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Safety and Efficacy of Coronary Artery Bypass Grafting Using Bilateral Internal Mammary Arteries Comparing Sequential and Non-Sequential Techniques in Distal Anastomosis

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ABSTRACT

Background: This study aimed to shed light on the use of bilateral internal mammary arteries (BIMAs) which is useful in patients undergoing coronary artery bypass grafting. To this end, free IMA grafts allowed to be used for their benefit in total cardiomyopathy in the patients chosen in this study.

Aim of the work: This study aims to determine safety and efficacy bilateral Sequentially and composite internal mammary that used for grafting of multiple coronary branches in comparison with bilateral non sequential internal mammary artery by assessment of hospital mortality, early clinical outcomes and postoperative complication.

Subjects and methods: The sample chosen in this study consisted of 100 patients who were prepared for on–pump CABG for multi-vessel coronary artery disease, classified into two groups fifty cases on each group (sequential and non- sequential).
Results: In this study, it was found that there are more coronary targets capable of revascularized with inward mammary artery using sequential technique compared to non-sequential one (p-value= 0.004 S).

Conclusion: Sequential technique is better than non-sequential one in achievement total and left system arterial revascularization with less leg incisions.

Keywords: CABG, BIMAs, sequential, non-sequential, LCX, LAD.

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INTRODUCTION

Usually, the procedure for Coronary artery bypass grafting (CABG) is used in patients suffering from ischemic heart disease, with the aim of improving long-term clinical outcomes, especially elimination of existing symptoms, hospitalization, coronary intervention, and death [1].

In this regard, there have been many studies that indicate the need for further adjustments to CABG surgery, with the aim of developing graft patency, which includes channel selection, long-term goal, and sequential anastomotic technology [2].

The concept of Sequential grafting mean that is the technique used to create more than one distal membrane for each channel used, which creates one or more spaced membranes for each approximate one. In this context, the advocates of this technique describe the haemodynamic advantage of increased total graft flow, which is done through remote and improved flow, aimed at increasing rates of graft gain [3].

Besides, the advocates of this technique describe how to maintain the duct and how to reduce aortic manipulation. Hence, serial vaccination facilitates greater vascular reconfiguration by permitting vacuity to the minor coronary arteries, and in this improved clinical outcome which are required [4].

Despite the alleged and significant benefits of this technique, the absorption of sequential grafting among surgeons was variable. However, there is a special critique of this technique, according to which multiple grafts rely on in-flow, with the potential for major consequences in the event of a blockage. From this, the large and at risk heart muscle is the main deterrent in the widespread adoption of serial vaccination, and in this context, surgeons who oppose the use of this technique have indicated that there are many defects that follow from increased manipulation of the channel, the presence of the substandard channel or anastomotic complication Certain from one side to another [5].

What is found in many medical centers to refer an increasing number of patients to surgical re-education with patients with diffuse coronary arteries or to repeat the process of transformation of the coronary artery with a limited and available channel. Within this framework, it is possible to increase the use of sequential grafting. Despite this, the published reports related to the safety and effectiveness of serial vaccination are conflicting in their results [6].

Although the long-term patency of the internal mammary arteries is proven to be much higher than that of the saphenous vein grafting, it does not depend on the left anterior descending artery (LAD), but also the left circumflex artery (LCX) and right coronary. artery (RCA). Which is bypassed with the internal mammary artery or other arterial grafts, to achieve good clinical results. However, the technical developments such as serial and bilateral vaccination and building anastomosis in the form of diamonds and guiding Rima through transverse sinuses enabled the surgeons to re-pump an increasing number of coronary vessels with IMA grafting [7].

It should be noted that the additional use of the free IMA layers, especially when free RIMA is installed on the lima grafting is laminated. This allows the heart muscle to be completely revascularization in the selected patients [8].

MATERIAL AND METHODS

In this study, a sample of 100 patients was selected who were prepared for on–pump CABG for multi-vessel coronary artery disease from February 2018 to march 2020 in a multicentric study. The patients selected in the study were classified into 2 groups, 50 patients each. Group (A): patients with bilateral sequential internal mammary artery grafting with composite configuration. Group (B): patients with bilateral non sequential internal mammary artery with composite configuration.

- Inclusion Criteria included: on-pump, isolated multi-vessels coronary artery disease meet the indication for CABG surge
- Exclusion Criteria included: Redo surgery, Off –pump, Patients with concomitant valve lesion, non-viable myocardium, acute evolving myocardial infarction, and Urgent cases.

