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OUTCOME AND FACTORS ASSOCIATED WITH HOSPITAL MORTALITY IN PATIENTS WITH IMPAIRED LEFT VENTRICULAR FUNCTION UNDERGOING CORONARY ARTERY BYPASS GRAFTING: WHERE DO WE STAND?

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ABSTRACT

Objective: Impaired ventricular function is a known risk factor for mortality after coronary artery bypass grafting however increasingly more patients with impaired ventricular function are referred for surgery. Currently no large data is available from Pakistan regarding this aspect of coronary surgery. Our objectives were to find out the hospital mortality and mid term functional improvement in patients with impaired ventricular function undergoing coronary artery by pass grafting and identify the risk factors for mortality.

Methodology: Retrospective analysis of preoperative, operative and postoperative variables of patients with impaired ventricular function who were operated for isolated first time coronary artery bypass between October 2006 to April 2009.

Results: Total 190 patients with impaired ventricular function underwent isolated first time coronary artery bypass grafting during this period with a male predominance (82.6%). Mean ejection fraction of the group was 25.4±5.3%. Mean predicted mortality on logistic Euro score was 10.9±2.7%. Actual in hospital mortality of the group was 4.7% which is comparable to contemporary published results. Multivariate analysis identified use of intra aortic balloon pump, non use of internal mammary artery and preoperative NYHA functional class as factors associated with mortality.

Conclusion: Coronary artery bypass grafting can be performed in patients with impaired ventricular function with acceptable hospital mortality and mid term functional improvement.

KEY WORDS: Out come, Factors, Mortality, CABG, Impaired ventricular function.

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INTRODUCTION

Balancing the risks and benefits has remained the cornerstone of decision making in surgery and this fact features prominently in offering the surgery for coronary artery bypass grafting to a patient with impaired left ventricular function. Traditionally impaired ventricular function has been a risk factor for mortality associated with CABG, however major randomized series have shown a survival benefit for patients with impaired LV function under-

going CABG as compared to medical treatment alone.[1,2] Presently the available literature has addressed the hospital outcome in these patients and identified peripheral artery disease, COPD, female sex, reoperation, renal failure, advanced age and serially decreasing EF as risk factors for mortality and one and five year survival being 88% and 75% respectively.[3-5] However no data is available from Pakistan making it pertinent to study this aspect of coronary artery disease in our country.

With improvements in thrombolytic therapy and PCI the proportion of patients with impaired LV function presenting for revascularization will increase. There is a requirement that we look into the outcome of CABG in this relatively high risk group and know the factors associated with mortality as well as midterm out come so that patients who would benefit more from the procedure are identified.

The objectives of this study were to know the hospital mortality and mid term functional improvement in patients with EF<or equal to 30% who had undergone isolated first time coronary artery bypass grafting as well as to find the factors associated with early mortality.

METHODOLOGY

Retrospective analysis of prospectively collected preoperative, operative and post operative data of patients with EF less than or equal to 30% undergoing isolated first time CABG at our institution between 2006 - 2009.

Inclusion criteria: Patients undergoing first time elective or urgent isolated CABG with an EF of 30% or less.

Exclusion criteria: Those undergoing an emergency procedure or in cardiogenic shock preoperatively.

Data collection and interpretation: All preoperative, intraoperative and postoperative variables were taken from a common data base form maintained for every cardiac patient, this includes telephonic interviews at one month and one year intervals after surgery. Additional information was taken from patient's record files if required.

Definitions: The definition of low EF or impaired ventricular function is an EF of less than or equal to 30% as assessed by 2D and color echo. Outcome as defined in our study included hospital mortality and functional status (NYHA class) at follow up the maximum duration being one year after surgery. Logistic EURO score was used for risk stratification of patients with those falling below 9% categorized as low to moderate risk and those above 9% as high risk group.

Emergency procedures were situations requiring immediate surgical intervention like cardiogenic shock, ongoing ST segment changes and failed or complicated PCI. Urgent procedures were situations where surgery was required as a priority during next few days eg. left main stenosis, unstable angina requiring IV nitrates or heparin.

