



## FREQUENCY OF DEEP INFECTION OF THE STERNAL WOUND IN DIABETIC PATIENTS UTILIZING SKELETONIZED VERSUS PEDICLED HARVESTING TECHNIQUE OF INTERNAL THORACIC ARTERY AFTER CABG SURGERY.

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**ABSTRACT... Objectives:** After coronary artery bypass graft (CABG) surgery, infection of the sternum is a serious issue as it would adversely affect the mortality of patient. Left internal thoracic artery (LITA) has significant benefits but after its utilization occurrence of sternal infection is documented especially in diabetic patients due to impairment in blood flow of sternum. Our objective was to document the frequency of deep infection of the sternal wound in patients with diabetes utilizing skeletonized versus pedicled harvesting technique of the left ITA after CABG Surgery in our population. **Study Design:** An observational study was retrospectively done. **Setting:** National Institute of Cardiovascular Diseases, Karachi. **Period:** January 2013 to October 2015. **Material and Methods:** The sample size of the study was determined to be a total of two hundred and twenty patients who had primary, isolated and elective CABG surgery. One hundred and ten patients were included in whom skeletonized left ITA was utilized and in one hundred and ten patients pedicled left ITA was utilized. We used the statistical Chi square test and  $p < 0.05$  was considered significant. **Results:** Deep infection of the sternal wound occurred in 3.64% of the patients with diabetes in whom the pedicled left ITA was utilized and did not occur in any of the diabetic patients in whom the skeletonized left ITA was utilized. Post CABG surgery frequency of deep infection of the sternal wound was greater in those patients in whom the LITA was harvested utilizing the pedicled technique ( $p < 0.05$ ). **Conclusion:** There is decreased frequency of deep infection of the sternal wound in patients with diabetes utilizing the skeletonized harvesting technique of the left ITA after CABG Surgery.

**Key words:** CABG Surgery, Internal Thoracic Artery, Pedicled Harvesting Technique, Skeletonized Harvesting Technique, Sternal Wound Infection.

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## INTRODUCTION

The patient population undergoing CABG surgery now has complex coronary artery disease and have multiple comorbidities. The conduit of choice is the internal thoracic artery (ITA) and its use is especially of value in diabetic patients due to its high patency rate and reduced postoperative cardiac events.<sup>1-4</sup>

After CABG surgery, infection of the sternum is a serious issue as it would adversely affect the mortality of patient.<sup>5</sup> ITA has significant benefits but after its utilization occurrence of sternal infection is documented especially in diabetic patients due to impairment in blood flow of sternum.<sup>6</sup> Occurrence of infection of sternal wound in post-

CABG patients is influenced by the ITA harvesting technique.<sup>5,7</sup> ITA can be harvested by either using the pedicled or skeletonized technique. Pedicled technique is the conventional method of harvesting the ITA. Now the skeletonized technique is also practiced.<sup>8,9</sup> A study documented the reduced occurrence of post-CABG sternal infection with use of skeletonized method of harvesting.<sup>10</sup> Randomized analyses documented the comparison of two harvesting techniques.<sup>1,10</sup> One of the major advantage of skeletonized technique is that it preserves the collateral supply of sternum so by this sternal wound complications can be minimized.<sup>8</sup> Skeletonized technique is more time consuming and demanding but it preserve collateral supply

of sternum, integrity of endothelium and has minimized the occurrence of postoperative adverse wound problems.<sup>1,8</sup> Studies showed that the skeletonized ITA minimizes the occurrence of infection in sternal wounds compared to its occurrence in pedicled ITA.<sup>5,10</sup> The objective of our study was to document the frequency of deep infection of the sternal wound in patients with diabetes utilizing skeletonized versus pedicled harvesting technique of the left ITA after CABG surgery in our population.