In this study, data were collected through history and basic clinical examination, along with the evaluation of coronary vessels images and outcome measures that were entered and analyzed through the use of Microsoft Excel. The data will then be imported into the SPSS version 20.0 in order to perform the purpose of the statistical analysis. According to the different data in number and proportion, mean ± SD was calculated in order to examine the significance. The differences between the quantitative independent groups were tested by t-test or by correlational checks including Pearson and Spearman correlation. Whereas, the value of p was determined as <0.05 for significant results and at> 0.001 for high significant results.

Operative techniques

Standard median sternotomy, both internal mammary arteries were harvested as skeletonized graft.,LIMAs were used as pedicle grafts while RIMAs were used as free grafts ,On pump CABG was standard operated on both groups

- The Proximal Anastomosis were performed In both groups by Construction of IMA T- or Y-Grafting by using free graft
- Distal anastomosis perfomed according

For group I

This image shows the anastomosis of the bilateral internal mammary artery that is present in the form of a serial vaccination, with anastomosis from side to side in the proximal artery and the end of the anastomosis from side to distal artery.

Figure 1: Show sequential anastomoses RIMA to OM and diagonal, T shaped anastomoses of RIMA on top of LIMA and distal LIMA to LAD (group I sequential)

For group II

Distal end to side anastomosis of LIMAs to LAD and RIMAs and saphenous vien to other diseased coronary arteries with considering each graft supply single coronary artery

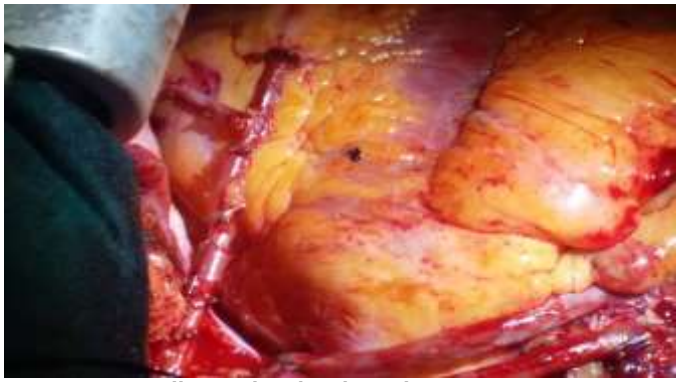

Figure 2: Shows LIMA to LAD, RIMA to diagonal and Y-shaped anastomoses RIMA on top of LIMA (group II non sequential)

Figure 3: shows RIMA to OM, LIMA to LAD, Y-shaped anastomoses of RIMA on top of LIMA (group II non sequential)

RESULTS

In this study, 100 patients were selected as a study sample and were divided into two main groups, *Group (A):* patients with bilateral sequential internal mammary artery grafting with composite configuration. *Group (B): This group includes patients with internal bilateral non-sequential breast artery* with composite configuration. the mean age of each group was 42.36±9.05 and 40.86±10.25 respectively.

We performed comparison trial between BIMA sequential grafting with composite configuration in group number (1) and BIMA non sequential grafting with composite configuration in group number (2), So that the two groups had similar baseline characteristics, and there was no significant difference between the two groups with regard to demographic data for the sample chosen in the study, hospital mortality (no mortality among both groups), post-operative ICU data(duration of ventilation, duration of inotropes, IABP usage and duration of ICU stay) and post-operative complication (table. 1, 2, 3, 4, 5) In that, two cases of bleeding occurred, constituting 4% in each group. Regarding the pulmonary problems that occurred after the operation, it occurred (4) cases, which constitutes 8% in the first group and (5) cases of what constitutes 10% in the second group (p-value = 0.727 NS). Meanwhile, the state of cardiac arrhythmia after surgery occurred in 3 cases in each group, and the incidence of superficial wound was slightly higher in the second group (non-seq), also (3) cases occurred and when it constituted 6% compared to the first group (seq And two cases 4% (p value = 0.646 NS), and the renal impairment after the operation was slightly higher in the first group compared to what was found in the second group and what will constitute 12%. (non-seq) 5 cases 10% (p-value=0.749 NS) and prolonged ventilation more than 24 h was slightly higher in group II(non-seq) 7 cases 14% compared to group I(seq) 3 cases 6% (p-value=0.182 NS) & neither deep wound infection nor myocardial infraction were remarked among both groups.

Table 1: demographic data distribution among studied group of patients.

