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Early results of Left Anterior Descending Coronary artery (LAD) reconstruction in patients with poor target LAD in Coronary Artery Bypass Grafting procedure

Mohamed shaffik Abd Allah
Department cardiothoracic surgery, Faculty of medicine, Al-Azhar University (Cairo)

Mohammed Hussieny Mahmoud
Department cardiothoracic surgery, Faculty of medicine, Al-Azhar University (Cairo)

Rami Ibrahim Abdelrehim Ibrahim
Department cardiothoracic surgery, Faculty of medicine, Al-Azhar University (Cairo),
ramiibrahiem87@gmail.com

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ORIGINAL ARTICLE

Early Results of Left Anterior Descending Coronary Artery Reconstruction in Patients With Poor Target Left Anterior Descending in Coronary Artery Bypass Grafting Procedure

Rami Ibrahim Abdelrehim Ibrahim*, Mohamed Shaffik Abd Allah, Mohamed Hussieny Mahmoud

Department of Cardiothoracic Surgery, Faculty of Medicine, Al-Azhar University, Cairo, Egypt

Abstract

Background: **The development of numerous atheromatous plaques often compromises the long-term patency of a left internal mammary artery (LIMA) to left anterior descending (LAD) in patients with diffuse LAD disease, making it difficult to attain full myocardial revascularization using traditional bypass procedures. Reconstructing such LAD has been proposed as a surgical solution.**

Aims: **To assess and compare the early surgical results of LAD coronary artery reconstruction patch-plasty using the LIMA only patch technique and the saphenous vein graft patch alongside LIMA anastomosed to the patch technique among individuals with diffusely diseased LAD coronary artery.**

Patients and methods: **This prospective study involves 60 individuals who underwent coronary artery bypass graft surgery with reconstruction of the LAD artery in the cardiothoracic surgery departments of Al-Azhar University and Nasser Institute Hospitals from March 2021 to March 2023.**

Results: **There were statistically significant variances among the groups being studied in terms of CK in the first 3 days postoperatively, echocardiography postoperatively (except for mitral valve (MV) resurge), and complications such as postoperative AF, ventricular arrhythmia, and hemorrhage. There were no clinically noteworthy variations in demographics, ECG changes, postoperative low cardiac out put (COP), or reopening among the groups. Problems with the kidneys, the brain, and the lungs.**

Conclusion: **Left internal mammary patch reconstruction of the LAD coronary artery appears to be an excellent option, superior to saphenous vein graft patch reconstruction without endarterectomy for patients with diffusely diseased LAD coronary artery.**

Keywords: Bypass grafting procedure, Left anterior descending coronary artery, Poor target left anterior descending, Reconstruction

1. Introduction

Coronary artery disease is a major health problem all over the world. It has stayed the same for decades, and it will continue to put pressure on healthcare systems around the world. More than a third of the adult population in underdeveloped countries die from it, and over half of the adult population in affluent countries die from it as well.[1]

Healthcare systems around the world bear a hefty financial burden due to the direct costs of cardiovascular disorders such as diagnosis, treatment, and hospitalization. Because people with this illness are less productive, there are additional indirect expenses.[2]

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* Corresponding author at: Cardiothoracic Surgery Department, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.
E-mail address: ramiibrahiem87@gmail.com (R.I.A. Ibrahim).

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More randomized controlled trials have been conducted to determine the optimal revascularization strategy using percutaneous interventions, coronary artery bypass grafting (CABG), or a combination of the two for myocardial revascularization than any other intervention.[3]

Currently, people with more advanced coronary lesions and other co-morbidities make up the majority of those referred for surgical revascularization. When it comes to surgical diseases, diffuse coronary disease is among the most difficult to treat. Diffuse coronary artery disease has been found to affect anywhere from 0.8% to 25% of the population, according to various studies.[4]

