Pertanika J. Sci. & Technol. 27 (3): 1361 - 1369 (2019)

PERTANIKA JOURNALS

SCIENCE & TECHNOLOGY

Journal homepage: http://www.pertanika.upm.edu.my/

Safety and Efficacy of Percutaneous Coronary Intervention in Symptomatic Patients with the History of Prior Coronary Artery bypass Graft Surgery

Behshad Naghshtabrizi[1], Farzad Emami[1], Mehdi Moeini[1], Maryam Farhadian[2] and Azadeh Mozayanimonfared[1]*

[1]Department of Cardiology, School of Medicine, Hamedan University of Medical Sciences, Hamedan, Islamic Republic of Iran
[2]Department of Biostatistics, School of Health, Hamadan University of Medical Sciences, Hamadan, Islamic Republic of Iran

ABSTRACT

After coronary artery bypass graft surgery (CABGs), repeat revascularization is often necessary due to progressive atherosclerosis of coronary arteries and grafts, poor patency, limited longevity, and higher risk of redo CABGs. However, data regarding percutaneous revascularization among post-CABGs patients are limited. In this cohort study, 83 subjects with a history of CABGs and recent percutaneous coronary intervention (PCI) at Ekbatan University Hospital were recruited, between January 2013 and January 2017. We followed them at 1-year intervals to evaluate the prevalence of major adverse cardiac events (MACE). The mean duration of follow-up was 28 months. The mean age of the patients was 63 years, and 75% were male. One hundred and three target vessels had undergone PCI with 109 stents, of which 90% were drug-eluting stents (DES). Procedural success was 90%. 19.6% of the procedures were performed on grafts. Mean angina class decreased by one during follow-up, from 2.94 to 1.8. Thirteen patients suffered MACE with 5 cardiac death, 4 nonfatal myocardial infarction (MI), and 8 repeat revascularization, of

ARTICLE INFO

Article history:
Received: 26 April 2018
Accepted: 27 March 2019
Published: 24 July 2019

E-mail addresses:
behshadnaghshtabrizi@yahoo.com (Behshad Naghshtabrizi)
farzademami43@yahoo.com (Farzad Emami)
mahdimoeeni@yahoo.com (Mehdi Moeini)
m.farhadian@umsha.ac.ir (Maryam Farhadian)
azadeh_m27@yahoo.com (Azadeh Mozayanimonfared)
* Corresponding author

ISSN: 0128-7680
e-ISSN: 2231-8526

which 4 were target vessel revascularization. The rate of MACE at one, two, and three years was 17.5%, 25%, and 35%, respectively. Based on univariate analysis, graft PCI was an independent predictor of MACE. Cardiac death can be predicted by age, left ventricular ejection fraction (LVEF), and history of MI. For patients with a history of CABG and recurrence of symptoms, PCI is considered as an efficient and risk-free modality, which can be relied on to alleviate symptoms.

Keyword: Coronary arteries bypass surgery, MACE, repeat revascularization

INTRODUCTION

By introducing CABG [grafting Left Internal Mammary Artery (LIMA) or Saphenous Vein (SVG) to native stenotic vessels] in 1964 for the first time, a revolution in the treatment of coronary artery disease occurred. Improving survival and achieving complete revascularization were two important factors in choosing this strategy in patients with multivesseles coronary artery disease especially with low left ventricular ejection fraction (LVEF) and history of diabetes mellitus. In addition to these considerable advantages, higher rate of morbidity and stroke in perioperative period and recurrence of angina pectoris and clinical evidence of ischemia in subsequent years after CABGs occurred frequently (Goldman et al., 2004). Vein graft failure, progression of atherosclerosis in native coronary arteries and incomplete initial revascularization due to inappropriate anatomy of coronary arteries are the most common causes of relapsing of ischemic symptoms (Webb et al., 1990). Managing of this situation is controversial. According to previous studies ,within 10 years follow up, between 20% and 30% of patients with the history of CABGs, need a second bypass procedure, and approximately 40% of the patients with a history of prior CABGs in a 20 year period of follow up underwent repeat revascularization, either reoperation CABGs (redo) or PCI (Sabik et al., 2006) and about 17.5% of the patients undergoing PCI have a history of prior CABG (Brilakis et al., 2011).