Demographic data		Group I (N = 50)		Group II (N = 50)		P-value
Age (years)	Mean ±SD	53.9 ± 8.5		54.6 ± 7.01		0.655 NS
Sex	Male	48	96%	45	90%	0.240 NS
	Female	2	4%	5	10%	
BMI (kg/m^2)	Mean ±SD	28.9 ± 0.8		29.0 ± 0.8		0.857 NS

Table 2: Comparison between the groups chosen in the study with respect to Co-morbidities

Co-morbidities			Group I (N = 50)		Group II (N = 50)		P-value
Smoker		Num/%	25	50%	27	54%	0.689 NS
DM		Num/%	24	48%	29	58%	0.316 NS
HbA1C (%)		Mean ±SD	6.09 ± 0.7		6.1 ± 0.7		0.757 NS
Angina (CANADIAN CLASS)	pain	II	30	60%	24	48%	0.484 NS
		III	17	34%	22	44%	
		IV	3	6%	4	8%	
HTN		Num/%	41	82%	39	78%	0.617 NS

Dyslipidemia	Num/%	34	68%	39	78%	0.260 NS
Pre-op Creat (mg/dl)	Mean ±SD	0.88 ± 0.2		0.89 ± 0.2		0.817 NS

Table 3: preoperative echocardiography.

Per-operative Echo-cardiography		Group I (N = 50)	Group II (N = 50)	P-value
LVEDD	Mean ±SD	5.3 ± 0.6	5.2 ± 0.5	0.582 NS
LVESD	Mean ±SD	3.6 ± 0.6	3.5 ± 0.6	0.146 NS
EF (%)	Mean ±SD	59.2 ± 7.8	61.1 ± 8.3	0.242 NS
LA	Mean ±SD	3.8 ± 0.4	3.8 ± 0.4	0.980 NS
PRE-OP SWMA	Num/%	11 22%	10 20%	0.806 NS

Table 4: post-operative complications

Post-operative complications	Group I (N = 50)	Group II (N = 50)	P-value
AF(atrial fibralation) Arrhythmia	3 6%	3 6%	1.0 NS
pulmonary problem	4 8%	5 10%	0.727 NS
Superficial wound infection (SWI)	2 4%	3 6%	0.646 NS
Post-op renal impairment	6 12%	5 10%	0.749 NS
Deep sternal wound infection (DSWI)	0 0%	0 0%	-----
In hospital Mortality	0 0%	0 0%	-----
High drainage and reopening	2 4%	2 4%	1.0 NS

Table 5: post-operative ICU data.

Post-operative data		Group I (N = 50)	Group II (N = 50)	P-value
Duration of Ventilation (hours)	Mean ±SD	11.5 ± 5.3	12.04 ± 6.8	0.658 NS
Long post-op ventilation>24h	Num/%	3 6%	7 14%	0.182 NS
Duration of inotropes (hours)	Mean ±SD	17.2 ± 10.1	16.2 ± 10.1	0.610 NS
Need of IABP	Num/%	3 4%	1 2%	0.307 NS
Long inotropic Support>48h	Num/%	7 14%	4 8%	0.338 NS
Troponin 6 hours post op (ng/ml)	Mean ±SD	0.95 ± 0.8	1.2 ± 0.7	0.125 NS
ECG ischemia change (raised ST segment, new path Q)	Num/%	0 0%	0 0%	------
Duration of ICU stay (days)	Mean ±SD	2.3 ± 0.8	2.2 ± 0.6	0.349 NS

Table 6: Comparison between the groups chosen in the study with regard to post-operative Echo-cardiography

Post-operative Echo-cardiography		Group I (N = 50)	Group II (N = 50)	P-value
LVEDV	Mean ±SD	5.3 ± 0.6	5.2 ± 0.6	0.419 NS
LVESD	Mean ±SD	3.6 ± 0.5	3.5 ± 0.6	0.702 NS
LVEF (%)	Mean ±SD	59.9 ± 6.8	58.4 ± 7.8	0.306 NS
LA	Mean ±SD	3.9 ± 0.6	3.9 ± 0.5	0.357 NS

Coronary Angiography for study group shows left main > 50% cases were significantly higher in group number (1) (seq) about (26) cases 52% compared to group number (2) (non-seq) about (14) cases 28%, total number of lesions. Which was significantly higher in the first group compared to that in the second group (diagram 1, 2) (4.6±1.14versus 4.1±1.35) Table (7).

Table 7: A comparison of the groups chosen in the study regarding coronary angiography.

