Primary Stenting of Totally Occluded Native Coronary Arteries II (PRISON II)

A Randomized Comparison of Bare Metal Stent Implantation With Sirolimus-Eluting Stent Implantation for the Treatment of Total Coronary Occlusions

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Background—Sirolimus-eluting stents markedly reduce the risk of restenosis compared with bare metal stents. However, it is not known whether there are differences in effectiveness between bare metal and sirolimus-eluting stents in patients with total coronary occlusions.

Methods and Results—In a prospective, randomized, single-blind, 2-center trial, we enrolled 200 patients with total coronary occlusions: Half (n=100) were randomly assigned to receive bare metal BxVelocity stents and half (n=100) to receive sirolimus-eluting Cypher stents. The primary end point was angiographic binary in-segment restenosis rate at 6-month follow-up. Secondary end points were a composite of major adverse cardiac events, target vessel failure, binary in-stent restenosis rate, in-stent and in-segment minimal lumen diameter, percent diameter stenosis, and late luminal loss at 6-month follow-up. The sirolimus stent group showed a significantly lower in-stent binary restenosis rate of 7% compared with 36% in the bare metal stent group ($P<0.001$). The in-segment binary restenosis rate was 11% in the group receiving a sirolimus stent versus 41% in the bare metal stent group ($P<0.0001$), resulting in a target lesion revascularization rate of 4% in the sirolimus group versus 19% in the bare metal group ($P<0.001$). Patients who received the drug-eluting stent also had significantly lower rates of target vessel revascularization, target vessel failure, and all major adverse cardiac events.

Conclusions—In patients with total coronary occlusions, use of the sirolimus-eluting stents are superior to the bare metal stents with significant reduction in angiographic binary restenosis, resulting in significantly less need for target lesion and target vessel revascularization. **(*Circulation*. 2006;114:921-928.)**

Key Words: angioplasty ■ coronary disease ■ stents ■ total coronary occlusions

Since data from the 2 landmark studies, the Belgium Netherlands Stent (BENESTENT) study and the Stent Restenosis Study (STRESS), showed that coronary stenting significantly decreases restenosis compared with conventional balloon angioplasty, this treatment modality has been shown to be superior in an increasing number of indications.[1,2] This included percutaneous coronary intervention (PCI) of chronic total occlusions, although restenosis rates remained relatively high (32% to 55%).[3–8] In 200 patients with total coronary occlusions randomized in the Primary Stenting of Totally Occluded Native Coronary Arteries I (PRISON I) study, we demonstrated a restenosis rate of 22% after bare metal stent implantation compared with 33% after conventional balloon angioplasty.[9] During the past few years, sirolimus (rapamycin), a cytostatic macrocyclic lactone with antiinflammatory and antiproliferative properties,[10–12] delivered from a polymer-encapsulated stent was shown to markedly reduce the risk of restenosis in selected groups of patients in several randomized trials.[13–16] However, no randomized data are available on the efficacy of sirolimus-eluting stent implantation in patients with totally occluded coronary arteries.

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We therefore conducted a prospective, randomized trial comparing the immediate and long-term angiographic and

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clinical results of bare metal stent implantation with sirolimus-eluting stent implantation in patients with total coronary occlusions.

Methods

Patients

The Primary Stenting of Totally Occluded Native Coronary Arteries II (PRISON II) study is a prospective, randomized, single-blind, 2-center trial in which 200 patients with total coronary occlusions were included. Enrollment of study patients began in January 2003 and was completed in September 2004. Patients were considered eligible if they had an estimated duration of the total coronary occlusion of at least 2 weeks with evidence of ischemia related to the target vessel (signs of ischemia during an abnormal exercise test, defined as ST depression of ≥1.0 mm that is horizontal or downsloping or upsloping ST depression of ≥2.0 mm or signs of ischemia found during nuclear imaging with exercise, dobutamine, or adenosine). Patients were excluded if the lesion could not be crossed, if the use of heparin, aspirin, and clopidogrel was prohibited, in case of severe renal failure (creatinine >250 μmol/L), or if patients were unwilling or unable to complete follow-up.

