Early Outcomes of Using Radial Artery in Coronary Artery Bypass Surgery in Cairo University Hospitals

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ABSTRACT

Background: Using arterial grafts is commonly associated with good outcome. Using left internal mammary artery and radial artery can achieve complete arterial revascularization of left coronary system by using sequential grafting or multiple Y Technique.

Objective: We present our experience in using internal mammary artery and radial artery (RA) Y-graft in 100 patients.

Patients and Methods: Between February 2016 and January 2019, 100 patients (aged 45-60 years) with the diagnosis of multi-vessel disease underwent complete arterial revascularization using left internal mammary artery (LIMA) and RA. We used the technique of RA (Y) or (T) graft on LIMA to revascularize left coronary system; we did multiple (Y) or (T) graft or sequential grafts.

Results The operating time was 220±20 minutes in average, the bypass time was (92.5 ± 16.7) minutes, and cross-clamp time was $(70.6 \pm 20.6$ minutes). LIMA was anastomosed to the left anterior descending coronary artery (LAD) system in all patients. RA Y-graft was anastomosed to LIMA in all patients. Sequential grating using RA was done in 20 patients. The mean ICU stay of the patients was $(2.2 \pm 0.5$ days). Mean hours of mechanical ventilation was (14.3 ± 2.9). Four patients required re-exploration for bleeding. 66 patients needed blood transfusion. 45 patients required inotropes.

Conclusions: RA can be used safely with LIMA to revascularize left coronary territory using sequential grafts or multiple (Y) grafts. This method allows for complete arterial grafting in multi-vessel disease using only single IMA and RA grafts with good early results.

Keywords: Radial Artery, Coronary artery bypass surgery, Left internal mammary artery.

INTRODUCTION

Arterial grafting of coronary arteries is a surgical method to improve long-term results of coronary artery disease (CAD). Using radial artery started since 1970 by Carpentier and coworkers [1].

The aim of coronary artery bypass graft surgery (CABG) is complete revascularization and it is better to use arterial grafts to reach this goal to avoid the failure of saphenous vein graft [2,3].

Due to the lack of enough length of the arterial grafts, and in order to achieve arterial revascularization, it is a must to do sequential or/and composite grafting techniques [4].

Bilateral internal mammary arteries (IMAs), and the radial artery (RA) were used as conduits in the patients. Sequential grafting using arterial grafts, besides, classical Y-graft technique of RA has been used [5].

MATERIALS AND METHODS

Between February 2016 and January 2019, 100 patients with multi-vessel coronary artery disease underwent total arterial revascularization with left internal mammary artery (LIMA) and RA.

The RA was anastomosed to branches of circumflex artery which must have more than 90% stenosis. No patients had other cardiac disease requiring surgical intervention.

The patients were 70 men and 30 women, with a mean age of 52.5±7 (table 1). The risk factors for these patients are shown in table 2. No patients had chronic pulmonary obstructive disease. Creatinine of all patients was within normal. Left ventricular ejection fraction (LVEF) was within normal (Table 3).

They all underwent total revascularization of left coronary territory using LIMA and Radial artery; using either multiple Y grafts or sequential grafting, as for right coronary artery saphenous vein graft (SVG) was used.

All operations were done through sternotomy, using heart lung machine and warm antegrade cardioplegia, skeletonized IMA was harvested routinely and RA was harvested. LIMA was anastomosed to LAD in all patients. Sequential anastomoses were performed with RA grafts if needed (20 patients).

The rest of patients received single or multiple (Y-graft).

190

Table (1): Descriptive statistics of demographic data in the study sample

Parameters	
Age (Years)	
Mean ± SD	52.5±7.
Minimum	40
Maximum	60
Gender (n, %)	
Male	70 (70)
Female	30 (30)

Table (2): Risk factors in the study sample

Risk factors	
Hypertension (n, %)	65 (65)
Diabetes (n, %)	40 (40
Smoking (n, %)	75 (75)

Table (3): Descriptive statistics of ejection fraction

Ejection fraction	
Mean ± SD	57.6 ± 7.6
Minimum	50
Maximum	65

Ethical approval:

An approval of the study was obtained from Cairo University academic and ethical committee. Every patient signed an informed written consent for acceptance of the operation.

Surgical technique

Radial artery of the non-dominant hand was chosen as the other graft in all patients after testing the hand perfusion using modified Allen's test.

To avoid radial artery spasm: Hong-Kong University solution protocol during the harvesting of RA which consists of: intravenous administration of verapamil during operation then after extubation of the patient oral verapamil 40 mg every eight hours for one year, while for topical and intraluminal injection the Hong Kong solution, which consists of: 300 ml of warm Ringer, verapamil 5 mg, 2.5 cc nitroglycerine, 0.2 cc $NaHCO_3$ 8.4%, and 500 unit heparin.

During left internal mammary artery harvesting, radial artery was dissected. The pericardium was opened, aorto-atrial cannulation was performed. After initiation of cardiopulmonary bypass (CPB) and target vessel identification, the aorta was cross clamped, distal anastomoses of radial artery was done to obtuse marginal branches of circumflex artery and possibly diagonal artery, then LIMA was anastomosed to LAD.

Finally the proximal end of RA was anastomosed to LIMA as Y graft. Sometimes double Y or multiple Y was needed. After finishing the Y graft, declamping of LIMA was done then giving antegrade warm blood then declamping of aorta. After recirculation gradual weaning of the heart lung machine then decannulation, hemostasis and sternal closure was done.

Statistical analysis

Numerical data were presented as minimum, maximum, mean and standard deviation (SD) values. Qualitative data were presented as frequencies and percentages. Statistical analysis was performed with IBM, SPSS Statistics Version 20 for Windows.

