BILATERAL INTERNAL THORACIC ARTERY AS A COMPOSITE ARTERIAL GRAFTS USED IN CORONARY ARTERY BYPASS GRAFTING.

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ADSTRACT:

Background*: With the increase use of IMA and arterial conduits, as well as evolution of other techniques of arterial anastomoses and usage of bilateral IMA, surgeons are able to graft more number of vessels especially with Pedicled internal thoracic arteries.*

Aim Of The Work*: to delineate the immediate term outcome and efficacy of bilateral internal mammary grafting for multiple coronary branches.*

Patients And Methods: *a prospective non randomized study done at National Heart Institute, Cairo, Egypt from January 2018 till the end of 2020. It included 50 patients indicated for first-do on pump CABG.*

Results: *No mortality was found in our study with no signs of ischemia or myocardial infarction, no rise in troponin level post-operatively.*

Conclusion*: Total arterial revascularization using the composite T graft is a safe procedure with low mortality rates .*

Key Words *: Total arterial, composite graft ,CABG.*

INTRODUCTION:

A lot of modifications have been emerged for CABG surgery form its evolution and up till now. Among these modifications is to choose the best conduit which gives a longer patency rate, choosing which coronary artery to be grafted and invention of more anastomosing techniques as sequential anastomosis(1).

According to the guidelines, performing LIMA to left anterior descending artery LAD is classified as class I for choice of the conduits for coronary revascularization(2). Owing to its very low incidence of spasm as well as nitric oxide and prostacyclin's release , the internal mammary artery is considered the conduit of choice and by far superior to other arterial conduits as well as the grate saphenous vein .This gives it the property of attenuating atherosclerosis process and providing the best short and long term outcomes and providing the highest patency rate exceeding ninety percentage after ten years of its implantation(3).

Furthermore, IMA can prevent intimal hyperplasia and atheroma formation which is the main pathology of graft failure. It has the histological properties of having low fenestrated intima with low inter cellular permeability, and having greater anti-thrombotic molecules as heparin. (4). Because of its excellent patency rate and long term outcome, IMA can be used for grafting not only the LAD but also other coronaries as circumflex artery CX and right coronary artery RCA. With the increase use of IMA and other arterial conduits, as well

as evolution of other techniques of arterial anastomoses as sequential technique and usage of bilateral IMA, surgeons became nowadays able to graft more number of vessels especially with Pedicled internal thoracic arteries[5]. Right internal thoracic artery has the advantage of longer length, when anastomosed to the left internal thoracic artery as a composite graft it can be used to perform a total revascularization of the left coronary system in selective cases[6]. Authors believe that some patients can benefit more from using bilateral internal thoracic arteries as: life expectancy more than ten years which is the estimated graft patency of vein grafts[7]. Patients with calcific ascending aorta providing no proper site of proximal anastomosis [8]. Unavailability of veins due to diseased veins or in cases of redo cases due to graft failure [9].and patients with hypercholesterolemia, hyperlipidemia, uncontrolled severe systemic hypertension and nicotine abuse[10].

AIM OF THE WORK:

The objective of this study is to delineate the immediate term outcome and efficacy of bilateral internal mammary grafting for multiple coronary branches by assessment of hospital mortality, early clinical outcomes and postoperative complication.

PATIENTS AND METHODS:

This is a prospective non randomized study done at National Heart Institute, Cairo, Egypt during the period from January 2018 till the end of 2020. It included 50 patients indicated for first-do on pump CABG procedure for multi-vessel ischemic heart disease.