The study was conducted according to the principles of the Declaration of Helsinki and was approved by the institutional ethics committees at the St Antonius Hospital Nieuwegein and Onze Lieve Vrouwe Gasthuis Amsterdam, both in the Netherlands. All patients gave written informed consent before they underwent the procedure. There was no industry involvement in the study design, conduct, or analysis of the trial. The authors had full access to the data and take full responsibility for its integrity. All authors have read and agree to the manuscript as written.

Randomization, Stent implantation, and Adjunct Drug Therapy

Before or at the time of the procedure, all patients were treated with a loading dose of ≥300 mg of clopidogrel and 80 mg of aspirin. At the start of the procedure, patients received a single dose of unfractionated heparin (80 to 120 U/kg body wt). After the occluded lesion was crossed with a guidewire and before initial dilatation with a balloon, patients were randomly assigned to receive either a conventional bare metal stent (BxVelocity, Cordis, a Johnson & Johnson company) or a sirolimus-eluting stent (Cypher, Cordis, a Johnson & Johnson company, Miami Lakes, Fla) with variable lengths (13, 18, 23, 28, and 33 mm) and diameters (2.5 to 3.5 mm). In case of additional stents, only the assigned stent type was used per lesion and/or vessel. Patients were randomized by a telephone allocation service; randomization was stratified by center in undisclosed permuted blocks of 6. Standard recanalization and stent implantation techniques were used from either the radial or femoral artery. The major goal was to achieve a residual lumen diameter stenosis <30% on visual assessment. Patients and referring physicians were blinded for stent allocation. Poststent dilatation was performed with high inflation pressures in all patients. After the intervention, the antiplatelet therapy was continued and consisted of ≥80 mg of aspirin once daily indefinitely and 75 mg clopidogrel daily for at least 6 months.

Follow-Up Protocol

After the index procedure, all patients remained in the hospital for at least 24 hours. A 12-lead ECG was obtained before the procedure, after the procedure, and before discharge. Blood samples were taken for the measurement of creatine kinase and its MB isoenzyme before stenting, at 8 to 16 hours after the procedure, and again at 18 to 24 hours after the procedure and continued if needed daily thereafter during longer hospitalization. Adverse events were assessed in the hospital, at 30 days, and at 6 and 12 months. At 30 days, a telephone interview was done to assess the patient's clinical status. All patients were asked to return for both clinical and angiographic follow-up at 6 months after the procedure or earlier if anginal symptoms occurred. An independent clinical event committee, members of which were unaware of the patient's treatment assignment, reviewed all clinical end points during follow-up.

Clinical long-term follow-up was performed at 6 months preceding the angiography and at 12 months. Recurrent angina, a positive exercise test, or abnormal nuclear imaging was considered a clinical sign of restenosis. Follow-up angiography was performed earlier if there were clinical signs of restenosis and, if indicated, was followed by (ischemia-driven) revascularization. Death, myocardial infarction, and target lesion revascularization (defined as ischemia-driven percutaneous or surgical revascularization of the target lesion due to restenosis within the stent or within 5 mm distal or proximal to the stent after the initial procedure) were recorded as major adverse cardiac events. Revascularization of the target lesion and vessel was considered to be driven by ischemia if the diameter stenosis was ≥50% as estimated by quantitative coronary angiography in the presence of ischemic signs or symptoms. In addition, occurrences of angina (Canadian Cardiovascular Society), target vessel revascularization (defined as repeat revascularization within the treated vessel), and target vessel failure (defined as a composite of death from cardiac causes, myocardial infarction, and ischemia-driven target vessel revascularization) were recorded.

Study End Points and Clinical and Angiographic Definitions

The primary end point was defined as the binary in-segment restenosis rate (defined as restenosis >50% on follow-up angiography) at 6-month angiography. Secondary end points included the following: a composite of major adverse cardiac events at 6 and 12 months, target vessel failure at 6 and 12 months, binary in-stent restenosis rate, in-stent and in-segment minimal lumen diameter, percent in-stent and in-segment diameter stenosis, and in-stent and in-segment late luminal loss at 6-month follow-up.

