The Egyptian Journal of Hospital Medicine (October 2022) Vol. 89 (2), Page 7737- 7740

Long Term Results of LAD reconstruction with LIMA Patch in Patients with multiple significant LAD disease

Khaled N. Leon[1], Ahmed Sultan[2], Ibrahim Radwan[2], Rafik F. B. Soliman[3]*

[1]Department of Cardiology, National Heart Institute, Giza, Egypt

[2]Department of Cardiothoracic Surgery, Faculty of Medicine, Cairo University, Cairo, Egypt

[3]Department of Cardiothoracic Surgery, Faculty of Medicine, Menoufia University, Shebin El-Kom, Egypt

***Corresponding author:** Rafik F.B. Soliman, **Mobile:** +201011102102, **E-Mail:** rafikfekry@hotmail.com

ABSTRACT

Background: A common and technically difficult condition is diffusely diseased left anterior descending (LAD) coronary artery with several severe stenoses. **Objective:** The aim of the present study was to assess the long-term patency following LAD reconstruction with a left internal mammary artery (LIMA) patch, in patients with substantial proximal, multiple long segments, mid and distal LAD stenosis.

Patients and methods: This case series was collected from Menoufia University, Farid Habib, and CardioTech Hospital between January 2012 and January 2022. A total of 100 patients who were presented with multi-vessel disease and proximal with multiple long segments mid to distal significant LAD stenoses were included.

Results: The majority (72%) of patients in the study were males, with a mean age of 59.08 (SD 2.06) years. The most prevalent comorbidities were hypertension, dyslipidemia, and diabetes mellitus (84%, 68%, and 54%, respectively). The mean EuroScore II was 1.02 (SD 0.24), and the mean ejection fraction was 49.29 (SD 3.5). Grafts of 5 (8%), 4 (70%), or 3 (22%) were used. At 5-years (N.49, 98%) and 10-years (N.46, 92%), follow-up revealed LIMA to LAD patency in every patient evaluated, but we lost track of 1 (1%) patient at 5-years and 4 (4%) patients at 10-years.

Conclusion: Coronary LAD reconstruction with LIMA patch is a good option for patients with diffuse coronary artery disease.

Keywords: LAD, Coronary artery disease, LIMA, Long-term patency, Case series.

INTRODUCTION

A dangerous disorder called diffuse coronary artery disease can cause significant myocardial ischemia that is resistant to standard revascularization procedures. When the left anterior descending artery (LAD) is significantly affected, there is an increased chance of developing ischemia, and the accompanying ischemia may be challenging to treat with traditional revascularization methods. For individuals with localized LAD, percutaneous coronary intervention with the placement of stents is preferable [(1)].

Numerous patients are not candidates for routine coronary artery bypass grafting (CABG), making surgical care of the severely damaged LAD difficult [(2)]. A typical anastomosis positioned distally in a diffusely sick LAD may fail to revascularize a significant portion of myocardium served by significant side branches. Endarterectomy has therefore been re-evaluated to be utilized in conjunction with traditional CABG in such instances [(3)].

Coronary endarterectomy (CE) was first described by **Bailey *et al.*** [(4)]. Different surgical procedures used in endarterectomy all involve the removal of the coronary artery's hardened core or atherosclerotic plaque [(3)]. However, the high rates of perioperative MI and operative mortality remained a concern among surgeons, making CE not appropriate for all coronary artery disease patients [(5)].

Coronary reconstruction without endarterectomy is a surgical modality that avoids removing the protective endothelium from the coronary artery. Surgical patch angioplasty was first described by **Effler *et al.*** [(6)] **and Sabiston *et al.*** [(7)] in 1965 using an autologous patch graft. With the help of patches extracted from the LIMA or great saphenous vein (GSV), diffusely stenotic coronary arteries can be efficiently dilated [(8)]. World-wide, LIMA is the gold standard for surgical patching angioplasty of the LAD, and its usage has been steadily increasing [(9)].

Multiple studies stated its favourable results regarding perioperative mortality, length of postoperative ICU stay, and long-term patency [(10, 11, 12, 13)].

Our study's objective was to assess the long-term patency of LAD rebuilding using the LIMA patch.

PATIENTS AND METHODS

This case series was collected from Menoufia University, Farid Habib and CardioTech Hospital between January 2012 and January 2022. A total of 100 patients who were presented with multi-vessel disease and proximal with multiple long segment mid to distal significant LAD stenoses were included.