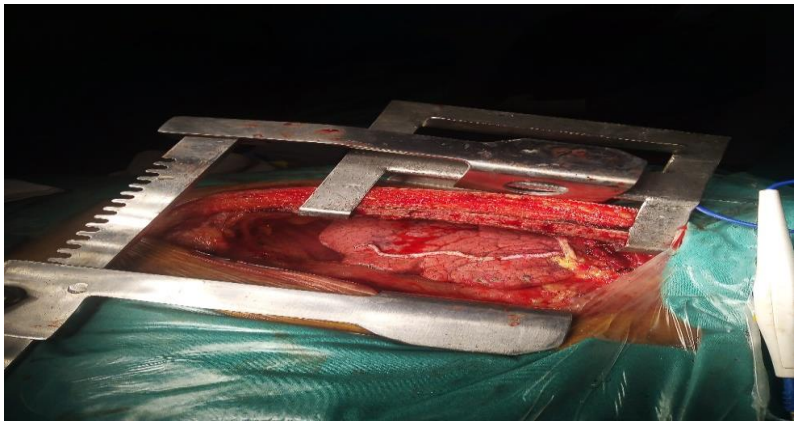

Figure (1): Show skeletonized RIMA after sternotomy

Operative techniques:

Standard median sternotomy, Internal mammary arteries were harvested as skeletonized graft (Fig 1). LIMAs were used as pedicle grafts while RIMAs were used as free grafts In which the free RIMA is proximally anastomosed to the left IMA at the level of main pulmonary artery creating a Y shaped graft as shown in figure (2), in which the RIMA represents the long limb and used to to graft inferior and lateral wall vessels from the posterior descending artery and proximally through the circumflex branches to the ramus intermediate artery and the short limb is represented by the LIMA which is anastomosed to the LAD and the diagonals in some cases. This approach allows for multiple branches of the circumflex coronary artery and some branches of the right coronary artery to be revascularized with arterial graft. Intermittent blood warm antegrade cardioplegia was used in all cases. The `parachute' technique with a running stitch of 7-0 or 8-0 polypropylene suture was used for all distal anastomosis. In most

circumstances it is easier to perform the terminal end-to-side anastomosis first and preference is given for this anastomosis to be located on a vessel of large diameter to facilitate flow through the graft.

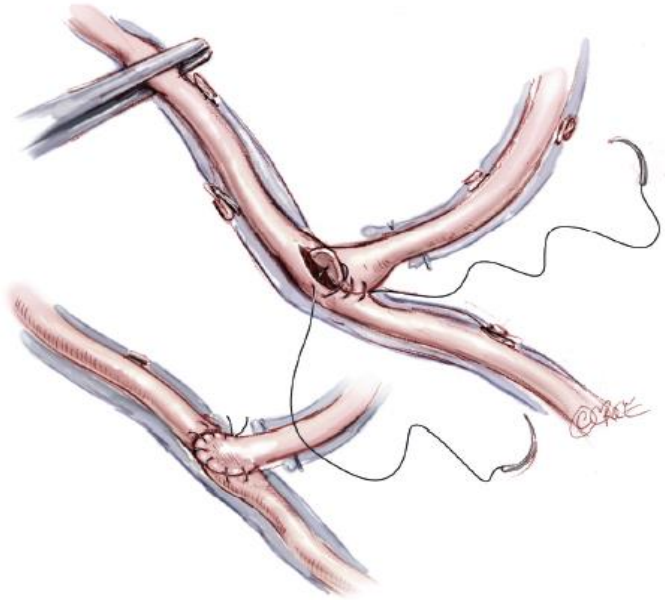

Figure (2): Show anastomotic technique of composite T- grafts [11].

Statistical Analysis: patients categorical predictor variables and outcomes were analyzed using Pearson Chi-Square (x^2) test for independence .Statistical analysis was performed using SPSS.

RESULTS:

The collected demographic data of the patients showed that mean age was 54.6 ± 7.01 with 40 patients were males (80%) and 10 patients were females (20%), indexed body mass index was 29.0 ± 0.8 kg/m2.40 Table (1) showing operative data.

patients were smokers (80%),31 patients were diabetics (62%) with mean glycated Hb 6.1 ± 0.7. 39 patients were hypertensive (78%),39 patients were dyslipidemic (78%), 24 patients represented by NYHA class Π (48%),22 in class III and only 4 patients were in class IV (8%).

Preoperative creatinine level was 0.89 ± 0.2 mg/dl, regarding co- morbidities, dyslipidemia and high cholesterol levels, hypertension, smoking and diabetes were the most common risk factors found.