The diagnosis of Q-wave myocardial infarction during follow-up was based on the presence of new Q waves on the ECG and an elevated creatine kinase to at least 2 times the upper limit of the normal range with an elevated level of MB isoenzyme. In the absence of pathological Q waves, the diagnosis of non–Q-wave myocardial infarction was based on the increase of creatine kinase level to more than twice the upper limit of the normal range with an elevated level of MB isoenzyme. Total coronary artery occlusion was defined by the absence of antegrade flow of contrast distal to the occlusion (Thrombolysis in Myocardial Infarction [TIMI] flow 0 according to the TIMI score) or only minimal flow of contrast distal to the occluded vessel (TIMI flow I).[17] The duration of the total coronary artery occlusion had to be at least 2 weeks and was estimated by clinical information, sequential angiographic information, or both. Chronic total coronary artery occlusion was defined with a duration >3 months according to the American College of Cardiology/American Heart Association lesion classification. The estimated length of the occlusion was measured from the point of the total occlusion to the most proximal point of the distal vessel, which was visualized by collateral filling with contrast.

Quantitative Coronary Angiography

Coronary angiograms were digitally recorded at baseline, immediately after the procedure, and at 6-month follow-up and were assessed offline at the quantitative angiographic core laboratory of the St Antonius Hospital Nieuwegein with an automatic edge-detection system (CMS version 5.3, Medis Medical Imaging Systems, Leiden, the Netherlands) by experienced personnel who were not provided with any clinical information on type of stent used. Before angiography, 300 to 500 μg nitroglycerin was given (intracoronary). The nontapered tip of the catheter was used as the calibration standard. All lesions were assessed in at least 2 orthogonal views; the projection showing the smallest diameter (worst view) was used for quantitative coronary angiography analysis, and views with the least foreshortening were used for measuring the length of the occlusion. In disease-free proximal segments, the reference diameter was measured. Cineangiograms were obtained before, immediately after, and at 6 months, with the same views used

at all times. Any coronary angiography performed within 3 months after the initial procedure was considered unscheduled. When an unscheduled angiography was followed by target lesion or target vessel revascularization, no further angiograms were needed. If no revascularization took place, repeat angiography at 6 months was still required. If the angiography took place after 3 months, 6-month angiographic assessment was not mandatory.

Quantitative measurement included the reference diameter of the vessel, the minimal lumen diameter, percent diameter stenosis, acute gain, late luminal loss, net luminal gain, and late-loss index (late loss divided by the acute gain). Quantitative coronary analysis was used to evaluate the stented area (in stent) and the area that included the stented segment as well as well as the 5-mm margins proximal and distal to the stent (in segment). Angiographic binary in-stent restenosis was defined as ≥50% residual diameter stenosis within the stent. In-segment binary restenosis was defined as ≥50% residual diameter stenosis located in the stent and/or at the 5-mm proximal or 5-mm distal edge. Reocclusion was defined as a recurrent total occlusion at the previous angioplasty site.

Stent thrombosis was defined as an acute coronary syndrome with angiographic documentation of either occlusion of the target lesion or thrombus within the previously stented segment.

Statistical Analysis

With the assumption that the restenosis rate in the conventional stent group was 22% (as found in the PRISON I study[9]), the PRISON II study was designed to find a rate difference of ≥15% with ≥80% power at a 2-sided α level of 5% and would therefore require 93 patients in both study groups. With allowance for a low dropout rate, comparable to the PRISON I study,[9] the target sample size was 100 patients in each group.

The primary end point was the angiographic binary restenosis rate at 6-month follow-up. The comparison between the 2 groups was assessed by means of Fisher exact test for a 2×2 table, and relative risks (RRs) were computed with 95% CIs. The in-stent and in-segment percent diameter stenosis, minimal lumen diameter, and late luminal loss were compared by means of the Student *t* test.