## METHODOLOGY

An observational study was retrospectively done in the cardiac surgical department of the National Institute of Cardiovascular Diseases, Karachi. After receiving informed consent, the data collection was carried out retrospectively for the duration of January 2013 to October 2015 utilizing the technique of non-probability consecutive sampling. The sample size of the study was determined to be a total of two hundred and twenty diabetic patients who had primary, isolated and elective on pump CABG surgery with age ranging from 55-70 years. Those patients who had preoperative remote infections which included distant extra thoracic infections, emergent or redo CABG surgery, left ventricular ejection fraction lower than thirty five percent, renal failure, peripheral vessel disease, age more than 70 years, were excluded from the study. One hundred and ten patients were included in whom skeletonized left ITA was utilized and in one hundred and ten patients pedicled left ITA was utilized.

After obtaining informed consent CABG surgery patients' data for the preoperative profile, operative characteristics and postoperative complications was collected. Preoperatively aggressive pulmonary toilet and smoking cessation was performed in patients who were actively smoking and in those patients who were diagnosed with chronic obstructive pulmonary disease. Preoperative glycemic control was optimized in patients with serum glucose levels >200 mg/dL and increased levels of HbA1c (>7.5). Pre-surgical bathing with chlorhexidine was done and preoperative intravenous antibiotics were

administered after induction of anesthesia.

All patients underwent on pump CABG surgery with a median sternotomy. The pedicled and skeletonized technique was utilized for harvesting the left ITA. In harvesting the left ITA as a pedicled graft the LITA's nerve and blood supply and its surrounding fascia was included. The technique of harvesting the skeletonized LITA involved dissecting of the LITA from its innervation, lymphatics, venous drainage, fascia and muscle.

Intraoperatively, the proper technique of opening and closing the sternum was used and good hemostasis was achieved, bone wax was not used in any patient, intravenous antibiotics were administered and glycemic control was maintained.

In the cardiac surgery ICU postoperative antibiotics and postoperative glycemic control was achieved. The protocol was followed for early extubation and early removal of indwelling urinary and central venous catheters to decrease the incidence of wound infections.

We defined deep infection of the sternal wound based on the definition of the Centers for Disease Control and Prevention, where one of the following parameters is required: 1. Organism detected from fluid of the mediastinum or tissue culture; 2. Mediastinitis evidence is observed during surgery; 3. Either sternal instability, fever (>38°C), or chest pain being present, and mediastinal purulent drainage, organism detected from culture of the mediastinum or blood.

SPSS version 19 statistical software was used for performing the data analysis. The frequencies, percentages, standard deviations, and means were determined. We used the statistical Chi square test and  $p < 0.05$  was considered significant.

## RESULTS

The size of the total sample was determined to be two hundred and twenty diabetic patients who had primary, isolated and elective CABG surgery. One hundred and ten patients were included in

whom skeletonized left ITA was utilized and in one hundred and ten patients pedicled left ITA was utilized.

The ages of the patients ranged from 55 to 65 years in the skeletonized LITA group and in the pedicled left ITA group the patients were aged from 56 to 64 years (Table-I). In the skeletonized and pedicled LITA groups 77% and 81% were males respectively. In the pedicled LITA group (Table-I). In the skeletonized LITA group 74% were hypertensive, 65% were smokers, 54% had hyperlipidemia, all the patients had diabetes mellitus, 19% had chronic lung disease, 89% had three vessel coronary artery disease, 11% had left main and three vessel coronary artery disease, 84% had left ventricular ejection fraction greater than 40% (Table-I). In the pedicled LITA group 76% were hypertensive, 68% were smokers, 49% had hyperlipidemia, all the patients had diabetes mellitus, 16% had chronic lung disease, 93% had three vessel coronary artery disease (CAD), 7% had left main and three vessel coronary artery disease, 81% had left ventricular ejection fraction greater than 40% (Table-I).

All the patients had a preoperative bath with chlorhexidine and underwent on-pump CABG surgery (Table-II). The mean number of coronary

anastomoses performed in the skeletonized LITA group was 3.9 and in the pedicled LITA group was 4 (Table-II). The duration of cardiopulmonary bypass and the duration the aorta was cross clamped in the patients in whom the skeletonized LITA was utilized was  $86 \pm 6.9$  minutes and  $67 \pm 4.3$  minutes, and, in the pedicled LITA group was  $83 \pm 7.4$  minutes and  $64 \pm 3.8$  minutes (Table-II). In all the patients anterior mediastinal and pleural drains were placed and diathermy was used for hemostasis (Table-II). Whereas bone wax was not used in any patients (Table-II).

