Original Article

Outcomes of Percutaneous Coronary Intervention on Saphenous Vein Graft and Native Coronary Vessels

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Abstract

Background: *The optimal target for revascularization in patients with history of coronary artery bypass graft surgery (CABG) is unclear. This study was designed to compare the outcome of percutaneous coronary intervention (PCI) on saphenous vein grafts (SVG) and that on native vessels in patients with previous CABG in terms of major adverse cardiac events (MACE).*

Methods: *The study drew upon data on consecutive patients hospitalized for PCI and MACE rate during a nine-month follow-up period. The patients were divided according to the target vessel for PCI into two groups: SVG and native vessel.*

Results: *Between 2003 and 2007, 226 patients underwent PCI 6.57 ± 4.55 years after CABG. Their mean age was 59.52±9.38 years, and 176 (77.9%) were male. PCI was performed on the SVG in 63 (27.9%) patients and on the native coronary artery in the rest. During a nine-month follow-up period, 9 (4%) patients suffered MACE; the prevalence of MACE was not significantly different between the SVG group (4.8%) and the native vessel group (4.9%), (p value = 0.999).*

Conclusion: *PCI on grafted and native vessels did not affect MACE in patients undergoing PCI after CABG.*

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Introduction

It is more than three decades since percutaneous coronary intervention (PCI) was first used to treat coronary lesions. The treatment of the stenotic lesions of the saphenous vein grafts (SVGs) still poses a challenge to cardiovascular medicine.

Nearly half of all SVGs tend to become occluded and 40% of the rest become severely diseased within a decade after coronary artery bypass graft surgery (CABG).[1, 2] The fact that repeat CABG is associated with high morbidity and mortality has rendered PCI the preferred method for revascularizing patients with a history of CABG.[3, 4] The search, however,

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still continues for newer devices and modalities for lesions in grafted vessels.[5-12]

There is a lesser tendency on the part of interventionists to attempt PCI on grafted vessels rather than on native coronary vessels; however, the ever-increasing number of patients who survive longer after CABG is leaving them with fewer choices. Although CABG and PCI can complement each other,[13] there is a paucity of data on the comparison between the outcome of PCI on grafted vessels and that on native coronary arteries.

The present study draws upon the Tehran Heart Center Registry-Interventional Cardiology (THCR-IC) and Laboratory Registry, which contain data on demographics, clinical and laboratory findings, in-hospital outcome, and mid-term follow-up in outpatient and/or inpatient settings and seeks to compare the short- and mid-term outcomes of intervention on the SVG and those on native coronary arteries in patients requiring revascularization after CABG.

Methods

Our study population, consisting of 226 consecutive patients with a history of previous CABG undergoing PCI between 2003 and 2007, was drawn from the Interventional Registry carried out at Tehran Heart Center (THCR-IC). The investigation was approved by the institutional Review Board, overseeing the participation of human subjects in research at Tehran University of Medical Sciences. This study conforms to the principles outlined in the Declaration of Helsinki. The inclusion criteria were a previous history of CABG before PCI with either balloon angioplasty alone or stenting with bare metal stents (BMS) or drug-eluting stents (DES). Patients who had an acute myocardial infarction (MI) ≤ 72 hours prior to PCI or those who underwent PCI on both native vessels and SVGs were excluded. The selection of the vessel for PCI was left to the discretion of the operators. Sixty-three patients (with 82 lesions) underwent percutaneous revascularization on their SVG lesions and 163 patients (with 212 lesions) had the procedure done on their native vessels. The operators selected the strategy based on a combination of patient symptoms, results of noninvasive testing, territory of ischemia, results of diagnostic angiographies, and complexity or feasibility of the procedure.

The PCI procedures and stent applications were performed via standard techniques using the femoral approach. Distal embolic protection devices were employed in 26.9% of the patients whose target vessel for PCI was a grafted vein.

All the patients received Aspirin (325 mg) and a 300-600mg loading dose of Clopidogrel before the index procedure, intravenous unfractionated heparin (70 - 100 IU/kg) during the procedure, which was terminated with the procedure, and Aspirin (325 mg) for a minimum of one month. Additionally, copidogrel was prescribed for at least one month after BMS

implantation and several months after DES implantation.

