

Original Research Article

Clinical and angiographic profile of symptomatic patients undergoing percutaneous transluminal coronary angioplasty and drug-eluting stent implantation

V. S. R. Bhupal *, P. Sampath Kumar

Department of Cardiology, Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation, Chinoutpalli, Vijayawada, Andhra Pradesh, India

Received: 31 July 2019

Accepted: 05 September 2019

***Correspondence:**

Dr. V. S. R. Bhupal,

E-mail: vsrbhupal@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: There are limited number of studies in India which have looked at this clinical and angiographic characteristic of the disease. Thus, this study was conducted to assess the clinical and angiographic profile of symptomatic patients who underwent percutaneous transluminal coronary angioplasty (PTCA) and drug-eluting stent (DES) implantation.

Methods: This was an observational study conducted at a tertiary-care center in India between November 2014 and November 2015. A total of 106 consecutive patients who received either Cypher/Xience/BioMime stent presented with anginal symptoms were included in the study. Based on the type of stent received, patients were divided into two groups: (A) Limus group; (B) Paclitaxel group. Coronary angiogram was done in all the patients. Angioplasty data were collected from patient records. Angiographic profiles of the two groups were compared and analysed.

Results: Among the 106 patients, 54 patients were included in the Limus group and 52 patients were included in the Taxus stent. De novo lesions were found to be significantly higher in the Limus group (40(74%), $p = 0.06$) whereas the in-stent restenosis was found to be significantly higher in the paclitaxel group (22(42.3%), $p = 0.08$). At follow-up, the incidence of death was 0% and no patients suffered by myocardial infarction. One (1.8%), two (3.8%) patients from the Limus and Paclitaxel groups had target vessel revascularization, respectively.

Conclusions: Development of lesions in new areas rather than in-stent restenosis is the cause for angina in the majority of patients who underwent angioplasty presenting with anginal symptoms.

Keywords: Drug-eluting stent, In-stent restenosis, Percutaneous coronary intervention, Percutaneous coronary transluminal angioplasty

INTRODUCTION

Since the first human percutaneous transluminal angioplasty (PTCA) was performed in 1977, the use of this procedure has been increased dramatically and is now widely accepted as a nonsurgical revascularization procedure for selected patients with coronary artery disease (CAD).¹ In specific, percutaneous coronary interventions (PCI) which include PTCA, stenting, and related techniques represent a major therapeutic

advancement in the management of CAD.² Advances in catheter technology, operators experience, and adjunctive drug therapy have improved the early outcomes of patients undergoing PTCA.^{3,4} Despite these advances, its long-term efficacy is limited by coronary restenosis or in-stent restenosis (ISR).¹

There are presently over 500 centers with cardiac catheterization lab facilities across the country and these numbers are steadily growing with increasingly more

complex patients and lesions being treated with this modality.⁵ Despite, this increasing panorama, ISR is the major limitation impeding the medium-term efficacy of coronary stenting.^{6,7} Sirolimus-eluting (SES) and paclitaxel-eluting stents (PES), the two drug-eluting stents (DES) most extensively studied so far have markedly altered the outcome of patients undergoing coronary angioplasty, mainly due to their effect on the reduction of restenosis.¹ Nevertheless, the efficacy of these DES has not been uniform across different patient populations; this suggests that specific characteristics still converse an increased risk of restenosis after DES placement.^{4,8,9} Not only ISR, these patients who have undergone PTCA and DES implantation are also at increased risk of progression of atherosclerosis despite aggressive control of all standard risk factors. So, identification of those clinical and angiographic characteristics that may predict the risk of restenosis and repeated revascularization procedures in the new era of DES may be of particular interest, because it may aid in the improvement of existing or the development of new tools and strategies to eliminate restenosis. There are limited number of studies in India which have looked at this aspect of the disease. Thus, this study was conducted to assess the clinical and angiographic profile of symptomatic patients who underwent PTCA and DES implantation.

