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Short Term Outcome of Off Pump Coronary Artery Bypass Grafting in Patients with Low Ejection Fraction

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Abstract

Objectives: Coronary artery bypass grafting in patients with low ejection fraction (<35%) still remains a high-risk procedure due to its high mortality and morbidity. Off pump coronary artery bypass grafting surgery can be an alternative technique in these patients. The aim of this study is to find out the short-term outcome of the patients with low ejection fraction (<35%) after off pump coronary artery bypass grafting and to quantify any improvement in overall functional status.

Methods: Low ejection fraction was confirmed preoperatively and the short-term outcome after off pump coronary artery bypass grafting was be determined by follow-up at the time of discharge, after 1 month of surgery and after 3 month of surgery.

Results: Significant improvement in terms of CCS grade and NYHA class was observed specially in <35% ejection fraction group. While there was a significant change between preoperative and postoperative 3 month follow up of patients in <35% ejection fraction group which was observed through echocardiographic evaluation and clinical assessment. The overall mortality was 2 in number. This was comparable with other international publications.

Keywords: Coronary artery; Cardiopulmonary bypass; Hypertension

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Introduction

Coronary artery disease is the most common cardiovascular disease and it is the major cause of death in the middle aged and older people in the most developing countries. Coronary artery disease is increasing in developing countries. In south Asian region, increased prevalence of coronary artery disease and excess mortality rate is reported in several studies. Moreover, this disease starts at young age and more aggressive presentation. Socioeconomic improvement and changes in life style in respect to increased saturated fat intake decrease in physical activity, increasing body weight, and consequently increasing rate of Diabetes Mellitus, Dyslipidemia and Hypertension in the population contribute to increase in coronary artery disease. According to the latest WHO data published in April 2011 Coronary Heart Disease Deaths in Bangladesh reached 163,769 or 17.11% of total deaths. Bangladesh ranks 25th position in the world in respect to cause of death due to coronary artery disease [1].

Significant morbidity and mortality due to ischemic heart failure is well documented. Revascularization in such patients with amenable coronary anatomy has yielded significant functional improvement [2]. However, Left Ventricular (LV) dysfunction has been clearly shown to be a predictor of perioperative morbidity and mortality during conventional Coronary Artery Bypass Grafting (CABG) on Cardiopulmonary Bypass (CPB). An analysis from the New York State cardiac surgery data- base including patients who underwent CABG from 1997 to 1999 showed that in-hospital mortality and morbidities were significantly higher in patients with depressed LV function compared with patients with normal LV function [3].

The use of substantial inotropic and vasopressor support is difficult to quantify but is clearly a frequent and integral component of cardiac surgery in patients with significant LV dysfunction. The use of an Intra-Aortic Balloon Pump (IABP) is a somewhat more definitive outcome, and in many settings, reflects the next step beyond inotropic support. Cross-clamp-

induced myocardial ischemia and adverse systemic effects of CPB may produce greater overall physiologic derangement in patients with ventricular dysfunction. Off-pump coronary artery bypass (OPCAB) obviates these factors and may provide a benefit [4].

Historically, CABG in patients with LV dysfunction was associated with high perioperative mortality [5]. However, advances in surgical techniques have led to improved outcomes, making CABG a relatively safe procedure in selected high-risk patients [6].

The development of specialized techniques, tissue stabilizers and apical suction devices allows the application of off-pump CABG to almost all patients, as surgeon experience matures. Furthermore, there are several reports that off-pump CABG is a safe alternative to on-pump grafting in high-risk patients such as redo CABG cases or those with advanced age, female sex, or impaired LV function [7-9].

Several prospective nonrandomized studies have supported the assumption that patients with the worst preoperative prognoses would benefit most from a less invasive procedure, avoiding cardiopulmonary bypass and cardioplegic arrest [10]. The safety of OPCAB techniques in multi vessel revascularization has been confirmed in this group of patients [11]. The purpose of this study is to assess the short-term outcome of OPCAB in patients with LV dysfunction.

Method and Materials

This study was conducted in the Department of Cardiac Surgery, Bangabandhu Seikh Mujib Medical University, and Dhaka over a period of 2 year from July 2012-June 2014. It was a Prospective Cohort Study. The study was carried out in patients with Ischemic Heart Disease (IHD) who underwent isolated off pump coronary artery bypass graft surgery. Total number of patients was 60 (Sixty). Sampling was purposive. Two groups were made. Group 1: 30 (Thirty) patients with Ejection Fraction (EF) ≥ 35% and Group 2: 30 (Thirty) patients with Ejection Fraction (EF) <35%.