Diffuse coronary artery disease would prohibit CABG, effectively rendering the patient inoperable or preventing total revascularization. The surgeon would be in a precarious position if the left anterior descending artery (LAD), which supplies a large section of the myocardium, were to be diffusely damaged. Large side branches, such as diagonals and septal perforators, are implicated in the atheromatous process, and a traditional anastomosis placed distal to the segment with diffuse disease would not adequately reperfusion the myocardium supplied by these branches.[5]

One of the operations used in coronary reconstruction is coronary endarterectomy, which can be performed using either an open or closed endarterectomy. However, they all have the common goal of clearing out the coronary artery of atherosclerotic plaque or calcified core, making way for revascularization via conventional arterial or venous channels. Therefore, it is a complement to traditional CABG, allowing for revascularization of previously unreachable locations.[5]

All subendothelial material exposed to blood flow can activate the coagulation cascade even when the endothelium is absent in the endarterectomized coronary artery. Inadequate distal run-off can lead to clot development and lumen thrombosis.[6]

The purpose of this study was to compare the early surgical outcomes of LAD artery reconstruction using the left internal mammary artery (LIMA) onlay patch technique to those using the saphenous vein graft (SVG) patch with LIMA anastomosed to the patch technique in patients with diffuse LAD coronary artery disease.

2. Patients and methods

Prospective study included individuals with diffuse LAD disease who were scheduled for CABG surgery at either Al Hussein University Hospital or Nasser Institute Hospital. Data collection lasted from March 2021 to March 2023.

We aimed to treat sixty individuals with diffuse coronary artery disease by reconstructing their LAD arteries. Group I (30 cases) underwent direct LIMA patch LAD reconstruction, whereas group II (30 cases) underwent LAD reconstruction by saphenous vein patch with LIMA anastomosis to the patch.

Inclusion criteria include participants undergoing elective CABG who have diffuse LAD artery disease necessitating reconstruction patch-plasty.

People with valvular heart disease and those who require endarterectomy or patch-plasty in diffusely diseased arteries other than the LAD were excluded.

Preoperative preparation included full history taking, physical examination, laboratory investigations with complete blood count, liver and kidney function, electrocardiogram, chest radiography, echocardiogram, coronary catheterization, dobutamine stress echo, thallium viability study in patients of akinetic apex or totally occluded LAD.

Table 1. Group I received a direct left internal mammary artery patch, and group II received a left internal mammary artery onlay patch, which was placed in a vein.

	Left internal mammary artery group	Venous group	Test value	*P*-value	Significance
	No. = 30	No. = 30			
Age					
Mean ± SD	55.90 ± 5.95	57.47 ± 6.91	−0.941[b]	0.350	NS
Range	47–66	41–69			
Sex					
Female	5 (16.7%)	4 (13.3%)	0.131[a]	0.718	NS
Male	25 (83.3%)	26 (86.7%)			
BMI					
Mean ± SD	31.37 ± 4.77	30.43 ± 4.09	0.816[b]	0.418	NS
Range	23.44–43.28	24.49–41.5			

P value greater than 0.05: Nonsignificant (NS); *P*-value less than 0.05: Significant (S); *P* value less than 0.01: highly significant (HS).
[a] Chi-square test.
[b] Independent *t*-test.

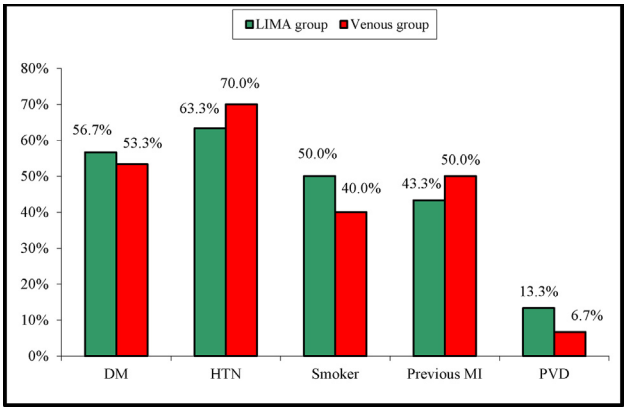

Fig. 1. Analyzing the risk factors among the two populations.

