FREQUENCY OF VEIN GRAFT OCCLUSION AFTER BYPASS SURGERY IN PATIENTS UNDERGOING CORONARY CT ANGIOGRAPHY WITH ANGINAL SYMPTOMS

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ABSTRACT

Objective: To assess the frequency of vein graft occlusion after bypass surgery in patients undergoing coronary computerized tomography angiography with anginal symptoms.

Study Design: A retrospective longitudinal study.

Place and Duration of Study: Computerized Tomography Angiography department, Armed Forces Institute of Cardiology/ National Institute of Heart Disease, Rawalpindi Pakistan, from Jan to Jun 2021.

Methodology: A total of 109 patients having angina symptoms after coronary artery bypass graft. For this purpose, we performed computerized tomography angiography for graft study to assess the patency/occlusion of bypass grafts and to rule out possible cause of anginal symptoms. Along with that, we also assessed the co-morbids, i.e. DM, HTN, Gender and age factor which could be the possible risk factors in occlusion of the grafts.

Results: A total of 109 patients according to the inclusion criteria were enrolled in the study. The mean age of the patient population was 61.55 ± 9.53. Among which 92 (84.4%) were males and 17 (15.5%) were females. Fifty (45.8%) patients were hypertensive while 55 (50.4%) were diabetic. Forty one (37.6%) had past history of coronary artery bypass graft with duration of 1-5 years followed by 29 (26.6%) patients with duration of 6-10 years and 21 (19.3%) patients had duration in 11-15 years. Among the study population 39 (35.8%) had left internal mammary artery-LAD, SVG-OM, SVG-RCA grafts followed by 13 (11.9%) patients who had left internal mammary artery to LAD and SVG to OM while only 5 patients had left internal mammary artery to LAD as lone graft. Out of 105 patients out of 109 (96.3%) received mammary graft. Two patients also received right internal mammary graft.

Graft occlusion occurred in SVG-RCA among 34 (31.2%) patients followed by 17 (15.6%) patients who had graft occlusion in SVG-OM. As far as the number of grafts is concerned, 66 (60.6%) had three grafts while 26 (23.93%) had two grafts and 12 (11%) had four grafts and only 5 (4.58%) had one graft. Sixty six (60.5%) patients had symptoms of angina CCS class I and II while 27 (24.7%) patients had presented with acute coronary syndrome (both STEMI and NSTEMI).

Conclusion: Less than ideal patency rate of saphenous vein grafts associated with adverse outcome reminds the necessity of performing technically perfect coronary artery bypass surgery alongwith special emphasis on secondary prevention. Further progress must be made in preventing intimal injury during harvesting and exposure to arterial pressure and platelet adherence resulting in development of intimal hyperplasia to improve graft patency.

Keywords: Vein graft occlusion, coronary, Computerized tomography angiography.

INTRODUCTION

Coronary artery bypass graft (CABG) surgery is the preferred treatment for coronary artery disease (CAD) with multiple complex lesions in different arteries with survival benefit in comparison to percutaneous coronary intervention (PCI). Compared to left internal mammary artery (LIMA), saphenous vein grafts (SVG) are most commonly used but are subject to graft disease and reduced long term patency. The success of bypass surgery relies on the long term patency rate of the conduits. Graft patencydepends upon several risk factors mostly related to the target vessel but damage to graft vessels during surgical preparation and dilatation has also been shown to affect patency[1,2].

Grafting the left anterior descending artery with left internal mammary artery is the gold standard in CABG because of long term patency ratecomparing vein graft, decrease incidence of coronary re-operation and improved survival[3,4]. Whether use of multiple arterial grafts compared to only a single arterial graft potentially provide long term survival benefit in selected patients remains debate able. One year after coronary surgery, 10-20% of saphenous vein grafts fail. From 1-5 years, an additional 5-10% fail, and from 6-10 years, an additional 20-25% fail. At 10 years, only about half of saphenous vein grafts are patent, and of those, only half are free of angiographic arteriosclerosis[1,2,24,25]. SVG failure is associated with angina symptoms, myocardial infarction and long term mortality after CABG.