METHODS

This was an observational study conducted at a tertiary-care center in India between November 2014 and November 2015. The records of consecutive 106 patients who received either Cypher/Xience/BioMime stent presented with anginal symptoms were included in the study. Patients were divided into two groups: (A) Limus group of patients who underwent CABG/PCI with sirolimus-eluting Bx velocity balloon-expandable stent (Cordis Corporation), BioMime sirolimus-eluting stent and Xience V everolimus-eluting stent (Abbott vascular) and of patients (B) Taxus group who underwent CABG/PCI with paclitaxel-eluting coronary stent (Boston Scientific, Inc.). A selective coronary angiography was performed according to standard techniques through the femoral or radial artery in the cardiac catheterization laboratory. Standard angioplasty and stent placement were performed by using a monorail technique. Before the intervention, all patients were administered with unfractionated heparin 5000 IU. At least four projections for the left coronary artery and two projections for the right coronary artery were taken for optimal views by using either 5F or 6F guiding catheters. Quantitative coronary angiography (QCA) was performed off-line by using edge detection system (Cardiovascular measurement system, Siemens) and the mean variation used in determining the absolute diameter is 0.13 mm. For calibration, the contrast filled guiding catheter was used. The normal diameter proximal and distal to the lesion were used to interpolate the reference diameter. The electrocardiographic tracing was also displayed in any angiographic sequence to select frames from the same cardiac cycles. A diastolic frame with

sharply defined edges without foreshortening and overlap was usually selected for quantitative coronary angiography.

Data collection and follow-up

The baseline data such as age, gender, medical history, angina status, clinical presentation and angioplasty data of all the patients were collected retrospectively from the clinical notes. All coronary angiograms were done and analyzed by the department of cardiology. At follow-up, angiography was carried out in the same orthogonal views as were done after the intervention and the area of interest was selected after reviewing all cine-films performed during the index procedure. From the orthogonal views of coronary angiography, the minimal luminal diameter, the reference diameter, and the percentage of stenosis were calculated. Coronary luminal diameter and degree of stenosis were measured before and after the intervention, and at follow-up. Besides, acute gain and late loss were also calculated.

Study endpoints and definitions

The primary endpoint of this study was the percentage stenosis at angiographic follow-up, as determined by quantitative angiographic analysis. The secondary endpoints consisted of late loss, the rate of restenosis (defined as stenosis of more than 50% of the luminal diameter), the in-stent minimal luminal diameter (MLD) and incidence of death, the need for coronary bypass or intervention to treat clinical ischemia due to restenosis of the target lesion, and myocardial infarction (Q-wave or non-Q-wave) due to restenosis of the target lesion. Target lesion revascularization (TLR) was defined as in-stent restenosis within 5mm proximal and 5mm distal to the stent edges. Target vessel revascularization (TVR) was defined as high-degree restenosis beyond the stent segment.

Statistical analysis

Continuous variables were expressed as mean \pm standard deviation and compared using the student's t-test or Mann-Whitney U test. Categorical variables were expressed as frequencies and percentages and compared using the Pearson chi-square test. A 95% confidence interval was calculated for time intervals. P-value <0.05 was considered as statistically significant. Analysis was performed using statistical package for social sciences (SPSS) software (IBM SPSS, version 20.0. Armonk, 2012).

RESULTS

Demographic characteristics

The total study population comprised of 106 patients, of whom, 54 patients received Limus stent and 52 patients received the Taxus stent. Mean age of the study population was 61 \pm 10 years and 59 \pm 11 years for Limus

and Paclitaxel group, respectively. There was no significant difference in age, gender and cardiac history of patients between the groups ($p > 0.05$). There was no significant difference in risk factors between the groups except smoking showed a significantly higher prevalence of coronary risk in the Limus group than in the Paclitaxel group (48.1% vs. 28.8%, $p = 0.004$). At the time of

admission, majority of the patients were presented with stable angina in both the groups (88.9% vs. 75%, $p = 0.14$) but, unstable angina was found to be significantly higher in Paclitaxel group than in the Limus group (21.2% vs. 9.3%, $p = 0.06$). Baseline demographic and clinical characteristics are illustrated in Table 1.