Preoperative renal failure was defined as serum creatinine level more than two gm/dl. Post operatively creatinine going above 2gm/dl or more than one gm/dl of the base line level was taken as renal failure. Prolonged ventilation was defined as more than 72 hours.

Surgical Strategy: The surgical strategy included approach through median sternotomy and establishment of cardiopulmonary bypass. Ante grade blood cardioplegia was used and if required combined with graft or retrograde cardioplegia. Ionotropic support was started before coming off by pass. The patients were shifted to CICU ventilated where they were gradually weaned off from mechanical ventilatory support. After extubation and discontinuation of ionotropic, IABP support patients were assessed and shifted to step down unit from where they are started on a rehabilitation programme.

Statistical Analysis: Data was analyzed on Statistical Package for the Social Sciences (SPSS) version 16. Discrete variables were expressed in frequency and percentage. Continuous variables were presented in mean (± standard deviation) for normally distributed data while median (inter-quartile range) was used for non-normal distribution. Their Scale analysis was done. Collinearity was checked for all the

independent variables. Univariate p-values of <0 .25 were determined by Exact and t-tests. Multivariable logistic regression was applied to estimate odds ratios for in-hospital mortality adjusting for other variables. Independent variables including age, cross clamped time, BMI, gender, CVA, PVD,CLD, Previous CV intervention, PCI, MI, CHF, NYHA, Angina, left main Disease >50%, Ejection Fraction, Operative Status, IABP, Internal mammary artery graft and distal anastomosis with venous conduit were scanned at P value of <0.05. Confounding effect at 15% and interaction at 10% were examined. Final model was built on Wald P value and verified by likelihood ratio test. Its fit was assessed by Deviance/ Pearson Chi square. Additionally, Survival plot was plotted for one month and one year follow up by using Kaplan Meier method and compared with Log-rank test.

RESULTS

All preoperative variables are shown in Table-I the study population comprised of total 190 patients with males being 82.6%. Mean age was 58.44±9.55 years .The incidence of important risk factors is shown here, important features are preop MI documented in 148(77.9%) patients and prior PCI seen in 11 (5.45%) patients. Overall EF of the group was 25.4± 5.3% and 18 (9.5%) patients had an EF of 20% or less. Mean logistic euroscore was 10.9± 2.7%.

Operative variables are shown in Table-II. Majority (94.7%) of the patients underwent conventional on pump CABG. Mean cross clamp time was 100.2 ±33.1mins and mean cross clamp time was 61 ± 23.4 mins. Mean number of grafts was 3.3±0.8 for on pump and 1.5±0.5 for off pump cases.

Post operative data is shown in Table-III. Over all incidence of complications was 26.3% (50 complications), post operative respiratory problems being the most frequent complication seen in 14.8 % patients. Over all mortality was 4.7 % (9/190).

An analysis of hospital mortality showed that out of 190 patients the intra aortic balloon

Table-I: Baseline characteristic of subjects with low ejection fraction (>30%) who underwent CABG surgery (n=190)

Variable	No./ range	Frequency/ mean
Total number	190	
male	157	82.60%
female	33	17.40%
BMI	17-72	25.9±5.3
age	35 – 90 years	58.4±9.5 years
Family history +ve	83	43.70%
smoker	96	50.50%
DM	111	58.40%
HTN	140	73.70%
Previous CVA,TIA	15	7.90%
Peripheral vascular disease	3	1.60%
Renal failure on dialysis	4	2.10%
COPD	9	4.70%
Prior MI	148	77.90%
MI with in past week	26	13.7%
NYHA class		
II	48	25.30%
III	98	51.60%
IV	44	23.20%
EF	10 – 30%	25.4±5.3%
20 – 30%	172	90.5%
< 20%	18	9.5%
Unstable angina	135	71.10%
Angiography		
1 VCAD	7	3.70%
2 V CAD	16	8.4%
3 VCAD	167	81.9%
LM stenosis	36	18.9%
Operative status		
Elective	107	56.3%
Urgent	83	43.7%
IABP	34	17.9%
EURO score	3 - 16	7.4±2.7
Log EURO score	2.6 – 52.7%	10.9±2.7%

pump was used only in 34 (17.9%) patients and not used in 156 (82.1%). Out of those who got an IABP there were 7 inhospital deaths so the mortality of patients with an IABP was 20.6% (7 out of 34) and mortality of those in which IABP was not used was 1.3% (two out of 156). As shown in table II internal mammary artery (IMA)was used in 85.7% (163) patients and not used in 14.2% (27) patients, out of those who got an IMA there were 2 hospital deaths,

