

## MYOCARDIAL REVASCULARIZATION UTILIZING INTERNAL MAMMARY ARTERIES

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### ABSTRACT

**Objective:** To study myocardial revascularization with arterial grafts utilizing internal mammary arteries, with special reference to its morbidity and mortality and the results of internal mammary artery grafting in various ages and genders.

**Study Design:** Retrospective study.

**Place and Duration of Study:** National Institute of Cardiovascular Diseases (NICVD), from Mar 2012 to Feb 2013.

**Material and Methods:** Patients with concomitant valve replacement, ventricular aneurysmectomy redo coronary bypass or other cardiac or ascending aortic procedures were excluded from this analysis. No patient was excluded for any other reason. The age range was 35 to 80 years. The statistical analysis for comparison of different proportions were carried out with the help of chi-square statistics, when the test is valid.

**Results:** A total of 150 patients were studied during the year 2012-2013, out of which 135 were males and 15 were females. The ages ranged between 35-80 years. Majority of the patients in both groups were in the age range between 45-60 years. Far less were females 10%-15 patients as compared to male patients (90% - 135). Out of these 18% had unstable and 5% had atypical angina. After surgery most of the patients in both the study groups experienced an equal degree of angina relief. Exertional dyspnea was present in 20% and palpitation in 5% of our patients.

**Conclusion:** In this study conclude that internal mammary grafting does not increase morbidity, has lower mortality. Possibly no absolute contra - indications to the use of single, internal mammary artery there may be some relative contra-indication.

**Keywords:** Aneurysmectomy, Concomitant valve replacement, Internal mammary, Literature, Saphenous vein.

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### INTRODUCTION

Atherosclerotic coronary artery disease, one of the major causes of cardiovascular morbidity and mortality was once treated by little more than bed rest, sedation and analgesics. But today coronary bypass surgery has become a common operation, because it is effective and it prolongs life and because of the increased incidence and progression of coronary artery disease, when first introduced in 1962, a saphenous vein graft was used for coronary bypass but the search continued for other conduits when Kolessove used Left internal mammary artery (LIMA) for coronary bypass. Subsequent clinical use and clinical trial proved the superior patency of

internal mammary IMA and set a trend for increased use of this physiologic conduit. At first only one IMA (LIMA) was used, then the era of bilateral internal mammary anastomosis started.

The redo coronary surgery has led to the more liberal use of single bilateral and sequential internal mammary arteries as well, as the search for other arterial conduits that share similarities with IMA. With continued efforts we may see the day, when veinless bypass surgery will be routine.

In Pakistan, initial coronary bypass operations were done in 1977 at the National Institute of Cardiovascular Diseases Karachi. Since then a large number of patients have undergone coronary bypass surgery at various centers. Recently coronary bypass surgery is being done in increasing number of centers in

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this country. The results reported from various local centers<sup>1-4</sup> so far are encouraging and are not significantly different from the experience abroad despite limited availability of resources in a developing country like Pakistan. Myocardial revascularization with arterial grafts utilizing internal mammary arteries, with special reference to its morbidity and mortality and the results of internal mammary artery grafting in various age and gender

**MATERIAL AND METHODS**

Total 150 patients had an initial elective

detailed history, thorough clinical examination and review of all investigations. Patient was premedicated with one of the benzodiazepines at bed time and two hours before shifting to operation theatre. Patient was induced with one of the benzodiazepines. The dose was titrated against patient's response which is followed by morphine, sodium thiopentone and non-depolarizing agents. Anesthesia was maintained with oxygen, nitrous oxide, halothane, enflurane or isoflurane through circle system.