Table 1: Baseline demographics and clinical characteristics.

Characteristics	Limus group (n=54)	Paclitaxel group (n=52)	p-value
Demographic characteristics			
Age, (Mean±SD, years)	61±10	59±11	0.32
Male, n (%)	41 (75.9%)	37 (71.2%)	0.47
Risk factors			
Smoking, n (%)	26 (48.1%)	15 (28.8%)	0.004*
Diabetes, n (%)	17 (31.5%)	12 (23.1%)	0.14
Hypertension, n (%)	45 (83.3%)	52 (100%)	0.31
Hypercholesterolemia, n (%)	52 (96.3%)	50 (96.2%)	0.69
Obesity, n (%)	18 (33.3%)	19 (36.5%)	0.72
Family history, n (%)	13 (24.1%)	16 (30.8%)	0.42
Clinical presentation			
Stable angina, n (%)	48 (88.9%)	39 (75.0%)	0.14
Unstable angina, n (%)	5 (9.3%)	11 (21.2%)	0.06*
NSTEMI, n (%)	1 (1.9%)	2 (3.8%)	0.44
Cardiac history			
Prior MI, n (%)	10 (18.5%)	10 (19.2%)	0.78
Prior CABG, n (%)	11 (20.4%)	7 (13.5%)	0.12

NSTEMI - Non-ST-segment elevation myocardial infarction; MI - Myocardial infarction; CABG-Coronary artery bypass graft, *significant

Table 2: Lesion characteristics.

Characteristics	Limus group (n = 54)	Paclitaxel group (n = 52)	p-value
No. of vessels involved			
SVD, n (%)	8 (14.8%)	16 (30.7%)	0.04*
DVD, n (%)	31 (57.4%)	17 (32.7%)	0.006*
TVD, n (%)	15 (27.7%)	19 (36.5%)	0.33
Target vessel location			
LAD, n (%)	22 (40.7%)	24 (46.2%)	0.62
LCX, n (%)	25 (46.3%)	15 (28.8%)	0.009*
RCA, n (%)	6 (11.1%)	11 (21.1%)	0.12
SVG, n (%)	1 (1.8%)	2 (3.8%)	0.45
Type of lesion			
De novo lesions, n (%)	40 (74%)	30 (57.7%)	0.06*
In-stent restenosis, n (%)	14 (25.9%)	22 (42.3%)	0.08*
Lesion classification (ACC/AHA score)			
Type A, n (%)	5 (9.2%)	6 (11.5%)	0.62
Type B1, n (%)	20 (37%)	17 (32.7%)	0.43
Type B2, n (%)	19 (35.2%)	15 (28.8%)	0.38
Type C, n (%)	10 (18.5%)	14 (26.9%)	0.27

SVD - Single vessel disease; DVD - Double vessel disease; TVD - Triple vessel disease; LAD-Left anterior descending; LCX - Left circumflex; RCA- Right coronary artery; SVG - Saphenous vein graft;

Lesion and procedural characteristics

Significantly, higher number of patients in the Limus group had double vessel disease (DVD) than those in the paclitaxel group (31(57.4%) vs. 17(32.7%), p=0.006), and the number of patients with single-vessel disease (SVD) was significantly higher in the Paclitaxel group (16(30.7%) vs. 8(14.8%), p=0.04). The number of patients with lesion located at left circumflex artery (LCX) was significantly higher in the Limus group than in the paclitaxel group 25(46.3%) vs. 15(28.8%), p=0.009). Type of the lesion revealed that De novo lesions were found to be significantly higher in the Limus group (40(74%), p=0.06) whereas the in-stent restenosis was found to be significantly higher in the paclitaxel group 22(42.3%), p=0.08).

All the other characteristics such as lesion classification (as per the American college of cardiology/American heart association scoring), average stent length, reference diameter, diameter stenosis, minimal luminal diameter (MLD), late loss, acute gain, net gain and loss index were relatively similar and did not show any significant difference (p >0.1). Binary restenosis was observed in 7 (12.9%), 8 (15.4%) patients who belong to the Limus and the Paclitaxel group, respectively. Of which, De novo lesions 3(5.8%) vs. 3(5.5%), p=0.06) and in-stent restenosis 5(9.6%) vs. 4(7.4%), p=0.07) was significantly higher in the Paclitaxel group than in the Limus group. Lesion and procedural characteristics are depicted in Table 2 and Table 3.