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Venous graft failure is a multifactorial complex process. Mechanical factors and endothelial damage after surgery cause thrombotic occlusion in the first 30 days after surgery. There after the predominant process causing failure is intimal hyperplasia triggered by activated platelets causing smooth muscle cell migration from media to intima. Accelerated atherosclerosis in the background of thrombosis and intimal hyperplasia is the principal cause of venous graft failure beyond first year after surgery[9,10,33].

METHODOLOGY

The study was conducted in Cardiac CT department at Armed Forces Institute of Cardiology/ National Institute of Heart Disease, Rawalpindi. A total of 109 patients with previous history of coronary bypass surgery and with anginal symptoms who underwent coronary computerized to mographic angiography (cCTA) Rawalpindi were enrolled in the study. Prior to the initiation of study approval from the institutional ethical review board was taken. Verbal consent from each patient was taken before enrollment in the study. Patients with history of CABG and Anginal symptoms were included in the study while patients with chronic kidney disease were excluded from the study. Non-probability consecutive sampling technique was used to enroll patients in study.

RESULTS

A total of 109 patients according to the inclusion criteria were enrolled in the study. The mean age of the patient population was 61.55 ± 9.53. Among which 92 (84.4%) were males and 17 (15.5%) were females 50 (45.8%) patients were hypertensive while 55 (50.4%) were diabetic, 41 (37.6%) had past history of CABG with duration of 1-5 years followed by 29 (26.6%) patients with duration of 6-10 years and 21 (19.3%) patients had duration in 11-15 years. Among the study population 39 (35.8%) had LIMA-LAD, SVG-OM, SVG-RCA grafts followed by 13 (11.9%) patients who had LIMA to LAD and SVG to OM while only 5 patients had LIMA to LAD as lone graft. Out of 105 patients out of 109 (96.3%) received mammary graft. Two patients also received right internal mammary graft.

Graft occlusion occurred in SVG-RCA among 34 (31.2%) patients followed by 17 (15.6%) patients who had graft occlusion in SVG-OM. As far as the number of grafts is concerned, 66 (60.6%) had three grafts while 26 (23.93%) had two grafts and 12 (11%) had four grafts and only 5 (4.58%) had one graft. Fifty five (50.4%) patients were diabetic and 50 (49.5%) were hyper-

Table-I: Demographic characteristics.

Variables	Mean ± SD /n(%)
Age	61.55 ± 9.53
Gender	
Male	92 (84.4%)
Female	17 (15.5%)
DM	
Yes	55 (50.4%)
No	54 (49.5%)
HTN	
Yes	50 (45.8%)
No	59 (54.12%)
Past History of CABG (Years)	
1-5	41 (37.6%)
6-10	29 (26.6%)
11-15	21 (19.3%)
16-20	12 (11%)
21-25	5 (4.6%)
26-30	1 (0.9%)

Table-II: Clinical Characteristics of study population.

Number of Grafts	
LIMA, SVG-OM, SVG-RCA	39 (35.8%)
LIMA, SVG-OM/Ramus	13 (11.9%)
LIMA, SVG-RCA	12 (10.1%)
LIMA,RIMA,Radial and SVG	3 (2.75%)
LIMA, SVG-diagonal and SVG OM	8 (7.33%)
LIMA, SVG-diagonal and SVG RCA	8 (7.33%)
LIMA,SVG-diagonal	2 (1.8%)
LIMA, SVG-OM,SVG-RCA,SVG-Diagonal	13 (11.9%)
LIMA to LAD	5 (4.6%)
LIMA-Diagonal, SVG-LAD, SVG-PDA	1 (0.91%)
SVG-Lad, SVG-OM, SVG-RCA	4 (3.7%)
LIMA, SVG-Diagonal, SVG-Ramus, SVG-RCA	1 (0.91)
Graft Number	
1	5 (4.58%)
2	26 (23.93%)
3	66 (60.6%)
4	12 (11%)
Graft Occlusion	
SVG RCA/OM	34 (31.2%)
SVG OM	17 (15.6%)
LAD	9 (8.25%)
No occlusion/Graft Patent	49 (45%)
Symptoms	
Angina CCS I/II	66 (60.5%)
Angina CCS III/IV	2 (1.83%)
ACS-STEMI/NSTEMI	27 (24.7%)
CHF	9 (8.25%)
None	5 (4.58%)
PCI	
LMS to Cx	1 (1%)
LMS to LAD	2 (2%)
SVG-OM	1 (1%)