Op. Time (hours)	Mean ±SD	5.1 ± 0.8	
Bypass Time (min)	Mean ±SD	104.4 ± 28.9	
Cross Clamp Time (min)	Mean ±SD	81.6 ± 16.2	
Need of Inotropes	Yes	18	36%
No. of coronary anastomosis	2	12	24%
	3	28	56%
	4	10	20%
	Yes	20	40%
	1	20	40%
	2	0	0%

The commonest presenting complaint was chest pain grade II having a high prevalence of 24 (48%).pre operative echocardiographic data showed left ventricular ejection fraction (LVEF) of 61.1% as a mean with segmental wall motion abnormalities found in 28 cases (56%). Pro-operatively coronary angiography revealed left main lesions in 22 patients (44%), LAD lesions in 50 patients (100%), diagonal lesions in 12 patients (24%),obtuse marginal OM lesions were found in 46 patients(92%), and posterior descending artery PDA lesion was found in 24 patients (48%) .Mean number of total lesions was 4.1±1.35. Intra-operatively, mean operation time was 5.1 ± 0.8 hours, bypass time was 104.4 ± 28.9 min, cross clamp time was 81.6 ± 16.2 min, eighteen patients needed inotropes during weaning from cardio-pulmonary bypass (36%).as regarding number of coronary anastomoses, only 2 grafts was done in 12 patients (24%) of cases, 3 grafts were done in 28 patients (56%), 4 grafts were done 10 patients (20%) as shown in table (1).

Mean duration of ventilation was 12.04 ± 6.8 hours, long post operative ventilation more than 24 hours occurred in 8 patients (16%), mean D. of inotropes was 16.2 ± 10.1 hours with only two patients needed an Intra Aortic Balloon Pump IABP (4%). Long inotropic support more than 24 hours was needed in 4 patients (8%).Mean level of troponin in the first 6 hours post operatively was 1.2 ± 0.7 ng/ml. Duration of intensive care unit ICU was 2.4 ± 0.6 days, long ICU stay more than 48 hours was found in 12 patient (24%).Mean duration of stay in the ward was 5.4 ± 1.4 days with high drainage and reopening in 2 patients (4%)as shown in table(2). No ECG changes or pathological Q waves were found in the ICU stay. Only 3 patients developed post operative arrythmias AF (6%), bronchospasm occurred in 2 patients (4%), superficial wound infection occurred in 3 patients (6%) with only one patients(2%) developing deep wound infection which required debridement and secondary wound closure after control of infection.

Table (2) showing post operative ICU data.

D. of Ventilation (hours)	Mean ±SD	12.04 ± 6.8
Long PO ventilation	Num/%	8 16%
D. of inotropes (hours)	Mean ±SD	16.2 ± 10.1
Need of IABP	Num/%	
		2 4%
Long INOT. Supp.	Num/%	
		4 8%
Troponin 6 hours post op (ng/ml)	Mean ±SD	1.2 ± 0.7
ECG ischemia	Num/%	
		0 0%
D ICU stay (days)	Mean ±SD	2.4 ± 0.6
Long ICU stay	Num/%	12 24%
D ward stay (days)	Mean ±SD	5.4 ± 1.4
High drainage and reopening	Num/%	2 4%

Mortality and re-admission for cardiac causes were of zero percentages. Pre-discharge ejection fraction was of mean 58.4 ± 7.8 with improvement of segmental wall motion abnormality in 22 cases out of 28 ones having preoperative wall motion abnormality.