All randomized patients were included in the clinical end point analyses according to the intention-to-treat principle. Analysis of angiographic end points was restricted to patients with follow-up angiography; myocardial infarctions were imputed with 100% diameter stenosis. The analysis of the primary end point of binary restenosis was performed on all patients with angiographic follow-up supplemented with patients fulfilling 1 of 2 situations: (1) being a patient without anginal complaints, with no intercurrent event, and refusing the follow-up angiogram on non–study-related grounds (ie, groin discomfort); and (2) being a patient suffering myocardial infarction during the first 6-month follow-up. The first situation was imputed with "no restenosis," the second with "restenosis." These decisions were made by the clinical event committee without knowledge of the type of stent used. An analysis without imputation gave similar results.

All data were collected, held, and analyzed by the trial coordination center at the St Antonius Hospital, without any involvement of the sponsor. Analyses were performed with the use of SAS version 8.2 software (SAS Corp, Cary, NC).

Results

Enrollment of patients started in January 2003 and was completed in September 2004. A total of 528 patients were screened for the study. Of these, 62 patients were excluded because the lesion could not be crossed, 14 patients because of spontaneous reperfusion to TIMI flow ≥II in the time between the diagnostic angiogram and the actual procedure, and 252 patients for other reasons (refusal to participate or according to the exclusion criteria). A total of 200 patients were enrolled in the study and randomly assigned to receive either a bare metal stent or a sirolimus-eluting stent. The median duration of the total coronary occlusion was 2.8 months. Baseline clinical characteristics are shown in Table 1. Severity of angina and cardiovascular risk profile were similar in both groups. In 1 patient of the sirolimus group, the procedure was complicated by a type C dissection with flow impairment. This resulted in a non–Q-wave myocardial infarction. Minor groin bleeding occurred in 1 patient in the bare metal group. The baseline angiographic characteristics are shown in Table 2. Stent implantation resulted in a similar postprocedural minimal lumen diameter in both groups (P=0.48). The maximal balloon size was slightly larger in the bare metal stent group than in the sirolimus stent group (P=0.006), and this resulted in a lower in-stent diameter stenosis (14.5% versus 19.3%) immediately after the index procedure (P=0.0013). One patient in the sirolimus group suffered from target vessel thrombosis due to local dissection directly distal from the study stent 1 week after inclusion, leading to a non–Q-wave myocardial infarction.

TABLE 1. Baseline Clinical Characteristics

	BMS Group (n=100)	SES Group (n=100)
Age, y	59.3±10.2	59.6±10.6
Women, %	24	17
CCS angina class, %		
II	30	29
III	38	42
IV	21	23
Risk factors, %		
Smoking	40	34
Diabetes mellitus		
Not insulin requiring	12	10
Insulin requiring	4	0
Hyperlipidemia	90	90
Hypertension	46	45
Previous MI, %	51	47
Previous intervention, %		
PCI	16	18
CABG	2	3
Previous stroke	3	1

BMS indicates bare metal stent; SES, sirolimus-eluting stent; CCS, Canadian Cardiovascular Society; and MI, myocardial infarction.

Angiographic Results

Angiographic follow-up was obtained in 94 patients (94%) of the bare metal stent group and 94 patients (94%) of the sirolimus stent group. Patients who refused follow-up angiography were free of symptoms, and no adverse events were observed among these patients. Table 3 shows the results of the quantitative analysis of follow-up angiograms. Follow-up angiograms obtained at 6 months demonstrated that patients assigned to sirolimus stent implantation had a larger in-segment minimal lumen diameter (difference, 0.77 mm; 95% CI, 0.55 to 0.97) with less residual stenosis (difference, 21.0%; 95% CI, 14.9 to 27.0) compared with bare metal stent implantation (Figure). As a result of these differences, the

