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Comparative Evaluation of Stainless Steel Stent (Sirolimus) and Cobalt Chromium Stent (Sirolimus) In Patient with Coronary Artery Disease

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ABSTRACT

Coronary Artery Disease (CAD) occurs when the arteries of the heart that normally provide blood and oxygen to the heart are narrowed or even completely blocked due to clot formation. The Stenting implantation composes 84.2% of all Percutaneous coronary intervention (PCI). Despite the widespread use of these devices, bare metal stents (BMS) have been associated with a 20-30% restenosis rate which requires reintervention. In December 2006, US Food and Drug Administration cardiovascular experts concluded that for many patients, such as those with uncomplicated medical histories who undergo elective stenting of simple coronary blockages, drug-eluting stents remain a safe and appropriate therapy. Previously reports are suggestive of similar clinical outcomes for stainless steel and cobalt chromium bare metal stent. No reports are available for comparison of sirolimus eluting stainless steel stent and sirolimus eluting cobalt chromium stent. The present study was undertaken with the objective of comparative evaluation of Stainless Steel Stent (Sirolimus) and Cobalt Chromium Stent (Sirolimus) in Patient with Coronary Artery Disease. A single centric, retrospective, non-randomized study involving 118 patients who have undergone PCI from January 2011 to March 2012 implanted with either Sirolimus Stainless Steel Stent (SSSS) or Sirolimus Cobalt Chromium Stents (SCCS) were included in the study. Primary objective was to determine and compare the clinical outcome and rates of target vessel revascularization (TVR) in patients undergoing primary PCI for CAD patients who were treated with Sirolimus cobalt-chromium stents and Sirolimus stainless steel stents. The secondary outcomes of study were Major Adverse Cardiac Events, mortality at the end of 1 month, 6 month and 1 year of outcomes. At 1 month follow up there was no significant difference between two groups (p = 0.96). The individual clinical component showed no difference in occurrence of death (p = 0.29), MI (p = 0.29) and TLR (p = 0.96) at end of 6 month. The cumulative clinical outcome at 1 year rate of target vessel revascularization TVR (SSSS 1.75% versus SCCS 0%, p = 0.29), target lesion revascularization (SSSS 5.27% versus SCCS 1.63%, p = 0.27), and Major Adverse Cardiac Events (SSSS 22.80% versus SCCS 13.11%, p = 0.16). This study showed that among Coronary artery disease (CAD) patients undergoing primary percutaneous coronary intervention, sirolimus stainless steel stent showed similar efficacy and safety to sirolimus cobalt chromium stent.

Keywords: Target Vessel Revascularization, Target Lesion Revascularization, Major Adverse Cardiac Events, Restenosis.

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INTRODUCTION

Coronary Artery Disease (CAD) occurs when the arteries of the heart that normally provide blood and oxygen to the heart are narrowed or even completely blocked due to clot formation. When a coronary artery (an artery feeding the heart muscle) is narrowed by a buildup of fatty deposits called plaque, it can reduce blood flow. If blood flow is reduced to the heart muscle, chest pain can result. If a clot forms and completely blocks the blood flow to part of the heart muscle, a heart attacks results. [1] When blockages in the arteries of the heart (coronary arteries) develop, individuals may experience symptoms caused by inadequate blood supply to the heart muscle. This typically produces chest pain or pressure and/or shortness of breath. Treatment for this condition (coronary artery disease) will depend on the type of the blockage and its extent. Several types of catheter-based procedures are available. More than one third of patients who undergo balloon angioplasty may experience restenosis (renarrowing) of the diseased artery segment within 6 months of the procedure. A stent is a tiny wire mesh tube. It props open an artery and is left there permanently. Stenting composes 84.2% of all PCI. Despite the widespread use of these devices, bare metal stents (BMS) have been associated with a 20-30% restenosis rate requiring reintervention. [2-3] Although stented arteries have less chance of renarrowing than arteries opened with a balloon alone, in-stent restenosis can still occur in more than 1 in 5 patients after stent placement. Concerns about the safety of drug-eluting stents have received much publicity, primarily related to a small increase in the number of blood clots that develop within drug-eluting stents late (more than 1 year) after implantation. In December 2006, the US Food and Drug Administration cardiovascular experts concluded that for many patients, such as those with uncomplicated medical histories who undergo elective stenting of simple coronary blockages, drug-eluting stents remain a safe and appropriate therapy. In addition to restenosis, Percutaneous transluminal coronary angioplasty (PTCA) and BMS implantation cause exaggerated endothelial injury and inflammation, rendering both the stent and vessel highly thrombogenic. [4-5] Current recommendations for patients with BMS include dual anti-platelet therapy with aspirin and clopidogrel, which are continued for 6 weeks to allow complete endothelialization of BMS. [6] In 2001, drug-eluting stents (DES) were introduced as a strategy to minimize restenosis and requirement for reintervention. The currently available polymer-coated stents contain antiproliferative agents which elute locally in the implanted coronary artery to prevent neointimal hyperplasia. [7] A recent pooled analysis demonstrated a 74% reduction in the risk of target lesion revascularization for both sirolimus-eluting stents (SES) and paclitaxel-eluting stents (PES) compared to BMS. [8] There are very few reports of comparative efficacy and safety studies involving stainless steel stent and cobalt chromium stents for the treatment of CAD in India. No reports are available for comparison of sirolimus eluting stainless steel stent and sirolimus eluting cobalt chromium stent. We attempted to carry out this study to determine safety and efficacy of Sirolimus eluting stainless steel and Sirolimus eluting cobalt chromium stents as well as clinical outcomes and rates of target vessel revascularization in patients undergoing PCI in CAD patients in India.