Table-II: Operative Data

Variable	No/ range	Frequency/ mean
On pump	180	94.70%
Off pump	10	5.20%
Cardiopulmonary by pass time	80 - 180	100.2±33.17
Cross clamp time	9 - 110	61.0±23.4
No of grafts		
Over all	1 – 5	3.3±0.8
On pump	1 – 5	3.3±0.8
Off pump	1 - 2	1.5±0.5
Use of internal mammary artery	163	85.70%

Table-III: Post operative data.

Variable	No/ range	Frequency/ mean
complications	50	26.3%
Prolonged ventilation	26	13.7%
Re opening		
Bleeding	9	4.7%
Graft	1	0.5%
others	2	1.1%
Renal failure	4	2.1%
stroke	2	1.1%
arrythmias	27	14.2%
sepsis	5	2.6%
Respiratory complications		
Pneumonia.effusion, pneumothorax	28	14.8%
Wound infection		
Leg	1	0.5%
sternum	0	0
arrest	5	2.6%
Multiorgan failure	4	2.1%
Mortality	9	4.7%

mortality being 1.22% and in the group where IMA was not used the hospital mortality was 25.9%. Based on preoperative NYHA functional class there were no hospital deaths in patients in class II, three out of a total 98 in class III(3.1%) and six out of a total 44 patients in class IV (13.6%). There were no patients in NYHA class I before surgery.

Post op follow up data was recorded at one month and one year intervals. Of the 181 patients discharged alive from the hospital there were three deaths at one month interval (1.65%) while six patients (3.3%) were lost to follow up. The cause of death shown in the table included two cardiac deaths and one due to infection. There were 22 (12.1%) readmissions during one month of discharge. This left 172 patients out of initial 190 for one year follow up. Out of those 124 completed one year time from operation and 48 were at various stages of one year time. There were six deaths (4.8%) at one year interval and 19 (15.3%) patients were lost to follow up. The patients who had not completed one year follow up time (n 48) were contacted on telephone. There were

Table-IV: Mortality Profile of subjects with low ejection fraction (<30%)
underwent CABG surgery (n=190)

	In-hospital mortality (n=190) n (%)	30 days mortality (n=181) n (%)	mid-term(1 year) mortality (n=124) n (%)
Expired	9.0 (4.73%)	3.0 (1.65%)	6.0 (4.8%)
Lost to follow up	0	6 (3.3%)	19(15.3%)
Age in years (mean±SD)	60.1± 14.10	61.3± 12.4	62.8± 9.3
Gender			
(Male)	8.0 (88.9%)	1.0 (33.3%)	5.0 (83.3%)
(Female)	1.0 (11.1%)	2.0 (66.7%)	1.0 (16.7%)
Cause of Death			
(Cardiac)	9.0 (100%)	2.0 (66.7%)	3.0 (50.0%)
(Infection)		1.0 (33.3%)	
(Neurological)	– –	– –	1.0 (16.7%)
(Respiratory)	– –	– –	2.0 (33.3%)
Operative Status			
(Elective)	1.0 (11.1%)	1 (33.3%)	3 (50.0%)
(Urgent)	8.0 (88.9%)	2.0 (66.7%)	3.0 (50.0%)

Table-V: NYHA functional class profile of low ejection fraction (<30%) underwent CABG surgery (n=190)

	Before operation (n=190) n(%)	Follow up at one month (n=172) n(%)	Follow up at one year (n=99)n(%)
NYHA Class			
(Class I	0	112.0 (65.1%)	45.0 (45.4%)
(Class II)	48.0 (25.3%)	55.0 (31.9%)	18.0 (18.8%)
(Class III)	98.0 (51.6%)	4.0 (2.9%)	36.0 (36.3%)
(Class IV)	44.0 (23.2%)	0	0

two deaths (4.1%) in this group, so in total eight documented deaths occurred between one month and one year following surgery. The cause of death at one year interval is shown in Table-IV.