Results and Observations

Total numbers of 60 patients were selected for off pump coronary artery bypass surgery. Among them 30 patients' ejection fraction was ≥ 35% and 30 patients' ejection fraction was <35%. The findings of the study obtained from data analysis **(Table 1)**.

Risk factors

All the patients had some risk factors for coronary artery disease (CAD). **Table 2** shows the distribution of risk factors in two groups of patients. In group 1 patients out of 30 patients 19 were smoker, 12 had Diabetes Mellitus, 11 had hypertension and 7 had hyperlipidaemia. On the other hand, in group 2 patients 25 were smoker, 17 had Diabetes Mellitus, 14 had hypertension and 8 had hyperlipidaemia.

ECG findings

In group 1, 12 (40%) patients were in no abnormality followed by 8 (26.66%) in evidence of old inferior MI, 6 (20%) in evidence of old antero-inferior MI and 4 (13.33%) in no specific findings. On the other hand, in group 2, 13 (43.33%) patients were in no abnormality followed by 7 (23.33%) in old inferior MI, 7 (23.33%) in old antero-inferior MI and only 3 (10%) in no specific finding **(Table 3)**.

Comparison of number of coronary arteries involved

In group 1, 2 patients had single vessel coronary disease, 7 patients had double vessels coronary disease and 21 patients had triple vessels disease. On the other hand, group 2 patients, 6 patients had double vessels disease and 24 patients had triple vessels coronary disease. No one had single vessel disease **(Table 4)**.

Comparison of echocardiographic variables

The following tables depict the change in preoperative and postoperative (during discharge, 1 month follow up, 3 month follow up) echocardiographic variables. It was found that in group 1 the mean ± SD LVIDd was 54.86 ± 3.45 mm during preoperative period and it was 57.56 ± 4.07 mm during discharge. During 1

Table 1: Shows that among group 1 patients , highest number of percentage 60% were in 41-50 years age group and both 51-60 and 61-70 years age group percentage were equal that is 20%. Whereas among group2 patients highest percentage were in 61-70 years age group and both 41-50 and 51-60 age group patients were 9.

Age of the Patients (years)	Group 1		Group 2	
	n	%	n	%
41-50	18	60	9	30
51-60	6	20	9	30
61-70	6	20	12	40
Total	30	100	30	100
Mean age (years)	51.9	-	57.2	-

Table 2: Comparison of risk factors.

Risk Factors	Group 1		Group 2	
Smoking	19	63.3	25	83.3
Diabetes mellitus	12	40	17	56.67
Hypertension	11	36.66	14	46.66
Hyperlipidaemia	7	23.33	8	26.66

Table 3: Distribution of patients in ECG findings.

ECG findings	Group 1		Group 2	
	n	%	n	%
No abnormality detected	12	40	13	43.33
Evidence of old inferior MI	8	26.66	7	23.33
Evidence of OLD antero-inferior MI	6	20	7	23.33
No specific findings	4	13.33	3	10

Table 4: Comparison of number of coronary arteries involved.

No. coronary arteries	Group 1	Group 2
Single vessel	2	0
Double Vessel	7	6
Triple Vessel	21	24

month, postoperative follow up LVIDd was 50.2 ± 4.18 mm and during 3 month follow up it was 45.43 ± 5.03 mm. In ANOVA test, preoperative, discharge, 1 month and 3 month follow up LVIDd was statistically significant (<0.05).

Similarly, it was observed that in group 2 the mean ± SD LVIDs was 45.23 ± 4.13 mm during preoperative period and it was 48.03 ± 4.46 mm during discharge. During 1 month, postoperative follow up LVIDs was 40.53 ± 4.83 mm and during 3 month follow up it was 34.7 ± 5.33 mm. In ANOVA test, preoperative, discharge, 1 month and 3 month follow up LVIDs was statistically significant (<0.05).

It was also found that in ≥ 35% ejection fraction patients group the mean ± SD LVEF was 42.7 ± 4.66 (%) during preoperative period and it was 39.66 ± 4.71 (%) during discharge. During 1 month, postoperative follow up LVEF was 48.6 ± 4.66 (%) and during 3 month follow up it was 53.46 ± 5.06 (%). In ANOVA test, preoperative, discharge, 1 month and 3 month follow up LVEF was statistically significant (<0.001).

