Risk of deep sternal wound infection of Pedicled versus Skeletonized Left Internal Mammary Artery in Diabetic patients Undergoing Coronary Artery Bypass Graft Surgery

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Abstract

Background: Diabetes is a major risk factor of IHD and responsible of many postoperative complications. Deep sternal wound infection after CABG is a major complication which associated with high mortality.

Objectives: The aim of this study is to compare between pedicled and skeletonized LIMA in diabetic patients undergoing CABG

Patients and methods: This study conducted on 100 diabetic patients underwent isolated CABG in the period between January 2017 and January 2018. Patients were divided into 2 groups: Group (A) patients had a pedicled LIMA (n=60) and Group (B) patients had a skeletonized LIMA (n=40). All patients in both groups were followed up during hospital stay and for one month after discharge for symptoms and signs of deep sternal wound infection.

Results: Regarding intraoperative date there was significant increase in total operative time in Group (B) was 221±76.5 versus 195±53 in Group (A) (P=-0.003) and no significant difference in other operative data. Regarding postoperative data there was significant increase in incidence of deep sternal wound infection in Group (A) 6 patients (10%0 versus 1 patient (2.5%) in Group (B) with (P=0.004) while other data showed no statistical difference in both groups, there was no mortality in both groups.

Conclusion: Skeletonized LIMA is better to be used than pedicled LIMA in diabetic patients undergoing CABG.

Keywords: Coronary artery bypass graft surgery; Pedicled left internal mammary artery; Skeletonized left internal mammary artery; Diabetes Mellitus; Sternal wound infections.

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Introduction

.Coronary artery bypass grafting (CABG) surgery is commonly used as an option for treatment of ischaemia artery diseases (IHD). Selection of conduits used in CABG is very important and in general it is better to use arterial conduits whenever possible, the left internal mammary artery (LIMA) has become the gold standard conduit for grafting the left anterior descending (LAD) artery (**Gaughan and Kobel, 2014**). LIMA patency to left anterior descending coronary artery (LAD) is superior to any other any conduit and they said nothing like LIMA to LAD **(Bakaeen, 2017).**

Diabetes mellitus (D.M) is one of the major risk factors in IHD and it may be responsible of many serous postoperative complications and it has been found that patients undergoing cardiac surgery with uncontrolled diabetes and high random blood sugar is associated with increased morbidity and mortality 4 times more diabetic patients with controlled blood sugar **(Nishi et al., 2011).** A new guidelines recommend not to go for cardiac surgery in diabetic patients with HbA1c more than 7.8 unless it is emergency surgery **(Nishi et al., 2011**).

There are two ways to harvest LIMA the first one is pedicled which is more commonly used in most of cardiac centers where the artery harvested together with the mammary vein enclosed within the end thoracic fascia while the other technique of harvesting is skeletonized way where the LIMA harvested only keeping mammary vein in place **(Lemaignen et al., 2015 ;Lazar et al., 2016)** . Many studies showed that skeletonized LIMA allow better sternal healing than pedicled one as it allows better blood supply of the sternum **(Lemaignen et al ., 2015**). Skeletonized LIMA harvesting requires more surgical skills and more time so many surgeons still prefers the pedicled LIMA **(Lazar et al., 2016)**

Deep sternal wound infections after cardiac surgery is one of the major complications which annoying all cardiac surgeons and represents a big challenge in its treatment whether by conservative or surgical methods **(Peterson et al., 2003)**. Many risk factors are responsible for postoperative deep sternal wound infections after cardiac surgery; obesity, uncontrolled D.M, chronic obstructive pulmonary disease (COPD), female gender, redo surgery, prolonged mechanical ventilation, massive blood transfusion and others **(Peterson et al., 2003 ;Lazar et al., 2016**).