Surgery was performed through median

**Table-I: Study group distribution (n=150).**

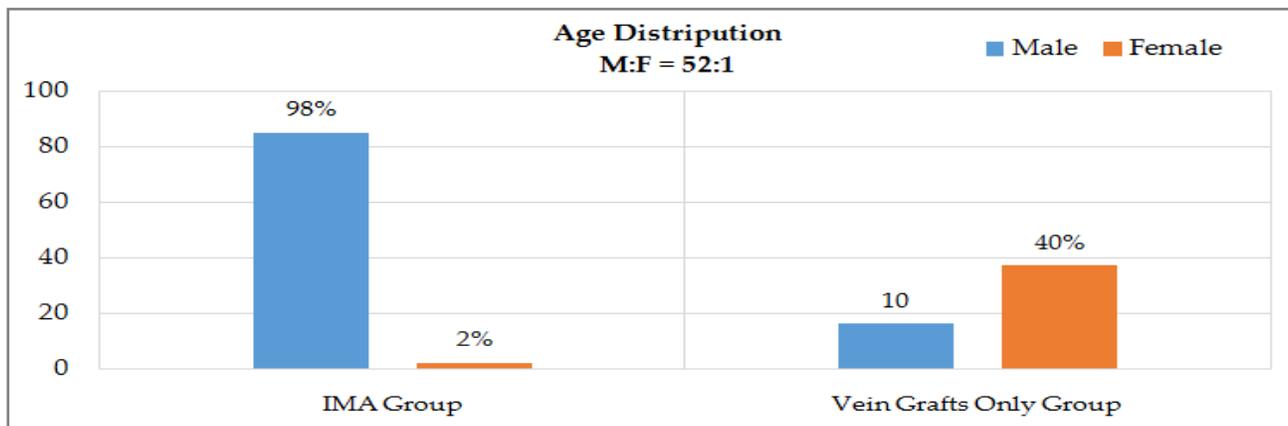
Study group	Frequency	Percentage
IMA (± vein)	106	71
Vein graft only	44	29
Total study population	150	100

coronary artery bypass procedure at the NICVD Karachi. This study was retrospective, the patients with concomitant valve replacement, ventricular aneurysmectomy redo coronary bypass or other cardiac or ascending aortic procedures were excluded from this analysis. No patient was excluded for any other reason. The age range was 35 to 80 years.

sternotomy. Left ventricle was vented through right superior pulmonary vein or aortic root. Moderate hemodilution and systemic hypothermia were maintained during cardio-pulmonary bypass.

Distal anastomoses were performed via binocular loupes with 3.5 power magnification. IMA flow was assessed visually. It was not used when very small in diameter with visually

Electrocardiograms (ECG) were obtained



**Figure-1: Age distribution.**

upon admission of the patient to the hospital, post-operatively each patient had ECG and serum enzyme determination.

Anesthetic management started with complete preoperative assessment including

inadequate flow. It was also abandoned in case of injury during dissection. Endarterectomy was performed in case the distal vessels were found blocked especially on the right coronary system. When all anastomoses are completed the heart

has regained a vigorous contraction and systemic rewarming is completed, cardiopulmonary bypass is discontinued and protamine is given to reverse the heparin followed by hemostasis. The pericardium is incised in a posterior direction

absorbable suture material, subcuticular layer is closed with polypropylene suture.

Postoperatively all these patients were ventilated until the vital signs, cardiac rhythm and chest tube drainage had stabilized. All the

**Table-II: Distribution sex, risk factors, symptomatology, extent of coronary artery disease and extent of coronary artery disease.**

Group		Male n=135 (90%)	Female n=15 (10%)	Total	M:F	p-value
IMA (± vein) group		104 (77%)	2 (13%)	106 (70%)	52:1	<0.001
Vein grafts only group		31 (23%)	13 (87%)	44 (30%)	3:1	
Symptoms						
		<b>IMA Group n=106 (70%) n (%)</b>		<b>Vein only group n=44 (30%) n (%)</b>		
Hypertension	Yes	34 (32)		16 (36)		<0.001
	No	72 (68)		28 (64)		
Total		106 (70)		44 (30)		
Diabetes mellitus	Yes	24 (23)		14 (32)		<0.001
	No	82 (77)		30 (68)		
Total		106 (70)		44 (30)		
Cholesterol	>200mg%	2 (2)		1 (2.3)		<0.001
	200mg%					
Total		106 (70)		44 (30)		
Triglycerides	>150mg%	28 (26)		6 (14)		<0.001
	150mg%					
Total		106 (70)		44 (30)		
Cholesterol & Triglycerides	Yes	28 (26)		13 (30)		<0.001
	No					
Total		106 (70)		44 (30)		
Smoking	Yes	21 (20)		7 (16)		<0.001
	No					
Total		106 (70)		44 (30)		
Previous MI.	Yes	49 (46)		17 (39)		<0.001
	No					
Total		106 (70)		44(30)		
<b>Severity</b>		<b>IMA Group n=106 (70)</b>		<b>VEIN only group n=44 (30)</b>		
S.V.D		3 (3)		-		0.537
D.V.D.		24 (23)		10 (23)		
T.V.D.		64 (60)		30 (68)		
L.M		15 (14)		4 (9)		