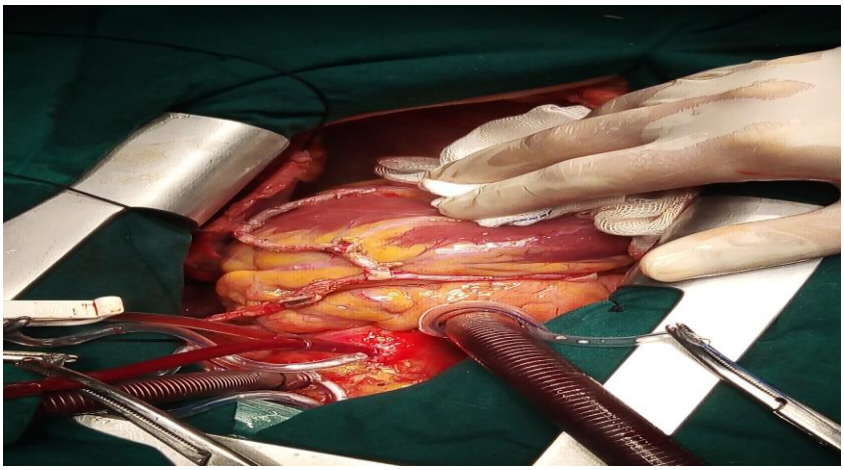

Figure (3): Show sequential anastomoses RIMA to OM and diagonal, T shaped anastomoses of RIMA on top of LIMA and distal LIMA to LAD

DISCUSSION:

In the mid eighties of the last century, Sauvage and colleagues published a study showing their results of performing a T or Y composite grafting technique using the left and right internal thoracic arteries .They anastomosed the RITA proximally to the LITA and then the RITA was used to anastomose the obtuse marginal artery while the LITA was used to anastomose the LAD artery. They showed good and promising results for a technique used for the first time in cardiac surgery **(11).**Few years later ,another study showed that the composite technique has many advantages among which is, the less handling of the ascending aorta doing no proximal aortic anastomoses, which led to marked decrease in cerebral accidents in particular during off pump procedures. Also it provided the whole length of the right internal thoracic artery available for more territories revascularization and hence preventing usage of vein grafts [(8).]On the other hand ,some surgeons do not recommend the routine use of this composite technique in CABG procedures due to their concerns of being more complicated, having a more technically demanding skills, needs more operative time, which may worsens the early outcome and increases the incidence of post operative complications especially deep infection.**(12)**

Therefore, we performed this study to evaluate the early outcomes observed following bilateral internal mammary artery BIMA grafting to assess the safety and early outcome of BIMA grafting as a routine procedure. The main finding of this study was that no in hospital mortality occurred and no ischemic changes occurred post-operatively as no ECG changes or Pathological Q waves , with no rise in post operative troponin level. More coronary targets were able to be revascularized using internal thoracic arteries so total and left system arterial revascularization is more achieved therefore obtaining better long-term outcomes.

Others refused this technique for fear of having high incidence of deep sternal wound infection. They conducted a study of more than thousand of patients comparing this composite technique to the conventional bypassing technique using LIMA and venous grafts, showing the composite technique using both mammary arteries to have a significant higher incidence of deep wound infection[(13)]. Others criticized this technique regarding having more conduits manipulations , difficulty in graft lay down, dependence of all grafts on a single flow

source which threatens a large area of the myocardium in case of impaired flow or occlusion of this single LIMA source of blood. They also were concerned about the use of the distal part of the LIMA with its relative small lumen diameter and profound relatively increased muscularity[14]. Other study comparing sequential anastomosing of the LITA to LAD in a group with other group in which the LITA was anastomosed to the diagonal and then to the LAD sequentially, they found the sequential anastomosis group to have an excellent results regarding outcome , morbidity and mortality same as the other group with no significant difference in between, revealing that sequential anastomosing multiple grafts does not subject the patient to a poor outcome or to a low patency rate. Both groups had had the same patency rate at short term follow up as elicited by using the coronary computed tomography. [15] In our study, we observed that revascularization of the coronary system using BIMA sequential grafting resulted in excellent in-hospital and early clinical outcomes and Sequential LIMA grafting was not found to be an independent predictor for post-operative MI.

