

# Arterial Conduits in Coronary Bypass Surgery: Iraqi Experience

Ala Hadi Alwan, Ahmed Abdul Raouf Ammar\*

Consultant Cardiac Surgeon, Department of Cardiac Surgery, Ibn Al-Bitar Specialized Center for Cardiac Surgery, Baghdad, IRAQ.

## ABSTRACT

**Background:** The arterial conduits in coronary artery bypass grafting CABG surgery using bilateral internal thoracic arteries BITA have conferred popular acceptance for special characteristics they have that implicated in better long-term patency rates than other conduits. The radial artery RA may consider an equivalent to Right ITA as a second conduit. The vein graft patency limits the long-term patency and free event survival. Total arterial revascularization TAR is expected to be beneficial for long-term outcome. **Objective:** The aim of this review is to evaluate our initial experience in using total arterial conduits in selected patients. **Methods:** Cross-sectional study was conducted in Ibn Al-Bitar hospital during 2 years, 2015 – 2016. Twelve patients were selected to receive TAR, 11 were males and 1 was female. Their ages ranged from 37 - 59 years, mean 46.8. No major risk factor for sternal infection was present in the selected patients apart from controlled non-insulin dependent diabetes mellitus NIDDM. **Results:** Seven patients received TAR. Still, five patients had saphenous vein graft SVG in addition to achieve complete revascularization. Left internal thoracic arteries LITA have always used as pedicle. Right internal thoracic artery RITA used as pedicle or in situ artery in 2 cases and as a free graft in 8 cases. No postoperative complication reported apart from re-exploration in one case due to postoperative bleeding. No sternal wound infection. No early or intermediate mortality was reported for follow up period ranging from 4 months - 2 years. All patients were free of ischemic events during follow-up period. **Conclusion:** In conclusion, the TAR is a feasible approach with satisfactory results in selected patients.

**Key words:** Coronary artery bypass, Internal thoracic arteries, Radial artery.

## Correspondence

Ahmed Abdul Raouf Ammar,  
MD, FIBMS

Consultant Cardiac Surgeon,  
Department of Cardiac Surgery,  
Ibn Al-Bitar Specialized Center  
for Cardiac Surgery, Salihiya.  
POBox: 55057 Baghdad. IRAQ.

**Ph.no:** +964 7708066190

**E-mail address:** ahmed.  
ar.ammar@gmail.com

**Submission Date:** 05-02-2018;

**Revision Date:** 18-04-2018;

**Accepted Date:** 06-05-2018.

**DOI :** 10.5530/jcdr.2018.2.17

## INTRODUCTION

The internal thoracic artery ITA has peculiar characteristics that make it a better arterial conduit for coronary artery bypass grafting CABG with patency rates as high as 80% in third decade after surgery.<sup>1</sup> The right ITA (RITA) behaves in a similar way to that of left ITA (LITA).<sup>1</sup> The ITA intima has a well-formed non-fenestrated internal thoracic lamina facilitating prevention of intimal hyperplasia and cellular migration. Its media layer is less muscular formed by a network of circularly and longitudinally interlacing elastic lamellae between which smooth muscle cells running in a spiral fashion. The endothelium has a property of higher basal production of nitric oxide and prostacyclin. In addition, the ITA reserves its ability to be adapted to the demand during exertion by increasing its laminar blood flow.<sup>2-4</sup>

On contrary, the vein graft patency reports as 88%, 75%, 50% at 1, 5, 12 years respectively.<sup>5-6</sup> The radial artery RA may consider an equivalent to RITA as a second conduit. It has a lower vulnerability to develop stenosis than vein graft but higher than that of ITA.<sup>7-10</sup> Its patency rate ranges from 83-93% after 1-7 years postoperatively.<sup>11</sup>

In that manner, the vein graft patency limits the long-term patency and free event survival.

Total arterial revascularization TAR is expected to be beneficial for long-term outcome. ESC/EACTS guidelines on myocardial revascularization, 2014, recommend TAR for patient with reasonable life expectancy, class II a, level B evidence and in patient with poor vein quality independently of age, Class I, Level C.<sup>12</sup>

The aim of this review is to evaluate our initial experience in using total arterial conduits in selected patients.

## MATERIALS AND METHODS

Cross-sectional study was conducted in Ibn Al-Bitar cardiac center during 2 years, 2015 – 2016. Twelve patients were selected to receive TAR, 11 were males and 1 was female. Their age ranged from 37 - 59 years (mean =46.8).