2.1. Operative technique

The on-pump CABG method was successfully completed in all 60 individuals. Both the SVG and the internal mammary artery graft were prepared prior to the initiation of cardiopulmonary bypass. All 60 patients underwent antegrade cold blood cardioplegia with systemic hypothermia to 30–32 °C, and distal anastomoses of coronary targets other than LAD were performed using 7/0 continuous polypropylene suture then exploration of LAD for a good target zone.

2.2. Statistical analysis

The statistical analysis was performed using the right version of SPSS (Statistical Package for the Social Sciences).

Each parameter's data was presented and analyzed appropriately for its type of data.

3. Results

Table 1.

There was no discernible variation in demographics across the two groups tested, as seen in the preceding table Fig. 1, Table 2 (see Tables 3, 4 and 5).

The previous table shows that when comparing preoperative echo data between the two groups, there was no discernible difference Fig. 2.

As can be observed in the preceding table, there was a statistically significant variation in CK levels among the two groups throughout the first three postoperative days Fig. 3.

Neither group differed substantially from the other in terms of postoperative ECG alterations, postoperative low cardiac out put (COP), or reopening as seen in the table above. Wound, lung, kidney, and nervous system problems. Postoperative atrial fibrillation, ventricular arrhythmia, and hemorrhage

Table 2. Comparison among left internal mammary artery group (group I) and venous group (group II) regarding echocardiographic data preoperative.

Echocardiography- preoperative	Left internal mammary artery group	Venous group	Test value	*P*-value	Significance
	No. = 30	No. = 30			
LVED					
Mean ± SD	5.70 ± 0.41	5.68 ± 0.21	0.280•	0.780	NS
Range	4.8–6.6	5.2–6.2			
LVES					
Mean ± SD	3.46 ± 0.41	3.69 ± 0.49	−2.045•	0.045	NS
Range	2.8–4.1	3–4.8			
EF (%)					
Mean ± SD	54.47 ± 5.89	53.33 ± 4.94	0.807•	0.423	NS
Range	41–67	43–65			
Mitral valve regurgitation					
No	20 (66.7%)	18 (60.0%)			
Mild	10 (33.3%)	12 (40.0%)	0.287*	0.592	NS
Moderate	0	0			
Severe	0	0			
RWMA in LAD terriority					
No	6 (20.0%)	10 (33.3%)			
Hypokinesia	23 (76.7%)	20 (66.7%)	2.209*	0.331	NS
Akinesia	1 (3.3%)	0			
Pre dobutamine stress echo					
No	22 (73.3%)	23 (76.7%)	0.089*	0.766	NS
Yes	8 (26.7%)	7 (23.3%)			
Thallium viability study					
No	25 (83.3%)	26 (86.7%)	0.131*	0.718	NS
Yes	5 (16.7%)	4 (13.3%)			

LVED, left ventricular end diastole; LVES, left ventricular end systole.

Table 3. Cardiac enzyme (CK) comparison among left internal mammary artery (group I) and venous (group II) groups over the first three post-operative days.

CK	Left internal mammary artery group	Venous group	Test value•	*P*-value	Significance
	No. = 30	No. = 30			
1st day					
Mean ± SD	854.87 ± 210.90	1128.17 ± 567.06	−2.474•	0.016	S
Range	447–1278	213–2420			
2nd day					
Mean ± SD	678.73 ± 201.29	900.73 ± 447.57	−2.478•	0.016	S
Range	209–990	206–1980			
3rd day					
Mean ± SD	480.13 ± 161.02	626.43 ± 310.61	−2.290•	0.026	S
Range	99–765	102–1200			
Repeated Measure ANOVA test	**254.856**	**76.990**			
P-value	**<0.001 (HS)**	**<0.001 (HS)**			

all differed substantially among the two groups, however.

