iranian Randomized Clinical Trial with register No: IRCT138712111723N1. Study protocol and procedural details were mentioned before.[13] In brief, stent placement procedures were performed according to standard methods and the selection of stent Type, the size of any devices and the pressure used during dilation were dependent on the operator's discretion.

Furthermore, Choice of stent was partly influenced by the participant's financial situation. DES is more expensive than BMS in the market. Lesion types were noted according to the American College of Cardiology/American Heart Association (ACC/AHA) lesion characteristics classification[14] and Thrombolysis in Myocardial Infarction (TIMI) flow grade, were determined by visual estimation using the guiding catheter as a reference object for calibration.

After successful percutaneous coronary intervention (PCI) each participant was considered as eligible for follow-up which was conducted by a structured telephone interview with the patients or one of his(er) immediate relatives up to one year. In the presence of any events the patient was evaluated by his(er) cardiologist at first and all patient's documents were reviewed by the Study Event Committee in the Isfahan cardiovascular research center for evaluation of his(er) event`s documents to decide about the occurrence of study endpoints.

Patients: From March 2007 to November 2009, 442 patients were included in the OPCES study. In our study exclusion criteria were combined DES and BMS stenting (n=31), and incomplete data (n=48). Two hundred seventy four (75.5%) and 23(6.3%) of the patients were enrolled in Isfahan centers (University and Private Hospitals, respectively). Other patients were enrolled in Shiraz (28(7.7%)), Tabriz (14(3.9%)), Mashhad 6(1.7%)) and Khoram Abad (18(5.0%) centers.

Definition: Myocardial infarction (MI) was defined by Ischemic symptoms accompany by at least one of the following criteria: positive cardiac enzymes, electrocardiographic changes (pathologic Q wave or new ST changes) and new cardiac motion abnormality on echocardiographic or radionuclide imaging. Non-Qwave MI was defined as a 5-fold increase in MB fraction of creatinine kinase without the development of new Q waves. Angiographic success was defined as residual stenosis <20% plus normal TIMI flow grade three in the target vessel. Clinical success was defined as angiographic success in all target lesions without any in-hospital major adverse cardiac events (In-hospital MACE: death, MI, emergency bypass surgery or PCI) during hospitalization. Early and late MACE were defined as the presence of cardiac death, non-fatal MI, or target vessel revascularization (TVR) or stroke during the 6 and 12 months of follow-up period, respectively. TVR was defined as ischemia-driven repeat percutaneous intervention or bypass surgery of the target vessel. Target lesion revascularization was defined as ischemia-driven repeat percutaneous intervention of the target lesion or bypass surgery of the target vessel.

Endpoints: The primary endpoint of this study was in-hospital MACE and clinical success rate. The secondary endpoints were consisted of early and late MACE.

Statistical analysis: Continuous variables are expressed as mean ± SD, and dichotomous variables as frequencies. Categorical variables were compared using the chi-square test (or Fisher's exact test if required) and continuous variables by using student t test or Mann-Whitney U test and

p values < 0.05 were considered as statistically significant. Univariate and multivariate analyses of hazard ratios, including 95% confidence intervals, were calculated using the Cox proportional hazard method. Factors with p values <0.15 in the univariate analysis were entered into the multivariate model. All the statistical analyses were performed using SPSS version 15.0 (SPSS Inc., Chicago, IL, USA) for windows.

Table-I: Baseline demographic, clinical and para clinical characteristics of the patients.

