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# Comparison of Outcome of Patients undergoing Coronary Artery Bypass Graft Surgery using Pedicled versus Skeletonized Internal Mammary Artery Graft

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## ABSTRACT

### Introduction

Coronary Artery Bypass Grafting (CABG) is a standard procedure to revascularize the ischemic myocardium. Left Internal Mammary Artery (LIMA) is preferred graft due to its superior long term patency. LIMA can be harvested through either pedicled and skeletonized technique. Skeletonized LIMA is becoming popular due to favourable clinical advantage. This study aimed to compare the clinical outcomes between two harvesting technique.

### Methods

This is a prospective comparative observational study of 41 patients who underwent CABG procedure at cardiac Centre from January 2020 to December 2020. Observational comparative study of 41 patients with 20 patients in Group A (skeletonized LIMA) and 21 patients in Group B (pedicled LIMA).The clinical parameters like postoperative drain output and patency of LIMA with selective Angiogram of LIMA at 3 to 6 months were compared.

### Results

The mean age of patients in group A was 54.35±6.8 years and in group B it was 57.80±10.88 years. Postoperative drain output was significantly lower in the skeletonized group (426±159.4 mL) compared to the pedicled group (682.85±312.15 mL; p=0.002).The patency of LIMA was 100 percent in Group B and 83% in Group A (p =0.40).Among the three atretic LIMA , two were associated with competitive flow due to recanalized LAD and one patient had proximal LIMA stenosis ,unrelated to harvesting method. There were 3 mortalities, not attributable to the harvesting technique.

### Conclusion

Both skeletonized or pedicled LIMA technique has similar patency at 3 to 6 months following CABG however skeletonized technique is associated with significant lesser postoperative bleeding.

**Keywords**

*CABG; LIMA; pedicled; skeletonized; competitive flow; patency*

## INTRODUCTION

Coronary artery bypass graft surgery remains the gold standard treatment for triple vessel disease particularly with reduced ejection fraction and left main involvement.[1,2] The long term outcome of CABG is defined by the selection of conduit, with internal mammary artery being the most favoured due to well developed vasavasorum, resistance to atherosclerosis and production of vasoactive substances leading to its long term patency.[3,4]

Traditionally internal mammary artery (IMA) was dissected along with surrounding veins, lymphatics and nerves which constituted pedicled technique. However there are concerns of devascularization of sternum causing sternal complication leading to increased adoption of skeletonized left internal mammary artery (LIMA) where IMA is dissected free as an isolated artery.[5,6] Skeletonization on the other hand has been suggested to reduce postoperative sternal complication, greater graft length, and potentially increase flow capacity although impact on clinical outcomes and patency remains a subject of ongoing debate.[7,8,9] Conversely, pedicled LIMA harvesting is supposed to be safer ,easier with less thermal and intimal damage.[10,11]

Given these considerations,the present study aims to evaluate and compare the outcomes of patients undergoing CABG using pedicled versus skeletonized internal mammary artery grafts in a single-center experience.

## METHODS

This is a prospective comparative observational study conducted in the Department of Cardiothoracic and Vascular Surgery at Cardiac Centre. The study period was from January 2020 to December 2020. All the patients undergoing CABG with valid consent during the time frame were enrolled in the study (total enrolled 41 patients) whereas those patients who underwent additional procedure other than CABG were excluded from the study. Patients were categorized according to the LIMA harvesting technique employed. It was harvested by Consultant Cardiac Surgeon in all the cases. Harvesting of the IMA as a pedicled conduit, including the artery with surrounding accompanying veins, fat, fascia, and lymphatic tissue, was classified as the pedicled method. Harvesting of the IMA after meticulous dissection -free from the endothoracic fascia and surrounding tissues, leaving the artery alone as the conduit, was classified as the skeletonized method. Patients in whom the LIMA was harvested using the skeletonized technique were assigned to Group A, whereas those in whom the LIMA was harvested using the pedicled technique were assigned to Group B. The division was based on the preference of cardiac surgeons and no randomization was performed. Adequacy of LIMA flow was confirmed intraoperatively by visual assessment of free flow and pulsatility at harvesting and reassessed after coronary anastomosis. Following surgery various parameters like postoperative drain, complications were measured and analysed. After the patient were discharged they underwent selective coronary angiogram to assess LIMA patency at 3 to 6 months following surgery. The statistical analysis was done using the SPSS software version 25.0. The Quantitative variables were compared using the independent *t*-test and Mann–Whitney U test. Qualitative variables were compared using the Fisher's exact test at $P < 0.05$ was considered statistically significant.

