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Research Brief

One-year clinical outcomes in patients with very small coronary artery disease treated with drug-eluting stents: An observational study in the Indian population

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ABSTRACT

Percutaneous coronary intervention (PCI) in very small vessel coronary arteries is challenging due to adverse short-term as well as long-term outcomes. This single-arm, open-label, observational study assessed 1-year clinical outcomes of drug-eluting stents (DES) in Indian patients undergoing PCI for symptomatic very small-calibre coronary artery disease. It enrolled 66 Indian patients with 74 very small coronary artery lesions (reference vessel diameter: ≥2.0 and ≤ 2.25 mm); eligible for implantation with 2.25 mm DES. The primary endpoint of major adverse cardiovascular events (MACE) was 3.0% indicating favourable 1-year clinical outcomes of DES in very small coronary artery lesions in Indian patients.

1. Introduction

Percutaneous coronary intervention (PCI) in small coronary arteries (reference vessel diameter [RVD]: >2.25 and ≤3 mm), is not only associated with technical challenges; but is also marred by increased risk of in-stent restenosis and poor long-term outcomes.[1–3] More recently, PCIs in small-caliber coronary arteries have demonstrated better outcomes due to development of newer DES designs and use of optimal antiplatelet regimes.[2–4]

Small size coronary arteries along with extensive and diffuse coronary artery disease (CAD) are prevalent among the Indian population.[5,6] Although a few trials on small coronary artery interventions in Indian patients have been reported,[7,8] data on PCI in very small vessel CAD (RVD: 2.0–2.25 mm) in the Indian population are scarce. The present study was therefore designed to assess 1-year clinical outcomes following PCI using DES for the treatment of symptomatic very small-vessel CAD in Indian patients.

2. Methods

2.1. Study design and study population

The study population of this single-arm, open-label, observational study comprised patients with very small vessel CAD who had been treated with DES between April 2014 and December 2018. Patients with evidence of ischemic heart disease were enrolled if they had either a single target lesion (coronary artery RVD ≥2.0 mm and ≤2.25 mm by visual estimation) or multiple target lesions located in the same or separate target vessels, with at least one of the lesions amenable to treatment with a ≤2.25 mm DES. Patients considered unfit for emergency bypass graft surgery or with general contraindications to revascularization procedure, device employed, or antiplatelet therapy were excluded from the study. The study protocol was approved by Institutional Ethics Committee (ECR/147/Indt/MH/2014/RR-20). All patients provided informed consent for the procedure and subsequent data collection and analysis for research purposes.

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2.2. Procedure details, study devices and adjunctive medications

PCI was performed in accordance with current standard of practice. Distribution of various contemporary 2.25 mm DES deployed in the study patients is displayed in Supplementary Figure 1. DES were deployed at low to moderate pressures of 10–14 atm, applied for 30 sec. Details of administration and duration of dual antiplatelet therapy (DAPT) are elaborated in Supplementary Table 1.

2.3. Data collection

Baseline demographics, clinical characteristics, and procedural data of the subjects were collected retrospectively. The in-hospital, 1-month, 6-months and 1-year clinical outcome data were collected from clinical visits, electronic medical records and telephone interviews. Follow-up coronary angiography was performed only in symptomatic study participants.

2.4. Study endpoints

The primary endpoint of the study was occurrence of MACE defined as a composite of all-cause mortality, myocardial infarction (MI), and clinically-driven target lesion revascularization (TLR) or clinically-driven target vessel revascularization (TVR) at 1-year. Secondary endpoints comprised individual components of MACE. Study endpoints and outcomes defined as per the Academic Research Consortium (ARC) 2 consensus criteria,[9] are listed in the Supplementary Data.

2.5. Statistical analysis

Categorical data was presented as numbers (n) and percentages (%). Continuous variables were presented as mean ± standard deviation. The outcomes of the present study were compared with those of earlier studies using Pearson's Chi-square test. A p value < 0.05 was considered statistically significant.

It was estimated that for this study with a sample size of 66 patients, a performance goal of 15% was required to yield greater than 80% power, so as to reject the null hypothesis in favour of the alternative.

3. Results

A total of 66 patients, with mean age of 59 ± 10.6 years were assessed in this study. Among these patients, 43 (65.2%) were hypertensive and 37 (56.1%) were diabetic. Baseline demographic and clinical characteristics of the study population are outlined in Table 1. A total of 74 target lesions were treated with 2.25 mm DES. Mean length of the target lesions (RVD <2.25 mm) was 18.9 ± 6.5 mm. Lesion and procedural characteristics are displayed in Table 2. Distribution of the DAPT regimen administered to study patients is outlined in Supplementary Table 2.

Table 3 depicts clinical outcomes of the study. The primary endpoint of MACE at 1-year occurred in 2 (3.0%) patients; attributable to cardiovascular death in one patient two months post procedure and to fatal intracranial hemorrhage in another patient six months post procedure. Thus, the primary endpoint rate fulfilled the pre-specified performance goal of 15% (chi-square = 6.104, $p = 0.013$; p <0.05) (Supplementary Figure 2).

4. Discussion

Technically challenging PCI with small vessel stenting holds special significance for Indian patients with CAD as Indians have smaller sized coronary arteries.[5,6] Properties of newer generation DES have made an improvement in the long-term clinical outcomes of PCI performed for small CAD.[10]

Amjad Ali et al[11] have reported procedural and in-hospital clinical outcomes of very small vessel PCI with DES implantation in Indian patients; whereas the present study investigated 1-year clinical outcomes. The current study recorded a low rate of MACE

Table 1
Patient demographics and baseline clinical characteristics (n = 66).