TABLE 2. Baseline Angiographic Characteristics

	BMS Group (n=100)	SES Group (n=100)
Duration of occlusion >3 mo, %	44	46
Coronary artery disease, %		
1 Vessel	51	47
2 Vessels	39	45
3 Vessels	10	8
LVEF, %		
>50	82	76
20–50	18	24
<20	0	0
Occluded vessel, %		
LAD	36	33
LCX	22	25
RCA	42	42
Collateral filling, %		
Bridge collaterals	17	24
Retrograde filling	75	72
TIMI flow, %		
0	64	69
I	36	31
Calcified lesion, %	21	27
Reference diameter, mm	2.60±0.65	2.53±0.67
Occlusion length, mm	16.3±9.3 (3-60)	16.0±9.3 (3-54)
Maximal balloon size, mm	3.32±0.39	3.18±0.32*
Maximal balloon pressure, atm	15.1±2.9	14.5±2.7
Total stent length, mm	28.9±13.7 (8-69)	31.9±15.3 (13-87)
No. of stents	1.4±1.2	1.4±0.7

Values are mean±SD unless indicated otherwise. LVEF indicates left ventricular ejection fraction; LAD, left anterior descending coronary artery; LCX, left circumflex coronary artery; and RCA, right coronary artery. Other abbreviations are as defined in Table 1.

*P=0.006.

rate of binary in-segment restenosis in the sirolimus stent group was lower than that in the bare metal stent group (RR, 0.27; 95% CI, 0.15 to 0.49). Table 4 depicts the subgroup analysis of in-segment and in-stent restenosis rate at 6 months in patients with a chronic total coronary occlusion with duration of >3 months. The outcome of binary in-segment restenosis in the sirolimus stent group was also lower than that in the bare metal stent group in patients with a chronic total occlusion of >3 months (RR, 0.16; 95% CI, 0.04 to 0.52).

Clinical Outcome

All patients completed the 6-month clinical follow-up. The clinical events during 6-month follow-up are shown in Table 5. None of the patients died during this follow-up period. Myocardial infarction was present in 3 patients (3%) in the bare metal stent group and 2 patients (2%) in the sirolimus stent group. At follow-up, the rate of major adverse cardiac events in the bare metal stent group was higher than in the sirolimus stent group (RR, 5.0; 95% CI, 1.77 to 14.11) as a result of a higher target lesion and target vessel revascularization rates. In the bare metal stent group, 19% needed target lesion revascularization versus 4% in the sirolimus stent group (RR, 4.75; 95% CI, 1.68 to 13.47). Target vessel revascularization was performed in 22% of the bare metal stent group compared with 8% in the sirolimus stent group (RR, 2.75; 95% CI, 1.29 to 5.88). Clinical signs of restenosis drove all revascularizations. In the bare metal stent group, there was no stent thrombosis of the study stent, and 1 patient suffered from late stent thrombosis in a nontarget vessel 6 months after inclusion. In the sirolimus stent group, 1 patient developed a late stent thrombosis 3 months after inclusion, leading to a Q-wave myocardial infarction. The clinical events between 6 and 12 months of follow-up are depicted in Table 6. One patient in the bare metal stent group died suddenly. At 12-month clinical follow-up, the rate of major adverse cardiac events in the bare metal stent group was higher than in the sirolimus stent group (RR, 2.67; 95% CI, 1.31 to 5.45) as a result of a higher target lesion and target vessel revascularization rates.

Discussion

This is the first randomized trial to compare the immediate and long-term angiographic and clinical results of bare metal stents versus sirolimus-eluting stents in patients with total coronary occlusions.

Since data from the beginning of this decade showed that drug-eluting stents significantly decrease coronary restenosis rates compared with bare metal stent implantation,[13–16,18] this treatment modality has been suggested to be superior in an increasing number of clinical and angiographic indications.[19–22]

Despite the relatively low initial success rates and high rates of restenosis, it is suggested that opening of total coronary occlusions can be of benefit by restoring blood flow to a hibernating myocardium and thus improving symptoms and left ventricular function.[23,24] Successfully revascularized chronic total occlusions confer a survival advantage compared with failed revascularization.[25] In 1991, Meier[26] stated that compared with other lesion types, total coronary occlusions, albeit a "different animal," are of the same species and deserve improved percutaneous revascularization techniques.