Surgical procedure:

The LIMA was opened broadly 1.3 times longer than the LAD opening and anastomosed in the usual manner with long length anastomosis using 7/0 prolene with 9 mm needle, leaving the most proximal lesion for probe 1.5 to pass smoothly through the distal LAD and proximal until the most proximal lesion.

All patients were given Aspirin and Clopidogrel for the first year after being released then followed by Aspirin only for the rest of their lives.

Received: 19/07/2022
Accepted: 21/09/2022

Follow-up:

All patients were given Aspirin and Clopidogrel for the first year after being released then followed by Aspirin only for the rest of their lives. At 5- and 10-year intervals after surgery, patients were mainly monitored by CT ANGIOGRAPHY.

Ethical considerations

The study was done at Menoufia University Hospital, Farid Habib Hospital and CardioTech Hospital and obtained approval from the Ethics Committee. The participants were informed about the study objectives, methodology, risks, and benefits, and an informed written consent was obtained from each patient. Participants' privacy was preserved by giving each patient an identifier code. The study was conducted according to the Declaration of Helsinki.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Qualitative data were described using number and percent. Quantitative data were described using median (minimum and maximum) and inter quartile range for non-parametric data, and mean and standard deviation (SD) for parametric data after testing normality using Kolmogrov-Smirnov test.

RESULTS

Table 1 summarizes the socio-demographic data and medical history of the studied patients.

Table (1): Sociodemographic data of the studied patients (N=50)

Variable	N=100
Age (Years)	
Mean ± SD	59.08 ± 2.06
Range	42 – 71
Sex	
Male	72 (72%)
Female	28(28%)
Risk Factors	
Diabetes Mellitus	54 (54%)
Hypertension	84 (84%)
Dyslipidemia	68 (68%)
Obesity	22 (22%)
Smoking	50 (50%)
Family History	46 (46%)
Ejection fraction (EF)	
Mean ± SD	49.29 ± 3.5
Range	44 – 57
EuroScore II	
Mean ± SD	1.02 ± 0.24
Range	0.5 – 1.91

N: number; SD: standard deviation.

Table 2 summarizes the operative history of the studied patients.

Table (2): Operative Data of patients who had LIMA patch angioplasty (N=50)

Variable	N=100
Operative Time (Minutes)	
Mean ± SD	230.50 ± 30.01
Range	196 - 294
Cross-Clamp Time (Minutes)	
Mean ± SD	60.71 ± 8.84
Range	43 - 69
Total Bypass Time (Minutes)	
Mean ± SD	95.07 ± 12.52
Range	62 - 100
Number of Grafts	
3	22 (22%)
4	70 (70%)
5	8 (8%)
Need for Inotropic Support	34 (34%)

N: number; SD: standard deviation.

Table 3 summarizes the postoperative data of the studied patients.

Table (3): Postoperative data of patients who had LIMA patch angioplasty (N= 50).

Variable	N= 50
Duration of Mechanical Ventilation (Hours)	
Mean ± SD	5.29 ± 1.59
Range	3 – 8
Duration of Inotropic Support (Hours)	
Mean ± SD	3.43 ± 5.17
Range	0 – 15
IABP	0
Myocardial Infarction	0
Exploration	3 (3%)
Atrial Fibrillation	18 (18%)
Renal Dysfunction	0
Chest Infection	0
Wound Infection	2 (2%)
ICU Stay (Hours)	
Mean ± SD	44.00 ± 6.25
Range	30 – 54
Hospital Stay (Days)	
Mean ± SD	7.71 ± 1.73
Range	5 – 10

N: number; SD: standard deviation.

In the 5-years postoperative follow-up, we lost follow-up of only 1 patient. All other patients showed patent LAD. Ten-years postoperative, all assessed patients also showed patency of LAD while follow-up was lost in 4 patients (**Table 4**).

Table (4): Follow-up of long-term patency of LAD reconstruction with LIMA patch in the studied patients (N=50).

Variable	N= 100
5-years Follow-up	
Patent	99 (99%)
Lost follow-up	1
10-years Follow-up	
Patent	96 (96%)
Lost follow-up	4 (4%)

N: number**.**

DISCUSSION

Diffuse CAD is a challenging condition for cardiologists and cardiac surgeons. Coronary endarterectomy with CABG used to be the only mode of coronary reconstruction for diffuse disease. Coronary endarterectomy guarantees complete revascularization of the myocardium, but it is associated with more perioperative mortality and MI than CABG alone [(14)]. When opposed to the right coronary artery, atherosclerotic plaque in the left anterior descending branch is typically hard and frail, making it more easily disrupted. When plaque is dragged in either direction, the diagonal and septal branches that emerge from LAD in two separate planes run the risk of shearing off [(14)]. Due to all of these factors, surgeons are now pickier about which patients need endarterectomy.