Angiography	Group I (N = 50)	Group II (N = 50)	P-value
Left Main Lesion (num/%)	26 52%	14 28%	0.014 S
LAD Lesion (num / %)	50 100%	50 100%	-----

DIAG Lesion (num/%)	38	76%	21	42%	0.001 S
RAMUS Lesion (num/%)	8	16%	4	8%	0.218 NS
CX Lesion (num/%)	45	90%	46	92%	0.727 NS
OM Lesion (num/%)	25	50%	26	52%	0.841 NS
RCA Lesion (num/%)	28	56%	31	62%	0.542 NS
PDA Lesion (num/%)	13	26%	18	36%	0.280 NS
PL Lesion (num/%)	3	6%	5	10%	0.461 NS
Total num of lesions (Mean ±SD)	4.6±1.14		4.1±1.35		0.048 S

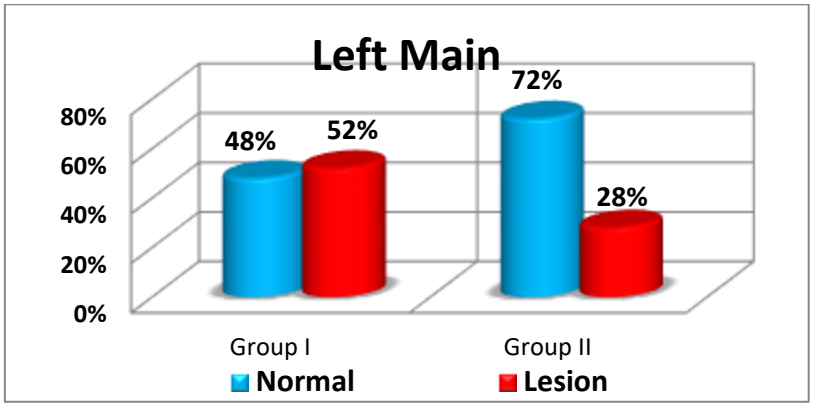

Diagram 1: **Comparison of the groups chosen in the study with respect to Left Main.**

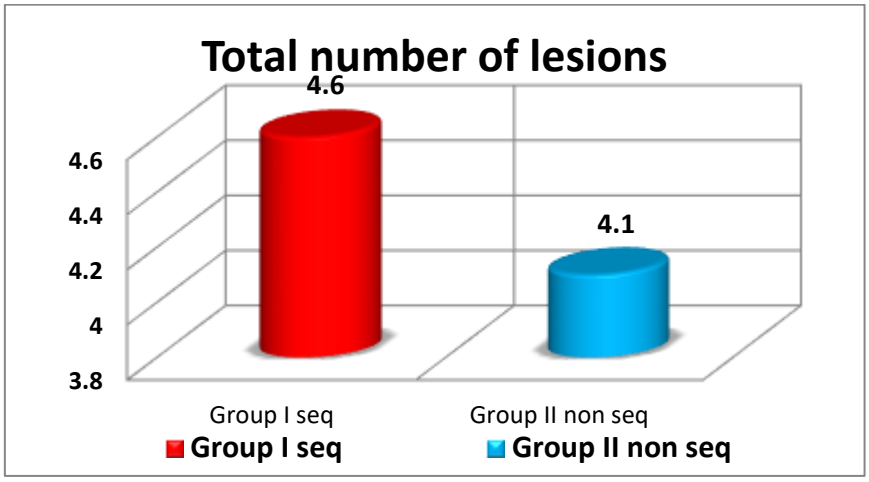

Diagram 2: **A comparison of the groups chosen in the study based on the total number of lesions**

The main result in this study revolves around that there are many coronary targets that can be recycled blood vessels with the internal mammary artery using sequential technique compared to non-sequential one (p-value= 0.004 S) (diagram 3, 4). For 2 coronary target (1) case (2%) in group I VS 43 case (86%) in group II, for 3 target 42 case (84%) in group number (1) To group No. (7) case (14%) in group No. (2) and for 4 target (7) cases (14%) in group No. (1) vs zero in group No. (2), leg incision which was much higher in the second group than in the first (diagram 5) (p value=0.0152) for single graft incision was 20 case 40% in group I while 24 case 48 % in group number (2), second graft incision was (6) case 12% in group number (2) while it was zero in group No. (1) and 30 cases in group No. (1) and 20 case %) in group No. (2) weren't utilized leg incision. Besides, the clamp time and time were significantly higher in the first group chosen in the study(seq) compared to group number (2) (non-seq): operative time (5.1 vs 4.1), bypass time (130.6 vs 104.4) and cross Clamp time (81.6 vs 62.04) respectively (table 8).

