

Clinical and Angiographic Analysis With a Cobalt Alloy Coronary Stent (Driver) in Stable and Unstable Angina Pectoris

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The Clinical and Angiographic analysis with a Cobalt Alloy Coronary Stent (Driver) (CLASS) study was a prospective, nonrandomized, multicenter study designed to assess the safety and efficacy of a cobalt-chromium alloy-based stent in patients with stable or unstable angina pectoris. A total of 203 lesions were treated in 202 enrolled patients. The percentage of major adverse cardiac event-free patients was 87.6% (177 of 202) at 6 months (primary safety end point; major adverse cardiac events were defined as death, myocardial infarction, emergency bypass surgery, or target lesion revascularization [percutaneous transluminal coronary angioplasty or coronary artery bypass grafting]). The angiographic success rate (primary efficacy end point) was 100%, and the procedural success rate was 98%. The binary in-stent restenosis rate at 6 months was 12.6%. Our results have demonstrated that the Driver cobalt-chromium alloy stent can be used with a low 6-month incidence of major adverse cardiac events, a low 6-month binary restenosis rate, and high angiographic and procedural success rates. © 2006 Elsevier Inc. All rights reserved. (Am J Cardiol 2006;97:349–352)

The Medtronic Driver stent (Medtronic Vascular, Santa Rosa, California) is composed of a cobalt-chromium alloy and is similar in design to the Medtronic S7 stent. The design is based on elements 1.0 mm in length with an elliptical-rectangular strut cross section and a strut thickness of 0.0036 in. (91 μ m). The cobalt-chromium alloy has superior mechanical properties compared with traditional 316L stainless steel, including greater strength and increased density. These properties have allowed the development of stents with thinner struts, offering increased flexibility and ease of delivery, without compromising radial strength or radiopacity. The strut thickness has been shown to be an important determinant of the long-term restenosis rate.^{1–4} This prospective, nonrandomized, multicenter study was designed to assess the safety and efficacy of the Medtronic Driver stent.

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Patients with clinical evidence of stable or unstable angina pectoris, or positive functional study findings, with a

planned percutaneous transluminal coronary angioplasty procedure of a single de novo lesion in a native coronary artery were considered for inclusion. Lesions (\leq 13 mm) situated in a major coronary artery or major branch with estimated stenosis of 50% to 100% and a diameter suitable for implantation of a single stent with a diameter of 3.0 to 4.0 mm were considered eligible for enrollment.

Preprocedural antiplatelet therapy was administered according to local routine with the following recommendations: aspirin (minimum 75 mg/day) and ticlopidine (500 mg loading dose followed by 250 mg twice daily) or aspirin and clopidogrel (300 mg loading dose followed by 75 mg/day). It was initiated \geq 24 hours before the procedure or before the conclusion of the catheterization. Ticlopidine or clopidogrel were discontinued after 14 to 28 days, and aspirin (\geq 75 mg/day) was maintained indefinitely (\geq 6 months after implantation).

After introduction of the arterial sheath (\geq 6Fr) and catheter, heparin was administered. The dose was adjusted to maintain an activated clotting time of $>$ 250 seconds (or $>$ 200 seconds if a glycoprotein IIb/IIIa platelet inhibitor was used) throughout the procedure. A stent of sufficient length and diameter to cover the target lesion was selected. Stents 3.0, 3.5, and 4.0 mm in diameter and 9.0, 12.0, and 15.0 mm long were available for use. The lesion was either pretreated with standard balloon angioplasty or the direct stenting technique was used, according to preference. Stent deployment was assessed visually, guided by on-line quantitative coronary angiographic measurement of the minimal lumen diameter. The angiographic criteria for optimal stent deployment were achieved with a diameter stenosis of \leq 15%.

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[†] A complete list of the investigators is included in the Appendix.

Table 1
Baseline demographic and clinical characteristics (n = 202)

Characteristic	
Age (mean \pm SD (yr))	61 \pm 9.8
Men	73.3%
Myocardial infarction	
Q wave	14.9%
Non-Q-wave	26.7%
Coronary artery bypass grafting	2.0%
Percutaneous transluminal coronary angioplasty	12.9%
Hypertension	53.0%
Hypercholesterolemia (>5.5 mmol/L)	68.8%
Diabetes mellitus	
Non-insulin-dependent	4.0%
Insulin-dependent	11.4%
Smoker or exsmoker	70.3%
Stable angina pectoris	47.5%
Unstable angina pectoris	40.6%
Silent myocardial ischemia	11.9%

Table 2
Angiographic characteristics (n = 203)