## RESULTS

A total of forty-one patients were enrolled in the study. There were 20 patients in the group A - CABG done using skeletonized internal mammary artery and 21 patients in the group B - CABG using pedicled internal mammary artery. A wide range of age groups were present in the present study ranging from 38 years to 76 years. In the group A, age ranged from 43 years to 65 years with mean age of 54.35±6.8 years. In the Group B – age ranged from 38 years to 76 years with mean of 57.80±10.88 years as shown in table no 1. A total of 78% had comorbidities in the form of hypertension, diabetes mellitus, thyroid disorder.

*Table 1. Comparison of Baseline Age Between Skeletonized and Pedicled IMA Groups*

| Variable | Group A (Skeletonized IMA, n = 20) | Group B (Pedicled IMA, n = 21) | p-value |
|---|---|---|---|
| Sample size | 20 | 21 | |
| Age range (years) | 43 – 65 | 38 – 76 | |
| Mean age (years) | 54.35 ± 6.8 | 57.80 ± 10.88 | 0.23 |

One patient in Group B required re-exploration following bleeding from LIMA harvesting bed. Comparing the drain output on zero postoperative day, in the Group A, the drain output ranged between 180ml to 730 ml with mean of 426± 159.4 ml and in Group B, the drain output varied between 280ml to 1550ml with mean of 682.85±312.15 ml (P value = 0.002). Similarly on the1st postoperative day, drain output in Group A was140.7±169.42ml and in group B it was 196.66±156.95 ml (p value of =0.096). There were three mortalities ,one in group A and two in group B which is described in table no 2.

*Table 2. Perioperative Characteristics and Causes of In-Hospital Mortality*

| Group | Age/ Sex | Risk factors | LVEF (%) | Postoperative course | ICU stay | Cause of death |
|---|---|---|---|---|---|---|
| A | 63/M | HTN, DM, TVD + left main disease | 30 | IABP support post-operatively | 2 days | Refractory heart failure |
| B | 61/M | TVD, low EF | 25 | Re-exploration for bleeding from LIMA bed (1000 mL/6 h) | 34 days | Septic shock with MODS |
| B | 76/M | HTN, TVD + Left Main disease | 55 | Intractable ventricular fibrillation on POD 1 | 1day | Cardiac arrhythmia |

A total of 35 patients (92%) underwent selective postoperative angiogram of LIMA via the radial or femoral artery route. Among the 35 patients that underwent coronary angiogram, 91% had patent LIMA at 3 to 6 months following surgery- Group B (100% patency) vs Group A (83% patency) with p value of 0.484. Table number 3 demonstrates the comparison of patency between the two study groups.

*Table 3. Demonstration of LIMA patency in the study group*

| | Skeletonized A | Pedicled B | Total | P value |
|---|---|---|---|---|
| LIMA patent | 15 | 16 | 31 | 0.484 |
| LIMA atretic | 3 | 0 | 3 | |
| Mortality | 1 | 2 | 3 | |
| Angiogram not done | 1 | 3 | 4 | |
| Total | 20 | 21 | 41 | |

## DISCUSSION

Coronary artery disease is not just a single entity as the patients present with multiple concomitant chronic disease. In the present study as many as 78% (n=32) had chronic diseases in the form of hypertension, diabetes mellitus, dyslipidemia, thyroid disorder. The two study groups in the current research were comparable in terms of comorbidities with p value of 0.486. Study shows having one cardiovascular disease increased the risk of another, co-occuring cardiovascular disease and even greater burden of chronic diseases.[12,13]