Table 8: operative data in the studied group of patients.

Operative data		Group I (N = 50)	Group II (N = 50)	P-value
Op. Time (hours)	Mean ±SD	5.1 ± 0.8	4.1 ± 1.1	< 0.001 HS
Bypass Time (min)	Mean ±SD	130.6 ± 21.5	104.4 ± 28.9	< 0.001 HS
Cross Clamp Time (min)	Mean ±SD	81.6 ± 16.2	62.04 ± 21.4	< 0.001 HS
Need of Inotropes	Yes	41 82%	42 84%	0.790 NS
No. of coronary anastomosis	2	3 6%	14 28%	0.004 S
	3	21 42%	22 44%	
	4	13 26%	11 22%	
	5	13 26%	3 6%	
No. of mammary utilization	2	1 2%	43 86%	< 0.001 HS
	3	42 84%	7 14%	
	4	7 14%	0 0%	
extra-graft utilization	No	30 60%	20 40%	0.045 S
	Yes	20 40%	30 60%	
Leg incision	0	30 60%	20 40%	0.0152 S

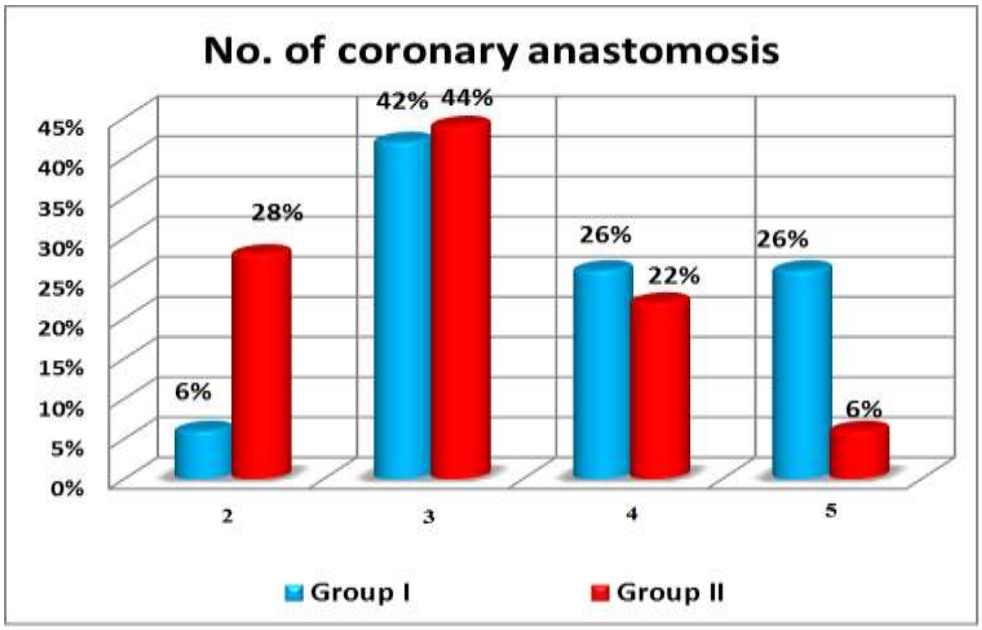

Diagram 3: A comparison of groups chosen in the study based on Number of coronary anastomosis.