Indeed, nonrandomized studies are suggesting a benefit of drug-eluting stent implantation over bare metal stent implantation in total coronary occlusions, more often referring patients with totally occluded coronary arteries to PCIs instead of coronary artery bypass graft surgery. Werner et al[27] investigated the effect of paclitaxel-eluting stents in chronic total occlusions in 48 patients and compared them with 48 matched patients with chronic total occlusions treated with a bare metal stent. The angiographic restenosis rate in this study was 8.3% with paclitaxel versus 51.1% with bare metal stents (P<0.001), with a higher survival free of major adverse cardiac events in the paclitaxel group due to a reduced target lesion revascularization rate (12.4% versus 47.9%; P<0.001). In a nonrandomized trial, Nakamura et al[28] found lower rates of restenosis, showing 2% in 60 patients who underwent sirolimus stent implantation versus 32% in 120 patients who received a bare metal stent (P=0.001), with

TABLE 3. Quantitative Coronary Angiographic Data

	BMS Group (n=100)	SES Group (n=100)	*P*
After procedure			
Reference diameter, mm	3.26±0.52	3.38±0.55	0.12
In-segment MLD, mm	1.96±0.47	2.01±0.51	0.48
In-segment DS, %	30.14±11.44	32.60±12.01	0.14
In-segment acute gain, mm	1.80±0.59	1.87±0.59	0.44
Proximal margin MLD, mm	2.61±0.67	2.79±0.73	0.07
In-stent MLD, mm	2.55±0.53	2.53±0.56	0.76
Distal margin MLD, mm	2.08±0.57	2.16±0.60	0.33
Proximal margin DS, %	19.4±13.9	17.7±13.8	0.39
In-stent DS, %	14.5±8.7	19.3±12.0	0.001
Distal margin DS, %	24.0±12.2	24.7±13.0	0.71
In-stent acute gain, mm	2.39±0.55	2.38±0.61	0.92
At 6-month follow-up			
Reference diameter, mm	3.01±0.85	3.44±0.54	<0.0001
In-segment MLD, mm	1.32±0.73	2.09±0.73	<0.0001
In-segment DS, %	53.32±23.14	31.85±19.02	<0.0001
In-segment late loss, mm	0.64±0.82	−0.07±0.72	<0.0001
In-segment net gain, mm	1.16±0.81	1.95±0.76	<0.0001
In-segment loss index	0.248±0.908	−0.096±0.440	0.0011
Proximal margin MLD, mm	2.42±0.97	2.68±0.86	0.06
In-segment MLD, mm	1.47±0.83	2.48±0.80	<0.0001
Distal margin MLD, mm	1.93±0.82	2.33±0.75	0.001
Proximal margin DS, %	21.2±27.5	21.8±19.8	0.89
In-stent DS, %	48.8±26.5	22.0±21.0	<0.0001
Distal margin DS, %	26.7±25.2	20.7±19.2	0.08
Proximal margin late loss, mm	0.24±0.98	0.13±0.91	0.45
In-stent late loss, mm	1.09±0.91	0.05±0.81	<0.0001
Distal margin late loss, mm	0.11±0.74	−0.13±0.79	0.04
In-stent net gain, mm	1.30±0.88	2.33±0.85	<0.0001
In-stent loss index	0.453±0.365	−0.020±0.406	<0.0001
Restenosis length, mm	14.0±7.2	12.2±4.4	0.46
Restenosis rate, % of patients*			
In segment†	41	11	<0.0001
In stent	36	7	<0.0001
Reocclusions	13	4	0.04