Variables	Patients (n = 66)
Age, years	59 ± 10.6
Male	52 (78.8%)
Medical history and comorbid conditions	
Diabetes mellitus	37 (56.1%)
Hypertension	43 (65.2%)
Hyperlipidemia	2 (3.0%)
Current smoker	2 (3.0%)
Chronic renal disease	1 (1.5%)
Prior PCI	2 (3.0%)
Clinical presentation	
Asymptomatic with positive functional test (TMT) result	4 (6.1%)
Unstable angina	41 (62.1%)
NSTEMI	1 (1.5%)
STEMI	20 (30.3%)

CABG, coronary artery bypass graft; ECG, electrocardiogram; MI, myocardial infarction; NSTEMI, non-ST-segment elevation myocardial infarction; PCI, percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction; TMT, treadmill test.
All data are expressed as numbers (percentage) or mean ± standard deviation.

Table 2
Lesion and procedural characteristics.

Variable	Patients (n = 66)
Total number of lesions with RVD ≤2.25 mm	74
Diseased vessel (66 patients)	
Single vessel disease	22 (33.3%)
Double vessel disease	33 (50.0%)
Triple vessel disease	9 (13.6%)
Four vessel disease	2 (3.0%)
Target coronary artery (74 lesions)	
Left anterior descending coronary artery	13 (17.6%)
Diagonal artery	14 (18.9%)
Ramus intermedius artery	3 (4.1%)
Left circumflex coronary artery	17 (23.0%)
Obtuse marginal artery	12 (16.2%)
Right coronary artery	8 (10.8%)
Posterior descending artery	4 (5.4%)
Posterior left ventricular branch artery	3 (4.1%)
Lesion complexity (66 patients)	
Thrombus burden	9 (12.2%)
Diffuse vessel disease	5 (6.8%)
Calcification	5 (6.8%)
Ostial lesion	17 (22.8%)
Bifurcation lesion	1 (1.4%)
Lesion and pre-procedural details (74 lesions)	
Reference vessel diameter in all 74 lesions, mm	2.25
Lesion length, mm	18.9 ± 6.5
Percentage of degree of stenosis	91.5 ± 6.5
Number of lesions with pre-dilatation	72 (97.3%)
Number of lesions with stent post-dilatation	68 (91.9%)
Diameter of DES used, mm	2.25
Length of DES used, mm	21.7 ± 6.1
Rotablation	3 (4.0%)
IVUS	4 (5.4%)
FFR	38 (51.3%)
Use of stent enhancement techniques	72 (97.3%)
Device success	100.0% (74/74)

DES, drug-eluting stent; FFR, fractional flow reserve; IVUS, intravascular ultrasound; RVD, reference vessel diameter.
All data are expressed as numbers (percentage) or mean ± standard deviation.

Table 3
Clinical outcomes of the study patients (n = 66/74 lesions).

Endpoints	In hospital	At 1-month	At 6-months	At 1-Year
MACE	0 (0.0%)	0 (0.0%)	2 (3.0%)	2 (3.0%)
All-cause mortality				
i) Cardiovascular	0 (0.0%)	0 (0.0%)	2 (3.0%)	2 (3.0%)
a) Death caused by sudden cardiac, including unwitnessed death	0 (0.0%)	0 (0.0%)	1 (1.5%)	1 (1.5%)
b) Death resulting from cardiovascular hemorrhage	0 (0.0%)	0 (0.0%)	1 (1.5%)	1 (1.5%)
ii) Non- cardiovascular	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
iii) Undetermined	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
MI	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Clinically-driven TLR	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Clinically-driven TVR	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Cardiac death	0 (0.0%)	0 (0.0%)	1 (1.5%)	1 (1.5%)

MACE, Major adverse cardiac events; MI, Myocardial infarction; TLF, Target lesion failure; TLR, Target lesion revascularization; TVR, Target vessel revascularization.
All data are expressed as numbers (percentage).

(3.0%) and there were no incidences of clinically-driven TLR and clinically-driven TVR, at 1-year follow-up. The favourable outcomes of very small vessel stenting achieved in patients above the age of 60 years (39.4%) in this study, may encourage the use of PCI over CABG in this subset considered high-risk for surgery.

As depicted in Supplementary Table 3, the present study recorded better clinical outcomes at 1-year follow-up; in comparison with previously conducted, similar outcome trials supporting the safety and efficacy of DES in small CAD.[2,12–15]

Besides implantation of newer generation DES in a larger percentage of patients (79.7%) and administration of more potent newer anti-platelet therapy (68.2%); better clinical outcomes of this study can also be attributed to sufficient pre-dilatations (97.3%) and use of stent enhancement techniques (97.3%) to guide adequate post-dilatations (91.9%) performed in majority of the study patients. However, the contribution of very small vessel lesions to the overall lesion subset that may not necessarily affect clinical outcomes, should be taken into account. Thus, further clarification of the benefits of small vessel angioplasty over medical management is warranted.

The present study has some limitations such as non-randomized study design, small study sample size, absence of a separate comparator arm, and lack of angiographic follow-up.

5. Conclusions

This study infers acceptable 1-year clinical outcomes for PCI in the treatment of very small coronary artery lesions (RVD $\leq$2.25 mm) among Indian patients; giving special attention to the use of latest generation DES, newer anti-platelet therapy, adequate preparation of the target lesion and optimization of acute PCI results. However, further data are required to support the use of PCI in very small vessels, in contrast to medical therapy.

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Disclosure of conflict of interest

There is no direct or indirect financial interest of author in the subject matter of the submitted manuscript. The authors declare no other potential conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ihj.2021.09.007.

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