

Anaortic off-pump Complete Arterial Revascularization Using Composite LIMA RIMA Y grafts: 1 Year Outcome

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Abstract:

Objective: The aim was to evaluate the early outcome of off-pump coronary artery bypass grafting (OPCABG) with a bilateral internal mammary artery (BIMA) Y configuration graft to achieve total arterial myocardial revascularization.

Materials and Methods: From March 2018 to March 2020 total 30 cases of off pump CABG surgery using LIMA RIMA Y sequential grafts to achieve total arterial myocardial revascularization. Comparisons between LIMA + SVG and BIMA Y grafts were not made here.

Result: The average age of the patients was 43.51±2.58 years. Most of them were male (93.34%). A total of 28 (93.34%) cases had triple-vessel disease. Double-vessel disease was found in 2 (6.66%) cases. The skeletonization

skill was used to harvest the two IMAs and then the free right internal mammary artery was anastomosed end-to-side to the in situ left internal mammary artery to composite a Y configuration graft. Off-pump and sequential anastomosis methods were used to perform coronary artery bypass surgery for the patients. Graft patency was assessed by doing CT angiogram. All distal and proximal Y anastomoses were patent at 1 year follow up. There were no perioperative deaths.

Conclusion: OPCABG by using LIMA RIMA Y graft is an effective option for total arterial revascularization and avoid surgical complications regarding the ascending aorta manipulation.

Key words: Bilateral internal mammary arteries, coronary artery bypass grafting, internal mammary artery, LIMA -RIMA Y graft, off-pump

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Introduction:

Despite of improved long-term survival attained by using bilateral internal mammary arteries (BIMA) over the standard left internal mammary artery (LIMA) with saphenous vein grafts (SVG) supported by recent literatures¹⁻⁴, the use of BIMA is very less in reality^{5, 6}. Since Barn & Barnett⁷, Tector et al⁸ and Barr et al⁹ proposed Y or T graft procedure done by anastomosing the proximal end of the free RIMA to the side of the in situ LIMA that provides an extra length to facilitate reaching the distal coronary artery branches, issues of complete arterial

revascularization using BIMA made a way out. Kamath et al.¹⁰ and Chocron et al.¹¹ were first to report their experiences using BIMA grafts in off-pump coronary artery bypass grafting (OPCABG) setting which subsequently become more popular to avoid cardiopulmonary bypass (CPB) related complications. We present here 1 year outcome of consecutive 30 patients on whom anaortic complete arterial OPCABG using composite LIMA RIMA Y sequential grafts were performed.

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Methods:

Clinical Data:

From March 2018 to March 2020 we performed 30 cases of off pump CABG surgery using LIMA RIMA Y sequential grafts to achieve total arterial myocardial revascularization. During these procedures, we considered whether BIMA angiograph data available or not ; whether the patients not suffering from serious peripheral artery disease; and personal willingness of patients. Comparisons between LIMA + SVG and BIMA Y grafts were not made here.

Surgical Technique:

All patients received general anesthesia under a standardized protocol of the median sternotomy. The skeletonization method of the BIMA harvesting technique was employed. The LIMA was harvested first and dissected from the origin to distal bifurcation. The RIMA was then dissected the same way as the LIMA. After heparinization, the RIMA was removed as a free graft. To ensure maximal length, both the internal mammary arteries (IMA) were tried to free much as possible between the subclavian artery proximally and bifurcation of IMA

distally. The endoBoth arteries were placed onto a thick pad of gauze. An oblique 1-cm incision was made in the LIMA and the proximal end of the RIMA was anastomosed with a continuous 8-0 polypropylene suture. The anastomosis location was under the level of the pulmonary annulus. The BIMA composed a Y configuration graft, with the LIMA being as the short limb of the Y graft, and the RIMA the long one. The length of the RIMA made it possible to graft as far as the lateral circumflex or posterior descending arteries. LIMA sequential to diagonal (D) D₁ and LAD constructed using 8-0 prolene suture. Then RIMA Y sequential to OM₂, OM₃ and posterior descending artery (PDA) were made using 7-0 prolene suture (figure 1).

