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Short-term and long-term clinical outcomes of percutaneous coronary intervention on saphenous vein grafts

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OriginalArticle

Abstract

BACKGROUND: Ischemic heart disease (IHD) is the leading cause of 16% of deaths globally. Percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) are the main treatment options. Saphenous vein grafts (SVGs) remain the most frequently used conduits for CABG. In addition, PCI in cases previously undergoing CABG is related to worse long-term outcomes. This study aimed to evaluate PCI's short-term and long-term clinical outcomes on SVGs.

METHODS: Sixty-three patients who underwent PCI on SVGs from 2017 to 2019 were enrolled. Short-term and long-term cardiac outcomes of patients in the 6-month follow-up, including major adverse cardiac events (MACE) and all causes of death, were collected. The collected data were also analyzed through statistical methods.

RESULTS: The mean age of the subjects was 63.26 ± 8.74 years. Out of 63 patients, five patients (7.94%) died. Two of them died because of cardiac death a day after PCI, and three other cases passed away during the 6 months after angioplasty. Four and three cases had non-fatal myocardial infarction and stroke 6 months after PCI, respectively.

CONCLUSION: In conclusion, in patients with coronary artery disease, PCI and CABG are complementary therapies. Revascularization on saphenous vein grafts seems to be a safe and practical technique in patients.

Keywords: Adverse Cardiac Events; Myocardial Infarction; Angioplasty; Coronary Artery Bypass Grafting; Heart Arrest; Revascularization

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Introduction

Ischemic heart disease (IHD) is known as the leading cause of death, responsible for 16% of the total deaths worldwide in 2019[1]. Percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) are the main treatment options. Recent guidelines recommend CABG for the revascularization of patients with multivessel disease or diabetes mellitus to improve their clinical outcomes and reduce major adverse cardiac events (MACE)[2-5]. Saphenous vein grafts (SVGs) remain the most frequently used conduits for CABG. Despite significant improvements in surgical techniques, the SVG failure rate remains high, with about 13% of cases undergoing CABG requiring repeated revascularization within 10 years. SVG failure is due to three pathophysiologic processes: technical failure and thrombosis within the first week and month after CABG, followed by intimal hyperplasia from one month to one year, and atherosclerosis after one year. Antiplatelet therapy and lipid management may delay the progression of SVG atherosclerosis and failure[6]. Repeated revascularization procedures are significantly different from recurrent interventional

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procedures. PCI in cases previously undergoing CABG is related to worse long-term and acute outcomes compared to de novo interventions. Likewise, patients undergoing CABG for the second time have higher mortality than the first operation[7]. SVG occlusive lesions are mostly treated with PCI, which has two important consequences: (1) acute distal embolism and no-reflow, and (2) high rates of SVG restenosis during follow-up[6]. There is little data comparing the efficacy and clinical outcomes of PCI and CABG in cases with previous CABG[7]. This study aimed to evaluate the short-term and long-term clinical outcomes of percutaneous coronary intervention on saphenous vein grafts.

Methods

Patient selection

This cross-sectional study was performed on 63 patients who underwent PCI on SVGs at Dr. Heshmat's Heart Center from January 2017 to December 2019. Patients with a history of cardiogenic shock, chronic kidney disease (GFR < 30), simultaneous PCI on SVG and native vessels, and simultaneous PCI on SVG and arterial grafts were excluded from the study. Baseline characteristics of subjects, including age, gender, smoking, history of diabetes mellitus, hypertension, stroke, and family history of coronary artery disease, were collected from subjects' files.

We then collected short-term and long-term clinical outcomes of patients, including cardiac death, non-fatal MI, stroke, recurrent revascularization on SVG, and non-cardiac death. Short-term and long-term outcomes were evaluated at baseline and 6 months after PCI. All of the aforementioned parameters were collected by a researcher-made checklist during the six-month follow-up via telephone.

Statistical Analysis

Frequency and percentage were used to describe qualitative data, while mean and standard deviation were used for quantitative data. The Shapiro-Wilk test was employed to check normality, and Levene's test was used to assess the homogeneity of variances. To establish relevant assumptions for quantitative variables, independent t-tests and paired t-tests were utilized. McNemar's and Fisher's exact tests were applied to examine qualitative variables. IBM SPSS Statistics software (version 28, IBM Corporation, Armonk, NY, USA) was used for all statistical analyses. The significance level was set at 0.05 for all tests.

Ethical Approval

This study was approved by the Cardiovascular Diseases Research Center at Heshmat Hospital of the Guilan University of Medical Sciences. Additionally, the Ethical Research Committee of the Guilan University of Medical Sciences approved it with the code IR.GUMS.REC.1399.114. Written informed consent was obtained from all participants during the enrollment process.

Results

In general, we investigated 63 patients who underwent PCI on SVGs. The mean age of the cases in this study was 63.26 ± 8.74 years (range: 37-93 years). The majority of patients were male (81%). Out of 63 patients, 17 (27%) were smokers, 3 (4.8%) had a history of stroke, 46 (73%) were hypertensive, 29 (46%) were diabetic, and 19 (30.2%) had a family history of coronary artery disease. The frequency of MACE was 14 (22.2%). We compared the short-term and long-term clinical outcomes of PCI on SVGs at baseline and 6 months after PCI (Table 1).