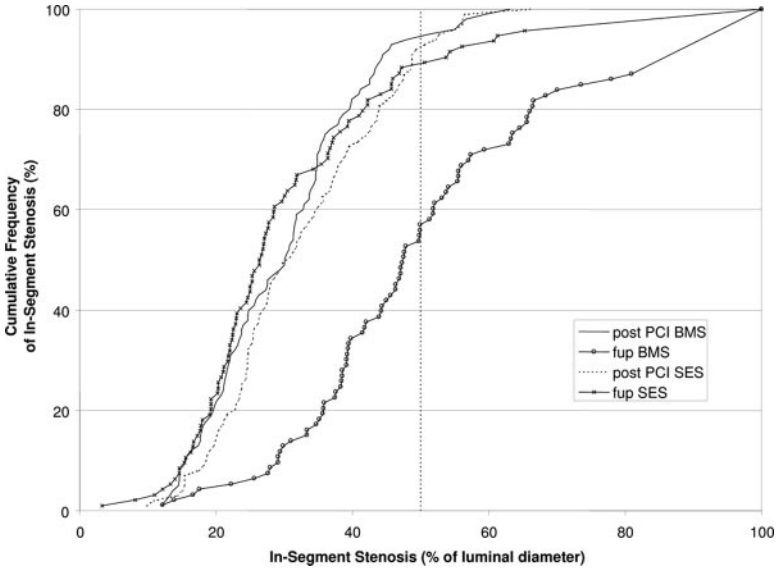
Values are mean±SD. MLD indicates minimal lumen diameter; DS, diameter stenosis. Other abbreviations are as defined in Table 1.

*Including reocclusion.

†Stented segment including proximal and distal 5 mm.

a target lesion revascularization rate of 2% versus 23% ($P=0.001$) and a target vessel revascularization rate of 3% versus 30% ($P=0.001$), respectively. In another nonrandomized study, Ge et al[29] found restenosis rates of 9.2% after sirolimus stent implantation and 33.3% after bare metal stent implantation ($P<0.001$), with a target lesion revascularization rate of 7.4% versus 26.3% (<0.001) and a target vessel revascularization rate of 9.0% versus 29.0% ($P<0.001$), respectively. In the Sirolimus-Eluting Stent in Chronic Total Occlusion (SICTO) study, an in-lesion late luminal loss of −0.15±0.39 mm was found in 25 patients with chronic total occlusions >3 months old treated with a sirolimus-eluting stent and showed a target lesion revascularization rate of 4% and a target vessel revascularization rate of 12% at 12-month follow-up.[30]

In the present randomized study, we showed that the sirolimus-eluting stent is superior to the bare metal stent in



Cumulative frequency of in-segment stenosis. BMS indicates bare metal stent; SES, sirolimus-eluting stent; and fup, 6-month follow-up.

treating patients with total coronary artery occlusions. Patients who received the drug-eluting stent had significantly lower rates of target lesion revascularization, target vessel revascularization, target vessel failure, and all major adverse cardiac events at 6 and 12 months of follow-up. Although the restenosis rate in our bare metal stent group is comparable to the restenosis rate of 32% to 55% in other studies using bare metal stents for chronic total occlusions,[3–8] it is higher than the 22% restenosis rate found in the PRISON I study.[9] Several reasons could account for this difference. In the PRISON I study, the diameter of the coronary arteries was larger, with a preprocedural reference diameter of 3.11±0.61 versus 2.60±0.65 mm in the present study. Accordingly, the postprocedural minimal lumen diameter was 2.90±0.41 versus 1.96±0.47 mm, respectively. The rate of diabetes was slightly lower in the PRISON I study (13% versus 16%), and fewer patients had an occlusion duration >3 months (38% versus 44% in this study). Furthermore, in the PRISON I study the NIR stent (Boston Scientific, Natick, Mass) with a different stent design was used compared with the BxVelocity stent in the present study. We noted a 2% stent thrombosis rate in the sirolimus stent group and no stent thrombosis in the bare metal stent group, although in 1 sirolimus-treated patient this was explained as due to an untreated distal dissection. The consequences of stent thrombosis in these patients may not be as dire because collateral vessels also supply most of these territories.

The results of the present study show that the first-choice treatment for total coronary artery occlusions is PCI with the use of a sirolimus-eluting stent. Compared with these randomized data with the sirolimus-eluting stent, the evidence for the benefit of paclitaxel stents is based on a smaller number of nonrandomized trial patients. Without direct head-to-head testing, it is not currently possible to say if one or the other drug-eluting stent platform might be more effective for this specific indication.