According to the data presented in the previous table, there was a statistically significant disparity among the groups in terms of echocardiographic postoperative ejection fraction (EF), RWMA in the LAD territory, and the degree of mitral valve (MV) regurgitation Fig. 4.

Table 4. Postoperative complication rates in the left internal mammary artery group (group I) compared with the venous group (group II).

	Left internal mammary artery group No. (%)	Venous group No. (%)	Test value*	*P*-value	Significance
ECG ST changes					
No	25 (83.3%)	23 (76.7%)	0.417	0.519	NS
Yes	5 (16.7%)	7 (23.3%)			
ECG nonsignificant					
No	5 (16.7%)	7 (23.3%)	0.417	0.519	NS
Yes	25 (83.3%)	23 (76.7%)			
Low COP					
No	27 (90.0%)	26 (86.7%)	0.162	0.688	NS
Yes	3 (10.0%)	4 (13.3%)			
Postoperative AF					
No	27 (90.0%)	20 (66.7%)	4.812	0.028	S
Yes	3 (10.0%)	10 (33.3%)			
Postoperative ventricular arrythmia					
No	28 (93.3%)	22 (73.3%)	4.320	0.038	S
Yes	2 (6.7%)	8 (26.7%)			
Renal					
No	29 (96.7%)	25 (83.3%)	2.963	0.085	NS
Yes	1 (3.3%)	5 (16.7%)			
Reopening					
No	28 (93.3%)	27 (90.0%)	0.218	0.640	NS
Yes	2 (6.7%)	3 (10.0%)			
Bleeding					
No	28 (93.3%)	21 (70.0%)	5.455	0.020	S
Yes	2 (6.7%)	9 (30.0%)			
Neurological complications					
No	29 (96.7%)	27 (90.0%)	1.071	0.301	NS
Yes	1 (3.3%)	3 (10.0%)			
Pulmonary complications					
No	27 (90.0%)	25 (83.3%)	0.577	0.448	NS
Yes	3 (10.0%)	5 (16.7%)			
Wound infection					
No	28 (93.3%)	25 (83.3%)	1.456	0.228	NS
Yes	2 (6.7%)	5 (16.7%)			

COP, cardiac out put.

Table 5. In this research, we compared postoperative echocardiogram results among the left internal mammary artery (group I) and venous (group II) groups.

	Left internal mammary artery group	Venous group	Test value	*P*-value	Significance
	No. = 30	No. = 30			
EF (%)					
Mean ± SD	57.50 ± 6.98	53.33 ± 5.23	2.618•	0.011	S
Range	30–68	44–65			
RWMA in LAD					
No	24 (80.0%)	13 (43.3%)			
Hypokinesia	5 (16.7%)	12 (40.0%)	8.604*	0.014	S
Akinesia	1 (3.3%)	2 (6.7%)			
MV resurge					
No	23 (76.7%)	14 (46.7%)			
Mild	7 (23.3%)	12 (40.0%)	5.427*	0.143	NS
Moderate	0	2 (6.7%)			
Severe	0	1 (3.3%)			

MV, mitral valve.

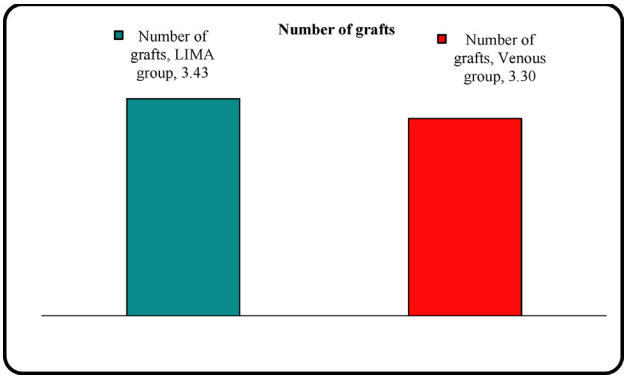

Fig. 2. Comparison between the two groups regarding number of grafts.