Mean lesion length	11.4 \pm 4.4
Before procedure (n = 203)	
RVD (mm)	3.0 \pm 0.5
MLD (mm)	1.0 \pm 0.4
DS \pm SD	66.4 \pm 11.3%
After procedure (n = 199)	
RVD (mm)	3.1 \pm 0.4
MLD (mm)	2.9 \pm 0.4
In-lesion DS \pm SD	11.5 \pm 10.4%
In-stent DS \pm SD	8.0 \pm 7.6%
Six-month (n = 187)	
RVD (mm)	3.0 \pm 0.5
MLD (mm)	2.1 \pm 0.6
In-lesion DS \pm SD	32.5 \pm 18.6%
In-stent DS \pm SD	29.7 \pm 16.7%
In-stent late loss (mm)	0.8 \pm 0.5
In-stent binary restenosis	12.6%
In-lesion binary restenosis	15.8%
In-segment binary restenosis	12.6%

Data are presented as means \pm SD or percentages.

DS = diameter stenosis; RVD = reference vessel diameter; MLD = minimal lumen diameter.

An electrocardiogram was obtained within 7 days before the procedure and between 18 and 24 hours after the procedure or before discharge. Cardiac enzyme levels were measured within 7 days before the procedure and 8 to 16 hours after the procedure. Clinical status (including anginal status and adverse events) was assessed at discharge. Clinical follow-up was performed at 30 \pm 5 days by telephone or clinic visit and at 6 months (22 to 28 weeks) after the procedure. Anginal status was determined, and adverse events were documented. Angiography was performed at 6 months on all patients who had received a Driver stent. All angiographic data were analyzed by the Core Laboratory (Heart Core BV, Leiden, The Netherlands).

The primary safety end point was the proportion of

patients without a major adverse cardiac event at 6 months. The primary efficacy end point was the angiographic success rate (postprocedural stenosis of <50% by core laboratory assessment). A major adverse cardiac event was any of the following: death, myocardial infarction (Q-wave and non-Q-wave), emergency bypass surgery, and target lesion revascularization (repeat percutaneous transluminal coronary angioplasty or coronary artery bypass grafting). The secondary end points were the binary 6-month restenosis rate (\geq 50% diameter stenosis at follow-up angiography), procedural success rate (proportion of patients with <50% diameter stenosis after the procedure, as assessed by the core laboratory, and no major adverse cardiac event during the hospital stay), and the proportion of patients without a major adverse cardiac event at 30 days.

All data were analyzed on an intent-to-treat basis, using descriptive statistical techniques. The difference in late loss at the proximal and distal edges was analyzed using the Wilcoxon signed-rank test for non-normally distributed data to establish whether it differed significantly from 0. The effect of the stenting method (i.e., direct stenting vs predilatation) on the late loss difference was assessed using a nonparametric analysis of variance test (Kruskal-Wallis test).

Between October 2002 and May 2003, 202 patients were enrolled at 13 centers. The baseline data are listed in Tables 1 and 2. One patient had 2 lesions that were treated using a study stent. A total of 203 lesions in 202 patients were therefore available for evaluation at baseline.

Three patients died before the 30-day follow-up evaluation; thus, 199 patients completed the 30-day follow-up evaluation. Of the 3 deaths, 1 was considered to be the result of in-stent thrombosis, and the other 2 were unrelated to the stent; 1 patient with acute depression committed suicide and the other death was due to a cardiac-related event. A total of 198 patients completed the 6-month follow-up visit, with 1 patient lost to follow-up between visits.

A total of 220 stents (217 Driver stents and 3 nonstudy stents) were used for the 203 procedures. Direct stenting was used in 118 of 202 patients (58.4%) and predilatation was used in 84 (41.6%). Postprocedural angiographic data were available for 199 lesions in 198 patients. The angiographic success rate for the lesions analyzed was 100%, and the procedural success rate was 98% (194 of 198 patients). The mean diameter stenosis of the target lesion was reduced from 66.4% before to 11.5% after the procedure.

