Early postoperative outcome of total arterial coronary revascularization versus conventional CABG

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Abstract: Although the long term superiority of arterial grafts over venous in CABG is well proven, still the fear from the complexity of the procedure and the potential complications are hindering factors for its widespread use. Our study is aiming at the assessment of the immediate postoperative results of arterial grafting in comparison to conventional single mammary + SVGs. **Patients and methods:** Our study included 200 patients undergoing elective CABG for multivessel disease and were divided into 2 groups. Group A: 100 patients who had CABG using arterial grafts other than the LIMA with or without vein grafts. Group B: 100 patients undergoing conventional CABG using LIMA to LAD plus additional SVGs. **Results:** The mean cross clamp (ischemic) time was 77.8 ± 17.49 minutes for group A; versus 39.1 ± 8.96 minutes for the conventional group B., there was no significant difference between the two groups regarding incidence of bleeding, reopening, ischemia or infection. There were no mortalities in our study. **Conclusion**: Extended arterial coronary revascularization (EACR) is a safe procedure with acceptable complications when compared to conventional CABG using a single mammary with veins.

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Key words: Extended arterial coronary revascularization (EACR).

1. Introduction:

Some surgeons still consider that the golden standard CABG procedure is the LIMA to LAD with SVGs to other vessels *(1)*. Although logic suggests that a second ITA graft would further improve the long term results of revascularization, bilateral ITA grafting has not been universally popular because of the increased time required for harvesting and the potential risk of chest complications, which occur more in obese and diabetic patients *(2)*.

Complete arterial grafting can be achieved by using a combination of ITAs, radial artery, gastroepiploic artery and inferior epigastric artery as well. Most patients require three conduits, but if additional grafts are needed, sequential anastomoses, Y or T grafting, Graft extension or a combination of these techniques can be used *(3)*.

However, due to the tendency for early postoperative spasm in arterial grafts, some research studies expressed some doubts that coronary revascularization based entirely on arterial grafting may not be entirely reliable and/ or effective in supporting the myocardium on short term basis. Others added that higher morbidity rates can be encountered especially if the operative time is markedly elongated. Moreover, local ischemic complications of the sternum and/ or hand may occur due to ITA and RA harvesting *(4)*.

Aim of the study:

Our study is aiming at the assessment of the immediate postoperative results of arterial grafting in comparison to conventional single mammary + SVGs mainly regarding the procedure time, postoperative complications including ischemia, infection and myocardial function.

2. Patients and Methods

This study included 200 patients undergoing CABG surgery at Kasr-El-Einy hospital I the period from Jan 2007 till Dec 2008.

Inclusion criteria:

Any patient submitted to CABG surgery within the mentioned period of time.

Exclusion criteria:

1) Single vessel disease.
2) Associated valvular disease requiring surgery.
3) Contraindications to arterial grafting as emergency CABG or low EF (<30%)

The patients were divided into 2 groups:

Group A: 100 patients who had CABG using arterial grafts other than the LIMA with or without vein grafts.

Group B:

100 patients undergoing conventional CABG using LIMA to LAD plus additional SVGs.

Demographic data:

In group A there were 91 men (91%) and 9 women (9%). In group B there were 94 men (94%) and 6 women (6%). In group A the mean age was 56.5 years; while in group B the mean age was 55.

Preoperative assessment:

For both groups, routine labs were done in addition to 12 lead ECG, chest x-ray, and echocardiography, Duplex on the carotids, radial arteries, and peripheral arterial and venous systems. CT chest was done for patients over 65 years of age for assessment of Aortic calcifications. Coronary angiography was done and careful history taking and clinical examination performed.

Surgical techniques:

All patients underwent the surgery through full median sternotomy and on CPB using Aortic and common atrial cannulation. Myocardial protection was achieved using antegrade warm blood cardioplegia.