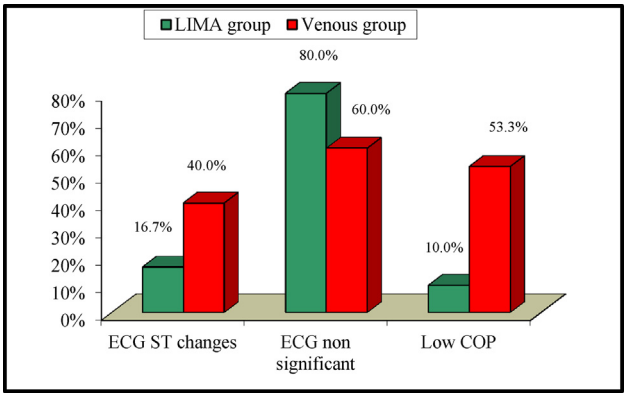

Fig. 3. ECG alterations, postoperative low cardiac output, and survival rates were compared among both groups.

4. Discussion

Fifty-one (85.0%) cases were male and nine (15.0%) individuals were female; all of them had diffuse disease of the LAD and had CABG surgery with LAD reconstruction utilizing a LIMA patch or a saphenous vein patch with LIMA anastomosis to the venous patch. Barra et al.[7] reported that 83.3% of the population was male, and this number is very close to that. Santini et al.[6] report that among the study's participants, almost all were male (93%). This shows that males are more likely than females to get CABG surgery.

The effect of estrogen has long been hypothesized to explain why premenopausal women are less likely to experience myocardial infarction and other complications of atherosclerosis, especially in the absence of other predisposing factors like diabetes, hyperlipidemia, or severe hypertension. Post-menopausal and elderly women, in particular, are more likely than males to suffer from disorders linked to atherosclerosis.

Attia et al.[8] reported that the average age of his investigated group was 53.9 (±7.9) years (ranged from 36 to 69 years), and Rezk et al.[9] noted that the average age of their group was 63.4 (±9.1) years. The age range of the individuals studied was 41–69 years.

Concerning potential risk factors, 46% of cases in the study groups reported ever smoking, while 54% reported never smoking due to the presence of chest discomfort. Among 30 patients, Owais et al.[10] discovered that 19 (63.33%) were smokers. In contrast, Emrecan et al.[11] revealed that only nine (19.2%) patients, were smokers, whereas 38 (80.8%) patients, did not smoke. This may indicate that risk factors other than smoking are involved in the development of diffuse CAD in patients who are not smokers.

A total of 19 patients in group I and 26 patients in group II met the criteria for NYHA Class II, where patients experience some degree of impairment in their ability to engage in otherwise normal activities. Class III was assigned to 19 (47.5%) individuals while class IV was assigned to 21 (52.5%) individuals in the study by Attia et al.[8]