MATERIALS AND METHOD

This retrospective, non-randomized, open label study compared the use of sirolimus cobalt chromium stent and sirolimus stainless steel stent in patients suffering from CAD. These are two different stents made from two different metals (cobalt chromium and stainless steel) with single eluting drug "Sirolimus". Total 118 patients who had undergone PCI from January 2011 to March 2012 and implanted with either sirolimus stainless steel or sirolimus cobalt chromium stents were included in the study. Target vessel revascularization (TVR), Target Lesion Revascularization (TLR), Major adverse cardiac event (MACE), mortality, restenosis rates were calculated in one year of outcomes. Data collection was done using angiographic parameters, Electrocardiogram (ECG). Primary end point of the study was to measure efficacy of the sirolimus stainless steel stent and sirolimus cobalt chromium stent in the patients with coronary artery disease at the time interval of 1 month, 6 months and 12 months. Efficacy parameters included rate of target lesion revascularization, target vessel revascularization and restenosis at 1 month, 6 months and 12 months. Target lesion revascularization, target vessel revascularization and restenosis rates from angiography, (repeat PTCA, PCI or CABG). Secondary outcome of the study was to Comparison of safety of the SSS and CCS in the patients with coronary artery disease at the time interval of 1 month, 6 months and 12 months. Safety parameters included incidence of Major Adverse Cardiac Events (MACE). MACE is defined as the composite endpoint of death, myocardial infarction, and angina, abnormalities in ECG and mortality rates.

Inclusion criteria

Male or non-pregnant female patients of at least 35 years of age who had implanted only single stent either sirolimus stainless steel stent or sirolimus cobalt chromium stent.

Exclusion Criteria

Patients with renal and hepatic dysfunction, patients participating in another investigational drug or device trial that has not completed the primary endpoint or would interfere with the endpoints of this study were excluded from the study. Female with a positive pregnancy test or lactating were excluded. Patients with an active infection, taking immunosuppressant therapy during follow up and planned intervention of a

lesion with overlapping 2-stent technique were excluded from the study.

Statistical analysis

Data was collected in spread sheet from CRF and was compiled as number and percentage. The data were analyzed by chi-square test. *P* value < 0.05 was considered as statistically significant.