Graft patency was assessed by using CT angiogram after 1 year. Cardiac enzyme analyses were performed on all patients peroperatively, immediately postoperatively and at 1, 2, and 6 days. Continuously ECG monitoring was done throughout the perioperative period up to discharge and 12 lead ECG was done in 3rd and 6th postoperativeday routinely. Follow-up echocardiography was done on 1st month ,3rd month and 1 year after surgery.

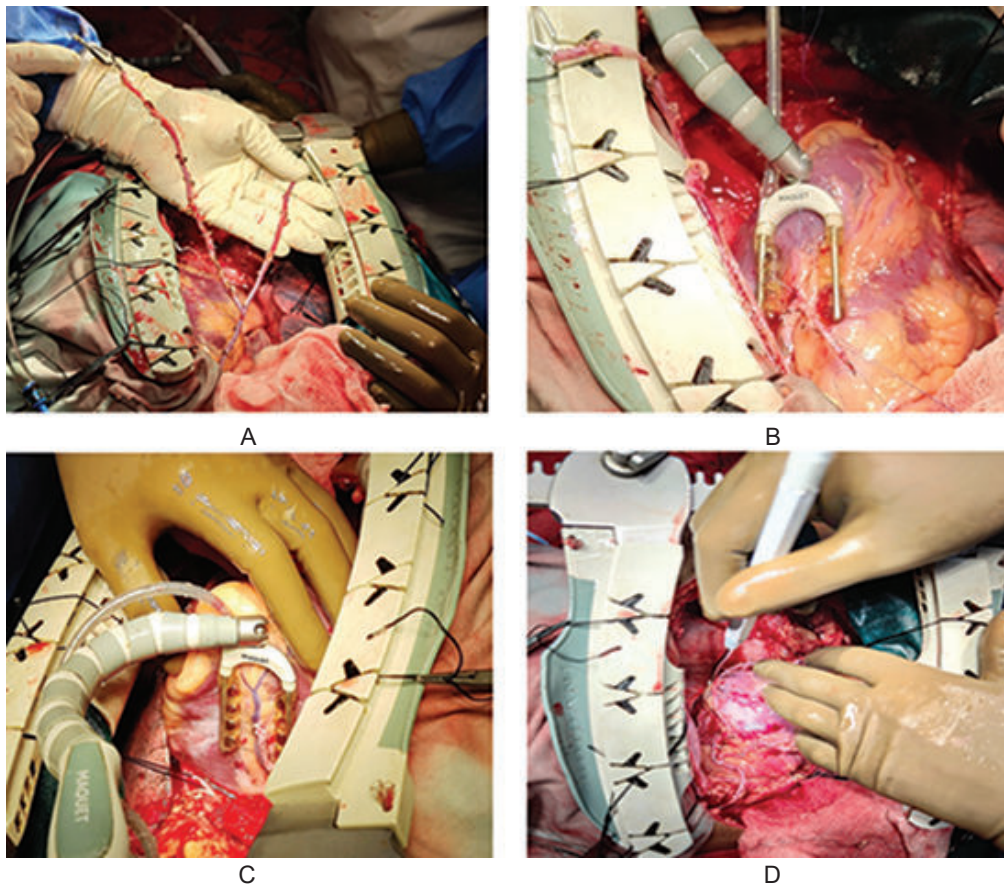


Fig.-1: A. After construction of Y anastomosis, B. LIMA to D₁ anastomosis is going on, C. Just after construction of RIMA Y to PDA anastomosis, D. after completion of LIMA RIMA Y grafting.