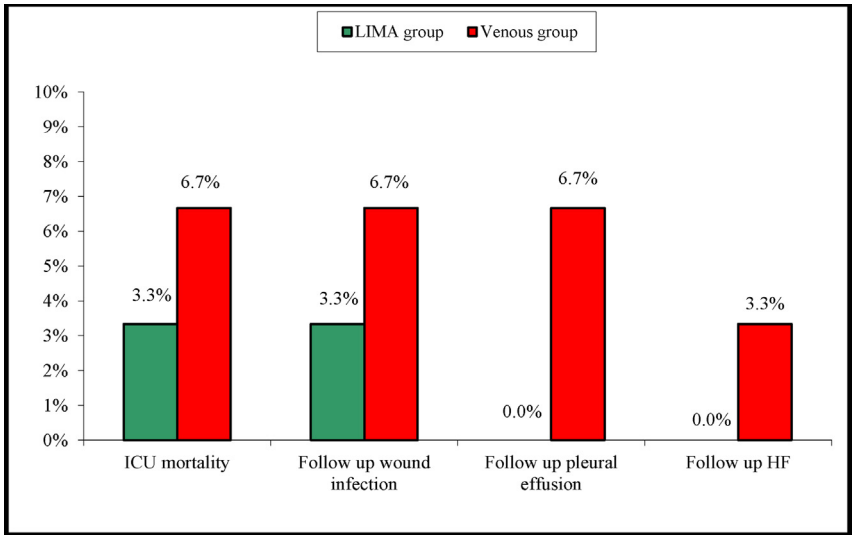

Fig. 4. Hospital mortality and postoperative follow-up 30 days after discharge were compared among the left internal mammary artery group (group I) and the venous group (group II).

All patients had preoperative echocardiogram, and the results showed a mean EF of 53.90% (5.42) with a range of 41–67.00%. Similar results were found by Emrecan et al.[11] who reported an EF of 52% (9), and by Rezk et al.[9] who reported an EF of 52% for their nonendarterectomy group. The research we conducted found that eleven individuals (18.3%) displayed akinesia, 35 (55.0%) individuals had hypokinesia in the LAD region, and 16 (262.7%) individuals had no RWMA.

During their hospital stays, one patient in group I (3.3% of the total) and two individuals in group II (6.7% of the total) died from complications related to surgery. The three individuals in the ICU needed IABP and strong inotropes.

In the study by Ogus et al.[10,12] patients died within the first 30 days, for an early mortality rate of 1.9%. Six individuals who had preoperative EF of 40% or below died because of inadequate cardiac output. Two deaths were reported by Rezk et al.[9] within 30 days of surgery, contributing to the overall 1.8% mortality rate. Attia et al.[8] reported a 2.5% mortality rate, based on the deaths of 40 people. In their investigation of 37 people, Omar et al.[13] discovered no fatalities. Demir's (2014) research reported one premature death, for an overall early mortality rate of 4.8%. Emrecan et al.[11] report a 100% survival rate among the study population.

Renal issues occurred in five individuals in group II (16.7%), but just one person in group I (3.3%). There was a single person in group II who needed renal dialysis prior to passing away, despite the fact that all of them had creatinine levels above 2 mg/dl. According to Ogus et al.[12] 48% of patients had creatinine levels above 2 mg/dl, and 3% needed temporary dialysis.

There were three cases of pulmonary issues in group I (10.0%), and five cases in group II (16.7%), all due to chest infections. Infections of the lungs and chest frequently occurred in patients who needed ventilation for longer than 48 h. According to the study by Fukui et al.[14] 6.0% of those participating in the LAD reconstruction with endarterectomy group and 4.9% of patients in the nonendarterectomy group developed pulmonary complications.

Two (6.7%) people in group I and five (16.7%) people in group II got sternal wound infections, but their wounds were all minor. Improvement was dramatic when antibiotics were chosen based on the wound culture and antibiotic sensitivity of the person being treated. In the study by Rezk et al.[9] only three (2.7%) patients had mediastinitis.

After surgery, there were statistical substantial variations among the LIMA and control groups in the LAD zone EF and right ventricular mass index (RWMA).

Preoperative EF was 47% (±2.1) in the LIMA patch group (18 people) and 49% (±2.5) in the vein patch group (12 people), but postoperative EF was 55% (1.4) in the LIMA patch group and 57% (0.12) in the vein patch group, with no substantial variations as (*P* value was 0.22).

4.1. Conclusion

LAD reconstruction with LIMA patch seems to be a good solution which is better than SVG patch without endarterectomy for diffusely diseased left

anterior declining coronary artery with mathematical superiority of LIMA patch over the SVG patch intraoperative and postoperative early term.

Conflicts of interest

There are no conflicts of interest.

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