Follow-up information was obtained by direct clinical visits of the patients at the first, sixth, and ninth post-procedural months or from the referring physicians and telephone interviews. The rate of loss to follow-up was about 5%, which was included in the analysis. The patients were not subjected to further coronary angiography unless clinically indicated.

Target vessel revascularization (TVR) was defined as all PCIs done on the same vessel or CABG. Target lesion revascularization (TLR) was defined as ischemia-driven repeat revascularization of the target lesion only by PCI.ST-elevation MI was defined as the presence of new pathological Q waves in the electrocardiogram and a rise in CKMB ≥ 3 of the normal limit. A non-ST elevation MI was defined as just creatine kinase-MB enzyme elevation ≥ 3 of the normal value. Major adverse cardiac events (MACE) were defined as cardiac death, non-fatalMI (ST-elevation or non- ST elevation), and TVR or TLR. All deaths were considered cardiac unless otherwise recorded.

The MACE rates were compared between the native vessel and SVG groupsin patients with a history of CABG with respect to both in-hospital and nine-month follow-up period. The results are reported as mean ± standard deviation (SD). The categorized variables were summarized as frequencies and percentages. The groups were compared using the Student t-test or Mann-Whitney U for the continuous variables and the $\chi2$ test for the dichotomous variables. Pvalues of 0.05 or less were considered statistically significant. All the statistical analyses were carried out via Statistical Package for Social Sciences version 15 (SPSS Inc., Chicago, Illinois, USA).

Results

The study population was comprised of 226 patients with a mean age of 59.52 ± 9.38 years. There were 176 (77.9%) male patients. The clinical and angiographic characteristics of the patients are listed in Table 1, which shows that the two groups of patients were similar in most of the baseline characteristics.

For 17 (26.9%) of the SVG patients, a distal embolic protection device was used. The no-reflow phenomenon occurred in 9 (14.2%) patients in the SVG group. There was no significant difference between the frequency of use and non-use of the distal protection device amongst the patients with no-reflow: 3 (17.6%) vs. 6 (13.0%) respectively, p value = 0.692). All the no-reflow patients were treated with adenosine or verapamil successfully. More patients in the SVG group had prior MI than did those in the native vessel group: 31 (49.2%) vs. 42 (25.8%), p value = 0.001. The SVG patients also had longer CABG to PCI intervals, larger reference vessel as well as stent diameters than did the other

patients (8.94 ± 4.83 vs. 5.67 ± 4.11, p value < 0.001, 3.58 ± 0.64 vs. 3.05 ± 0.42, p value < 0.001 and 3.46 ± 0.54 vs. 3.07 ± 0.41, respectively, p value < 0.001) (Table 1). However, MACE, both in hospital and mid-term, had no significant difference between the two groups (Figure1& 2). In the SVG group, 3 patients had non-ST elevation MI (NSTEMI) compared to 2 cases of NSTEMIs in the native vessel group patients (4.8% vs. 1.8%, p value = 0.134).
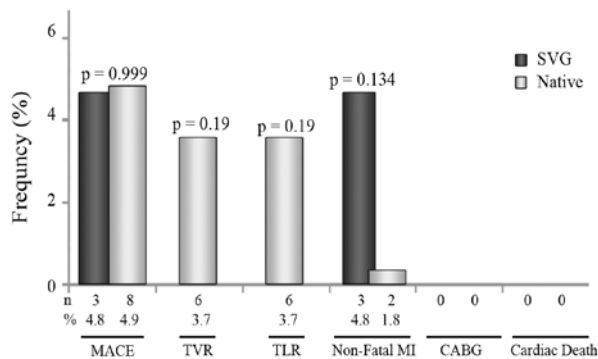