so that the in-situ IMA grafts are routed to the heart through those incisions. If the pleura has been opened, a pleural chest tube is placed, two mediastinal chest tubes are always employed. Sternal closure is accomplished with stainless steel wire and the subcutaneous layer with

patients were maintained indefinitely on aspirin 150mg daily beginning on the 1st postoperative day. Most of the patients were discharged between 7th to 10th postoperative days.

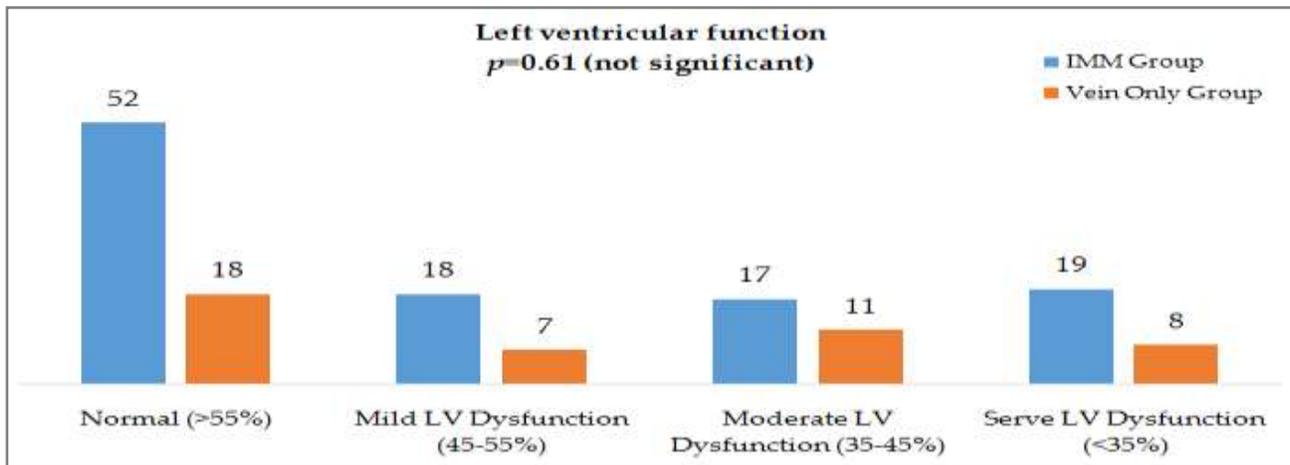
A perioperative myocardial infarction was defined as the appearance of new Q wave on

ECG, or an elevation in the creatine kinase isoenzyme (CK-MB) greater than 50 units/liter or left bundle branch block with elevation of CK -MB greater than 30 units/liter. Low cardiac output was labelled conditionally. The patient required inotropic support to maintain systolic pressure of 80mm Hg after cardiopulmonary

for the comparison between groups Alpha was kept 0.05.