Patients and Methods

We conducted this study in the period between January 2017 and January 2018, 100 diabetic patients undergoing isolated CABG were selected whether on pump or off pump. In this study we exclude patients with combined CABG and other surgeries, patients with bilateral internal mammary arteries or radial arteries, in all patients the conduits was LIMA and saphenous vein graft (SVG). All patients were electively underwent surgery and all of them has HbA1C <8 with random blood sugar < 180.

All patients routinely prepared for surgery by adequate history taking, routine preoperative laboratory investigations (C.B.C, liver function test, kidney function test and coagulation profile), and postero-anterior chest X-ray Echocardiography and Duplex over carotid arteries and superficial and deep venous system of the lower limbs.

Surgical technique

In all patients the patient lying on supine position, induction of general anesthesia and insertion of central venous cannula, skin incision, median sternotomy and proper hemostasis of the sternum then a mammary retractor put along the left side of the sternum and retractor is opened then left pleura opened and pleural fat shaved from

the surface of the end thoracic fascia to start LIMA. Patients were divided into 2 groups: Group (A) 60 patients with LIMA harvested in pedicled way with a diathermy 2 lines made 1 cm medial and lateral to mammary bundle including artery and vein then harvesting started from lower part by separating the end thoracic fascia (including mammary artery and vein) from chest wall with putting a metal clips over branches of mammary artery and vein and cauterize these branches distal to metal clips. In Group (B) 40 patients LIMA was harvested in skeletonized way where the LIMA identified and an opening made in the end thoracic fascia just over the LIMA then the fascia is opened all over the LIMA to expose it below to above the mammary veins identified and LIMA harvested from between the two mammary veins using diathermy and small metal clips for branches of LIMA. SVG is harvested at the same time from the lower limb In all patients once LIMA harvested heparin given and once ACT is between 400-600 LIMA divided and sternal retractor put with cross bar above then pericardium opened and hold with stitches and in cases done with CPB, aorto-caval cannulation done and going on bypass and target coronary vessels identified, aorta cross clamped and heart arrested with intermittent worm blood cardioplegia every 20 min, SVG anstomosed to target vessels using prolene 7/0 and last graft was LIMA to LAD done the hot shot given for 3 minutes and aorta declamped then a side bitter applied to ascending aorta to make proximal anastomoses of SVG to the aorta with prolene 6/0 then weaning of CPB. In patients done by off pump technique the site of target vessel stabilized by suction stabilizer and LIMA to LAD was the first anastomosis done followed by other venous grafts. In all patients proper hemostasis done followed by insertion of left pleural chest tube and 2 mediastinal tubes, 2 ventricular pace maker wires and the sternum closed by standard wire and patients transferred to ICU unit.

All patients of both groups were followed up during ICU and hospital stay and for one month after discharge in the outpatient clinic. Patient was diagnosed as having deep sternal wound infection by: fever, leukocytosis with shift to the left, local signs of infection of the wound as redness, tenderness and hyperemic wound edges, discharge of purulent discharge or pus from sternal wound, instability of the sternum in form of click or dehiscence of the sternum and C.T of chest showed separation of the 2 sides of the sternum.

Statistical analysis

Statistical analysis was performed using the IBM SPSS Statistics for Windows, Version 22 (IBM SPSS Statistics for Windows, IBM Corporation, Armonk, NY, USA). Quantitative data were expressed as mean ± standard deviation, and qualitative data were expressed as number and percentage.

Results

Comparison of pre-operative data between both groups showed no statistical difference , mean age in Group (A) was 55±11 versus 56±9 in Group (B) with(P=0.21), male gender in Group (A) was 38 patients (63.3%) versus 24 patients (60%) in Group(B) wit (P=0.31), female gender in Group (A) was 22 patients (36.7%) versus 16 patients (40%) in Group(B) wit (P=0.19), obese patients with BMI>35 was in Group (A) 9 patients (15%) versus 7 patients (17.5%) in Group (B) (P=0.11), COPD patients in Group (A) was 4 patients (6%) versus 2 patients (5%) with (P=0.12), In Group (A) there were 10 dyslipidemic patients (16.6%) versus 7 patients (17.5%) in Group (B) with (P=0.18), patients with hypertension in Group (A) was 18 patients (30%) versus 10 patients (25%) in Group (B) with (P=0.34), patients with creatinine level > 1.6 in Group (A) was 3 (5%) versus

2 (5%) in Group (B) with (P=0.1), preoperative mean EF in Group (A) was 48±11 versus 46±10.5 in Group (B) with (P=0.12), mean Euro score in Group (A) was 3.5±1.2 versus 3.8±1.1 in Group (B) with (P=0.09) (**Table.1**).