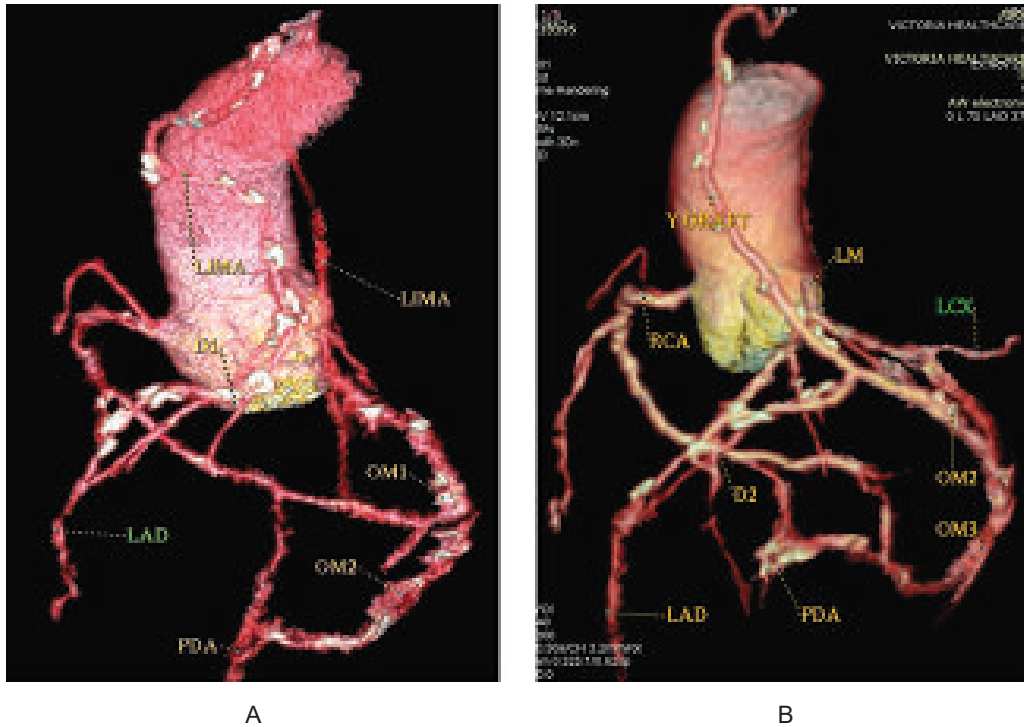


Fig.-2: CT angiogram after 1 year of surgery. A. CT angiogram showing patent graft LIMA sequential to D1 & LAD and RIMA Y sequential to OM1, OM2 and PDA.. B. CT angiogram showing patent LIMA sequential to D2 & LAD and RIMA sequential to OM2, OM3 and PDA.

Statistical analysis:

The variables were expressed as means±standard deviations (SDs). The baseline characteristics and outcomes were compared using χ^2 analysis for categorical data and Student’s t-test for continuous variables. Differences were considered significant only when the P-value was < 0.05.

Results:

Table-I
Main Demographic and clinical characteristics

Variables	Distribution
Age in years (Mean± SD)	43.51±2.58
Sex	
Male	93.34%
Female	6.66%
BMI (Mean± SD)	24.2±3.70
History of MI	40%
DM	73%
HTN	70%
Dyslipidemia	76.66%
Preoperative LVEF (Mean± SD)	45.59±2.01
CAG Findings	
TVD	93.34%
DVD	6.66%

Table-II
Distribution of per operative variables

Variables	Distribution
Operative time in hrs (Mean± SD)	4.68±1.21
Conversion to on pump	10%
Peroperative arrhythmia	16.66%
Peroperative MI	0%
Number of grafts	3.96±0.48

We performed 30 cases of off pump CABG surgery using LIMA RIMA Y sequential grafts to achieve total arterial myocardial revascularization. Mean age was 43.51±2.58. Most of them were male (93.34%). A total of 119 distal anastomoses were made in all patients, with an average of 3.96±0.4 bypasses performed for each patient. No one received supplemental vein graft. There were no perioperative deaths.

Two (6.66%) cases needed reoperation for bleeding. Surgical site infection was 10% in early postoperative period. Superficial skin and soft tissue infection was 6.66% in late postoperative period.