Table 1: Baseline Parameter of the Patients

Parameters	Group-I (SCCS)	Group-II (SSSS)
Age	56.88 ± 10.16	55.84 ± 10.71
Height (cm)	172.5 ± 9.42	173.1± 9.80
Weight (kg)	73.26 ± 10.33	72.14± 9.44
BMI	24.77 ± 2.42	24.28 ± 2.59
Smoker	18.03% (11)	15.78% (09)
Tobacco	9.83% (06)	8.77% (05)
Diabetes mellitus	31.14% (19)	26.31% (15)
Hyperlipidemia	32.78% (20)	29.82% (17)
Hypertension	32.78% (20)	28.07% (16)
MI	14.75% (09)	12.28% (07)
Unstable Angina	50.81% (31)	47.36% (27)
Stable Angina	34.42% (21)	40.35% (23)

Table 2: Angiographic parameter of patients

Parameter	Group-I SCCS (n=61)	Group-II SSSS (n=57)
Left Anterior Descending Artery	55.73% (34)	52.63% (30)
Left Circumflex Artery	13.11% (08)	14.03% (08)
Right Coronary Artery	22.95% (14)	26.31% (15)
Obtuse Marginal	8.19% (05)	7.01% (04)
Lesion length, mm	26.26 ± 8.88	28.68 ± 8.51
Reference vessel diameter	2.94 ± 0.34	2.90 ± 0.31

Table 3: Clinical outcome at 1 month follow up

Parameters	SCCS (n=61)	SSSS (n=57)	P value
Death	00	00	
MI	00	00	
Unstable Angina	00	00	
Stable Angina	1.63% (01)	1.75% (01)	0.96
Post CABG	00	00	
Re-PCI	00	00	
Restenosis	00	00	

Table 4: Clinical outcome 6 month follow up

Parameters	SCCS (n=61)	SSSS (n=57)	P value
Death	00	1.75% (01)	0.29
MI	00	1.75% (01)	0.29
Unstable Angina	1.63% (01)	1.75% (01)	0.96
Stable Angina	1.63% (01)	3.50% (2)	0.51
Post CABG	00	00	
Re-PCI	1.63% (01)	1.75% (01)	0.96
Restenosis	1.63% (01)	1.75% (01)	0.96

Table 5: Cumulative clinical outcome at 1 year follow up

Parameters	SCCS (n=61)	SSSS (n=57)	P value
Death	1	2	0.51
MI	1	3	0.27
Unstable Angina	2	3	0.59
Stable Angina	6.25(4)	6	0.43
Post CABG	00	1	0.29
Re-PCI	1	3	0.27
Restenosis	3	5	0.40

RESULTS

A total of 118 patients operated for angioplasty between January 2011 and March 2012 were included in the study. Among these, 61 cases were implanted with Sirolimus Cobalt Chromium stent (Group-I), whereas 57 cases were implanted with Sirolimus Stainless Steel Stent (Group- II).

Table 1 indicates the baseline characteristics of patients. The mean age of patients was 56.17 ± 10.43 years, with 50.81% and 47.36% of unstable angina patients in SCCS Group and SSSS group respectively. Risk factors like diabetes, smoking, tobacco, hyperlipidemia, hypertension and past history of the patients like unstable angina, stable angina and myocardial infarction were almost same in both the groups.

Angiography parameters indicated that the incidence of blockage was higher in Left Anterior Descending Artery followed by Right Coronary Artery, Left Circumflex Artery and Obtuse marginal artery.

As depicted in Table 3, at end of 1 month follow up, there was no significant difference in clinical outcome between the two groups (p = 0.96). Major clinical events after 6 months follow up were also similar between the two groups (p = 0.20). The individual clinical component showed no difference in occurrence of death (p = 0.29), MI (p = 0.29) and TLR (p = 0.96). The cumulative clinical outcome at the end of 1 year i.e. rate of target vessel revascularization TVR (SSSS 1.75% versus SCCS 0%, p = 0.29), target lesion revascularization (SSSS 5.27% versus SCCS 1.63%, p = 0.27), and Major Adverse Cardiac Events (SSSS 22.80% versus SCCS 13.11%, p = 0.16) were also not significant.