Deep infection of the sternal wound occurred in 3.64% of the patients with diabetes in whom the pedicled left ITA was utilized and did not occur in any of the diabetic patients in whom the skeletonized left ITA was utilized (Table-III). Post CABG surgery frequency of deep infection of the sternal wound was greater in those patients in whom the LITA was harvested utilizing the pedicled technique ( $p < 0.05$ ). Hence, in diabetic patients in whom the LITA is harvested using the skeletonized technique the frequency of deep sternal wound infection is lower. Prolonged mechanical ventilation occurred in 0.91% of the pedicled LITA group. The hospital stay in the skeletonized LITA group was  $5.7 \pm 1.8$  days and in the pedicled LITA group was  $10 \pm 4.3$  days.

	Skeletonized L ITA	Pedicled LITA
	Number (percentage)	Number (percentage)
Age (years)	55-65 years	56-64 years
Gender	Male: 85 (77%), Female: 25 (23%)	Male: 89 (81%), Female: 21 (19%)
Hypertension	81 (74%)	84 (76%)
Smokers	72 (65%)	75 (68%)
Hyperlipidemia	59 (54%)	54 (49%)
Basal Metabolic Index (kg/m <sup>2</sup> ) range: 25-29.9	110 (100%)	110 (100%)
Diabetes mellitus	110 (100%)	110 (100%)
Chronic lung disease	21 (19%)	18 (16%)
Renal failure	0 (0%)	0 (0%)
Three-vessel CAD	98 (89%)	102 (93%)
Left main plus Three-vessel CAD	12 (11%)	8 (7%)
Ejection fraction > 40%	92 (84%)	89 (81%)
Ejection fraction = 35-40%	18 (16%)	21 (19%)

Table-I. Preoperative patient profile

	Skeletonized LITA	Pedicled LITA
	Number (Percentage)	Number (Percentage)
Use of chlorhexidine	110 (100%)	110 (100%)
Number of coronary anastomoses (mean)	3.9	4
On-pump coronary artery bypass graft surgery	110 (100%)	110 (100%)
Cardiopulmonary bypass time (mean±SD)	86 ± 6.9 minutes	83± 7.4 minutes
Aortic cross-clamp time (mean±SD)	67 ± 4.3 minutes	64 ± 3.8 minutes
Bone wax used	0 (0%)	0 (0%)
Diathermy used	110 (100%)	110 (100%)
Anterior mediastinal drain	110 (100%)	110 (100%)
Pleural drain	110 (100%)	110 (100%)

**Table-II. Operative patient characteristics**

	Skeletonized L ITA	Pedicled LITA
	Number (Percentage)	Number (Percentage)
Deep infection of the sternal wound in patients with diabetes mellitus	0 (0%)	4 (3.64%)
Mechanical ventilation > 48 hours	0 (0%)	1 (0.91%)
Blood transfusion (>2 packed RBCs)	2 (1.82%)	1 (0.91%)
Hospital stay (mean±SD)	5.7± 1.8 days	10±4.3 days

**Table-III. Postoperative patient complications**

packed RBCs: packed red blood cells.

**DISCUSSION**

The conduit of choice for CABG surgery is internal mammary artery. ITA use is especially of value in diabetic patients due to reduced incidence of postoperative cardiac events.<sup>1-4,11-17</sup> ITA is a branch of subclavian artery. ITA has more nutrient supply to its wall, quick removal of metabolites, production of prostacyclin and nitric acid from its wall all play a role in reducing the incidence of adverse cardiac effects.<sup>9</sup>

After CABG surgery, sternal infection is still not an uncommon complication. Wound infection of sternum is major adverse outcome after CABG surgery.<sup>18</sup> The results of studies showed 0.25-5% incidence of deep infection of sternal wound.<sup>19</sup> This increases the postoperative morbidity and mortality of patients, prolongs hospital stay and also increases the cost.<sup>19,20</sup>