Due to prior studies, the 10-year patency rate of the internal mammary artery graft has been reported to be 85–95%. 10 to 25% of SVGs will fail at 1 year after procedure, between 1 and 5 years after CABGs ,5 to 10% of SVGs will occlud and from 6 to 10 years, 20 – 25% of vein grafts will close. So, the patency rate of SVGs at 10 years is 50% (McKavanagh et al., 2017).

Due to technical difficulty and the high risk profile of these patients, hospital mortality and morbidity, the overall risk of redo has been consistently higher than initial one (Sabik et al., 2005) and it has inferior results with regard to symptom relief. Therefore, it is rational to use appropriate alternative therapies to reduce ischemic symptoms and improve quality of life. Percutaneous coronary intervention (PCI) in either the native vessel

(NV) or the graft becomes the preferential option for revascularization following CABG treatment. The result of previous studies about the optimal percutaneous strategy in patients with SVG stenosis was controversial. In some study Graft-PCI shows superior outcomes to redo; however, graft-PCI is complex due to the anatomy of the saphenous vein and results in low success rates. Graft-PCI is easily complicated by distal thrombosis during the procedure, post-procedural restenosis and unconfirmed long-term efficacy; therefore, current guidelines do not recommend PCI for the treatment of totally occluded graft, so PCI on native vessels if possible is logical, but on the other hand, due to atherosclerosis progression and increasing the rate of complex, calcified and totally occluded lesions, it can be impossible. Therefor select of target vessel revascularization for either the graft or native coronary arteries remains unanswered.

In this study, we try to analyze the safety and efficacy of PCI in symptomatic patients with the history of CABGs, particularly its effect on reducing ischemic symptoms and as a result improving quality of life.

MATERIALS AND METHODS

Between 2013 and 2017, a total of 83 patients with the history of CABGs, who were candidates for repeat revascularization based on clinical and paraclinical findings were enrolled in this study, consecutively. The study was performed at Ekbatan University Hospital, Hamadan, Iran. Patients underwent selective coronary angiography (SCA) depending on their symptoms (acute coronary symptoms or chronic stable angina) and the intermediate to high risk result of noninvasive tests. Study protocol was approved by the local institutional review board and ethnics committee of Hamadan University of medical sciences.

The physician selected the suitable patients for PCI (with bare metal or drug eluting stents) who were described as high-risk for redo CABGs due to comorbidities, emergencies situations, or coronaries anatomy. Patients who had contraindications for dual antiplatelet therapy were excluded. PCI was performed using current standard interventional techniques. Decision to perform PCI on native or grafted vessels was operator dependent and target vessel revascularization was performed based on the patient symptoms, noninvasive tests and coronary angiogram results, ischemia territory, and procedural complexities. Diameter and length of the lesions were assessed by two-dimensional Quantitative Coronary Angiography (QCA). The size and type of the selected stents for each patient were at the discretion of the interventionists performing the procedure according to the last European Society of Cardiology (ESC). All patients were received Aspirin (325 mg) and Clopidogrel (600 mg) and Statins orally before the procedure. During the procedure weight adjusted unfractionated heparin was given (in order to achieving activated clotting time of 250 – 350 seconds, bolus dose of 100 unit/Kg was given). Procedural success was defined as

TIMI flow 3 and less than 20% residual stenosis with no major hospital or procedural complications (emergency operation or death). After the procedure, all patients received dual antiplatelet therapy according to guidelines recommendation for at least one year. Cardiac enzymes and 12-lead electrocardiogram were obtained after PCI and at 12-hour intervals for 24 hours. Myocardial infarction was described as a rise in CK-MB ≥ 3 times the upper normal limit. All of them were followed at 1-year intervals and follow-up information was obtained via clinic visits, telephone interviews, or rehospitalization documents and information regarding events that were documented at other medical centers was also gathered. Selective coronary angiography or repeat revascularization during the follow up period was performed, if the patients had new onset typical symptoms of ischemia or documents of ischemia in noninvasive tests and in all patients quantitative assessment of the severity of chest pain was performed with Canadian Cardiovascular Society grading of angina pectoris (CCS), before the procedure and during follow up period. Reference limits of left ventricular function and the socio-demographic and medical characteristics of patients are presented in Table 1.