Table 3: Procedural characteristics.

Characteristics	Limus group (n=54)	Paclitaxel group (n=52)	p-value
Average stent length, (Mean±SD, mm)	12.82±2.61	14.61±2.83	0.15
Reference diameter, (Mean±SD, mm)	3.02±0.49	3.20±0.26	0.20
Diameter stenosis			
Before, (Mean±SD, mm)	70.25±13.39	71.46±14.27	0.65
After, (Mean±SD, mm)	9.51±9.42	10.40±6.27	0.57
At follow-up, (Mean±SD, mm)	25.11±18.24	25.90±21.23	0.83
Minimal luminal diameter			
Before, (Mean±SD, mm)	0.90±0.45	0.87±0.42	0.73
After, (Mean±SD, mm)	2.73±0.47	2.80±0.33	0.32
At follow-up, (Mean±SD, mm)	2.27±0.62	2.34±0.72	0.57
Late loss, (Mean±SD, mm)	0.41±0.58	0.45±0.60	0.71
Acute gain, (Mean±SD, mm)	1.79±0.46	1.94±0.47	0.10
Net gain, (Mean±SD, mm)	1.37±0.57	1.64±0.84	0.52
Loss index, (Mean±SD, mm)	0.34±0.38	0.29±0.42	0.59
Binary restenosis, n (%)	7(12.9%)	8(15.4%)	0.65
De novo lesions, n (%)	3(5.5%)	3(5.8%)	0.06*
In-stent restenosis, n (%)	4(7.4%)	5(9.6%)	0.07*

Table 4: Clinical outcomes at follow-up.

Events	Limus group (n=54)	Paclitaxel group (n=52)	p-value
Death, n (%)	0 (0%)	0 (0%)	-
Myocardial infarction			
Q-wave, n (%)	0 (0%)	0 (0%)	-
Non Q-wave, n (%)	0 (0%)	0 (0%)	-
Target lesion revascularization (TLR)			
CABG, n (%)	0 (0%)	0 (0%)	-
PCI, n (%)	6 (11.1%)	6 (11.5%)	0.78
TVR, n (%)	1 (1.8%)	2 (3.8%)	0.44
TVF, n (%)	2 (3.7%)	3 (5.7%)	0.52

Clinical outcomes

The incidence of death was 0% in both the groups and no patients in both the groups suffered from myocardial infarction (either Q-wave or non Q-wave) at follow-up.

At follow-up, six (11.1%), six (11.5%) patients from the Limus and the Paclitaxel groups underwent PCI due to high-degree of restenosis at target lesion segment (TLR), whereas the one (1.8%), two (3.8%) patients from the Limus and the Paclitaxel groups were treated with DES

implantation due to high-degree restenosis beyond the stent edges (TVR).

At follow-up, two (3.7%), three (5.7%) patients from the Limus and the Paclitaxel group had target vessel failure (TVF), respectively. Of the two patients, first patient had received a Xience V stent for a de novo lesion, whereas the second one underwent stent implantation for a de novo lesion in segment 7 distal to previously implanted Cypher stent at follow-up. Three (5.7%) patients in the Paclitaxel group underwent PCI for ISR with Xience V stent.

DISCUSSION

The present study provides an insight into the ISR rates and angiographic profiles of anginal symptomatic patients who underwent angioplasty with either limus-eluting or paclitaxel-eluting stents. The main findings of this study showed that the incidence of new lesions was greater than ISR.