Table 1. The preoperative data

Variables	Group (A)	Group (B)	P value
Age	55±11	56±9	0.21
Male gender	38 (63.3%)	24 (60%)	0.31
Female gender	22 (36.7%)	16 (40%)	0.19
Body mass index>35	9 (15%)	7 (17.5%)	0.11
COPD	4 (6%)	2 (5%)	0.12
Dyslipidemia	10 (16.6%)	7 (17.5%)	0.18
Hypertension	18 (30%)	10 (25%)	0.34
Creatinine>1.6	3 (5%)	2 (5%)	0.1
Ejection Fraction	45±11	46±10.5	0.19
Euro score	3.5±1.2	3.8±1.1	0.09

Regarding the intraoperative data there was significant increase in total operative time in Group (B) with mean time in minutes 221±76 versus 195±53in Group (B) with (P=0.003), while there was no significant statistical differences in the other data, total CPB time in minutes in Group (A) was 98±30.1 versus 101±30 in Group (B) with (P=0.21), total aortic clamp time in minutes in Group (A) was 49±21 versus 56±23.5 in Group (B) with (P=0.16), mean number of grafts in Group (A) was 3 (1-5) versus 3 (1-5) in Group (B) with (P>0.99) and patients underwent off pump CABG in Group (A) was 6 patients (10%) versus 3 patients (7.5%) in Group (B) with (P=0.2) (**Table. 2**).

Table 2. Intraoperative data

Variables	Group (A)	Group (B)	P value
Cardiopulmonary bypass time in min	98±30.1	101±30	0.21
Aortic clamp time in min	49±21	56±23.5	0.16
Number of grafts	1-5 (3)	1-5 (3)	>0.99
Off pump CABG	6 (10%)	3 (7.5%)	0.2
Total operative time in min	195±53	221±76.5	0.003

Regarding the postoperative data there was only significant increase in number of patients developed deep sternal wound infections after surgery in Group (A) 6 patients (10%) versus 1 patient (2.5%) with (P=0.004) while other data showed no statistical differences in both groups, reopening due to bleeding was in Group (A) 3 patients (5%) versus 2 patients (5%) in Group (B) with (P=0.82), postoperative arrhythmias occurred in 11 patients (18.3%) in Group (A) versus 9 patients (22.5%) in Group (B) with (P=0.71), patients received blood transfusion in Group (A) was 65 patients (91.6%) versus 36 patients (90%) in Group (B) with (P>0.99), IAB was inserted in 3 patients (5%) in Group (A) versus 1 patient (2.5%) in Group (B) with (P>0.99),

prolonged mechanical ventilation occurred in 3 patients (5%) in Group (A) versus 1 patient (2.5%) in Group (B) with (P=0.6), postoperative pneumonia occurred in 4 patients (6%) in Group (A) versus 3 patients (7.5%) in Group (B) with (p>0.99), renal dialysis needed in 3 patients (5%) in Group (A) versus 3 patients (7.5%) in Group (b) with (P>0.99), postoperative neurological complications occurred in 1 patient (2.5%) in Group (B) versus no patients in Group (A) with (P>0.99), mean total ICU stay in days in Group (A) was 1.9±0.8 versus 2.1±0.9 in Group (B) with (P=0.19), mean total hospital stays in days was in Group (A) 7±3.1 versus 6.8±2.9 in Group (B) with (P=0.42) and there were no postoperative mortality in both groups (**Table.3**).