Other authors concluded that when performing post operative PET scan, the flow reserve in the IMA and in the perfused myocardial territory was not optimum despite having sufficient flow measurements that met the myocardial demand when measured intra operatively by doppler measurements. They support the theory of competitive and decreased flow in the composite Y grafts that may lead to hypo-perfusion of the myocardium[8]. Many studies supporting were done revealing that composite grafts has a significant incidence of arterial vasospasm, decreased and competitive flow in the graft showing steal phenomenon which leads to high risk of fatal myocardial infarction and subsequently high mortality and poor outcome[16,17,18]. On the other hand, other studies were done comparing performing BIMA grafting as a composite graft to other group of BIMA anastomosis in situ, they found that performing composite grafting had the same mortality and outcome as the BIMA in situ group with the composite grafting group having more number or arteries grafted and less incidence of having MACCE than the in situ grafting group[19]. In our study we did not observe perioperative infraction or hypoperfusion syndrome as Post op troponin level was within normal level (0.95-1.2) and there is no ECG ischemic change (new pathological Q or ST segment elevation) was remarked, however low cardiac output states had been recorded in the study as prolonged inotropic support occurred in 4 cases 8 % of the total cases. Some authors recommend the skeleton-nization technique of harvesting the internal mammary artery as it has many advantages as providing much length than the pedicled one allowing more grafting and preservation of blood supply to the sternum leading to decrease incidence of mediastinitis[20].

Literature used to suggest that diabetic patients has a higher incidence of post operative mediastinal wound infection, hence considering diabetic patients to be a relative contra-indication of using BIMA for coronary bypass surgeries. A study was conducted comparing a group of five hundred patients who had BIMA grafting either in a composite Y graft or in situ grafting of both internal mammary arteries, to another control group . They concluded that BIMA group has a higher incidence of post operative complications especially mediastinal wound infection.[21]

Another meta analysis suggested that control of some risk factors can markedly decrease the incidence of post operative mediastinal wound infection. Among these factors is tight control of diabetes melliteus with glycated hemoglobin less than 7%, avoiding smoking, prophylactic peri-operative antibiotics, and most importantly meticulous surgical technique regarding IMA harvesting and hemostasis. They found

that low cardiac output, re-opening for bleeding, use of IABP and multiple transfusion of blood products , markedly increase the risk of wound infection. This study considered some relative contra-indications for BIMA harvesting as uncontrolled diabetes, severe interstitial lung diseases and morbid obesity with body mass index more than 35 kg/m^2 **(22).** In our study we faced one case of deep wound infection with three cases of superficial wound infection. This was related mainly to uncontrolled diabetes, prolonged operation time and reopening for bleeding.

Conclusion:

Total arterial revascularization with skeletonized bilateral internal mammary arteries as a composite graft has excellent results concerning mortality and short term outcome. Despite its relative high technically demanding skills, it should be considered as a routine procedure for coronary artery bypass grafting especially for young patients as we are facing markedly increasing number of young patients referred for CABG. Even in diabetic patients, strict control of well known risk factors of deep wound infection, will lead to marked improvement in outcome regarding post operative complications especially wound infection. It increases patient satisfaction with absence of leg wounds.

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استخدام شرايين الصدر الداخلية بطريقة الوصلة الشريانيه المركبة في عمليات ترقيع الشرايين التاجيه للقلب

المقدمة : مع ازدياد استخدام شرايين الصدر الداخليه و الوصلات الشريانيه اصبح الجراحون قادرون علي ترقيع عدد اكبر من الشرايين التاجيه للقلب.

الهدف من البحث: دراسة فاعلية استخدام شرياني الصدر الداخليان بطريقة الوصله الشريانيه المركبة في عملية ترقيع الشرايين التاجية للقلب.

المرضي و الطرق: اجريت هذه الدراسه علي خمسين مريض ممن اجريت لهم عملية ترقيع الشرايين التاجيه للقلب في معهد القلب القومي.

النتائج: لا يوجد حالات وفيات بين المرضي كما اثبتت النتائج عدم حدوث جلطات حديثه مصاحبه للعمليه.

التوصيات: الطريقه الشريانيه المركبة لترقيع الشرايين التاجيه للقلب هي طريقه امنه و لها معدل وفيات ضئيل.