All patients were successfully discharged from the hospital.

Table-III
Distribution of post-operative variables:

Variables	Distribution	
Early postoperative outcome		
Ventilation time in hrs (Mean± SD)	4.68±1.02	
Chest drain collection ml in 1 st 24 hrs (Mean± SD)	350.53±78.29	
ICU stay in days (Mean± SD)	4.22±1.73	
Postoperative arrhythmia	20%	
Postoperative MI	0%	
Reoperation for bleeding	6.66%	
Surgical site infection	10%	
Late postoperative outcome		
Deep sternal wound infection	0%	
Superficial Skin and soft tissue infection	6.66%	
Postoperative LVEF % (Mean± SD)	53.81±2.79	
Postoperative MI	0%	
Distribution of graft patency		
Name of grafts	Number of grafts	Graft Patency at 1 year
LIMA to LAD	30	100%
RIMA Y to D	26	100%
RIMA Y to OM	33	100%
RIMA Y to PDA	30	100%
Mortality		
Early	0	
Late	0	

Discussion:

Among the various strategies regarding the selection of the ideal arterial graft; the IMA, we used a single Y configuration graft with a free RIMA attached to the side of the LIMA in situ. The RIMA is histologically identical to the LIMA and might show similar long-term patency rates. In most patients, the RIMA could reach the RCA system without difficulty. Composite LIMA RIMA Y first proposed by Sauvage et al.¹² in 1986. Construction of this Y limb using LIMA and free RIMA is technically challenging but that provides an extra length to reach the distal targets including the PDA. The use of this Y conduit in the revascularization of the blocked territory has several advantages¹³.

As like all surgical techniques, it has some pitfalls as well. Single source blood supply with steal phenomenon, competitive flow and hypoperfusion syndrome are some of the well recognized drawbacks associated with composite grafting^{14,15,16}. Glineur et al¹⁷ conducted a study to determine the capacity of Y graft configuration to provide sufficient blood flow to the whole left coronary system and about possible steal phenomenon occurring

during period of maximal myocardial blood flow demand. Sakaguchi G et al.²⁰ told that total arterial revascularization with two arterial grafts can cause the life-threatening hypoperfusion syndrome. Because reperfusion of the entire myocardium depends on the proximal source of the left IMA. Several reports had concluded that the LIMA RIMA composite graft allowed complete myocardial revascularization with good perioperative results and that the flow reserve of the proximal LIMA was adequate for multiple coronary anastomoses.²⁰ Clinically, we did not observe any hypoperfusion syndrome in our study, which was consistent with other surgeons who preferred this graft strategy²¹. We performed CABG without CPB to reduce the occurrence of unstable hemodynamics and avoided using the distal IMA for anastomoses. There were evidences that the coronary flow reserve could be improved several months after operation^{22,23} and that the IMA could adapt to the myocardial blood demand by compensatory dilatation^{24,25}.

Increased long time survival has been reported in high risk patients undergone BIMA grafting^{18,19,26}. Despite of these good results using BIMA; the use of BIMA grafting

found surprisingly low among the surgeons. LaPar et al.⁶ reported that from 2001 to 2013; use of BIMA was only 3% in the overall bypass population and 6% in a subgroup of patients considered "low risk" for BIMA use. An analysis of the Society of Thoracic Surgeons database revealed the use of BIMA was 3.5% in 1999 and 4.1% in 2009⁵. Wound infection can be minimized by harvesting skeletonized IMA²⁷ and the aggressive control of blood glucose. Di Mauro et al.²⁸ reported a better 17 years survival in patients with skeletonized BIMA grafts than in patients with pedicled BIMA grafts. We harvested both LIMA and RIMA as skeletonized graft in this study.