As Table 1 shows, there is no significant difference

Table 1. Comparison of short-term and long-term clinical outcomes after PCI

Variables	Short-term outcomes N (%) N=63	Long-term outcomes N (%) N=63	P-value*
Cardiac death	2 (3.17%)	0	0.500
Non-cardiac death	0	3 (4.76%)	0.250
Non-fatal MI	0	4 (6.35%)	0.125
Stroke	0	3 (4.76%)	0.250
Recurrent TVR on the same SVG	1 (1.59%)	3 (4.76%)	0.625
Recurrent TVR on another SVG	5 (7.94%)	1 (1.59%)	0.125

MI: Myocardial Infarction; TVR: Target Vessel Revascularization, SVG: Saphenous vein graft
*McNemar test

Table 2. Frequency of target vessels

Target vessels	N (%)
OM	24 (38.1%)
PDA	16 (25.4%)
Diagonal	6 (9.5%)
LAD & Diagonal	6 (9.5%)
RCA	5 (7.9%)
OM & RCA	2 (3.2%)
PDA & OM	1 (1.6%)
SVG	1 (1.6%)
OM & Diagonal	1 (1.6%)
LCX	1 (1.6%)

OM: obtuse marginal; PDA: posterior descending artery; LAD: left anterior descending; RCA: Right coronary artery; SVG: Saphenous vein graft; LCX: left circumflex

between outcomes in short-term and long-term follow-up.

The grafts' locations on which PCIs were performed are shown in Table 2.

Out of 63 patients in this study, 5 (7.94%) died. Two of them died due to cardiac death one day after PCI. The other three patients passed away due to non-cardiac causes such as stroke, infectious diseases, and diabetes complications. Additionally, 55.6% of the participants had no cardiac symptoms and felt well after PCI.

Discussion

In this study, we investigated the short-term and long-term clinical outcomes of primary coronary intervention on saphenous vein grafts (SVGs).

Graft patency is an important and useful determinant of patients' long-term survival[5,8]. Long-term patency of SVGs remains a concurrent challenge[9]. These grafts are subject to intimal hyperplasia, thrombosis, and atherosclerosis, leading to graft failure between 50-60% at 10 years[5,10]. In the present study, the average time between CABG and SVG PCI requirements was around 10.5 years. This result is in accord with recent studies indicating that almost half of venous graft conduits fail at 10 years[5,11]. The rate of all-cause mortality in our study was 9.5%, which is similar to the Hara et al. study. Their study showed 9.27% all-cause mortality during a two-year follow-up of patients with prior CABG who underwent PCI, in comparison with 2.66% in patients without prior CABG[12]. Prior studies have noted that PCI in patients with prior CABG is associated with worse outcomes compared with patients who had no history of CABG[13,14].

In our study, the 6-month MACE was 22.2%. Ferrari et al. reviewed data from several articles which studied 14,748 individuals, and the pooled one-year MACE was 15.5%. The majority of mortalities among our patients were caused by cardiovascular events, which is consistent with data obtained in the Baqi et al. study[15]. In the present survey, about half of the deaths (50.2%) were due to cardiac events, while other causes included stroke, infection, and diabetes progression, with similar rates. These results differ from some published studies[16-18]. A possible explanation for this might be caused by the small sample size and short duration of follow-up. In our study, about 50% of deaths came about during the first day after graft PCI. Halkin et al. showed that all mortalities occurred six months after hospital discharge[19]. This differs from the findings presented here. There were no non-fatal MIs reported in this study during hospitalization; however, Halkin et al. reported a 7.5% intra-hospital non-fatal MI rate after graft PCI[19]. Another study also showed a few cases of non-fatal MI after graft PCI during hospitalization[20]. In this study, 6.3% of participants experienced non-fatal MI six months after SVG PCI, which is somewhat similar to the results of the Alidoosti et al. study[21]. In the current study, 4 patients (6.3%) required recurrent revascularization. The Adnan et al. study reported a 9% incidence of target vessel revascularization[22].

The study revealed that more than 80% of the study population was male. This finding is similar to a study by Baqi et al., in which 86.6% of patients were male[15]. As previously reported, the male gender is an independent risk factor for coronary artery diseases[22]. The average age of participants in our study was about 63 years, which also accords with some earlier observations conducted to evaluate the outcomes of PCI on vein grafts[22,23]. About three-fourths of participants in this study had a history of hypertension, similar to the findings of the Adnan et al. study[22], and less than half of them were diabetic, consistent with the Redfors et al. study[23].

Our findings showed that the most common location of SVG anastomosis was on the OM (38.1%), which is in agreement with those obtained in previous research by Baqi et al., who worked on periprocedural and in-hospital outcomes among PCI

on SVG[15]. A great deal of previous studies revealed that target vessel diameter can affect long-term graft patency. At 10 years, SVG patency in vessels with a diameter ≤ 2mm was 55%, which is clearly lower than SVG patency in vessels with a diameter > 2mm[6]. Furthermore, target vessel quality affects graft patency. SVG to a right coronary artery or the circumflex has a higher risk of occlusion compared with those to the LAD[6].

Our study is not free of limitations. The findings in this report are subject to at least three limitations. First, the small sample size of our study, which investigates patients from a single center, may not represent the whole population. Second, a six-month follow-up may underestimate the adverse outcomes of the procedure. Thus, further studies with longer follow-ups need to be carried out to assess all procedure-related outcomes. In addition, we suggest a prospective randomized cohort study to achieve more reliable results.

Conclusion

In conclusion, in patients with coronary artery disease, PCI and CABG are complementary therapies. Revascularization on saphenous vein grafts seems to be a safe and practical technique in patients.

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Conflict of interests

The authors declare no conflict of interest.

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Author's Contributions

SN contributed to the conception and analysis. AS, SN and AFM contributed to the study design and supervised the study. MGH contributed to data collection. AGH and BMZ wrote the initial draft. AP revised the manuscript. All authors approved the final manuscript for submission.

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