	BMS	*DES*	*p value*
Demographic characteristics			
No of cases (%)	197(54.3)	166(45.7)	
Age	58.92±9.51	59.25±9.30	0.253
Female Gender	60(30.5)	63(38.0)	0.133
Height(cm)	165.04±10.33	164.72±9.91	0.775
Weight(kg)	71.91±12.95	73.42±11.75	0.253
Body Mass index (kg/m2)	26.43±4.41	27.07±3.81	0.145
Obese(BMI>30)	41(21.0)	34(20.5)	0.899
Osvix (vs. plavix) Consumption	97(49.2)	89(53.6)	0.406
Paraclinical characteristics			
FBS(mg/dl)	106.79±35.41	124.44±59.10	0.001
cr(mg/dl)	1.02±0.28	1.06±0.27	0.271
BUN(mg/dl)	15.80±4.81	15.64±4.72	0.764
Renal insufficiency (cr>1.5 mg/dl)	9(4.7)	15(9.2)	0.089
Clinical characteristics			
Multivessel disease	75(38.1)	59(35.5)	0.619
Low EF (<40%)	23(11.9)	18(11.0)	0.794
Wall motion abnormality*	84(43.1)	71(43.3)	0.967
Dyslipidemia†	126(64.3)	110(66.3)	0.694
Hypertension‡	122(62.6)	112(67.9)	0.292
Diabetes mellitus	54(27.4)	66(39.8)	0.013
History of smoking§	95(48.2)	54(32.5)	0.002
History of MI	102(51.8)	93(56.0)	0.419
History of CHF	3(1.5)	1(0.6)	0.403
History of Stroke	3(1.5)	3(1.8)	0.832
History of Peripheral vascular disease	0(0.0)	2(1.2)	0.208
Prior CABG	1(0.5)	0(0.0)	>0.999
Prior PCI	11(5.6)	14(8.4)	0.285

Categorical variables are expressed as N (%) & Continuous variables are expressed as Mean ± SD

BMS, bare metal stents; DES, drug-eluting stents; Low EF=Left ventricular ejection fraction <40%; MI, Myocardial infarction; CHF, Congestive heart failure; CABG, Coronary artery bypass grafting; PCI, Percutaneous coronary intervention *diagnosed by Echocardiography †Dysipidemia: LDL cholesterol **1.0 mg/dl, triglycerides **150 mg/dl and HDL ≤ 40 mg/dl or on treatment of Dyslipidemia ‡Hypertension: Systolic blood pressure > 140 mmHg or diastolic blood pressure > 90 mmHg or taking hypertensive drug § smoking: person smoking at least 1 cigarette (or cigar, pipe) in the last month.

RESULTS

Totally, 426 lesions in 363 patients (Lesion/ patient ratio: 1.16±0.39) were treated in this study. One hundred twenty three (33.9%) of the patients were female and their mean age was 59.07 ± 9.41 years old. They were divided in two groups. 197(54.3%) and 166(45.7%) patients were in BMS and DES group, respectively.

Table-I reveals the clinical and demographic characteristics of the patients at baseline. As it shows patients in the DES group are more often diabetics (27.4% vs. 38.9%, P=0.013) and less frequently have positive smoking history (48.2% vs. 32.5%, P=0.002). Other baseline characteristics are comparable between the groups.

Table-II shows 216 lesion (Lesion/patient ratio: 1.12±0.35) and 176 lesion (Lesion/patient ratio: 1.06±0.27) were treated in the BMS and DES group, respectively. In the DES group, the lesions are more

Table-II: Angiographic, lesion and procedural characteristics o the patients*

	BMS	*DES*	*p value*
Angiographic characteristics			
No of arteries (%)	216(50.7)	176(41.3)	
Lesions/patient Ratio	1.12±0.35	1.06±0.27	0.065
%Diameter stenosis	86.62±7.90	88.53±9.18	0.027
Preprocedural TIMI Flow	2.87±0.39	2.67±0.64	0.001
Target territory			<0.001
LAD	111(51.4)	138(78.4)	
LCX	38(17.6)	15(8.5)	
RCA	67(31.0)	23(13.1)	
Lesion characteristics			
ACC/AHA typing			<0.001
A	128(59.5)	35(20.1)	
B	73(34.0)	79(45.4)	
C	14(6.5)	60(34.5)	
Tubular(10< ≤20mm)	169(80.1)	55(32.5)	<0.001
Diffuse(>20mm)	19(9.0)	114(67.5)	<0.001
Total occlusion	13(6.0)	30(17.0)	0.001
Direct stenting	138(66.7)	65(38.2)	<0.001
Stent length	14.64±4.40	25.46±8.21	<0.001
Stent diameter	3.12±0.41	2.94±0.26	<0.001
Postprocedural stenosis %	2.14±10.34	4.17±18.09	0.192
Postprocedural TIMI Flow	3.00±0.00	2.97±0.2	0.059
Angiographic success rate	214(99.1)	170(96.6)	0.084

Categorical variables are expressed as N(%) & Continuous variables are expressed as mean ± SD

BMS, bare metal stents; DES, drug-eluting stents; LAD, left anterior descending; LCX, left circumflex artery;

RCA, right coronary artery; ACC/AHA, American college of cardiology/American heart association

*Lesion-based Analysis

complex, diffuse, stenotic and located in the tighter vessels than the BMS group. They are located more frequently in the LAD territory and also total occlusion was observed more frequently in them.