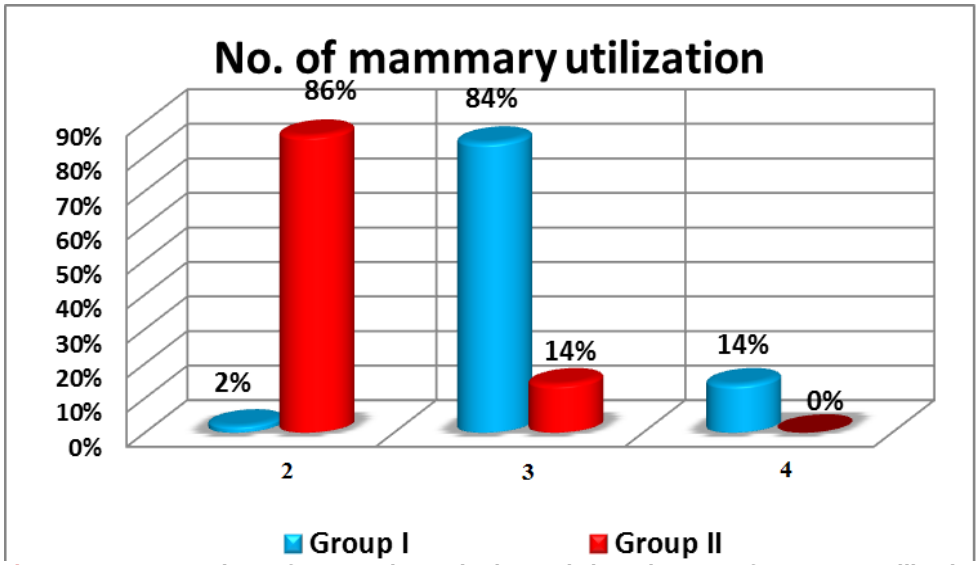

Diagram 4: A comparison of groups chosen in the study based on No. of mammary utilization

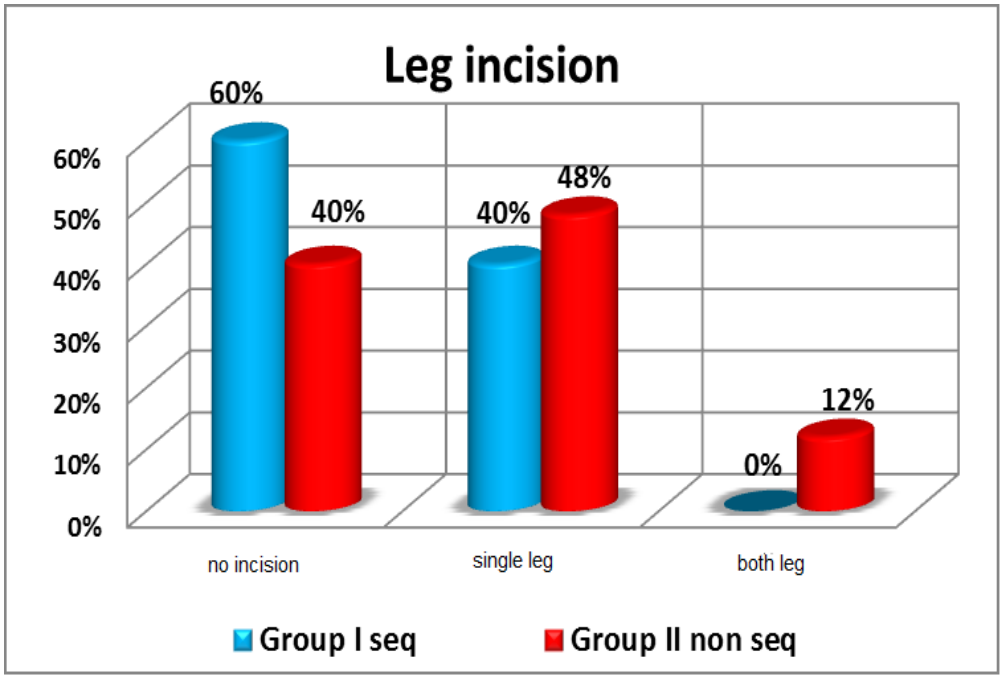

Diagram 5: A comparison of groups chosen in the study based on leg incision

DISCUSSION

Bilateral internal vaccination is linked to improved grafting patency, higher survival and more than the IMA graft and individual and venous grafting alone [9].

From this basis, some cardiothoracic surgeons have reservations about what is the routine use of bilateral IMA, in relation to coronary vessel rehabilitation, with some concerns about BIMA grafting. Which is a relatively complex procedure that requires better technical skill, and takes longer time to work, besides it negatively affects the presence of many patients and early deaths in hospitals, especially with regard to the incidence of deep sternal infections [10]

Therefore, this study was conducted in order to evaluate the early and observed results after the BIMA grafting procedure, with the aim of assessing the safety and effectiveness of BIMA grafting as a routine procedure in which the sequential and non-sequential technique is compared.

In this study, a comparison was made between the serial vaccination known as BIMA vaccination with the existing compound composition in the first group, and the non-sequential vaccination BIMA that has a compound composition. In this regard, the two groups had similar baseline characteristics, such as age, gender, body mass index, smoking history, the presence of certain conditions such as diabetes, hypertension, creatinine before surgery, hyperlipidemia, and LV function. As for coronary angiography, what was found in the main left disease and the total number of lesion, which was in favor of the first group, especially when it was compared with other groups in the study.