Figure 1. Cumulative clinical outcome during 9 months in SVG and native vessels

SVG, Saphenous vein graft; MI, Myocardial infarction; MACE, Major adverse cardiac event; TVR, Target vessel revascularization; TLR, Target lesion revascularization; CABG, Coronary artery bypass graft
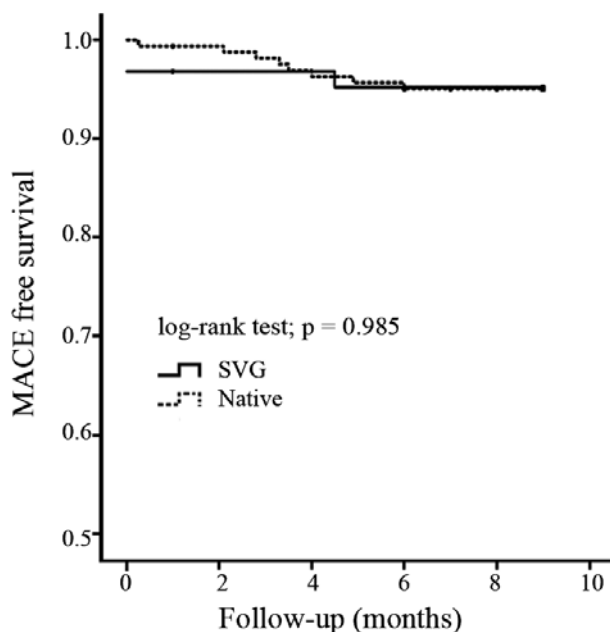

Figure 2. Kaplan-Meier curves with log-rank test for survival withoutmajor adverse cardiac events (MACE) in patients undergoing angioplasty on saphenousvein grafts versus native vessels

Of the 163 patients in the native vessel group, 17 (10.4%) were treated with balloon angioplasty and the rest with stenting (DES, n = 75; BMS, n = 68; and mixed, n = 3).

The reference vessels are depicted in Table 2 in detail. After nine months, the incidence of MACE in the patients with native vessel intervention was 4.9% compared with 4.8% in the SVG group (p value = 0.999), (Figure2). The univariate analyses showed no statistically significant relation with the end-point events.

Discussion

The main finding of this report is that PCI for the treatment of SVG lesions appears safe, feasible, and effective when compared to PCI on native coronary vesselsin patients with history of previous CABG.

It is expected that more than 50% of SVGs will develop stenosis within 10 years of surgery.[14] In the present study, we observed that the interval between CABG and PCI on SVGs was 8.94 ± 4.83 years, which was significantly longer than that between CABG and PCI on native coronary arteries (5.67 ± 4.11 years). We would argue that a lesser tendency on the part of interventionists to challenge grafted vessels could be the reason for this difference.

The no-reflow phenomenon is a concern in SVG intervention. Distal embolic protection devices have been shown to be beneficial in the prevention of this complication.[15] These devices were used in 26.9% of our SVG group patients (17 of 63 patients), which is close to a reported 22% in the US hospitals.[16]

Recent advances in technology have decreased the rate of early MACE, including both ST and non-ST elevation MI, to less than 3%.[17, 18] In our study, 2 (0.88%) of the study patients had in-hospital NSTEMI: The two cases were found in the SVG group (3.17%) versus none in-hospital NSTEMI cases identifiedin the native vessel group (p value = 0.077). The occurrence of MI after PCI lowers survival and worsens prognosis. In the present study, however, the limited number of cases precludes an in-depth discussion on these end-points.

Because of higher morbidity and mortality associated with repeat CABG, percutaneous intervention is a preferred option for SVG lesions.[19] Early reports of using PCI to treat SVG lesions did not show good results[20] and the incidence of restenosis was relatively high.[21, 22] In contrast, of our 63 patients, only 3 (4.8%) patients (p value = 0.999) had MACE during the nine-month follow-up period, which may have been due to improvements in the techniques, skills of the operators, and qualities of the devices utilized such as stents, balloons, and wires. Some authors recommend that native artery lesions be targeted first, whenever possible, because of their lower restenosis rate. In this study, the selection of the strategy was based on the preference of the individual operator.