The criteria of selection were: patients younger than 60 years old age, non-diabetic or controlled non-insulin dependent diabetes mellitus NIDDM, Ejection fraction EF not less than 41% and no morbid obese, Body mass index BMI less than 35 kilogram kg/square meter m<sup>2</sup>. Normal renal indices with no severe chronic obstructive pulmonary disease COPD. All patients were operated on electively.

The patients had been assessed completely before surgery. On-pump coronary bypass surgery was conducted in a standard manner. Antegrade and retrograde St Thomas cardioplegic protection with mild hypothermia 34°C was the standard. The RA was harvested from a non-dominant arm in skeletonized fashion. The antispasmodic solution used was comprised of papaverine 60 mg, 1 ml lidocaine 2%, 5000 IU heparin added to 200 ml isotonic saline. No specific antispasmodic medication postoperatively apart from routine use Calcium channel blocker for at least 6 months.

Intensive care unit stay was up to 48 h while hospital stay was ranged from 7-10 days. Follow-up was by clinic visit and telephone call.

## RESULTS

Twelve patients with triple-vessel coronary artery disease have been selected for elective CABG surgery.

Seven patients received TAR. LITA was used in 12 cases, RITA in 10 cases and RA in 10 cases also. Still, five patients had saphenous vein graft SVG in addition to achieve a complete revascularization.

Tables 1 and 2 show preoperative and operative data respectively.

Configurations of proximal and distal coronary anastomoses are shown in Figures 1 and 2.

RITA was used as pedicle or in situ artery in 2 cases and as a free graft in 8 cases.

No postoperative complication was reported apart from re-exploration in one case due to postoperative bleeding. No sternal wound infection. No early or intermediate mortality was reported during follow up period ranging from 4 months - 2 years.

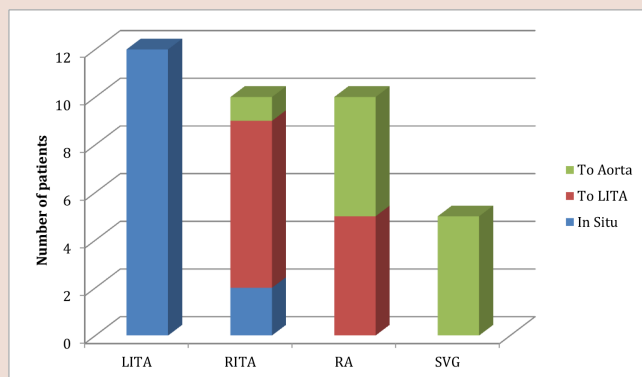
All patients were free of ischemic events during follow-up period.

**Table 1: Preoperative data for 12 patients with arterial conduits coronary bypass surgery. SD is standard deviation.**

Parameter	N=12
Age	37-59 years, mean 46.8
Sex	Male 11, Female 1
Body surface area	1.94 m <sup>2</sup> (1.59-2.19)
Co-morbid disease/ risk factors	
Smoking	9
NIDDM	5
Hypertension	3
Hyperlipidemia	1
Ejection Fraction %	53% (SD 9.9)
Number of diseased vessels	3 vessels disease

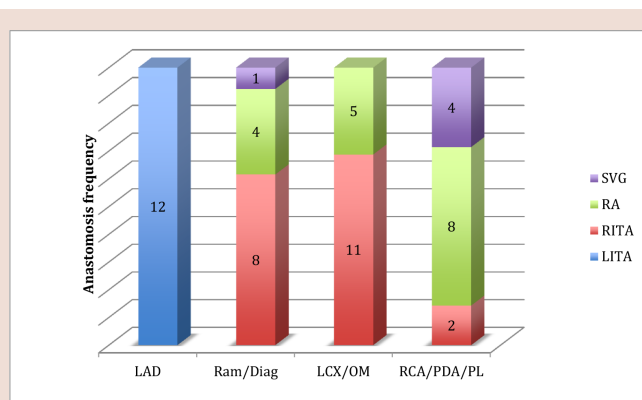
**Table 2: Operative data for 12 patients have undergone arterial conduit coronary bypass surgery.**

Parameter	N=12
On-pump bypass	12 cases
Aortic cross-clamp time	101.5 minutes (SD 12.1)
Total bypass time	128.3 minutes (SD 9.7)
Number of vessels' anastomosis/ case	4.7 graft/case
Number of patients with arterial conduits only	7
Number of patients having venous conduits in addition	5
Inotropic support	3 cases

**Figure 1:** Configurations of coronary artery proximal anastomosis in 12 cases of CABG surgery using arterial conduits. LITA: left internal thoracic artery. RITA: right internal thoracic artery. RA: radial artery. SVG: saphenous vein graft.