TABLE 4. Restenosis Rate at 6-Month Follow-Up for Patients With Chronic Total Coronary Occlusion >3 Months

	Restenosis Rate, %*		
	BMS Group (n=44)	SES Group (n=46)	*P*
In segment†	46	12	<0.001
In stent	39	7	<0.001
Reocclusions	15	5	0.16

Abbreviations are as defined in Table 1.
*Including reocclusion.
†Stented segment including proximal and distal 5 mm.

TABLE 5. Clinical Events During 6-Month Follow-Up

	BMS Group (n=100)	SES Group (n=100)	*P*
Recurrent angina CCS class, %			0.52
III	10	9	
IV	4	2	
Death, %	0	0	NS
Myocardial infarction, %			1.000
Target lesion related	1	2	
Not target lesion related	2	0	
MACE, %	20	4	<0.001
Target lesion revascularization, %			0.001
Repeat angioplasty	18	3	
Coronary bypass surgery	1	1	
Target vessel revascularization, %*	22	8	0.009
Non–target vessel PCI, %	11	4	0.06
Stroke, %	0	0	NS
Target vessel failure, %	24	8	0.003
Stent thrombosis, %	0	2	0.497

MACE indicates major adverse cardiac events (cardiac death, myocardial infarction, and ischemia-driven target lesion revascularization). Other abbreviations are as defined in Table 1.
*Including target lesion revascularizations.

TABLE 6. Clinical Events During 6- to 12-Month Follow-Up

	BMS Group (n=100)	SES Group (n=100)	*P*
Recurrent angina CCS class, %			
III	4	9	0.1515
IV	2	4	0.6827
Death, %	1	0	1.0000
Myocardial infarction, %			
Target lesion related	0	0	NS
Not target lesion related	1	0	1.0000
MACE, %	4	1	0.3687
Target lesion revascularization, %			
Repeat angioplasty	1	1	NS
Coronary bypass surgery	1	0	1.0000
Target vessel revascularization, %*	2	1	1.0000
Non–target vessel PCI, %	1	4	0.3687
Stroke, %	1	0	1.0000
Target vessel failure, %	4	1	0.3687

MACE indicates major adverse cardiac events (cardiac death, myocardial infarction, and ischemia-driven target lesion revascularization). Other abbreviations are as defined in Table 1.

*Including target lesion revascularizations.

In conclusion, the sirolimus-eluting stent is superior to the bare metal stent in treating patients with total coronary occlusions with significant reduction in angiographic binary in-stent and in-segment restenosis, resulting in significantly less need for target lesion and target vessel revascularization. Furthermore, we also showed a significantly lower rate of target vessel failure and major adverse cardiac events in patients treated with the sirolimus-eluting stent compared with bare metal stent implantation.

Disclosures

None.

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CLINICAL PERSPECTIVE

The Primary Stenting of Totally Occluded Native Coronary Arteries II (PRISON II) study evaluated the potential benefits of drug-eluting stents compared with bare metal stents for the treatment of total coronary occlusions. In this prospective, randomized, 2-center trial, we enrolled 200 patients with total coronary occlusions, and they were randomly assigned to receive either sirolimus drug-eluting Cypher stents or bare metal BxVelocity stents. The primary end point was angiographic binary in-segment restenosis rate at 6-month follow-up. The sirolimus stent group showed a significantly lower in-stent binary restenosis rate of 7% compared with 36% in the bare metal stent group ($P<0.001$). The in-segment binary restenosis rate was 11% in the group receiving a sirolimus stent versus 41% in the bare metal stent group ($P<0.0001$), resulting in a target lesion revascularization rate of 4% in the sirolimus stent group versus 19% in the bare metal stent group ($P<0.001$). Patients who received the drug-eluting stent had significantly lower rates of target vessel revascularization, target vessel failure, and all major adverse cardiac events. Thus, in patients with total coronary occlusions, the use of sirolimus-eluting stents is superior to the use of bare metal stents, with significant reductions in angiographic and clinical restenosis.