For group A:

All the patients had at least one arterial graft in addition to the LIMA. The conduits used were in most cases the left radial artery (except in left handed patients where the right radial artery was used instead). Others had the RIMA used (except in insulin dependant diabetic patients). Some patients had the radial artery anastomosed to 2 or 3 vessels. The proximal anastomosis of the RIMA or the radial arteries was to the LIMA in a Y or T fashion. For patients with bilateral ITA grafts, the Mammaries were harvested in a skelitonized manner.

*** For group B:**

All patients had a LIMA to LAD anastomosis in addition to one or more SVGs. The vein grafts were used whether for a single distal anastomosis or sequentially to 2 or more vessels.

Operative and postoperative assessment:

Operative recording was done for:

1) Number of anastomoses.
2) Ischemic and total CPB times.
3) Need for inotropic support or IABP

Postoperative recording was done for:

1) Duration of mechanical ventilation.
2) Drainage, need for blood transfusion, and reoperation for bleeding.
3) Duration of ICU stay
4) New evidence of ischemia.
5) Postoperative arrhythmias as AF, ventricular arrhythmias.
6) Wound complications (sternal dehiscence)

Hospital mortality was defined as deaths occurring within 30 days of the operation.

Statistical analysis:

SPSS version 3 was used in the analysis. Quantitative variables were expressed using mean and standard deviation, they were compared using student -t test. Qualitative variables were compared using Chi-square or Fischer's exact test. In all tests, p value was considered significant when $p < 0.05$ and considered highly significant when $p < 0.01$.

3. Results:

Demographic data:

Table (1): Demographic Data

	Group A	*Group B*	*P value*
Age (M±SD) (Years)	56.5± 8.90	55.4± 8.54	0.387
Gender (m/f)	91/9	94/6	0.593

There was no significant difference between the 2 groups regarding the age or gender.

Preoperative clinical data:

Table (2): Preoperative clinical data

	Group A	*Group B*	*P value*
Hypertension	66	68	0.881
COPD	1	0	1.000
DM	51	51	-
Hypercholesterolemia	28	21	0.324
Obesity	21	14	0.264
Renal dysfunction	5	8	0.568
Ejection fraction 30-50%	12	24	0.042 significant
Euro score	1.76	1.79	0.9

From these data we can notice that there was no major significant difference between the 2 groups regarding the preoperative co- morbidities.

Distribution of conduits and number of distal anastomoses for both groups:

The distal anastomotic points were 350 in group A, while in group B 284 anastomoses were done. The conduits used were as follows:

Conduits used in Group A and Group B

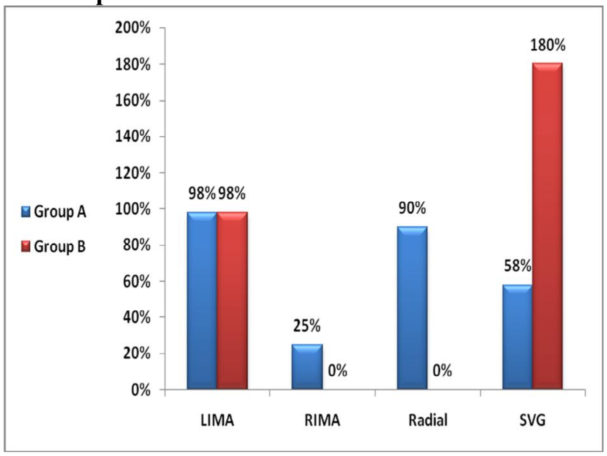

Figure (1): Conduits used in group A and group B

Details of surgery:

The mean duration of surgery was 307.4 ± 64.46 minutes for group A patients; versus 191.5 ± 36.59 minutes for group B patients ($p< 0.001$). The mean time for aortic cross clamping (ischemic time) was 39.1 ± 8.96 minutes for group B cases; versus 77.8 ± 17.49 minutes in group A cases ($p< 0.001$) and consequently, the total CPB time was 63.9 ± 17.15 minutes in group B patients; versus 109.7 ± 26.49 minutes in group A patients ($p< 0.001$). The operative details are demonstrated in the next table :