## DISCUSSION

The arterial conduits in CABG surgery using bilateral internal thoracic arteries BITA have conferred popular acceptance for special characteristics implicating in better long-term patency rates compared with other conduits. However, the sternal complications that comprise non-union and deep wound infections are the primary concern about bilateral harvesting of ITA. The complications were reported to be higher in BITA grafting than using single ITA (SITA).<sup>13</sup>

**Figure 2:** Configurations of coronary artery distal anastomosis in 12 cases of CABG surgery using arterial conduits. LAD: left anterior descending artery, Ram / Diag: ramus or diagonal branch, LCX / OM: left circumflex artery or obtuse marginal, RCA/ PDA/ PL: right coronary, posterior descending artery or posterolateral branch. LITA: left internal thoracic artery. RITA: right internal thoracic artery. RA: radial artery. SVG: saphenous vein graft.

Sternal circulation can be diminished with the harvesting leading to sternal dehiscence<sup>13</sup> especially after using both ITA. Diabetes mellitus, BMI more than 35, severe COPD, exposure to radiotherapy and immunosuppressant<sup>14</sup> consider as risk factors that contribute to the raising incidence of this complication. However, simultaneous presence of more than one risk factor may increase worrisome of contraindication.

In this review, we judiciously selected our patients and excluded uncontrolled DM or insulin dependent diabetes mellitus IDDM patients from this type of surgery. Still, five out of 12 patients had controlled NIDDM. We experienced no infection in those patients.

Pevni *et al.*<sup>15</sup> had compared the outcome of BITA grafting to that of SITA grafting in 1528 diabetic patients. The mean follow-up was 12.2 ± 4.3 years. The two groups had similar operative mortality (2.6% BITA versus 3.0% SITA) and sternal infection (3.1% versus 3.9%, respectively). 10-year survival of the BITA group was better than that of the SITA group and was not significantly different between the matched groups; however, the Cox-adjusted survival of the BITA patients was better.

Gatti *et al.*<sup>16</sup> mentioned that diabetic had higher risk profiles than non-diabetic patients with BITA grafting i.e. use of adrenergic agonists, postoperative bleeding, deep sternal wound infection and means of longer hospital stay. However, it did not impact on hospital mortality, 2.2% versus 1.8%, p=0.52.

Vrancic *et al.*<sup>17</sup> showed, in his series, that BITA did not increase the risk of mediastinitis. The incidence of mediastinitis was (BITA 1.9% versus SITA 1.5%, p = 0.6). Propensity score matching showed no difference in mediastinitis (BITA 2.5% versus SITA 1.3% p = 0.17). BITA patients had lower unadjusted hospital mortality (1.6%, versus 5.3% for SITA, p < 0.0001). The diabetes (p < 0.01) and non-elective surgery (p = 0.004) were the only predictors of mediastinitis in the entire population.

The vascularity of sternum after harvesting depends only on collaterals.<sup>18</sup> In some patients these collaterals would not appear to be at risk with harvesting. Other subtypes due to different ITA branching patterns the collateral supply is at high risk for disruption.<sup>13</sup>

In spite of small statistical sample in this review, we suggest that the key point in harvesting methods is to preserve the collaterals, trying to apply clips close to the artery and do not use excessive cauterization but rapid interrupted spark to cut the branches. Still, Skeletonization of one of ITA may be beneficial. Benedetto *et al.*<sup>19</sup> reported odds ratio of sternal wound complication 1.8 with pedicled BITA, while ratio was 1 with skeletonized

BITA and 0.89 with skeletonized SITA. We lack comparison groups to determine a better way of harvesting BITA.

Lev-Ran *et al.*<sup>20</sup> recommended usage of skeletonized BITA grafts with acceptable risk in a substantial portion of insulin-treated diabetic patients.

There is no specific anatomical configuration apart from use the general rule: in situ LITA to LAD. It makes no difference whether to use RITA as pedicle or as a free graft. Regarding RA graft, we try to avoid bypass in less than 90% stenosis to RCA.