From that framework, it was observed that there was no significant difference between the two groups chosen in the study with respect to the hospital mortality (no mortality among both groups), post-operative ICU data(duration of ventilation, duration of inotropes, IABP usage and duration of ICU stay) and post-operative complication (Bleeding in two cases was present in this study and it accounted for 4% in each of the groups selected in the study, post op pulmonary problems occurred in (4) cases was present in this study and it accounted for 8% in group number (1) and (5) cases 10% in group number (2) (p-value=0.727 NS), post-operative arrhythmia (A.F) which occurred in 3 cases in each group present in the study and Superficial wound infection which was slightly higher in the second group (non-seq) 3 cases 6% compared to group number (1) (seq) (2) cases 4% (p-value=0.646 NS), post-op renal impairment was slightly higher in group I (seq) (6) cases 12% compared to group II (non-seq) (5) cases 10%(p-value=0.749 NS) and prolonged ventilation more than 24 h was slightly higher in group number (2) (non-seq) (7) cases 14% compared to group number (1) (seq) (3) cases 6%(p-value=0.182 NS)(neither deep wound infection nor myocardial infraction were remarked among both groups).

Whereas, the main result was in this study the higher mammary utilization in group number (1) than group number (2) (For 2 coronary target (1) case (2%) in group number (1) VS (43) cases (86%) in group number (2), for 3 target (42) cases (84%) in group number (1) VS group number (7) case (14%) in group number (2) and for 4 target (7) cases (14%) in group number (1) vs zero in group number (2)), the extra graft utilization Which was significantly higher in the placebo group in the study than group number (1) (30 cases (60%) in group II VS 20 cases (40 %) in group I), the leg incision was significantly higher in the second group than in the first group (p value=0.0152) for single leg incision was (20) cases 40% in group number (1) while (24) cases 48 % in group number (2), both leg incision was (6) cases 12% in group number (2) while it was zero in group number (1) and (30) cases in group number (1) and 20 case in group number (2) weren't utilized leg incision and operative time, at a time when the winding and the clamp time was much higher in group number (1) (seq) compared to group number (2) (non-seq): operative time (5.1 vs 4.1), bypass time (130.6 vs 104.4) and cross Clamp time (81.6 vs 62.04) respectively.

Because of maximum mammary utilization in sequential group, so that it was possible to rebuild more coronary targets through the use of internal thoracic arteries so total and left system arterial revascularization is more achieved in group I than group II, therefore better long-term outcomes, while the more extra graft utilization in group II the more leg incisions as mentioned before.

While there are some surgeons who pointed to the faults of the chain technique in increasing channel manipulation and the anastomosis complication from one side to the other side, while they criticized the sequential series technique that depends on multiple grafts and joint flow, especially that there is a possibility in the presence of significant consequences in the case of proximal obstruction. As for the use of the LIMA technique, which has raised multiple violations regarding the concerns related to the graft's patency, it has a smaller lumen diameter and a larger wall muscle than the proximal part. However, the Qiang and colleagues [11] study in which a comparison study was conducted between the two identical groups of tendency degrees, in which 120 pairs of patients who were first subject to the CABG schedule were inserted, with the maximum LIMA vaccination at the left anterior descending artery (LAD) and in a sequential group (in which the lima vaccination was detected in the diagonal artery and then to the LAD) while the other group is the control group (and by separate vaccination from LIMA to the LAD). Clinical results have been compared in the hospital, as well as with regard to the follow-up of gynecological graft in Lima. In this regard, the study revealed that there is a re-awareness of the left coronary artery system through the use of serial Lima major grafting, which led to excellent clinical results in the hospital and in the middle of Duration, while the bait was not found passive and serialized Lima vaccinated as an independent indication of adverse events. During the follow-up period which lasted approximately (27.0 ± 7.3) months, the patent was identified as 99.1% patency for the diagonal site and 98.3% for the LAD site, which was done by angiography after coronary computed tomography after sequencing grafting of LIMA, both of which were Similar to the presence of a separate grafting patent for the skeletonized LIMA on the LAD site.

In this study, it was observed that the reassortment of the coronary arterial system through the use of BIMA series vaccination, resulted in excellent clinical results early in the hospital. However, the LIMA sequencing vaccination was not found to be an indication of MI independence after the operation, for the placebo group to be similar early in the clinical outcomes in the non- sequential BIMA group.