Table (3) postoperative data

Variables	Group (A)	Group (B)	P value
Reopening for bleeding	3 (5%)	2 (5%)	0.82
Arrhythmias	11 (18.3%)	9 (22.5%)	0.71
Blood transfusion	65 (91.6%)	36 (90%)	>0.99
Intraaortic ballon insertion	3 (5%)	1 (2.5%)	>0.99
Prolonged mechanical ventilation	3 (5%)	1 (2.5%)	0.6
Pneumonia	4 (6%)	3 (7.5%)	>0.99
Renal dialysis	3 (5%)	3 (7.5%)	>0.99
Neurological complications	0	1 (2.5%)	>0.99
Intensive care unit stay in days	1.9±0.8	2.1±0.9	0.19
Total hospital stay in days	7±3.1	6.8±2.9	0.12

Discussion

Sternal wound infection after cardiac surgery is remaining a major complication which may be a leading cause of **(Mannacio et al., 2011; Litwinowicz et al., 2016).** In our study, the overall incidence of sternal wound infection was 7% (n=7). These cases were treated with intravenous antibiotics according to culture and sensitivity from wound discharge and applying a vacum with negative pressure closed system after proper debridement of the wound without surgical rewiring or reconstructive flap surgery. The reported incidence of deep sternal wound infection after CABG in diabetic patients is within reported ranges in the literature as it is ranging from 0.5% to 8% in high risk patients **(Singh et al., 2011; Lazar ., 2018)** .The choice to harvest the LIMA in skeletonized way in CABG should be made according to the surgeon experience and capability of doing this procedure safely without risk of injury of LIMA during harvesting **(Hu and Zhao Q., 2011; Mnnacio et al.,2011; Lazar., 2018).**

Optimizing the blood sugar level in patients undergoing CABG is very important so, we have not performing surgery with HbA1C > 8 nor random blood sugar >180 unless it is emergency surgery and in cases with uncontrolled blood sugar or high HbA1C surgery should be postponed for 2 weeks keeping the patient under tight glycemic control, the previous measures considered as golden rule to lower the incidence of deep sternal wound infection after CABG (**Peterson et al.,2003; Nishi et al., 2011; Egiton et al., 2013**).

In our study, the incidence of sternal wound infection after CABG in diabetic patients is significantly decreased with skeletonized LIMA as it occurred in 1 patient (2.5%) compared to pedicled LIMA as it occurred in 6 patients (10%) with P

value 0.004, Also we noticed that patients with skeletonized LIMA had a shorter mean total hospital stay 6.8±2.9 compared to 7±3.1 in patients with pedicled LIMA despite the difference is not statistically significant.

These findings are consistent with other studies, which examined the postoperative complications after CABG surgery in using pedicled versus skeletonized LIMA. A meta-analysis of 22 study conducted by Sa and Coworkers involving 4817 patients (2424 skeletonized; 2393 pedicled) and they concluded that incidence of deep sternal wound infection is getting lower with skeletonized LIMA than with pedicled LIMA which is constant with results of our study **(Sa et al., 2013).**

Fouquet and coworkers reported that despite skeletonized LIMA require longer time in harvesting than pedicled LIMA yet, it is associated with lower incidence of sternal wound infection, less pain at the surgical site as well as less hospital stay (**Fouquet et al., 2015**). The lower incidence of deep sternal wound infection with skeletonized LIMA can be explained by keeping better blood supply and vascularity than with pedicled LIMA which allow better healing of the sternum and less pain with skeletonized LIMA than with pedicled LIMA can be explained by excessive use of diathermy during harvesting of pedicled LIMA in contrary to skeletonized LIMA (**De Poulis et al., 2005**).

Conclusion

Skeletonized LIMA is better to be used than pedicled LIMA in diabetic patients undergoing CABG as it has a better sternal wound healing and associated with lower incidence of deep sternal wound infections.

Conflict of interest: Authors declare no conflict of interest.

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