The beneficial early and late outcomes with the using BITA or TAR concept have proved by several studies. Tatoulis and his colleague<sup>21-22</sup> showed that the early mortality was less in non-diabetic patients submitted to TAR than non-TAR groups (0.8 versus 1.8 % respectively) while it was nearly similar in diabetic patients (1.2% versus 1.4% respectively). However, the late mortality would be less with TAR than non-TAR (0.8% versus 1.8%) and in diabetic patient undergoing TAR it was 10.2 % versus 12.2 %. Long-term prognostic benefit better in diabetic too. Kaplan – Meier survival for 4.9 years follow-up was better in TAR patients 97.2, 91.3, 85.4 % versus 96.5, 90.1, 81.2 % at 1, 5, 10 years respectively

Several studies<sup>14,23-24</sup> mentioned that TAR improves long-term survival, even with two arterial grafts only.<sup>23</sup>

Yanagawa *et al.*<sup>23</sup> mentioned that TAR leads to lower long-term all-cause mortality but no difference in perioperative stroke, myocardial infarction and mortality. TAR was associated with greater sternal complications.

Fleissners *et al.*<sup>25</sup> showed that LITA with RA graft had excellent result after 10 years.

Shi *et al.*<sup>26</sup> proved that BITA whether in situ or free graft would give greater survival over SITA and RA.

## CONCLUSION

In conclusion, the TAR is a feasible approach with satisfactory results in selected patients despite of our small sample and relatively short follow-up period.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## ABBREVIATIONS

**ITA:** Internal Thoracic Artery, **CABG:** Coronary Artery Bypass Grafting, **RITA:** Right ITA, **LITA:** Left ITA, **RA:** Radial Artery, **TAR:** Total Arterial Revascularization, **NIDDM:** Non-Insulin Dependent Diabetes Mellitus, **EF:** Ejection Fraction, **BMI:** Body Mass Index, **Kg/m<sup>2</sup>:** Kilogram/square meter, **COPD:** Chronic Obstructive Pulmonary Disease, **SD:** Standard Deviation, **SVG:** Saphenous Vein Graft, **LAD:** Left Anterior Descending Artery, **Ram / Diag:** Ramus or Diagonal Branch, **LCX / OM:** Left Circumflex Artery or Obtuse Marginal Artery, **RCA/ PDA/ PL:** Right Coronary, Posterior Descending Artery or Posterolateral Branch, **BITA:** Bilateral Internal Thoracic Arteries, **SITA:** Single ITA, **IDDM:** Insulin Dependent Diabetes Mellitus

## REFERENCES

- Buxton BF, Hayward PA. The art of arterial revascularization-total arterial revascularization in patients with triple vessel coronary artery disease. *Ann Cardiothorac Surg.* 2013;2(4):543-51.
- Sajja LR, Mannam G. Internal thoracic artery: Anatomical and biological characteristics revisited. *Asian Cardiovascular and Thoracic Annals.* 2015;23(1):88-99.
- Van Son JA, Smedts F, Vincent JG, Van Lier HJ, Kubat K. Comparative anatomic studies of various arterial conduits for myocardial revascularization. *J Thorac*

*Cardiovasc Surg.* 1990;99(4):703-7.