Our endpoint, MACE, was defined as death, non-fatal MI (due to in stent thrombosis), or repeat revascularization. Death was described as any cause of death (cardiac or noncardiac). In-stent restenosis was defined as more than 50% stenosis at or 5 mm proximal or distal to the stent. Indications for repeat revascularization were new significant stenosis not present at previous angiography or emerging restenosis in the previous stents. In-stent thrombosis was categorized as definite (an acute coronary syndrome with angiographic or autopsy evidence of thrombus or occlusion adjacent to a stent), probable (unexplained death within 30 days after stent implantation or AMI involving the target vessel territory without angiographic confirmation), and possible (any unexplained death beyond 30 days after the procedure) according to the Academic Research Consortium (ARC) criteria. Two-Dimensional QCA is the technique which is based on contrast coronary angiogram obtaining parameters that objectively quantify the coronary lumen measuring the significance of a coronary stenosis. To obtain the most comprehensive data and avoid foreshortening or underestimation of stenosis severity, at least two projections orthogonal to each other and both perpendicular were analyzed with automated edge detection system (QAngio XA, Medis, Leiden, Netherlands). Complete revascularization was defined as successful treatment of the subject vessel and presence of no lesion of more than 70% stenosis in the remaining coronary arteries or grafted vessel supplying a territory with severe stenosis. Angina class was defined as the Canadian Cardiovascular Society grading of angina pectoris (CCS Functional Classification of Angina) which classified the severity of exertional angina (Campeau, 1976). For statistical analysis, SPSS 21 was used, and comparisons were performed using Chi square, student t-test, logistic regression, and categorical variable comparison tests.

RESULTS

Table 1 showed the baseline characteristic and angiographic data of the subjects. 4 patients (4.8%) were excluded due to inaccessibility during follow up. Mean patient age was 63 years and 65 patients (75.9%) were males. Mean LVEF was 43%. 61% of patients had HTN, 35% had diabetes mellitus, 49% experienced dyslipidemia, and 20% had the history of cigarettes smoking. Fifty percent of patients represented with chronic stable angina and the remains experienced acute coronary syndrome (acute MI or unstable angina).

PCI was performed on 103 target vessels using 109 stents (90% of them were DES). The mean Clinical follow-up was 28 months. Overall, in 19.6% of patients PCI on grafts was performed , and 38.2%, 32.4% and 29.4% of the lesions were type C, B and A, respectively. The more details of the lesions were showed in Table 2. Multi vessel disease was present in 92.4% of patients (in 34.1% of the subjects multivessel PCI was performed).

The mean angina class decreased by approximately one score during follow-up, from 2.94 to 1.8.

Table1

Socio-demographic and medical Characteristics of patients with a history of CABGs and recent percutaneous coronary intervention (PCI)

Socio-demographic Characteristics	N (%)
Age(M±SD)	63.08 ± 9.72
Men	65 (75.9%)
Diabetes mellitus	29 (35.4%)
Hypertension	51 (62.2%)
Hyperlipidemia	41 (50.06%)
Smoking	16 (20.3%)
Previous myocardial infarction	51 (63%)
Clinical presentation	
Stable angina	39 (49.4%)
Unstable angina	28 (35.4%)
Acute myocardial infarction	12 (15.2%)
Left ventricular ejection fraction(M±SD)	42.63±9.72
Left ventricular function	
Normal function (≥55%)	14(18.4%)
Mild dysfunction (45-54%)	20(26.3%)
Moderate dysfunction (30-44%)	24(31.6%)
Severe dysfunction (<30%)	18(23.7%)
Time from bypass surgery(M±SD)	7.79±4.97

The procedural success rate was 90%. Meanwhile, MACE was found in 12 patients (5 cases of cardiac death with no cases of noncardiac death, 4 cases of nonfatal MI, 7 cases need repeat revascularization included 4 of grafts revascularization). The cardiac death was occurred between 11 and 21 month after PCI. The rate of MACE at 1, 2, and 3 years was 17.5%, 25%, and 32.4%, respectively and the rate of cardiac death at 1,2 and 3 years was 7.5%, 11% and 13.5% , respectively. Based on univariate analysis, graft PCI was an independent predictor of MACE. Old age, severity of LV dysfunction, and history of previous MI were independent predictors of cardiac death.