As a rescue procedure following challenging percutaneous coronary intervention (PCI), coronary artery reconstruction with surgical patch angioplasty was primarily reported for the treatment of solitary ostial stenosis of the left main coronary artery [(12)]. Its application to diffuse CAD is expanding, and positive outcomes have been reported in various investigations [(10,11,12)].

The patients in our study had a mean age of 59.08 years. People over the age of 65 were found to have the highest prevalence of CAD in the United States in 2010, followed by those between the ages of 45 and 64.

The majority of patients were males (72%). This is consistent with earlier studies where most patients with LAD necessitating surgical intervention were males [(3,15,16)]. The different sex hormone profiles as a contributing to faster atherogenesis is one proposed explanation for the incidence of coronary artery disease in men. Up until postmenopausal age, the prevalence of heart disease in women is lower than that in males; after that point, women surpass men [(17,18)].

Most of our patients suffered from hypertension. They also suffered from dyslipidemia and diabetes mellitus. Half of the studied population were smokers. All these are known risk factors for coronary heart diseases as reported by the American Heart Association [(19)].

The mean operative time for the patients was 230.5 minutes with a mean cross clamp time of 60.71 minutes.

The mean total bypass time was 95.07 minutes. Patients who either had coronary artery reconstruction with surgical patch angioplasty of the coronary artery (reconstruction group) or standard CABG alone were the subjects of a retrospective cohort research by **Li *et al.*** [(12)]. The length of cardiopulmonary bypass time and aortic cross-clamping in the reconstruction group were much longer than in the group receiving normal CABG, according to the study's findings.

Modern myocardial protection approaches can satisfy the needs of lengthy surgical procedures without raising the danger of surgery, therefore even if reconstruction and surgical patch angioplasty need lengthy surgical procedures, this shouldn't be a barrier [(12)].

In the postoperative period, no patients needed intra-aortic balloon pump, and exploration for the occurrence of re-bleeding except for only 3 patients. The mean duration of ICU stay was 44.00 (SD 6.25) hours, and the mean duration of hospital stay was 7.71 (SD 1.73) days. The decreased need for IABP and exploration after coronary reconstruction and LIMA patch was also reported by **Prabhu *et al.*** [(8)]. They studied 104 patients who had the same procedure. Only one patient needed IABP and none of their patient's needed exploration. The durations of ICU and hospital stay in their study were in accordance with our findings as well.

Regarding postoperative complications, in our study, neither myocardial infarction, renal dysfunction nor chest infection were reported in any of the patients. Atrial fibrillation was recorded in 18% of the patients and wound infection was reported in only 2%. The low incidence of postoperative complications was in accordance with what was reported by **Li *et al.*** [(12)]**.** In their study, postoperative MI and ventricular arrhythmias did not occur in any of the patients in the reconstruction group. The low incidence of MI emphasizes the belief that reconstruction using LIMA patches leads to satisfactory blood flows in grafts and good vascularization of the myocardium [(20)].

Five-years postoperatively, all patients (except for 1 patient who was lost in the follow-up) showed patent LAD. Ten-years postoperatively, all assessed patients also showed patency of LAD; however, follow-up was lost in 4 patients. Long-term patency of LAD after using LIMA patch in all patients was also reported by **Li *et al.*** [(12)]. However, the patency rate was not significantly different from the standard CABG group. In addition, the 16 patients who agreed to have coronary angiography at the 1-year follow-up in **Prabhu *et al.*** [(8)] study, also all had patent LIMA-to-LAD anastomosis. With a 97.6% patency rate in the 3-year follow-up study, **Fukui *et al.*** [(10)] discovered that LIMA patch rebuilding can result in a greater patency rate.

CONCLUSION

Coronary LAD reconstruction with LIMA patch is a good option for patients with diffuse CAD. It has a low incidence of early postoperative complications, such as postoperative MI, renal dysfunction, and wound infection. The results of long-term follow-up of the LAD reconstruction patency were excellent.