**RESULTS**

A total of 150 patients undergoing elective coronary bypass graft (CABG) were studied comparatively, IMA (± vein) 106 patients (71%)



**Figure-2: Left ventricular function distribution.**

bypass. Sternal wound infection were diagnosed if prolonged hospitalization was required because of antibiotic therapy or surgical procedures in patients from whom pathogenic organisms had been recovered from the wound. Early mortality was defined as a death occurring within 30 days of the operation or during the hospital stay. A postoperative stroke was diagnosed if a persistent, neurologic deficit was

and vein graft only 44 patients (29%) (table-I). The ages ranged between 35-80 years. Majority of the patients in both groups were in the age range between 45-60 years. Patients under the age of 60 years received more internal mammary artery grafts compared with patients over 60 years of age (fig-1). We operated far less females (10%-15 patients) as compared to male patients (90%-135 patients). The IMA was used in very small number of female patients ( $p < 0.001$ ). Two-thirds

**Table-III: Description of conduit, receiving vessel, endarterectomies.**

Symptoms	No.of patients	Percentage
Single ima	102	68
Double ima	4	3
Vein grafts only	44	29
Vessel		
Lad	104	98
Diagonal	1	1
Ramus	1	1

present at the time of discharge.

Data was analyzed in SPSS version 21. Descriptive statistics like frequency and percentage were used. Chi-square was applied

of our patients had angina pectoris before revascularization, Same incidence was noted in another study from our Centre, which was the main indication for coronary revascularization. Out of these 18% had unstable and 5% had

atypical angina. After surgery most of the patients in both the study groups experienced an equal degree of angina relief. Exertional dyspnea was present in 20% and palpitation in 5% of our patients. Risk factors distribution revealed that IMA group had more smokers and patients with previous myocardial infarction while vein group had more diabetics and increased incidence of hyperlipidemia. Hypertension was equally prevalent in both the groups. The distribution of risk factors is not dependent on any group (IMA Vs. vein,  $p < 0.52$ ). It is also obvious that the incidence of coronary bypass patients with major risk factors is increasing. The extent of coronary

is nearly the same in both the study groups. A total of 21 patients required endarterectomies ( $p < 0.001$ ), out of which 17 were performed in the RCA system and 4 on the LAD system. We used single internal mammary artery (LIMA) in 102 patients (68%). Bilateral internal mammary arteries were used in 4 patients (3%). In these four patients the right internal mammary artery was anastomosed to the right coronary artery as a free graft, while left internal mammary artery was anastomosed to the left anterior descending coronary artery as pedicle graft.

Forty-four patients (29%) received only

**Table-IV: Methods of myocardial protection, morbidity (Groups).**

Method	IMA group n=106 (70%) n(%)	Vein only group n=44 (30%) n(%)	p-value
Cold, crystalloid cardiologic arrest	20 (19)	9 (20)	$p < 0.82$ (not significant),
Intermittent aortic x-clamp & fibrillation	86 (81)	35 (80)	
Type	IMA ( $\pm$ vein) %(n)	Vein only group %(n)	ETT
Reoperation for bleeding	4.7 (5)	4.5 (2)	With negative ETT for ischemia and no change in severity with exercise
Sternal wound complications	6.6 (7)	6.8 (3)	
Low cardiac output	7.5 (8)	6.8 (3)	
Perioperative MI	3.7 (4)	4.5 (2)	
Hest infection	2 (2)	2.27 (1)	
Renal dysfunction	2.8 (3)	4.5 (2)	
Cerebrovascular accident	2 (2)	2.27 (1)	
Left sided chest wall pain	15 (16)	4.5 (2)	
<b>Group</b>	<b>Percentage (n)</b>		<b>p-value</b>
IMA ( $\pm$ vein) group	5.6% (6)		0.52
Vein graft only group	6.7% (3)		
Overall mortality	6% (9)		

artery disease as determined by angiography is shown in (table-II). Double and tripple vessel disease was equally prevalent in both the groups (no significant difference in both groups,  $p < 0.63$ ). Patients with left main disease were more in the IMA group, signifying that left main disease is not a contra- indication for the IMA use. Only three patients (3%) had isolated left anterior descending lesion, which was bypassed with left IMA in all the patients.