Functional class improvement is shown in Table-V. It is evident that majority of the patients were in class III or IV preoperatively, however at one month and one year follow-up the proportion of patients in class I and II increased.

Multivariate analysis performed showed use of intra aortic balloon pump, non use of internal mammary artery and preoperative NYHA functional class as factors significantly associated with hospital mortality.

First two variables shows strong positive association (OR=11.47 and 95%CI=2.00, 65.65) and (OR=14.27 and 95%CI=2.36, 87.76) while third one shows protective to positive association (OR=5.38 and 95%CI=0.99, 28.95) with outcome (Table-VI). When stratification was done on NYHA, Survival curve at both one month and one year follow up showed significant association with P value of 0.034 and <0.001 respectively. Both intervals showed better survival of Low Ejection Fraction CABG in functional class I as compared to class II, III and IV (Fig IA & IB). Furthermore, improved outcome in terms of NYHA functional class (Table-V) even with huge missing data in lost

to follow up (6 at one month follow up and 19 at one year follow up) was also evident.

DISCUSSION

In this retrospective study we have analyzed the out come of CABG in low EF group. Main findings of the study are an acceptable hospital mortality and functional improvement at one month and one year interval. These results reflect improving results of surgery in this high risk group. The reported incidence of patients with EF less than 30% presenting for CABG is up to 15%,[6] at our institution the incidence of CABG for patients with a low ejection fraction is about 12% of all the coronary artery revascularization procedures performed which compares with a range of 3.4-15% in literature[5,6] and this number is expected to increase in future.[7]

Post operative out come in these patients is worse as compared to those with normal EF,[9] however major randomized controlled series have shown a survival benefit for surgically treated patients in this group[8,9] and CABG is frequently performed in this group.[10]

The hospital mortality in our study is 4.75% whereas predicted mortality by logistic euro score was 10.9%. This observation has been made in other contemporary studies.[11] In Canadian registry data base the reported mortality for CABG in patients with an EF of less

Table-VI: Multivariable associated factors for in-hospital mortality among subjects with low ejection fraction (<30%) underwent CABG surgery (n=190)