RESULTS

The operating time was 220±20 minutes in average, the bypass time was (92.5 ± 16.7) minutes, and cross-clamp time was (70.6 ± 20.6 minutes). LIMA was anastomosed to the left anterior descending coronary artery (LAD) system in all patients. RA Y-graft was anastomosed to LIMA in all patients. Sequential grating using RA was done in 20 patients (table 4).

The mean ICU stay and other postoperative findings are shown in table 5. No patients suffered deep sternal wound infection, only five patients suffered superficial wound discharge that required only frequent dressing. No patients suffered RA harvest site infection. All patients were alive.

I. Intraoperative findings

Table (4): Descriptive statistics of intraoperative findings

Intraoperative findings	
Number of grafts	
Mean ± SD	3.9 ±1
Minimum	2
Maximum	5
Cross-clamp time	
Mean ± SD	70.6 ± 20.6
Minimum	50
Maximum	100
Total CPB	
Mean ± SD	92.5 ± 16.7
Minimum	60
Maximum	125
LIMA-LAD	100%
RA Y ON LIMA	100%
Sequential anastomoses with radial artery	20%

II. Postoperative findings

Table (5): Descriptive statistics of postoperative findings

Postoperative findings	
ICU stay (Days)	
Mean ± SD	2.2 ± 0.5
Minimum	2
Maximum	4
Mechanical ventilation (Hours)	
Mean ± SD	14.3 ± 2.9
Minimum	9
Maximum	21
Reoperation for bleeding (n, %)	4 (4)
Blood transfusion (n, %)	66 (66)
Use of Inotropes (n, %)	45 (45)
IABP (n, %)	0 (0)
Atrial fibrillation (n, %)	10 (10)
MI (n, %)	0 (0)
Postoperative stay (Days)	
Mean ± SD	6.3 ± 0.9
Minimum	4
Maximum	9
Acute renal failure (ARF) (n, %)	5 (5)

DISCUSSION

One of the biggest problems encountered during complete arterial revascularization with one or two arterial grafts is difficulty to obtain sufficient graft length to perform multiple distal anastomosis [4]. In our study we overcame this by doing multiple sequential anastomoses or multiple Y grafts. In some studies all proximal anastomoses of Y-graft segments are performed during preparation of the IMA, thus decreasing the time of operation [6].

In our study we did all proximal anastomoses of Y graft during cross clamp, which increase clamp time. Calafiore and co-workers stated that the patency of Y graft of RA is superior to anastomosing the RA to aorta [7]. In our study radial artery harvest site showed no complication, Tatoulis and coworkers evaluated RA-harvest-site results in 2,417 patients who received one or more RA grafts during CABG and observed a 0.08% incidence of fingertip ischemia [8]. The success of using the RA is related to decrease trauma during harvesting and the use of topical and intraluminal papaverine, which minimizes RA spasm [9]. The use of verapamil and nitroglycerine solution during preparation of RA preserves endothelial function [10].

It has been recommended by several studies that the RA should not be used to graft arteries with less than 70% stenosis [11, 12]. In our study we used the RA to graft the branches of circumflex artery (obtuse marginal) when they showed critical stenosis more than 90% stenosis.

CONCLUSIONS

RA can be used safely with LIMA to revascularization left coronary territory using sequential grafts or multiple (Y) grafts. This method allows for complete arterial grafting in multi-vessel disease using only single IMA and RA grafts with good early results.

REFERENCES
1. **Carpentier A, Guermonprez J, Deloche A et al. (1973):** The aorta to coronary radial artery bypass graft. Ann Thorac Surg., 16: 111-121.
2. **Lytle B, Blackstone E, Loop F et al. (1999):** Two internal thoracic artery grafts are better than one. J Thorac Cardiovasc Surg., 117:855–872.
3. **Sundt T, Barner H, Camillo C et al. (1999):** Total arterial revascularization with an internal thoracic artery and radial artery T graft. Ann Thorac Surg., 68:399–404.
4. **Barner H (1997):** Techniques of myocardial revascularization. Edmunds LH, editor. Cardiac surgery in the adult, New York, NY: McGrawHill, Pp. 481–534.
5. **Wendler O, Hennen B, Demertzis S et al. (2000):** Complete arterial revascularization in multivessel coronary artery disease with two conduits (skeletonized grafts and T grafts). Circulation, 102:79-83.
6. **Yilmaz A, Ozal E, Gu¨nay C et al. (2001):** Extended use of radial artery with Y-graft technique for complete arterial revascularization. Ann Thorac Surg., 72:636–637
7. **Calafiore A, Di Giammarco G, Lucian N et al. (1994):** Composite arterial conduits for a wider arterial myocardial revascularization. Ann Thorac Surg., 58: 185-190.
8. **Tatoulis J, Buxton B, Fuller J (1998):** Bilateral radial artery grafts in coronary reconstruction: technique and early results in 261 patients. Ann Thorac Surg., 66(3):714-20.
9. **Tatoulis J, Royse A, Buxton B et al. (2002):** The radial artery in coronary surgery. A 5-year experience clinical and angiographic results. Ann Thorac Surg., 73:143–8.
10. **He G (1998):** Verapomil plus nitroglycerine solution maximally preserves endothelial function of the radial artery comparison with papaverine solution. J Thorac Cardiovasc Surg., 115:1321–7.
11. **Royse A, Royse C, Tatoulis J et al. (2000):** Post-operative radial artery angiography for coronary artery bypass surgery. Eur J Cardiothorac Surg., 17:294–304.
12. **Maniar H, Sundt T, Barner H et al. (2002):** Effect of target stenosis and location on radial artery graft patency. J Thorac Cardiovasc Surg., 123:45–52.