Functional status of the left ventricle (fig-2) as assessed on the basis of left ventriculography

reversed great saphenous vein grafts. The left internal mammary was utilized for LAD grafting in 104 patients 98% (table-III). Methods of myocardial protection were same in both the groups ( $p < 0.82$ ). Eighty percent operations were performed by using intermittent aortic cross-clamping and the rest with cold crystalloid cardioplegia. This is in contrast with other local studies<sup>1,2</sup>.

The rate of reopening for bleeding is about the same in both the groups, out of five patients in the IMA ( $\pm$  vein) group the bleeding was from

the IMA bed in only one patient; in rest of the patients the bleeding was not related to the IMA. The incidence of sternal complications and low cardiac output is about same in both groups. Most common sternal wound complications were superficial infection and sterile dehiscence, no patient had mediastinitis. Perioperative myocardial infarction, chest infection, renal dysfunction and neurologic problems are slightly less in the IMA ( $\pm$  vein) group. Relatively larger number of patients in the IMA ( $\pm$  vein) group, experienced chronic left sided chest wall pain despite lack of evidence in favour of ischemic pain. Comparing the two groups (IMA VS. Vein) the IMA ( $\pm$  vein) group has less mortality than the vein group (table-IV). The overall mortality is about 6% as in other local studies<sup>3</sup>.

## DISCUSSION

Myocardial revascularization continues<sup>5</sup> to be an accepted mode of therapy for ischemic heart disease in specific subgroups of symptomatic patients. Relief of angina pectoris, prolongation of life and preservation of ventricular function have been demonstrated in the long term follow-up of patients undergoing coronary bypass grafting<sup>14</sup>. Of particular interest is the analysis and comparison of results obtained with the use of either IMA or saphenous vein grafts.

The incidence of hemorrhage requiring reoperation was similar in both the IMA ( $\pm$  vein) and vein grafts only group. In the IMA group five patients (4.7%) developed excessive mediastinal bleeding<sup>6</sup>. Postoperatively requiring reoperation, this was uneventful in all five patients. The bleeding was from the bed of the IMA in only one patient (1%). Therefore it is obvious that if site of bleeding is considered the incidence of bleeding is even less in the IMA ( $\pm$  vein) group<sup>7</sup>.

Most of the patients in this group had either superficial infection or sterile sternal dehiscence, no patient had mediastinal or other complication requiring major surgery (plastic procedure). Number of patients (4=3%) who underwent bilateral IMA grafting is very small so no conclusions can be drawn from our study about

the role of bilateral IMA grafting in sternal complications<sup>8</sup>.

One of the concerns in the use of IMA grafts is the possibility of sternal wound infections. Initially increased rate of sternal wound infection was noted both, for single and bilateral IMA's, our data comparing patients receiving saphenous vein grafts with patients receiving mainly one IMA graft failed to demonstrate an increased incidence of wound problems associated with this procedure, this is comparable with other similar studies<sup>9-11,2</sup>.

There was a slightly increased incidence of left sided small pleural effusion in both the groups, which resolved without intervention. This complication has also been reported by others<sup>12</sup>.

In the present study we noticed an increased incidence 15% in IMA ( $\pm$  vein) group and 4.5% in saphenous vein group of chronic left sided chest wall pain in the internal mammary artery group after discharge from hospital. There was no increase in the severity of pain with exercise and the exercise tolerance test, was negative for ischennia. This problem has also been reported in other studies<sup>13,14</sup>. Several factors may be responsible including damage to intercostal nerves and their branches during IMA harvesting. The incidence of the problem can be reduced by proper operative technique, judicious use of diathermy and careful sternal retraction<sup>13,15</sup>. There is no significant difference between the two groups regarding operative and postoperative complication such as low cardiac output, perioperative myocardial infarction, renal and neurologic complications. Comparative mortality was slightly low ( $p<0.85$ ) in the IMA group, the most important risk factors for mortality in both the groups were low ejection fraction (<35%) female sex and old age.

## CONCLUSION

In this retrospective study, we conclude that internal mammary grafting does not increase morbidity, has lower mortality, possibly no absolute contra-indications to the use of single,

internal mammary artery, there may be some relative contraindication. The use of bilateral and sequential IMA may be reserved for well selected cases.

### CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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