In this study, the mean age of the study population is comparable to the other studies conducted in India i.e. CREATE registry, study by Jose V, et al. and COURAGE trial.¹⁰⁻¹² As shown in this study, male predominance was also observed in the studies conducted in the past.^{13,14} In the present study, the number of smoking patients showed a significantly higher prevalence of coronary risk in the Limus group (48.2%) than in the Paclitaxel group (28.8%) which can be compared to SIRIUS study (18%) and Sanghvi S et al study (64%).^{2,8} Among all the clinical presentations, unstable angina showed a significant difference between the two study groups which is similar to a study conducted by Abhyankar, et al.¹⁵ In the current study, majority of the patients were presented with a target lesion located at the LCX artery in the Limus group and LAD artery in the paclitaxel group, but, LCX showed a significant difference between the two groups which is in contrast to the previous studies.^{2,15} Though strict risk factor control was achieved, majority of the patients were with new lesions leading to the progression of atherosclerosis. This reinforces the importance of regular follow-up and investigation for new-onset lesions in patients who present with anginal symptoms.

A majority of patients in this study were complaining about medications, the novel local drug delivery systems using coated stent technologies that elute potent antiproliferative agents resulted in another dramatic reduction in restenosis rates. Among the DES, sirolimus, everolimus and paclitaxel-eluting stents showed promising results in reducing the restenosis rates when compared with bare-metal stents.¹⁶ Binary restenosis rates at follow-up showed that patients who presented with anginal symptoms were significantly low in limus group than in the paclitaxel group which is similar to the studies conducted in the past.¹⁷⁻²⁰ No deaths or MI were reported at follow-up. Target lesion revascularization, target vessel revascularization, and target vessel failure rates were

similar between the two groups. Thus, this study suggests that atherosclerosis is a constantly progressing disease and patients who underwent PTCA are prone to a significant increase in the development of new lesions which is the most common cause for anginal symptoms rather than ISR.

This study had some limitations. Firstly, the sample size was small. Secondly, it was an observational study and the patients were not randomized. However, the demographic differences which appeared were very minor, it is possible that confounding factors also play a major role were not accounted. Finally, the number of sample size between the two groups were different. authors consider this limitation as unlikely because neither in the angiographic parameters nor in the clinical data showed no favor for one or other stent system

CONCLUSION

This observational study concludes that the development of new lesions rather than ISR is the cause for angina in the majority of patients who underwent angioplasty presenting with anginal symptoms. With an exponential increase in the number of patients presenting with ISR, it is imperative that this study would enable us to upgrade the information system and need to establish such studies in all states of India to enrich our databases by improving the quality of care by providing data feedback.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Praveen S, Baiju R, Radhakrishnan VV, Kumar SKK. Predictors of angiographic restenosis in patients with coronary artery disease who have undergone percutaneous coronary intervention with drug eluting stents. *Int J Res Med Sci.* 2018;6(2):448-54.
2. Sanjeev Sanghvi AK, Rohit Mathur, Anil Baroopal. Clinical and angiographic profile in patients of western Rajasthan undergoing percutaneous coronary interventions: a single centre experience. *Int J Res Med Scie.* 2018 September;6:3124-31.
3. Aldea GS, Mokadam NA, Melford Jr R, Stewart D, Maynard C, Reisman M, et al. Changing volumes, risk profiles, and outcomes of coronary artery bypass grafting and percutaneous coronary interventions. *Ann Thor Surg.* 2009;87(6):1828-38.
4. Morice MC, Serruys PW, Kappetein AP, Feldman TE,Stahle E, Colombo A, et al. Outcomes in patients with de novo left main disease treated with either PCI using paclitaxel-eluting stents or CABG treatment in the SYNTAX trial. *Circulation.* 2010;24:2645-53.