Table (3): Details of surgery (Mean ±SD)

	Group A *n = 100*	*Group B* *n = 100*	*P value*
Cross clamping time (min)	77.8 ±17.49	39.1± 8.96	<0.001
Total CPB time (min)	109.7 ±26.49	63.9± 17.15	<0.001
Total operative time (min)	307.4 ±64.46	191.5 ± 36.59	<0.001

Postoperative Variables and Complications:

- ***Inotropic support:***

Inotropic support was needed to aid the hemodynamics in 34 patients of group A cases; versus 59 patients of group B cases ($p< 0.001$).

- ***ICU stay:***

The mean period of ICU stay was 65.2 ± 47.43 hours for group A cases; versus 69.2 ± 38.82 hours for group B cases (p= NS).

- ***Mechanical ventilatory support:***

The mean time(in hours) of mechanical ventilatory support was nearly the same in both groups was 9.9 ± 4.5 in group A patients; versus 9.9 ± 4.4 hours in group B patients (p=NS).

- ***Hospital stay:***

The time from admission till discharge from the hospital for all the patients was nearly comparable, it was in group A patients 8.5 ± 2.59 days; versus 8.2 ± 3.27days in group B (p=NS).

- **Hospital mortality:**

No hospital mortalities were recorded in either groups.

- ***Atrial fibrillation:***

Postoperative atrial fibrillation was encountered in 4 cases of group A patients; versus only 1 patient in group B (p=NS)

- ***Reoperation for bleeding:***

Significantly higher rate of reopening for bleeding in Group A patients was noted (10 cases); compared to group B patients (2 cases only) (p=0.033) which can be attributed to the relatively longer CPB time leading to depletion of the coagulation factors as evidenced by exclusion of surgical bleeding from the anastmotic points performed in all the 10 cases.

- **Acute renal failure:**

Apart from the five and eight patients with preoperative renal dysfunction in groups A and B respectively, it should be mentioned that this event was newly developed equally in four cases of each group.

- **CVA:**

Only one patient in group B developed postoperative stroke; while no such complication was observed in any patient of group A cases (p=NS). This patient did not have any past history suggesting TIAs and his carotid duplex did not show any hemodynamically significant lesions.

- **IABCP support *:***

The support of Intra-Aortic Balloon Counter-Pulsations catheter was needed to aid the hemodynamic status in only one patient from group B postoperatively; versus no patients in group A (*p*=NS).

- **MI :**

Despite all our technical precautions, newly developed postoperative Myocardial Infarction complicated the outcome of 7 patients in group B one of whom required the support of IABCP to aid the hemodynamics; versus only 1 patient in group A (*p*=NS).

- **Sternal dehiscence:**

Postoperative deep sternal wound infection occurred equally in one patient in each group (*p*=NS).The patient in group A was diabetic, did not receive BIMAs. Postoperative dyspnea progressed with fever, leucocytosis and wide retrosternal space with fluid collection in plain chest radiographs. For both patients, re-wiring was performed after adequate debridement and thorough irrigation of the retrosternal spaces was done followed by the insertion of two retrosternal drainage tubes connected to an underwater-seal. Infection subsided afterwards in parallel with sternal healing. Both patients of groups A and B were discharged after 17 and 20 days respectively.

4. Discussion:

The mean duration of surgery in our study was 307.4 ± 64.46 minutes for group A; versus 191.5 ± 36.59 minutes for group B ($p < 0.001$). The more prolonged total time of surgery in the extended arterial coronary revascularization (EACR) group can be attributed to the relatively more difficult technical demands of the arterial grafting technique and the fact that we adopted the technique of constructing all the composite grafting on arrested heart which enables us to make use of the arterial conduits to the maximal limit. Our operative time closely conforms well with those reported in other series like **Possati *et al.*** [(5)], who reported 225 ± 2.2 and 181 ± 4.1 minutes (respectively).