The in-stent and in-segment binary restenosis rate (\geq 50% diameter stenosis) at 6 months was 12.6% (22 of 174 patients; Table 2). The overall mean in-stent late loss at 6 months was 0.83 mm, based on data from 147 lesions (92 from the predilatation group and 55 from the direct stenting group). Late loss was not significantly different between patients who underwent direct stenting or stenting after predilatation (0.86 vs 0.77 mm, respectively, $p = 0.25$; Figure 1). The proximal edge late loss was significantly higher than the distal edge late loss. This difference held for

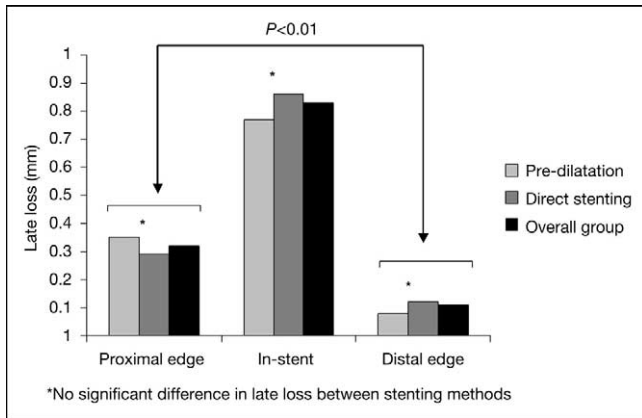


Figure 1. Comparison of late loss (in-stent and proximal and distal edges) for direct stenting (dark gray bars) and stenting with predilatation (light gray bars) groups. Black bars, overall group.

Table 3
Major adverse cardiac events (n = 202)

Event	In-hospital	30 Days	6 Months
Death	0	1.5%	1.5%
Myocardial infarction			
Q wave	0	0	0
Non-Q wave	2.5%	2.5%	3.0%
Coronary artery bypass graft	0	0	0.5%
Percutaneous target lesion revascularization	1.0%	1.0%	9.4%
Patients with major adverse cardiac event	2.5%	4.0%	12.4%
Major adverse cardiac event-free survival	97.5%	96.0%	87.6%

the entire set of patients and in the 2 subgroups defined by direct stenting and predilatation.

The frequency of major adverse cardiac events during the 6-month follow-up is listed in Table 3. The proportion of patients without a major adverse cardiac event at 6 months after the procedure was 87.6% (177 of 202).

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The present study was designed to assess the safety and efficacy of the Medtronic Driver stent in patients with stable and unstable angina for the treatment of single de novo lesions in native coronary arteries. The Driver stent was deployed with a high degree of procedural and angiographic success, similar to results obtained from studies using stents manufactured from stainless steel (87% to 100%).⁵⁻¹⁰ The primary safety outcome, the cumulative incidence of major adverse cardiac events at 6 months, also compared favorably with that in studies using stainless steel stents.^{7,8,10} Furthermore, the procedural and angiographic success rates we observed were consistent with those obtained from the recently completed Driver Registry, which evaluated the Driver stent in patients with symptomatic ischemic heart disease.¹¹

The only other cobalt-chromium alloy stent to be evaluated in a clinical trial is the thin-strut (0.0032 in) Guidant Vision Multi-Link stent (Guidant Corporation, Indianapolis,

Indiana). The results observed in the present study are comparable to those obtained from the Guidant Vision Multi-Link stent registry. The degree of late loss and the frequency of binary in-stent restenosis at 6 months were similar.¹²

Several comparative studies have demonstrated that stents with thinner struts significantly reduce the incidence of restenosis by $\leq 40\%$ relative to thicker strut devices.¹⁻³ The 6-month restenosis rate and the degree of late lumen loss observed in our study compared favorably with the results from other studies in which thin-strut stainless steel stents were used.⁶⁻⁸

The Driver stent can be used as the platform for the drug-eluting stent, Endeavor. Biocompatibility is an important feature in drug-eluting stents, preventing late restenosis and device failure. The results of the Clinical and Angiographic analysis with a Cobalt Alloy Coronary Stent (CLASS) study, in terms of restenosis rates and late loss, suggest that the biocompatibility of the Driver stent is good.

Appendix

The CLASS Study Investigators are as follows: V. Legrand, CHU Sart Tilman, Liege, Belgium; H. Kelbaek, Denmark, Rigshospitalet, Copenhagen, Denmark; K.E. Hauptmann, Krankenhaus der Barmherzigen Brüder, Trier, Germany; D. Glogar, AKH, Vienna, Austria; W. Rutsch, Universitätsklinikum Charité, Berlin, Germany; G. Grollier, CHU, Caen, France; P. Vermeersch, AZ Middelheim, Antwerp, Belgium; J. Elias, St. Charles Hospital, Beirut, Lebanon; C.C. De Cock, VU Medical Center, Amsterdam, The Netherlands; V. Voudris, Onassis Cardiac Surgery Center, Athens, Greece; M. Gomez-Recio, Hospital La Princesa, Madrid, Spain; A. Schömig, Deutsches Herzzentrum München, Munich, Germany; V. Mainar, Hospital General Universitario de Alicante, Alicante, Spain.

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