Table2

Procedural and angiographic characteristics of patients with a history of CABGs and recent percutaneous coronary intervention (PCI)

Procedural and angiographic characteristics	N (%)
Target vessel	
Left main	4 (3.9)
Left main-Left circumflex	2(1.9)
Left anterior descending	16 (15.5)
Diagonal	6(5.8)
Left circumflex	21 (21.3)
Obtuse Marginal	18(17.5)
Ramus	3(2.9)
Right coronary arteries	28 (27.2)
Posterior descending arteries	3(2.9)
Poster lateral branch	1(1)
Saphenous vein graft	20 (18.69)
Left internal mammary artery	1 (0.93)
Type of treated vessel	
Unprotected native	63 (58.9)
Protected native	23 (21.5)
Grafts	21 (19.6)
Lesion Location	
Ostium	8(7.96)
Proximal	54 (51.9)
Midpart	29 (27.9)
Distal	13 (12.5)
Chronic total occlusion	13 (12.1)
Drug-eluting stent	98 (89.9)
Bare metal stent	11 (10.1)

Table2 *(Continued)*

Procedural and angiographic characteristics	N (%)
Stent number/patient	
1 stent	52(62.7)
2 stent	18(21.7)
3 stent	6(7.2)
4 stent	3(3.6)
ACC/AHA coronary artery lesions type	
Type A	30 (29.4)
Type B	33 (32.4)
Type C	39 (38.2)

DISCUSSION

The need for repeat revascularization over the next years after CABGs was driven by two pivotal factors: progression of atherosclerosis in native coronary arteries and low rate of vein graft patency. After relapsing the ischemic symptoms, the selection of the best therapeutic strategy in these patients is still indeterminate. In order to widespread use of stents and their acceptable results, PCI is introduced as an alternative choice to revascularization of patients after CABGs, so many trials were performed in this era.

In comparison to previous study such as Tejada trial (Tejada et al., 2009), we tried to enroll the patients with older age, lower EF (55% versus 19.8% with LVEF < 50%) and a higher rate of previous MI (63% versus 18.7%) and we revealed that intervention on SVG was an independent predictor of MACE occurrence, although Behboudi et al (2011). and Alidoosti et al.(2011); reported no correlation between PCI on SVG and MACE in two separate studies. This difference may be related to the short follow-up period (6 and 9 months, respectively) that are not long enough to evaluate the long-term results, such as instent restenosis. In our study MACE occurred almost 1 year later after PCI.

In numerous similar studies different risk factors have been reported for this issue. For example Behboudi reported HTN and bare metal stent (BMS) as independent predictors of MACE (Behboudi et al., 2011). In our study, BMS (10%) was deployed less than other studies; thus, despite the odds ratio of 2.36 showing a trend towards MACE occurrence, the correlation was not significant. Most studies such as J-Cypher registry have shown that graft PCI is associated with worse outcomes specially by deploying first generation of DES (Yamaji et al., 2013). By Cole et al (2002), trial on diabetes mellitus was reported as a predictor of death and in their study, similar to ours, the rate of 1, 2 and 3 -year MACE was 17.5%, 25% and 35%, respectively. Bundhoo et al. (2015) with an average 13.5 month follow-up, reported a MACE occurrence in 13.6% of the patients, and PCI on SVG was a predictive factor for it.

Our procedural success rate was 90%, which is slightly lower than similar studies; it could be due to a higher risk patients and greater number of type C and B lesions, which correlated significantly with procedural failure,

Notably, we showed that PCI could reduce mean angina class, which is similar to other studies but our result was higher than theirs (0.67 and 0.7 versus 1 in our study) (Bundhoo et al., 2015; Mathew et al., 2000).

CONCLUSION

We conclude that angioplasty is a safe, efficient and low risk modality in patients with a history of CABGs and recurrent symptoms. PCI on SVG was recognized as an autonomous predictor of MACE. Thus, if coronary anatomy is suitable for PCI, intervention on native vessels instead of grafts, especially in older patients, could improve the outcomes. Older patients with lower LVEF have a higher risk of death; therefore, performing PCI in them must be careful, weighing the benefits and risks.