tensive. Sixty six (60.5%) patients had symptoms of Angina CCS class I and II while 27 (24.7%) patients had presented with acute coronary syndrome (Both STEMI and NSTEMI).

No statistically significant association was seen between duration of years and grafts occlusion, *p*-value is 0.154. Graft occlusion with duration of years showed 44% occlusion in SVG RCA during 6-10 yeartime period, 16% with SVG OM during time period of 6-10 years and maximum patency of 69.2% was observed in 1-5 years period post CABG.

There is no statistically significant association between number of grafts and graft occlusion. Patients with 3 grafts had 35.8% occlusion in SVG RCA, 17.9% in SVG OM and 7.5% In LAD while 38.8% had no occlusion. On the other hand patients with 4 grafts had 27.35% occlusion in SVG RCA, 9.1% in both SVG OM and LAD, while 54.5% had no occlusion.

Table-III: Association between duration of years and graft occlusion.

	SVG RCA	SVG OM	LAD	No Occlusion/Graft Patent	Total
Duration of year (1-5 yrs) Count	8	1	3	27	39
% within graft occlusion	20.5%	2.6%	7.7%	69.2%	100%
Duration of year (6-10 yrs)Count	11	4	2	8	25
% within graft occlusion	44.%	16%	8%	32%	100
Duration of year (11-15 yrs) Count					
% within graft occlusion	6	3	-	9	18
% of total	33.3%	16.7%		50%	100%
Duration of year (16-20 yrs) Count	5	2	1	3	11
% within graft occlusion	45.5%	18.2%	19.1%	27.3%	100%
Duration of year (21-25 yrs) Count	3	-	-	2	5
% within graft occlusion	60%			40%	100%
p-value	0.154				

Table No IV: Association between number of grafts and graft occlusion.

	SVG RCA	SVG OM	LAD	No Occlusion/Graft Patent	Total
Graft (1) Count	1	-	1	3	5
% within graft number	20%		20%	60.0%	100%
Graft (2) Count	6	4	1	13	24
% within graft number	25%	16.7%	4.2%	54.2%	100%
Graft (3) Count	24	12	5	26	67
% within graft number	35.8%	17.9%	7.5%	38.8%	100%
Graft (4) Count	3	1	1	6	11
% within graft number	27.3%	9.1%	9.1%	54.5%	100%
p-value	0.816				

DISCUSSION

Saphenous vein graft was the first conduit used in initial coronary bypass surgery and remains the most commonly used conduit after revascularization of left anterior descending artery[27]. Extensive use of saphenous vein has several reasons namely its relatively large diameter, technically easy use and harvesting, long length which can reach any coronary artery and its plentifulness, therefore can be used to perform multiple grafts[28,29]. Patency after coronary artery bypass surgery is influenced by a number of factors. An important factor influencing bypass graft patency is target coronary artery.

Best patency is seen in the bypass grafts performed to the left anterior descending artery; those performed to diagonals, circumflex branches, and the posterior descending artery have an intermediate patency. Worst patency is seen in those performed to the main right coronary artery.