Following cardiac surgery, drains in mediastinum and pleura are placed to outline and monitor the bleeding from surgical site and also to prevent cardiac tamponade. A comparison between the drain output between the two study groups was done, in the Group B the drain output at zero postoperative day showed significant higher value as compared to Group A (682.85±312.15 ml vs 426±159.4ml with p value of 0.002), this may be attributed to wider extent of tissue dissection and increased raw surface area associated with pedicled LIMA harvesting. Mazur P et al using

a randomized controlled trial demonstrated that LIMA skeletonization (OR [95% CI], 0.04 [0.003-0.44], p=0.009) and higher Body Mass Index (OR [95% CI], 0.63 [0.45-0.89], p=0.008) were protective against the odds of being in the top drainage quartile at 12 hour (>_550ml) which was similar to our study with higher drain amount in pedicled group as compared to skeletonized group.[14]

In any cardiac surgery the need for reexploration may always be present particularly in context of high postoperative bleeding. Studies have shown that reexploration in cardiac surgery increased the mortality by two fold.[15,16] There was one reexploration in the group B for high drain output (bleeding from pedicled LIMA harvesting bed) who ultimately had unfavourable outcome in the post-operative period.

Following Coronary Artery Bypass Surgery, post-operative selective LIMA angiogram was done 3 to 6 months following surgery. The patency of LIMA was 100 percent in Group B as three were atretic in Group A (83% patency) with p value of 0.40, out of three atretic Internal Mammary Artery (IMA), two patients had recanalization of left anterior descending artery with competitive flow between IMA and LAD and one patient had proximal LIMA stenosis which were unrelated to harvesting technique. Due to reversal of stenosis of left anterior descending artery, two of three patients had atresia of LIMA. Nawaz R et al described a rare case which an occluded LIMA graft became patent following progression of native LAD disease demonstrating dynamic interaction between graft and native vessels.[17] In summary LIMA may be atretic if native vessel has reverse remodelling and reverse may also be true.[18] Sometimes overtreatment and over diagnosis contribute to these findings. Pinar Dogan et al during evaluation of coronary angiogram performed between January 2015 and December 2015, among 8248 diagnostic coronary angiographies– 886 coronary angiographies were following CABG, among these LIMA graft occlusion was detected in 19 patents (2.1%), LIMA– LAD competitive flow was found in 86(9.7%) in CABG patients. Among these patients, 20 (20%) had mild stenosis, moderate in 61 (70%) and severe coronary artery disease in 4 (5%) patients. In conclusion there was 9.78% rate of LIMA-LAD competitive flow.[18] This may explain the LIMA atresia observed in two of our patients. This finding underscores that, despite appropriate assessment of coronary stenosis, competitive flow may be present as much as 9-10%[19]. This may be reduced by careful selection of hemody namically significant lesion using Fractional Flow Reserve and intraoperative graft assessment but cannot be entirely avoided.[20] Similarly in one patient, LIMA was found to be atretic secondary to proximal stenosis of LIMA which highlights potential utility of routine or selective preoperative imaging of the subclavian–LIMA axis where arterial graft is anticipated.

In terms of patency, Hirose et al prospectively analysed data for 115 patients receiving skeletonized and 99 patients receiving pedicled, where patency was 100 percent in both the groups[21]. Similarly Calafiore et al in a research, 304 patients received pedicled conduits and 842 patients received skeletonized conduits, early patency rates were 98.2% in the skeletonized group and 97.5% in the pedicled. The late patency in the skeletonized group showed 96.8% and pedicled 94.3% patency.[22] This may demonstrate harvesting technique may not affect the patency of LIMA.

This was a comparative descriptive study aiming to compare the clinical outcome following CABG using skeletonized and pedicled LIMA. The sample size was small in this study and it was done over a limited period. Allocation according to surgeon preference may have introduced selection bias. Preoperative LIMA angiogram if had been done could prevent LIMA atresia due to proximal IMA stenosis that occurred in one of the patient. It was a single hospital based study and not all the patients in the research gave consent for postoperative coronary angiogram.

## CONCLUSION

The post-operative bleeding on the day of surgery was significantly more, when pedicled LIMA was used, as compared to skeletonized LIMA while graft patency rate at three to six months postoperative period were comparable in two groups. Thus, skeletonized LIMA in CABG is associated with less postoperative bleeding with a similar graft patency rate at 3-6 months as compared to the pedicled LIMA.

## CONFLICT OF INTEREST

None

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