Although, procedural complications were seen more frequently in the DES group (1.0% vs. 4.8%, P=0.027) but the prevalence of the in-hospital MACE were the same in both groups (2.5% vs. 2.4%, P=0.938)(Table-III). Also Angiographic and clinical success rate were the same in BMS vs. DES groups (99.1% vs. 96.6%, p=0.084; 96.4% vs. 94.0%, _P=0.267, respectively).

After exclusion of the patients with failed PCI (n=17), 346(95.3%) patients were eligible for follow up. The response rate during one year of follow-up was 95.4% which was significantly different between the groups (92.1% in BMS vs. 99.4% in DES group, p=0.001).There was no significant difference regarding early and late MACE in patients treated by BMS vs. DES (1.1% vs. 0.6%, p>0.999; 3.4% vs. 2.6%, p=0.755, respectively) (Table-IV). The study groups had the same frequency of MI, cardiac death, stroke and TVR (Table-IV). Multivariate analysis reveals that no factor had a predictive role in developing the MACE.

Table-III: Procedural characteristics, complications and Primary Endpoints

BMS	*DES*	*p value*	
Procedural characteristics	197(54.3)	166(45.7)	
MVPCI (%)	36(18.3)	23(13.9)	0.256
Most complex Lesion (ACC/AHA typing)			<0.001
A 113(57.7)	34(20.6)		
B 68(34.7)	74(44.8)		
C 15(7.7)	57(34.5)		
Procedural complications	2(1.0)	8(4.8)	0.027
Dissection	1(0.5)	4(2.4)	0.121
Percutaneous arterial complication	1(0.5)	3(1.9)	0.334
Slow Flow/No reflow	0(0.0)	2(1.2)	0.208
Coronary artery perforation	0(0.0)	1(0.6)	0.457
Side Branch Occlusion	0(0.0)	1(0.6)	0.457
Acute segment closure	0(0.0)	1(0.6)	0.457
LOS	3.12±1.79	3.40±2.23	0.185
Inhospital MACE	5(2.5)	4(2.4)	0.938
Emergent CABG	0(0.0)	1(0.6)	0.457
Q wave MI	1(0.5)	3(1.8)	0.336
NonQ wave MI	3(1.5)	1(0.6)	0.354
Death	1(0.5)	1(0.6)	>0.999
CSR	190(96.4)	156(94.0)	0.267

Categorical variables are expressed as N(%) & Continuous variables are expressed as mean ± SD
BMS, bare metal stents; DES, drug-eluting stents; MVPCI, Multivessel percutaneous coronary intervention;
ACC/AHA, American college of cardiology/American heart association; LOS, Length of stay;
MACE, Major adverse cardiac events; CSR, Clinical success rate
*Patient-based Analysi

DISCUSSION

DES implantation has been proved to markedly reduce the incidence of early restenosis and repeat revascularization in clinical trials or daily practice population.[3-6] But during the past decade questions about DES safety and long term results are being asked.[3]

The BASKET-LATE[15] (Basel Stent Kosten-Effekivitats Trial- Late Thrombotic Events) Investigators present the long-term follow-up of a cohort of patients from the BASKET trial, a study of a randomized comparison of BMS with DES among a broad spectrum of unselected patients from a single practice. In the BASKET trial, all patients received the combination of aspirin plus clopidogrel for 6 months; after the cessation of clopidogrel, the investigators prospectively followed patients who had had survived the first 6 months without an ischemic event. Between 7 and 18 months, they observed an increase in the death/ myocardial infarction composite among the DES patients compared with the BMS patients (adjusted hazard ratio 2.2, P=0.03). Their conclusion

Table-IV: Follow up Data and secondary endpoints.