Financial support and sponsorship: Nil.
Conflict of interest: Nil.

REFERENCES

1. **Brown R, Shantsila E, Varma C *et al.* (2016):** Epidemiology and pathogenesis of diffuse obstructive coronary artery disease: the role of arterial stiffness, shear stress, monocyte subsets and circulating microparticles. Annals of Medicine, 48:444-55.
2. **Lozano I, Capin E, de la Hera J *et al.* (2015):** Diffuse Coronary Artery Disease Not Amenable to Revascularization: Long-term Prognosis. Revista Espanola de Cardiologia, 68:631-3.
3. **Elsayed M, Hassanein W, Keshk S *et al.* (2018):** Evaluation of different surgical modalities for coronary reconstruction of diffusely diseased left anterior descending artery. Vessel Plus, 2:39. doi:10.20517/2574-1209.2018.65
4. **Bailey C, May A, Lemmon W (1957):** Survival after coronary endarterectomy in man. Journal of the American Medical Association, 164(6):641-6.
5. **Stavrou A, Gkiousias V, Kyprianou K *et al.* (2016):** Coronary endarterectomy: The current state of knowledge. Atherosclerosis, 249:88-98.
6. **Effler D, Sones F, Favaloro R *et al.* (1965):** Coronary endarterotomy with patch-graft reconstruction: clinical experience with 34 cases. Annals of Surgery, 162:590-601.
7. **Sabiston D, Ebert P, Friesinger G *et al.* (1965):** Proximal endarterectomy, arterial reconstruction for coronary occlusion at aortic origin. Archives of Surgery, 91:758-64.
8. **Prabhu A, Thazhkuni I, Rajendran S *et al.* (2008):** Mammary artery patch reconstruction of left anterior descending coronary artery. Asian Cardiovascular & Thoracic Annals, 16:313-7.
9. **Karthik S, Fabri B (2006):** Left internal mammary artery usage in coronary artery bypass grafting: a measure of quality control. Annals of the Royal College of Surgeons of England, 88:367-9.
10. **Fukui T, Tabata M, Taguri M *et al.* (2011):** Extensive reconstruction of the left anterior descending coronary artery with an internal thoracic artery graft. The Annals of Thoracic Surgery, 91:445-51.
11. **Khalifa A, Cornily J, David C *et al.* (2011):** Medium-Term Survival of Diffuse Coronary Artery Disease Patients following Coronary Artery Reconstruction with the Internal Thoracic Artery. Cardiology, 120:192-9.
12. **Li D, Guo P, Chen L *et al.* (2020):** Outcomes of Surgical Patch Angioplasty of The Coronary Artery for Diffuse Coronary Artery Disease. Brazilian Journal of Cardiovascular Surgery, 35:706-12.
13. **Fayad E Amr M (2021):** Short-term outcomes of reconstruction of extensively diseased left anterior descending artery with or without endarterectomy: a propensity score analysis. The Cardiothoracic Surgeon, 29:1-7.
14. **Ghatanatti R, Teli A (2017):** Coronary Endarterectomy: Recent Trends. Journal of Clinical and Diagnostic Research, 11:1-4.
15. **Haberal I, Gurer O, Ozsoy D *et al.* (2015):** Coronary flow reserve in patients with left anterior descending artery-left internal mammary artery long patch plasty anastomosis: a prospective study. Journal of Cardiothoracic Surgery, 10:51. doi: 10.1186/s13019-015-0247-4
16. **Bitan O, Pirundini P, Leshem E *et al.* (2018):** Coronary Endarterectomy or Patch Angioplasty for Diffuse Left Anterior Descending Artery Disease. The Thoracic and Cardiovascular Surgeon, 66:491-7.
17. **Thom T, Haase N, Rosamond W *et al.* (2006):** Heart disease and stroke statistics--2006 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Circulation, 113:85-151.
18. **Masjedi S, Ferdous Z (2015):** Understanding the role of sex in heart valve and major vascular diseases. Cardiovascular Engineering and Technology, 6:209-19.
19. **Virani S, Alonso A, Benjamin E *et al.* (2020):** Heart disease and stroke statistics-2020 update: A report from the american heart association. Circulation, 141:e139-e596.
20. **Soylu E, Harling L, Ashrafian H *et al.* (2014):** Does coronary endarterectomy technique affect surgical outcome when combined with coronary artery bypass grafting? Interactive Cardiovascular and Thoracic Surgery, 19:848-55.