On the other hand, in <35% ejection fraction patients group it was evident that the mean ± SD LVIDd in preoperative period was 67.06 ± 3.67 mm and during discharge it was 68.1 ± 3.39 mm. and during 1month follow up the LVIDd was 61.13 ± 5.45 mm and during 3 month follow up it was 57.56 ± 4.96 mm. in ANOVA test the preoperative, discharge, 1 month and 3 month follow up of LVIDd was statistically significant (<0.05).

It was found that in <35% ejection fraction patients group the mean ± SD LVIDs in preoperative period was 59.1 ± 4.35 mm and during discharge it was 60.53 ± 4.44 mm. and during 1month follow up the LVIDs was 52.83 ± 6.34 mm and during 3 month follow up it was 48.3 ± 5.53 mm. in ANOVA test the preoperative, discharge, 1 month and 3 month follow up of LVIDs was statistically significant (<0.05).

Similarly, it was found that in <35% ejection fraction patients group the mean ± SD LVEF in preoperative period was 29.26 ± 4.25 (%) and during discharge it was 27.63 ± 4.01 (%) and during 1month follow up the LVEF was 34.8 ± 5.56 (%) and during 3 month follow up it was 38.93 ± 6.03 (%) in ANOVA test the preoperative, discharge, 1 month and 3 month follow up of LVEF was statistically significant (<0.001) **(Tables 5-7).**

Comparison of some postoperative outcome parameters

This table shows the postoperative outcome parameters like duration of mechanical ventilation (hours), ICU stay (hours) and total hospital stay (days) between the ≥35% ejection fraction patients group and the <35% ejection fraction patients group. The mean duration of mechanical ventilation in ≥35% ejection fraction group and <35% ejection fraction group was 7.55 ± 2.03 hrs and 12.76 ± 5.36 hrs respectively. And the difference was statistically in significant (p>0.05) in unpaired t-test. Whereas the mean duration of ICU stay between ≥35% ejection fraction group and <35% ejection fraction group was 30.85 ± 7.44 hrs and 32.36 ± 7.31 hrs respectively. The difference between this two group was statistically significant (<0.001) in unpaired t-test. The last postoperative parameter was total hospital stay. The mean duration of total hospital stay in ≥35% ejection fraction group and <35% ejection fraction group was 7.7 ± 1.2 days and 9 ± 1.98 days respectively. This difference between this two group was statistically significant (<0.05) in unpaired t-test **(Tables 8 and 9)**.

Table 5: Changes in echocardiographic findings.

Findings	Preoperative	At discharge	1 month after operation	3 month after operation	P value
			Group 1		
LVIDd (mm)	54.86 ± 3.45	57.56 ± 4.07	50.2 ± 4.18	45.43 ± 5.03	<0.05
LIVDs (mm)	45.23 ± 4.13	48.03 ± 4.46	40.53 ± 4.83	34.7 ± 5.33	<0.05
LVEF (%)	42.7 ± 4.66	39.66 ± 4.71	48.6 ± 4.66	53.46 ± 5.06	<0.001
			Group 2		
LVIDd(mm)	67.06 ± 3.67	68.1 ± 3.39	61.13 ± 5.45	57.56 ± 4.96	<0.05
LIVDs (mm)	59.1 ± 4.35	60.53 ± 4.44	52.83 ± 6.34	48.3 ± 5.53	<0.05
LVEF (%)	29.26 ± 4.25	27.63 ± 4.01	34.8 ± 5.56	38.93 ± 6.03	<0.001

Table 6: Comparison of echocardiographic parameters between preoperative and postoperative 3 month follow up.

Findings	Preoperative	3 month after operation	P value
	Group 1		
LVIDd (mm)	54.86 ± 3.45	45.43 ± 5.03	<0.001
LIVDs (mm)	45.23 ± 4.13	34.7 ± 5.33	<0.05
LVEF (%)	42.7 ± 4.66	53.46 ± 5.06	0.1232
	Group 2		
LVIDd (mm)	67.06 ± 3.67	57.56 ± 4.96	<0.001
LIVDs (mm)	59.1 ± 4.35	48.3 ± 5.53	<0.05
LVEF (%)	29.26 ± 4.25	38.93 ± 6.03	<0.001

Table 7: States the comparison of postoperative 3 month follow up of LVEF. In paired t-test it was statistically significant (<0.001). Changes in LVEF.

Change of LVEF after 3 month (%)	Group 1	Group 2	P value
	38.93 ± 6.03	53.46 ± 5.06	0.0001

Table 8: Comparison of some postoperative outcome parameters.