	BMS	*DES*	*p value*
Eligible to Follow	190	156	
Follow up Rate	175(92.1)	155(99.4)	0.001
Any Event	36(20.6)	23(14.8)	0.175
Readmit	33(18.9)	23(14.8)	0.332
Angina	21(12.0)	11(7.1)	0.133
Repeated PCI	6(3.4)	2(1.3)	0.290
CABG	1(0.61)	0(0.0)	>0.999
TLR	1(0.6)	0(0.0)	>0.999
Instent Restenosis	2(1.1)	1(0.6)	>0.999
Early MACE (6 months)	2(1.1)	1(0.6)	>0.999
Late MACE (12 months)	6(3.4)	4(2.6)	0.755
TVR	3(1.7)	0(0.0)	0.250
Cardiac Death	2(1.1)	1(0.6)	>0.999
Stroke	0(0.0)	1(0.6)	0.470
MI	1(0.6)	1(0.6)	>0.999

Categorical variables are expressed as N(%) & Continuous variables are expressed as mean ± SD
BMS, bare metal stents; DES, drug-eluting stents; PCI, Percutaneous coronary intervention;
CABG, Coronary artery bypass grafting; TLR, Target lesion revascularization;
MACE, Major adverse cardiac events; TVR, Target vessel revascularization; MI, Myocardial infarction.

is carefully worded to note that there was an observed continued lesser incidence of target vessel revascularization with the DES and that the late clinical events.

But our study could not reveal any significant difference regarding primary endpoints or early and long term MACE between DES and BMS groups. In fact the rate of MACE in our study was more lower than the BASKET and the basket late (7.2% DES and 12.1% BMS in 6 months and 9.3% DES and 7.9% BMS between 6 and 18 months of follow up).[12] Also in our study MACE pattern was not the same as BASKET (time dependant) at least in 12 months.

In this regard our results are comparable with the Alidoosti`s study.[16] They evaluated long-term clinical outcome of the DES vs. BMS based on their single center registry (1796 patients: 228 DES and 1568 BMS) and they did not find any statistically significant difference between those groups in terms of angiographic and clinical success rates (P=0.72 and P=0.097, respectively). Although, the rate of MACE during follow-up was not significantly different between DES(2.2%) and BMS (4.2%), they reported that the risk of MACE was about one third when DES was compared with BMS (hazard ratio=0.36, 95% CI 0.13-0.95) which was not confirmed in our study.

We think that lower rate of MACE in Iranian population comparing to other countries is an important finding which must be investigated in more powerful studies. At first, we have the hypothesis that the same clinical outcome of DES and BMS groups in our study, in regard of some other studies[3-6], could be explained by the point that patients of the DES group have higher risk profile than the BMS group. They are more diabetic and they have more diffuse and complex lesions in the smaller vessels. Therefore, longer stents with smaller dimensions were implanted (P<0.001). After more analysis we conclude that although this hypothesis could explain the cause of more procedural complications rate in the DES group but it could not explain the cause of the same results in secondary endpoints, the mentioned factors did not play any role in the development of MACE in the multivariate analysis after adjusting for differences in baseline characteristics.

AS mentioned before, the patients in the DES group were more compliant by the Follow-up protocol. It could be related to different socio-economical status of the patients. Furthermore, high cost of the DES and higher risk profile of these patients may encourage them to be more compliant with the study follow-up protocols.

Study limitation: The choice between the two stent types was partly subject to the patients' financial situation, leading to possible selection bias. For the evaluation of effects of drug-eluting stents use during long-term follow up, further studies on larger populations are required.

CONCLUSION

In view of the same clinical outcome and the economical parameters, use of the BMS after proper patient selection are recommended. Of course further studies on large number of patients are needed to confirm our findings.