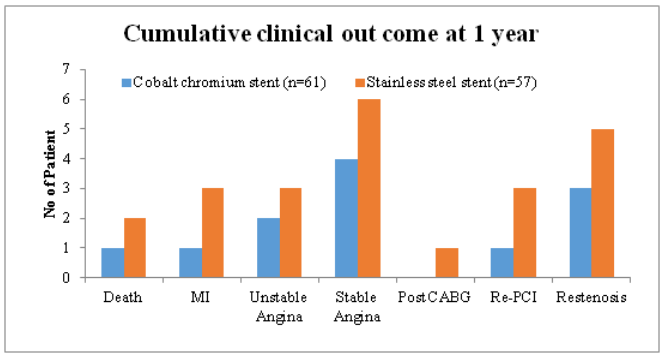

Fig. 1: Cumulative clinical outcome at 1 year follow up

DISCUSSION

The present retrospective, non-randomized, open label study was undertaken with the objective of comparative evaluation of Sirolimus cobalt chromium stents versus Sirolimus stainless steel stents in patients suffering from CAD. The clinical outcomes in two different metal materials eluting same drug *i.e.* Sirolimus were compared in patients who had undergone Percutaneous coronary intervention from January 2011 to March 2012.

The major findings of this study revealed that at the 1 month, 6 month, and 1 year follow up, clinical outcomes were not significantly different for sirolimus cobalt chromium stent and sirolimus stainless steel stent group. At 1 year, TLR and TVR were higher in stainless steel stent group as compared to cobalt chromium stent group but the difference was statistically insignificant.

Treatment with sirolimus cobalt chromium stents was associated with similar risk of target vessel revascularization and no risk of death at the end of 30 days as compared to sirolimus stainless steel stents whereas MACE was observed in one patient in both the group of patients.

At the end of 6 months, the rate of TLR was low in both the group of patients whereas low risk of death was observed in sirolimus stainless steel stent group. Koh *et al.,* (2011) reported that Stainless steel and cobalt chromium stents are associated with similar and low risk of target vessel revascularization (TVR result at 6 month 3.5% in stainless steel stent and 3.4% in cobalt chromium stent). [9-20] At the end of one year, the rate of TLR was high as compared to TVR in sirolimus stainless steel stent group. The risk of death was observed to be similar in both the groups.

Primary end points of the present study were rate of target lesion revascularization, target vessel revascularization and restenosis, which were statistically insignificant in both the groups at 1 month, 6 months and 1 year follow up. The secondary end point was assessment of safety in patients implanted with sirolimus stainless steel stent or sirolimus cobalt chromium stent. Safety parameters included rate of death, myocardial infarction, coronary intervention and angina. The results showed that there was no significant difference in the safety profile in both the treatment groups. Henrique B *et al.*, (2011) carried out a clinical trial involving 316 patients and reported similar efficacy and safety to stainless steel stent as compared to cobalt chromium stent. [18] Results of the present study showed that there was no significant difference in efficacy and safety of cobalt chromium stent and stainless steel stent and are in harmony with Henrique et al.

The angiographic data showed that there was no incidence of restenosis at the end of 1 month in both the treatment groups. While incidence of restenosis was similar at the end of 6 months follow up in both the treatment groups, it was insignificantly higher at the end of 1 year follow up.

MACE observed at the end of 6 months and 1 year was higher in sirolimus stainless steel stent as compared to sirolimus cobalt chromium stent. Previous study involving comparison of Everolimus-Eluting Stent and Sirolimus Eluting Stent reported that there is no significant difference in the clinical outcome in patients treated with Everolimus-Eluting Stent and Sirolimus Eluting Stent. [15] Naito *et al.*, (2011) reported that there was no significant difference in the long term clinical outcome between sirolimus eluting stent and paclitaxel eluting stent. [16] Our study found no difference between sirolimus stainless steel stent and sirolimus cobalt chromium stent with respect to the incidence of death and unstable angina at the end of 1 year follow up.

Limitation of the study

Our study was a single centric, retrospective, observational study with small sample size which seemed to be too small to represent the real world clinical practice. The limited sample size may increase the risk of failing to detect differences in both safety and efficacy between the two stents. The choice of stent by the intervention specialist who performs the primary PCI is a fundamental limitation of a non-randomized, observational analysis.

Our study suggested that among CAD patient undergoing primary Percutaneous Coronary Intervention, sirolimus stainless steel stent showed similar safety and efficacy profile as compared to sirolimus cobalt chromium stent. Although low risk of TVR was observed in both the type of stents, it was slightly higher in sirolimus stainless stent group as compared to sirolimus cobalt chromium stent groups. Further studies are warranted to investigate higher rates of survival amongst the cobalt chromium group.

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