Findings	Group 1	Group 2	t value	df	P-value
Period of mechanical ventilation (hours)	7.55 ± 2.03	12.76 ± 2.03	0.797	58	0.431
ICU Stay (hours)	30.85 ± 7.44	32.36 ± 7.31	4.974	58	0.001
Total hospital stay (days)	7.7 ± 1.2	9 ± 1.98	3.075	58	0.0032

Table 9: Comparison of major postoperative complications and mortality.

Major post-operative Complications	Group 1	Group 2
Stroke	0	0
Renal dysfunction	0	0
Prolonged ventilation >24 hrs	0	2
Deep sternal wound infection	1	1
Reoperation	0	0
Mortality	2	0

Discussion

Bangabandhu Sheikh Mujib Medical University is the only medical university in Bangladesh and the department of Cardiac Surgery of Bangabandhu Sheikh Mujib Medical University started its journey in 2004. Since then it has become the leading cardiac surgery center of Bangladesh. This study was conducted in the department of cardiac surgery of Bangabandhu Sheikh Mujib Medical University from July 2012–June 2014. The same surgical team performed all the surgery. Total number of patients was 60, which was divided into two groups, 30patients in each group.

Male predominance in this study has been seen in both the groups which is <84% and these findings are similar to the study conducted by Meharwal et al. which was which is 90.4% [7]. According to the age distribution highest number of patients was in 61-70 yr group in both groups. Study conducted by Goldstein et al. also found highest number of patients belonging to 61-70 year age group [8].

The study risk factors showed majority of the patients were smoker. They also had other risk factors like Diabetes Mellitus, hypertension and hyperlipidemia.

Echocardiography was done preoperatively, during discharge and postoperative 1 month and 3 month follow up using modified Simpson's biplane method. For in group 1 patients preoperative LVIDd and LVIDs was 54.86 ± 3.45 mm and 45.23 ± 4.13 mm respectively. LVEF for this group is 42.7 ± 4.66 (%). Postoperatively at 3 month follow up in this group of patients is LVIDd 45.43 ± 5.03 mm, LVIDs 34.7 ± 5.33 mm and LVEF 53.46 ± 5.06 (%). The improvement of mean LVIDd and LVIDs is statistically significant ($p<0.001$) and ($p<0.05$) respectively. But improvement of LVEF is not statistically significant ($p>0.05$).

Similarly in group 2 patients preoperative LVIDd, LVIDs and LVEF is 67.06 ± 3.67 mm, 59.1 ± 4.35 mm and 29.26 ± 4.25 (%) respectively. Postoperatively at 3 months follow up of this group the LVIDd, LVIDs and LVEF is changed to 57.56 ± 4.96 mm, 48.3 ± 5.53 mm and 38.93 ± 6.03 (%) respectively. The improvement of mean LVIDd and LVIDs is statistically significant ($p<0.001$) and ($p<0.05$) respectively. And the improvement of LVEF is also statistically significant ($p<0.001$) [12].

These findings are mostly consistent with the findings of other studies conducted by Trachiotis et al. and Lslamoglu et al. [13,20].

Postoperative ICU stay was measured in hours. The mean ± SD ICU stay for group 1 patients was 30.85 ± 7.44 hrs and for group 2 patients it was 32.36 ± 7.31 hrs, comparison of this findings was statistically significant ($p<0.001$). But comparison of duration of mechanical ventilation and total hospital stay between these two groups were not statistically significant.

The mortality was found in only in group 1 patients which was 2 in number. No mortality in another group. Morbidity was observed in prolonged ventilation in group 2. And equal number of case found in wound infection in each group. These above findings were consistent with studies conducted by Ascione et al. and Lslamoglu et al. [14-23].

Conclusion

In this series of patients with left ventricular dysfunction, off pump CABG was carried out with good early outcome with low mortality and morbidity and significant improvement in postoperative left ventricular function.

Post-operative morbidity like arrhythmia, neurological manifestation, renal failure, and reoperation did not take place, but only a single case of wound infection was found in each group. Mortality was encountered in normal ejection fraction group. No mortality was found in group 2. It can be concluded that off pump coronary artery bypass grafting can be safely performed to the patients with normal and poor left ventricular ejection. However poor ejection fraction patients show somewhat better result regarding mortality and morbidity. From this study, it can be concluded that off pump coronary artery bypass grafting can be performed safely and effectively for <35% ejection fraction patients which helps to improve patients' quality of life in and echocardiographic findings of left ventricular status.

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