REFERENCES

1. Jensen J, Lagerqvist B, Aasa M, Rev T, Nilsson T, Tornvall P. Clinical and angiographic follow-up after coronary drug-eluting and bare metal stent implantation. Do drug-eluting stents hold the promise? J Internal Med. 2006;260:118–124.
2. Robert A. Harrington RA, Califf RM. Late Ischemic Events After Clopidogrel Cessation Following Drug-Eluting Stenting. Should We Be Worried? JACC. 2006;48(12):2592–2595.
3. Babapulle MN, Joseph L, Belisle P, Brophy JM, Eisenberg MJ. A hierarchical Bayesian meta-analysis of randomised clinical trials of drug-eluting stents. Lancet. 2004;364:583–591.
4. Katritsis DG, Karvouni E, Ioannidis JP. Meta-analysis comparing drug-eluting stents with bare metal stents. Am J Cardiol. 2005;95:640–643.
5. Lemos PA, Serruys PW, van Domburg RT, Saia F, Arampatazis CA, Hoye A, et al. Unrestricted utilization of sirolimus-eluting stents compared with conventional bare stent implantation in the real world. The rapamycin-eluting stent evaluated at Rotterdam Cardiology Hospital (RESEARCH) registry. Circulation. 2004;109:190–195.
6. Ong AT, Serruys PW, Aoki J, van Mieghem CAG, Rodriguez-Granillo GA, et al. The unrestricted use of paclitaxel- versus sirolimus-eluting stents for coronary artery disease in an unselected population. One year results of the Taxus-stent evaluated at Rotterdam Cardiology Hospital (T-SEARCH) registry. J Am Coll Cardiol. 2005;45:1135–1141.
7. Win HK, Caldera AE, Maresh K, Lopez J, Rihal CS, Parikh MA, et al. Clinical outcomes and stent thrombosis following off-label use of drug-eluting stents. JAMA 2007;297:2001–2009.
8. Beohar N, Davidson CJ, Kip KE, Goodreau L, Vlachos HA, Meyers SN, et al. Outcomes and complications associated with off-label and untested use of drug-eluting stents. JAMA. 2007;297:1992–2000.
9. Iakovou I, Schmidt T, Bonizzoni E, Ge L, Sangiorgi GM, Stankovic C, et al. Incidence, predictors and outcome of thrombosis after successful implantation of drug-eluting stents. JAMA. 2005;293:2126-2130.
10. Bavry AA, Kumbhani DJ, Helton TJ, Borek PP, Mood GR, Bhatt DL. Late Thrombosis of Drug-Eluting Stents: A Meta-Analysis of Randomized Clinical Trials. Am J Med. 2006;119:1056-1061.

11. Jaffe R, Strauss BH. Late and Very Late Thrombosis of Drug-Eluting Stents Evolving Concepts and Perspectives. J Am Coll Cardiol. 2007;50:119–127.
12. Kaiser C, Brunner-La Rocca HP, Buser PT, Bonetti PO, Osswald S, Linka A, et al. Incremental cost-effectiveness of drug-eluting stents compared with a third-generation bare-metal stent in a real world setting: randomised Basel Stent Kosten Effektivitats Trial (BASKET). Lancet. 2005;366:921–929.
13. Khosravi AR., Pourmoqhadas M, Ostovan M, Mehr GK, Gharipour M, Zakeri H, et al. The impact of generic form of Clopidogrel on cardiovascular events in patients with coronary artery stent: results of the OPCES study. JRMS. 2011;16(5):640-650.
14. Smith SC Jr, Dove JT, Jacobs AK, Kennedy JW, Kereiakes D, Kern MJ, et al. ACC/AHA guidelines for percutaneous coronary intervention (revision of the 1993 PTCA guidelines)-executive summary: a report of the American College of Cardiology/American Heart Association task force on practice guidelines (Committee to revise the 1993 guidelines for percutaneous transluminal coronary angioplasty) endorsed by the Society for Cardiac Angiography and Interventions. Circulation. 2001;103:3019-3041.
15. Pfisterer M, Brunner-La Rocca HP, Buser PT, Rickenbacher P., Hunziker P, Mueller C et al. for the BASKET-LATE Investigators. Late clinical events after clopidogrel discontinuation may limit the benefit of drug-eluting stents: an observational study of drug-eluting versus bare-metal stents. J Am Coll Cardiol. 2006;48:2584-2591.
16. Alidoosti M, Salarifar M, Haji-zeinali AM, Kassaian SE, Dehkordi MR, Sheikhfatholahi M. Clinical Outcomes of Drug-Eluting Stents Compared with Bare Metal Stents in Our Routine Clinical Practice. Hellenic J Cardiol. 2008;49:132-138.

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