ACKNOWLEDGEMENT

We would like to extend our gratitude to a number of patients whose help were very valuable in this research.

REFERENCES

Alidoosti, M., Hosseini, S. K., Sharafi, A., Nematipour, E., Salarifar, M., Poorhoseini, H., … & Lotfi-Tokalday, M. (2011). Outcomes of percutaneous coronary intervention on saphenous vein graft and native coronary vessels. *The Journal of Tehran Heart Center*, *6*(3), 143-147.

Behboudi, F., Vakili, H., Hashemi, R., Hekmat, M., Safi, M., & Namazi, M. H. (2011). Immediate results and six-month clinical outcome after percutaneous coronary intervention in patients with prior coronary artery bypass surgery. *The Journal of Tehran Heart Center*, *66*(11), 31-3631.

Brilakis, E. S., Rao, S. V., Banerjee, S., Goldman, S., Shunk, K. A., Holmes, D. R., … & Roe, M. T. (2011). Percutaneous coronary intervention in native arteries versus bypass grafts in prior coronary artery bypass grafting patients: A report from the national cardiovascular data registry. *JACC: Cardiovascular Interventions*, *4*(8), 844-850.

Bundhoo, M. A. Z., Mohee, R., & Hassan, M. A. (2015). Effects of pre-treatment technologies on dark fermentative biohydrogen production: A review. *Journal of Environmental Management*, *157*, 20-48.

Campeau, L. (1976). Letter: Grading of angina pectoris. *Circulation*, *54*(3), 522-523.

Cole, J. H., Jones, E. L., Craver, J. M., Guyton, R. A., Morris, D. C., Douglas, J. S., … & Weintraub, W. S. (2002). Outcomes of repeat revascularization in diabetic patients with prior coronary surgery. *Journal of the American College of Cardiology*, *40*(11), 1968-1975.

Goldman, S., Zadina, K., Moritz, T., Ovitt, T., Sethi, G., Copeland, J. G., … & Henderson, W. (2004). Long-term patency of saphenous vein and left internal mammary artery grafts after coronary artery bypass surgery: Results from a Department of Veterans Affairs Cooperative Study. *Journal of the American College of Cardiology*, *44*(11), 2149-2156.

Mathew, V., Clavell, A. L., Lennon, R. J., Grill, D. E., & Holmes, D. R. J. (2000). Percutaneous coronary interventions in patients with prior coronary artery bypass surgery: Changes in patient characteristics and outcome during two decades. *The American Journal of Medicine*, *108*(2), 127-135.

McKavanagh, P., Yanagawa, B., Zawadowski, G., & Cheema, A. (2017). Management and prevention of saphenous vein graft failure: a review. *Cardiology and Therapy*, *6*(2), 203–223.

Sabik, J. F., Blackstone, E. H., Gillinov, A. M., Smedira, N. G., & Lytle, B. W. (2006). Occurrence and risk factors for reintervention after coronary artery bypass grafting. *Circulation*, *114*(SUPPL. 1), 454-461.

Sabik, J. F., Blackstone, E. H., Houghtaling, P. L., Walts, P. A., & Lytle, B. W. (2005). Is reoperation still a risk factor in coronary artery bypass surgery? *Annals of Thoracic Surgery*, *80*(5), 1719-1727.

Tejada, J. G., Velazquez, M., Hernandez, F., Albarran, A., Gomez, I., Rodriguez, S., … & Tascon, J. (2009). Percutaneous revascularization in patients with previous coronary artery bypass graft surgery: Immediate and 1-year clinical outcomes. *International Journal of Cardiology*, *134*(2), 201-206.

Webb, J. G., Myler, R. K., Shaw, R. E., Anwar, A., Mayo, J. R., Murphy, M. C., … & Stertzer, S. H. (1990). Coronary angioplasty after coronary bypass surgery: Initial results and late outcome in 422 patients. *Journal of the American College of Cardiology*, *16*(4), 812-820.

Yamaji, K., Kimura, T., Morimoto, T., Nakagawa, Y., Inoue, K., Nobuyoshi, M., & Mitsudo, K. (2013). Percutaneous coronary intervention in patients with previous coronary artery bypass grafting (from the j-Cypher Registry). *American Journal of Cardiology*, *112*(8), 1110-1119.