Previous studies such as Raja [12], Jones [13] and their colleagues declared that single source blood supply in Composite arterial grafting may be complicated with hypoperfusion syndrome in the form of steal phenomenon, competitive flow, and Vasospasm of arterial grafts which may lead to catastrophic consequences with high mortality due to hypo perfusion of the whole left coronary system lead to perioperative ischemia, infarction, low cardiac output states, however David Glineur and associates [14] who conducted a randomized study were allocated to 304 patients undergoing coronary artery vaccination through the use of BIMA vaccination, while the vaccination would be either on-site or in Y. Besides, the study revealed that there was no significant difference in graft validity between BIMA configurations. In this regard, more coronary targets were able to revitalize through the use of internal thoracic arteries in patients who were randomly distributed in Y vaccination, in contrast the localized group (3.2 ± 0.8 versus 2.4 ± 0.5 arteries / patient; P <0.01) . As for the comparison in terms of in situ formation, the use of BIMA in the formation of Y vaccination leads to a decrease in the rates of cardiovascular and cerebrovascular events that took place during 7 years.

In our study, we performed composite graft in both group, however we did not observe perioperative infraction or hypoperfusion syndrome as Post op troponin level was within normal level (0.95-1.2) in study groups respectively and there is no ECG ischemic change (new pathological Q or

ST segment elevation) was remarked in both groups, however low cardiac output states had been recorded in the study as prolonged inotropic support which occurred in 7 cases that were shown in a percentage of 14% in the first group and 4 cases who were 8% in the second group.

While the major anastomosis was characterized by many advantages in that it perfectly matches and avoids the problems of near-aortic anastomosis, along with the "no touch" technique reduces the risk of stroke and the greater length of RIMA available in order to re-educate the heart muscle, which indicates avoiding the use of The third channel [15].

On the other hand, previous studies indicate that diabetes is considered a risk factor for fair wound infection after surgery, although there are possible relative contraindications to carrying out bilateral IMA mobilization in these patients, such as Mario Gaudinoa and colleagues[16]. They conducted a study on a sample of 500 patients who underwent the primary and non-strengthened CABG technique that is not emerging with BIMA, and the results were compared with the other group of 500 of the controls applied to the historical trend. However, existing mammary arteries were harvested to be used for targeted vessel vaccination. In mammals, arteries were used either in the same location or as the Y-shaped, in which coronary arteries were dissected. In addition, double Y sequences, alternate grafts and alternative flow sources were used, and it was concluded that the systematic use of BIMA technology was closely related to adverse events surrounding surgery (which were found in sternal complications).

Sajja L.R [17]. They conducted an analytical study to determine the modifiable risk factors for deep sternal wound infection, and what was reached in this study that there are certain strategies to occur from the occurrence of DSWI after being BIMA graft, which focuses on the importance of quitting smoking and optimal control of hyperglycemia in the period Postoperative (control the level of sugar in the blood so that it does not reach in patients with diabetes by HbA1C> 8.0%) In this study, it was explained that the timely and appropriate prophylactic antibiotics are given, within the conditions provided by in-depth surgical conditions and the chosen surgical techniques (which include IMA harvest and sternal closure which reduce the incidence of DSWI after the BIMA is harvested. In this case, a decrease is avoided Cardiac output status and use of support from IABP, with the aim of re-exploring bleeding and many blood transfusions and platelets associated with a lower incidence of DSWI. BIMA grafting is avoided in patients with body mass> 35 kg / m2 as well as who suffer from uncontrolled diabetes and who have a disease Chronic and severe pulmonary embolism, it is recommended DSWI protection.

Our study support Sajja L.R [17] results as no DSWI is observed In ours, only superficial wound infection has been remarked, it was significant related to high HBA1c (more than 7.6), prolonged operative time (more than 6 h) and bleeding and resternotomy. Therefore it was recommended that good surgical technology and strong diabetes control be observed in both the periods before and after the surgery, as well as work to stop bleeding; And that the operation can be performed safely even in patients with diabetes.

CONCLUSION

Based on our study we conclude that, BIMA grafting either sequential or non -sequential technique seems clinically accepted as safe and efficient procedure that can be used routinely in CABG especially for young non or controlled diabetic patients as regard short –term outcomes and hospital mortality.

Sequential and non-sequential technique have nearly similar outcomes as regard hospital mortality, and that is related to short-term results and complications after surgery (wound infection, pulmonary problems, atrial fibrillation, myocardial infraction, bleeding and low cardiac output).

Sequential technique is better than non-sequential one in achievement total and left system arterial revascularization with less surgical incisions.

CONFLICT OF INTEREST

None

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