IMA hypoperfusion syndrome resulting from vasospasm of the arterial grafts is associated with high mortality²⁹. Perioperative hypoperfusion may lead to ischaemia, infarction, low output states, profound hypotension in 1-2% cases undergoing composite grafting³⁰. The hypoperfusion syndrome may result from injury to the conduit during harvesting, technical errors in the anastomosis, linear tension on the conduit, angulation at the anastomotic site and unresolved harvest spasm³¹. To reduce the incidence of perioperative hypoperfusion, proper preoperative assessment of the quality of IMA graft and the subclavian artery by angiography, carefulness and adherence of meticulous surgical techniques during conduit harvesting and flow measurement by transit time Doppler flow meter after completion of anastomosis are the key³².

We performed 30 cases of off pump CABG surgery using LIMA RIMA Y sequential grafts to achieve total arterial myocardial revascularization. In our cases LIMA were grafted sequentially to D₁ and LAD, while RIMA Y were grafted sequentially to OM₂, OM₃ and PDA. Gu et al.³³ performed OPCABG using LIMA RIMA Y grafts in 208 patients from October 2002 to December 2008. Their average distal anastomoses was 3.5±1.3 per person. They found OPCABG using the BIMA Y graft was safe and effective to achieve total arterial revascularization. In our cases total 119 distal anastomoses were made in all patients, with an average of 3.96±0.4 bypasses performed for each patient. No one received supplemental vein graft. There were no perioperative deaths. Another study conducted by Glineur et al.³⁴ from January 2000 to December 2010 among 436 patients at 2 different institutes, using the BIMA Y grafts to assess the utilization of BIMA Y in comparison to BIMA with additional vein grafts revealed improved survival with the use of BIMA Y grafts. Their average number of grafts in BIMA Y group and BIMA with additional vein grafts group was 4.0±0.7 vs 4.0±0.7; p=0.24. Di Mauro et al.³⁵ in their

BIMA in situ vs Y graft 20 year outcome study, reported outcome of BIMA grafting is independent of surgical configuration.

Numerous studies had shown that the use of both internal mammary arteries improved long-term survival relative to the use of the left internal thoracic artery and SVGs. However, the concern that diabetes may lead to an increased risk of deep sternal wound infection had limited the use of both internal mammary arteries in nondiabetic patients^{36,37,38}. Although use of BIMA is considered a risk factor for sternal infection³⁹, this risk appears to be attenuated by skeletonized IMA mobilization⁴⁰. Tarrío and colleagues reported the largest group of patients (743 cases) who underwent OPCABG with the BIMA Y or T graft⁴¹. They used the skeletonization technique to reduce the sternal complication. The rate of mediastinitis was 0.9% (7/743). In our study surgical site infection was 10% in early postoperative period and superficial skin and soft tissue infection was 6.66% in late postoperative period. In our study using skeletonization technique for BIMA harvesting causing muscle was left attached to the chest wall. Thus minimizing sternal devascularization and possibly reducing the risk of deep sternal wound infection as well. We did not find any difference with the other CABG patients without the BIMA Y graft in our department. If the blood glucose was controlled ideally before operation and the sternum fracture was avoided; diabetic patients could get same result as non diabetic patients. So in our experience diabetes is not a contraindication to the BIMA Y graft.

OPCABG combined with the aorta no-touch technique has been accepted as an effective procedure to avoid neurologic and aortic complications, and to reduce operative risks⁴¹. In our study, there was no incidence of stroke. In Tarrío's study incidence of stroke was 0.4%, 3 of 743⁴¹.

In our study, the off-pump coronary artery bypass graft with the BIMA Y graft was safe and feasible for all patients. No one was obliged to change off-pump to on-pump intraoperation, especially including moderate or severe heart function (LVEF<30%). There was no death postoperatively.

Conclusion:

OPCABG by using LIMA RIMA Y .graft is an effective option for total arterial revascularization. Adherence to meticulous surgical techniques can avoid the possible complications as well as to overcome the fear of incomplete revascularization despite the number of target lesions.

For a mature team, this technique could be easily performed in daily practice. It was not a time-consuming procedure and was the same technique as the conventional technique in our department. In fact, a long learning curve is needed for a fresh team.

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