- Narin C, Kiris I, Abud B. Arterial grafts in coronary artery bypass surgery. *J Cardiol Clin Res.* 2016;4(2):1058.
- FitzGibbon GM, Kafka HP, Leach AJ, Burton JR. Interventions for coronary stenosis- a Canadian experience of 30 revolutionary years. *Can J Cardiol.* 1996;12(10):893-900.
- Bourassa MG. Long-term vein graft patency. *Curr Opin Cardiol.* 1994;9(6):685-91.
- Artery,s. Barner HB. Conduits for coronary bypass: Arteries other than the internal thoracic arteries. *Korean J Thorac Cardiovasc Surg.* 2013;46(3):165-77.
- Cao C, Manganas C, Horton M *et al.* Angiographic outcomes of radial artery versus saphenous vein in coronary artery bypass graft surgery: A meta-analysis of randomized controlled trials. *J Thorac Cardiovasc Surg.* 2013;146(2):255-61.
- Schwann TA, Engoren M, Bonnell M, Clancy C, Habib RH. Comparison of late coronary artery bypass graft survival effects of radial artery versus saphenous vein grafting in male and female patients. *Ann Thorac Surg.* 2012;94(5):1485-91.
- Gaudino M, Crea F, Cammeroni F, Massetti M. The radial artery: A forgotten conduit. *Ann Thorac Surg.* 2015;99(4):1479-85.
- Ngaage DL, Cowen ME, Griffin S, Guvendik L, Cale AR. The impact of symptom severity on cardiac reoperative risk: Early referral and reoperation is warranted. *Eur J Cardiothorac Surg.* 2007;32(4):623-8.
- Windecker S, *et al.* ESC/EACTS Guidelines on myocardial revascularization. *European Heart J.* 2014;35(37):2541-619.
- Puri N, Gupta PK, Mahani TS, Puri D. Bilateral internal thoracic artery harvesting; anatomical variation to be considered. *Ind J Thorac Cardiovasc Surg.* 2007; 23(3):192-196.
- Panakonstantinou NA, Baikoussis NG. Total arterial revascularization: A superior method of cardiac revascularization. *Hellenic J Cardiol.* 2016;57(3):152-6.
- Pevni D, Medalion B, Mohr R, Ben-Gal Y, Laub A, Nevo A, *et al.* Should bilateral internal thoracic artery grafting be used in patients with diabetes mellitus?. *Ann Thorac Surg.* 2017;103(2):551-8.
- Gatti G, Dell Angela L, Maschietto L, Luzzati R, Sinagra G, Pappalardo A. The impact of diabetes on early outcomes after routine bilateral internal thoracic artery grafting. *Heart Lung Circ.* 2016;25(8):862-9.
- Vrancic JM, Piccinini F, Camporrotondo M, Espinoza JC, Camou JI, Nacinovich F, *et al.* Bilateral internal thoracic artery grafting increase mediastinitis: Myth or fact?. *Ann Thorac Surg.* 2017;103(39):834-9.
- Berdajs D, Zund G, Turina MI, Genoni M. Blood supply of the sternum and its importance in internal thoracic artery harvesting. *Ann Thorac Surg.* 2006;81(6):2155-9.
- Benedetto U, Altman DG, Gerry S, Gray A, Lees B, Pawlaczyk R, *et al.* Pedicled and skeletonized single and bilateral internal thoracic artery grafts and the incidence of sternal wound complications: Insights from the arterial revascularization trail. *J Thorac Cardiovasc Surg.* 2016;152(1):270-6.
- Lev-Ran O, Matsa M, Ishay Y, Abod MA, Vodonos A, Sahar G. Bilateral internal thoracic artery grafting in insulin- treated diabetes. *Asian Cardiovasc Ann.* 2013;21(6):661-8.
- Tatoulis J, Wynne R, Skillington PD, Buxton BF. Total arterial revascularization: A superior strategy for diabetic patient who require coronary surgery. *Ann Thorac Surg.* 2016;102(6):1948-55.
- Tatoulis J, Wynne R, Skillington PD, Buxton BF. Total arterial revascularization: Achievable and prognostically effective – A multicenter analysis. *Ann Thorac Surg.* 2015;100(4):1268-75.
- Yanagawa B, Verma S, MazineA, Tam DY, Juni P, Puskas JD. Impact of total arterial revascularization on long-term survival: A systemic review and meta-analysis of 130,305 patients. *Int J Cardiol.* 2017;15(300):29-36.
- Bisleri G, DiBacco L, Giroletti L, Muneretto C. Total arterial grafting is associated with improved clinical outcomes compared to conventional myocardial revascularization at 10 years follow-up. *Heart Vessels.* 2017;32(2):109–16.
- Fleissner F, Engelke H, Rojas-Hernandez s, Ismail I, Stiefel P, Cebotari S, *et al.* Long-term follow-up of total arterial revascularization with left internal thoracic artery and radial artery T-graft: Survival, cardiac morbidity and quality of life. *Eur J Cardiothorac Surg.* 2016;49(4):1195-200.
- Shi WY, Hayward PA, Tatoulis J, Rosalion A, Newcomb AE, Fuller JA, *et al.* Are all form of total arterial revascularization equal? A comparison of single versus bilateral internal thoracic artery grafting strategies. *J Thorac Cardiovasc Surg.* 2015;150(69):1526-33.

**Cite this article :** Alwan AH, Ammar AAR. Arterial conduits in coronary bypass surgery: Iraqi experience. *J Cardiovasc Disease Res.* 2018; 9(2):68-70.