Technical errors, thrombosis and intimal hyperplasia are the main reasons for SVG failure after the first year of surgery. Endothelial damage during harvesting and exposure to arterial pressure leads to platelet adhesion that may result in graft thrombosis acute occlusion. Platelets adherence also stimulates intimal hyperplasia by releasing mitogenic proteins stimulating smooth muscle cell proliferation and hyperplasia[16-18]. Arteriosclerosis preceded by mural thrombosis and intimal hyperplasia followed by lipid deposition is responsible for graft failure and stenosis after first year[19-20]. The study by Mehta *et al*, along with previous publications from the PREVENT IV trial, are a sobering reminder of the Achilles' heel of saphenous

vein grafts-their less than ideal patency rate. The study underscores the necessity of doing technically perfect coronary artery bypass surgery. SVGs whether performed with single or multiple distal anastomoses must be done technically perfectly, with care taken to get the anastomoses, graft lengths, and lies correct[26].

In our study LIMA was used in >96% of patients which is in conformity with international usage. Out of 109 patients, there were only 5 cases withatretic LIMA or totally occluded. SVG to right coronary artery was the most commonly blocked graft followed by SVG to obtuse marginal branch. There was no association between graft occlusion and duration of surgery. Our study is limited in the sense that it did not account for vein harvesting technique, length of vein graft, quality of target vessel and technique of implantation.

Adequate secondary prevention remains the corner stone of strategies to improve graft patency. Diabetes, hypertension, hyperlipidemia and smoking influence graft occlusion after surgery and manage-ment of all these decrease adverse clinical events[10,11,14].

Early use of aspirin post-operatively accrues substantial benefit with reduction in the risk of death and ischaemic complications. Addition of P2Y12 inhibitor clopidogrel showed better graft patency in some studies. Such variable response to clopidogrel could be because of inadequate platelet inhibition in almost 30% of patients due to genetic polymorphism[12,14]. Addition of vitamin K antagonist warfarin does not provide any improvement in graft patency and therefore guidelines do not recommend routine use of anticoagulants after CABG for improved venous graft patency. Currently there is only limited evidence concerning the effect of novel anticoagulants after CABG. Statins should be continued for life after CABG and addition of Ezetimibi and PCSK9 inhibitors might amplify the clinical benefits of lipid lowering statins[15].

Measures to improve vein graft patency have been adopted since its inception and have met with variable success. Although most risk factors are related to the target vessel and cannot be influenced, vein harvesting followed by technically correct grafting and damage to graft vessel has been shown to influence graft patency in majority of cases[11]. "Endoscopic" vein harvesting, graft preservation in buffered solutions preserving intimal integrity, use of "no touch technique", pedicled graft, multiple distal anastomoses, all have been tried to improve patency with variable success. Earlier studies showed reduced patency rates with endoscopic vein harvesting as compared to open conventional technique but lately this has not been substantiated in recent study[7]. "No touch technique" for vein harvesting has been shown to be superior for long term patency in a small randomized trial[21]. Similarly SVG preservation in buffered solution by preserving intimal integrity can improve patency over graft preserved in normal saline or blood based solution[9].

The appropriate length of the SVG to avoid both overstretching and kinking, measuring intraoperative graft flow potentially identifying technical problems with the anastomoses and outflow targets can help improve early graft patency[22]. In some studies sequential grafting providing inferior patency rates has been reported compared with the single grafts, although as many studies report no difference between both strategies[23].

Non touch (NT) pedicledvein grafting has been employed to improve patency rates and has been in use for the last fifteen years, it was only associated with a lower risk for repeat angiography without any difference in mortality or need for re-intervention[24].

CONCLUSION

Less than ideal patency rate of saphenous vein grafts associated with adverse outcome reminds the necessity of performing technically perfect coronary artery bypass surgery along with special emphasis on secondary prevention. Further progress must be made in preventing intimal injury during harvesting and exposure to arterial pressure and platelet adherence resulting in development of intimal hyperplasia to improve graft patency.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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