5. Beig JR, Shah TR, Hafeez I, Dar MI, Rather HA, Trambo NA, et al. Clinico-angiographic profile and procedural outcomes in patients undergoing percutaneous coronary interventions: The Srinagar registry. *Indian Heart J.* 2017;69(5):589-96.
6. Mabin TA, Holmes Jr DR, Smith HC, Vlietstra RE, Reeder GS, Bresnahan JF, et al. Follow-up clinical results in patients undergoing percutaneous transluminal coronary angioplasty. *Circulation.* 1985 Apr;71(4):754-60.
7. Kaltenbach M, Kober G, Scherer D, Vallbracht C. Recurrence rate after successful coronary angioplasty. *Eur Heart J.* 1985;6(3):276-81.
8. Moses JW, Leon MB, Popma JJ, Fitzgerald PJ, Holmes DR, O'Shaughnessy C, et al. Sirolimus-eluting stents versus standard stents in patients with stenosis in a native coronary artery. *New Engl J Med.* 2003;349(14):1315-23.
9. Stone GW, Ellis SG, Cox DA, Hermiller J, O'Shaughnessy C, Mann JT, et al. A polymer-based, paclitaxel-eluting stent in patients with coronary artery disease. *New Engl J Med.* 2004;350(3):221-31.
10. Xavier D, Pais P, Devereaux P, Xie C, Prabhakaran D, Reddy KS, et al. Treatment and outcomes of acute coronary syndromes in India (CREATE): a prospective analysis of registry data. *Lancet.* 2008;371(9622):1435-42.
11. Jose VJ, Gupta SN. Mortality and morbidity of acute ST segment elevation myocardial infarction in the current era. *Ind Heart J.* 2004;56(3):210-4.
12. Boden WE, O'Rourke RA, Teo KK, Hartigan PM, Maron DJ, Kostuk WJ, et al. Optimal medical therapy with or without PCI for stable coronary disease. *New Engl J Med.* 2007;356(15):1503-16.
13. Lemos PA, Hoyer A, Goedhart D, Arampatzis CA, Saia F, van der Giessen WJ, et al. Clinical, angiographic, and procedural predictors of angiographic restenosis after sirolimus-eluting stent implantation in complex patients: an evaluation from the Rapamycin-Eluting Stent Evaluated at Rotterdam Cardiology Hospital (RESEARCH) study. *Circulation.* 2004;109(11):1366-70.
14. Kastrati A, Dibra A, Mehilli J, Mayer S, Pinieck S, Pache J, et al. Predictive factors of restenosis after coronary implantation of sirolimus- or paclitaxel-eluting stents. *Circulation.* 2006;113(19):2293-300.
15. Abhayankar A, Sandhu MS, Polavrapu RS. Twelve-month comparative analysis of clinical outcomes using biodegradable polymer-coated everolimus-eluting stents versus durable polymer-coated everolimus-eluting stents in all-comers patients. *Ind Heart J.* 2019 Mar-Apr;71(2):149-54.
16. Serruys PW, De Jaegere P, Kiemeneij F, Macaya C, Rutsch W, Heyndrickx G, et al. A comparison of balloon-expandable-stent implantation with balloon angioplasty in patients with coronary artery disease. *New Engl J Med.* 1994;331(8):489-95.
17. Elezi S, Dibra A, Mehilli J, Pache J, Wessely R, Schömig A, et al. Vessel size and outcome after coronary drug-eluting stent placement: results from a large cohort of patients treated with sirolimus-or paclitaxel-eluting stents. *J Am College of Cardiol.* 2006;48(7):1304-09.
18. Togni M, Eber S, Widmer J, Billinger M, Wenaweser P, Cook S, et al. Impact of vessel size on outcome after implantation of sirolimus-eluting and paclitaxel-eluting stents: a subgroup analysis of the SIRTAX trial. *J Am College of Cardiol.* 2007;50(12):1123-31.
19. Dibra A, Kastrati A, Mehilli J, Pache J, Schühlen H, von Beckerath N, et al. Paclitaxel-eluting or sirolimus-eluting stents to prevent restenosis in diabetic patients. *New England J Med.* 2005;353(7):663-70.
20. Alazzoni A, Al-Saleh A, Jolly SS. Everolimus-eluting versus paclitaxel-eluting stents in percutaneous coronary intervention: meta-analysis of randomized trials. *Thrombosis.* 2012 May 9;2012.

Cite this article as: Bhupal VSR, Kumar PS. Clinical and angiographic profile of symptomatic patients undergoing percutaneous transluminal coronary angioplasty and drug-eluting stent implantation. *Int J Res Med Sci* 2019;7:3819-24.