Table 1. Baseline Clinical and Angiographic Characteristics (n=226)*

	All (n=226)	SVG (n=63)	Native (n=163)	p value
Age (y)	59.52±9.38	60.51±9.67	59.13±9.26	0.325
Male gender	176 (77.9)	52 (82.5)	124 (76.1)	0.294
HLP	178 (78.8)	55 (87.3)	123 (75.5)	0.051
HTN	112 (49.6)	28 (44.4)	84 (51.5)	0.339
DM	67 (29.6)	19 (30.2)	48 (29.4)	0.916
C/S				0.021
No	131 (58.0)	31 (49.2)	100 (61.3)	
Current	31 (13.7)	15 (23.8)	16 (9.8)	
Quitted	64 (28.3)	17 (27.0)	47 (28.8)	
BMI (kg/m²)	27.36±3.87	27.10±3.30	27.47±4.09	0.531
LVEF (%)	49.11±10.30	46.96±11.01	49.89±9.96	0.079
Previous PCI	21 (9.3)	7 (11.1)	14 (8.6)	0.558
Previous MI	73 (32.3)	31 (49.2)	42 (25.8)	0.001
RVD (mm)	3.2±0.55	3.58±0.64	3.05±0.42	<0.001
Lesion Length (mm)	20.33±9.68	19.60±9.95	20.63±9.58	0.481
Lesion Number	1.30±0.54	1.30±0.56	1.30±0.53	0.990
Stent Length (mm)	21.54±6.99	21.44±6.26	21.58±7.29	0.888
Stent Diameter (mm)	3.19±0.48	3.46±0.54	3.07±0.41	<0.001
Stent Number	1.14±0.58	1.25±0.57	1.10±0.58	0.070
Type of Procedure				
POBA	18 (8.0)	1 (1.6)	17 (10.4)	0.028
Stenting				0.011
DES	97 (42.9)	22 (34.9)	75 (46.0)	
BMS	104 (46.0)	36 (57.1)	68 (41.7)	
Mixed	7 (3.1)	4 (6.3)	3 (1.8)	
CABG Interval (y)	6.57±4.55	8.94±4.83	5.67±4.11	<0.001

*Data are presented as mean±SD or n (%)

SVG, Saphenous vein graft; HLP, Hyperlipidemia; HTN, Hypertension; DM, Diabetes mellitus; C/S, Cigarette smoking; BMI, Body mass index; EF, Ejection fraction; PCI, Percutaneous coronary intervention; MI, Myocardial infarction; RVD, Reference vessel diameter; POBA, Plain old balloon angioplasty; DES, Drug-eluting stent; BMS, Bare metal stent; CABG, Coronary artery bypass graft

Table 2. Reference Vessels (n=226)*

	SVG (n=63)	Native (n=163)
Diagonal	5 (7.9)	1 (0.6)
LAD	4 (6.3)	31 (19.0)
LCX	0	38 (23.3)
LM- protected	0	2 (1.2)
OM	25 (39.7)	8 (4.9)
Ramus	5 (7.9)	3 (1.8)
RCA	9 (14.3)	36 (22.1)
PDA	4 (6.3)	0
Muli-vessel	11 (17.5)	44 (27.0)

*Data are presented as n (%)

LAD, Left anterior descending; LCX, Left circumflex; LM, Left main; OM, Obtuse marginal; RCA, Right coronary artery; PDA, Posterior descending arter

Some researchers have investigated the rate of late occlusion in SVG lesions following PCI based on the type of the stent[23] and the pattern of restenosis in comparison with the same rate after PCI on native coronary arteries;[24] this issue is not dealt with in the present study.

The data used in this study were derived from a single-center registry; therefore, the study is bound to have some limitations. The small sample size precludes an analysis on the basis of different methods of angioplasty and different types of stents. Furthermore, the follow-up duration of our study population is relatively short; longer follow-up durations may yield different conclusions. Another limitation is the absence of routine angiographic follow-up, which means that not all vessel and stent restenoses were detected.

Conclusion

It seems that in patients with coronary artery disease, PCI and CABG, far from being rivals, are indeed complementary

treatment modalities. Percutaneous revascularization in SVG lesions appears feasible and safe with a good procedural, in hospital and midterm outcome compared with PCI for native vessels in patients with history of CABG. Improvements in the proficiency of interventionists and efficacy of devices are expected to usher in more favorable outcomes for intervention on grafted vessels.

Acknowledgement

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