Due to the relative complexity and the technical demand of the technique of composite arterial revascularization, the cross clamp time and hence the total cardiopulmonary bypass times were increased in the EACR group with statistical significance in relation to the conventional group. In our study, the mean cross clamp (ischemic) time was 77.8 ± 17.49 minutes for group A (EACR); versus 39.1 ± 8.96 minutes for the conventional group B ($p<0.001$) Our ischemic time was closely comparable to other mean cross clamp times reported in other series like **Tatoulis *et al.*** [(6)], who reported 55 ± 24 and 59 ± 22 minutes for TACR group versus the conventional CABG group (respectively); **Tashiro *et al.*** [(7)], who reported cross-clamp times of 49 ± 12 versus 45 ± 5 minutes, respectively.

According to our results, hemodynamic support was needed for some of our patients in both groups. Intraoperative inotropic support (adrenaline) was needed to support the hemodynamics during weaning off-CPB in 34 patients (34%) of group A; versus 59 (59%) patients in group B ($p< 0.001$). **Calafiore** *et al.* [(8)] reported the use of postoperative inotropic support in only 7.5 % of their TACR group for 10.6 ± 2.1 hours; versus 12.2 % of the SVGs group for 9.8 ± hours . **Pick** *et al.* (9) reported the respective values of 8.8 % for 10 hours and 13.6 % for 7.3 hours.

Our previous conclusion lies in line with those reported in other series like:, **Calafiore** *et al.* [(8)], **Tashiro** *et al.* [(7)], **Tatoulis** *et al.* [(6)]. They all reported that EACR, alone, was soundly capable of supporting the postoperative myocardial functions with some help offered by inotropic support and IABCP. The "relatively-higher" incidence rate of inotropes used in our study is attributed to the limited number of our cases in relation to those reported in the other studies, and also to the difference of the methodology of using such medications in our study related to the others.

Calafiore *et al.* [(8)] reported that the incidence of forearm wound infection (the site of harvesting the RA) was lower than the incidence of lower limb wound infection (the site of SVGs harvesting). However, complications other than infection may occur at the site of RA harvesting such as forearm hematoma, and temporary parasthesia. **Tatoulis** *et al.* [(6)] reported rates of 2.4%, 22%, 1.5% for hematoma, paraesthesia, and superficial wound infection (respectively). **Calafiore** *et al.* [(8)] reported rates of 1.9%, 18%, and 0.9% (respectively).

Due to our accurate preoperative RA examination and harvesting technique, none of the serious functional disturbances was noticed in any of our study cases (e.g. hand ischemia, forearm hematoma, or wound infection). Temporary mild parasthesia of the thumb finger was noticed in many of group A cases. However, it was spontaneously ameliorated with no residual effect. In our study, only one patient in each group, had sternal wound infection. The postoperative complications and side effects noticed at the ITA harvest site occurred as deep sternal wound infection. Our rate of infection which is 2/200 patients (1%) in the two groups is less than those reported by others like**: Barner** *et al.* [(10)] who reported 2.1%; **Calafiore** *et al.*. [(8)] who reported

1.2% ; and **Tatoulis** *et al.* [(6)], who reported 1.6% . This complication was well-controlled afterwards without any serious residual consequences. Our choice of avoiding the use of BIMA grafts in patients with IDDM, COPD and obesity has been successful in preserving the sternal blood supply (hence decreasing the incidence of sternal complications) in the majority of our patients.

Intra-aortic balloon counter-pulsation catheter (IABCP) was instituted in one patient of group B cases (1%) versus none of group A patients (p=NS). In most of the studies, IABCP was used to obtain a systolic blood pressure > 90 *mmHg*, and a cardiac index greater than 2.2 liters/minute/meter^2.

Conclusion:

Extended arterial coronary revascularization (EACR)is a safe procedure with acceptable complications when compared to conventional CABG using a single mammary with veins, if we consider its well proven long term results and freedom from reintervention.

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