Studies documented several predisposing factors for development of deep sternal wound infection that are male gender, obesity, advanced age, hypertension, diabetes mellitus, peripheral

vessel disease, smoking, chronic obstructive pulmonary disease, renal failure. Furthermore, other predisposing factors include hospitalization prior to the surgical procedure, skin preparation of operative area, surgical technique, duration of operation, utilization of ITA, techniques of ITA harvesting, excessive bleeding that required re-exploration, prolonged mechanical ventilation and low cardiac output.<sup>19,20</sup>

Infection of the sternum would adversely affects the mortality of patient.<sup>5,17</sup> ITA has significant benefits but after its utilization occurrence of sternal infection is documented especially in diabetic patients due to impairment in blood flow of sternum.<sup>6</sup> Occurrence of infection of sternal wound in post-CABG patients is influenced by the ITA harvesting technique.<sup>5,7,18</sup> ITA can be harvested by either using the pedicled or skeletonized technique. Pedicled technique is the conventional method of harvesting the ITA which includes the dissection of artery, accompanying veins, lymphatics, fascia and also the adipose tissue along with ITA so a pedicle is developed.<sup>5,7</sup>

In our study the size of the total sample was determined to be two hundred and twenty patients who had isolated and elective CABG surgery. One hundred and ten patients were included in whom skeletonized left ITA was utilized and in one hundred and ten patients pedicled left ITA was utilized. Deep infection of the sternal wound occurred in 3.64% of the patients with diabetes in whom the pedicled left ITA was utilized and did not occur in any of the diabetic patients in whom the skeletonized left ITA was utilized. Post CABG surgery frequency of deep sternal wound infection was greater in those patients in whom the LITA was harvested utilizing the pedicled technique ( $p < 0.05$ ). Hence, in diabetic patients in whom the LITA is harvested using the skeletonized technique the frequency of deep sternal wound infection is lower. We defined deep infection of the sternal wound based on the definition of the Centers for Disease Control and Prevention, where one of the following parameters is required: 1. Organism detected from fluid of the mediastinum or tissue culture; 2. Mediastinitis evidence is observed during surgery; 3. Either sternal instability, fever ( $> 38^{\circ}\text{C}$ ), or chest pain being present, and mediastinal purulent drainage, organism detected from culture of the mediastinum or blood.<sup>21</sup>

In skeletonized technique only the ITA is dissected from surrounding tissues and it does not contain any of the above structure.<sup>5,7-9,18,22</sup> In skeletonized harvesting technique the collateral blood supply of sternum is preserved while taking down the ITA from chest wall.<sup>15</sup> Skeletonized ITA has advantage of reduced incidence of sternal wound infection as it preserves the vascular supply of sternum.<sup>22</sup> Although the skeletonized technique is more time consuming and demanding but it preserve collateral supply of sternum, integrity of endothelium and so minimizes the occurrence of postoperative adverse wound problems and hospitalization duration is also minimized.<sup>8,10,15</sup>

Studies were conducted for comparison of skeletonized with pedicled technique in patients with diabetes and to document occurrence of postoperative sternal wound complications.<sup>8,15</sup> Studies showed that the skeletonized ITA minimizes the occurrence of infection in sternal

wounds compared to its occurrence in pedicled ITA.<sup>5,10</sup> One of the major advantage of skeletonized technique is that it preserves the collateral supply of the sternum hence the sternal wound complications can be minimized.<sup>8</sup>

Studies showed a significant difference between pedicled and skeletonized techniques in the occurrence of infection of sternal wounds.<sup>18</sup> A meta-analysis documented advantage of skeletonized ITA as it had reduced risk of post-CABG sternal infection. This advantage of skeletonized ITA is also documented in diabetic patients. This may be related to improved blood flow of the sternum after utilizing the skeletonized technique.<sup>6,9,18</sup> Diabetes mellitus effects the immunity (both cellular and humoral) and healing of wounds and so infection risk is increased.<sup>19,20</sup> Skeletonized technique in the diabetics protects against deep infection of the sternal wound.<sup>23</sup>

## CONCLUSION

There is decreased frequency of deep infection of the sternal wound in patients with diabetes utilizing the skeletonized harvesting technique of the left ITA after CABG Surgery.

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