Variables	ß co-effifient	S.E.	Adj OR	95%CI	P value
Intra aortic balloon pump use	2.44	0.89	11.47	(2.00, 65.65)	0.006
Internal mammary artery graft non use	2.66	0.92	14.27	(2.36, 87.76)	0.004
NYHA functional class	1.68	0.86	5.38	(0.99, 28.95)	0.051
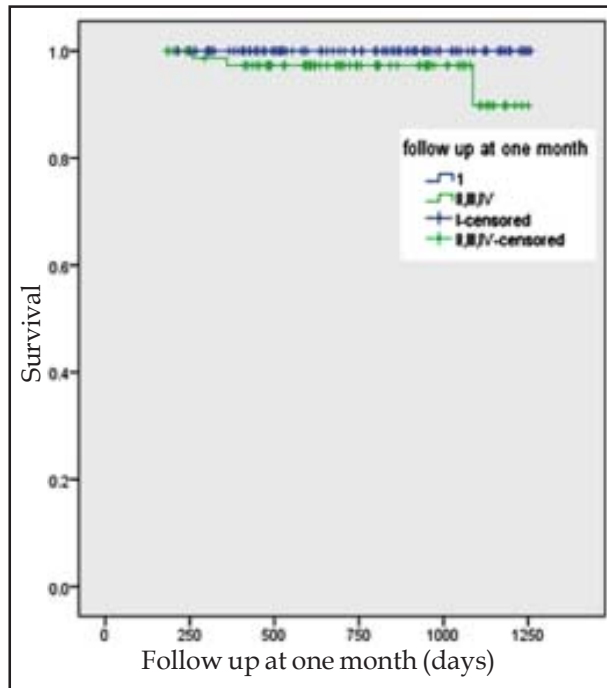
Fig-1A: Survival curve of low ejection fraction
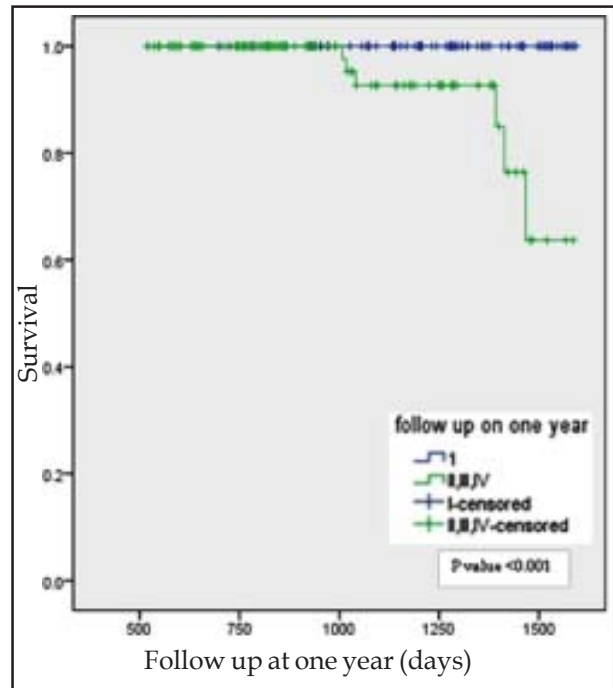(<30%) CABG at one month follow up
stratified on NYHA

Fig-1B: Survival curve of low ejection fraction
(<30%) CABG at one year follow up
stratified on NYHA

than 30% was 4.6% between 1996 and 2001.[12] The improvement in operative results is probably attributed to better myocardial protection, improved perioperative care as well as better patient selection involving myocardial viability studies.[11]

Although our data is deficient in terms of follow up however of the 190 patients 172 were seen at one month interval (9 in hospital deaths, three deaths during one month and six were lost to follow up). Of these remaining patients 124 completed one year after surgery but there were another 19 patients missing in follow up and six more deaths were recorded so 99 patients were living out of 124 at one year interval with an actual survival rate of 79.8%. The survival data in similar group of patients ranges from 81 – 92% at one year and 68 – 875 at three years interval.[5,14] Similarly as shown in results there was a significant improvement in the functional status of the patients both at one month and one year interval a fact that must carry an equal weight while balancing risks and benefits of surgery.

We have shown that use of intra aortic balloon pump, non use of internal mammary artery and preoperative worse functional class were the risk factors associated with in hospital mortality. Out of these first two factors reflect the criticality of patient (only more sick patients are likely to get an intra aortic balloon pump or would not be a candidate for internal mammary artery use) rather than having a direct bearing on the mortality. These factors have been quoted in other studies as well as being associated with the perioperative mortality.[10,11] Additional risk factors found in New York state department of Health data such as advanced age, female sex, hepatic failure, renal failure and emergent procedures were not confirmed in our study.

The fact that significant number of patients were lost to follow up is a potential weakness in our study however it should be noted that some of the patients were from out side Karachi from areas as far as Skardu (a common referral base for AKU) and did not have an access to even a phone. Similarly a few would contact on phone without any formal

documentation or would follow up with their family doctor after surgery so their record does not show in our medical documents.

Strength: The importance of this study is that it is from a developing country, provides detailed view of pre-operative co-morbidities and associated factors. It also shows improved outcome which justified CABG surgery in this high risk group

Limitation: It has the following limitations:

* sparse data with very small number of outcome which is reflected with large CI
* Retrospective data analysis
* Huge number of missing data in lost to follow up
* Lack of data about post operative co-morbidity, complications, and cost-benefit analysis

CONCLUSION

CABG can be performed in patients with low ejection fraction with acceptable hospital mortality and improvement in functional status. Careful patient selection for revascularization would confer maximum benefit to the patients in this relatively high risk group.

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