Off-pump versus on-pump coronary artery by-pass surgery in patient with left main coronary artery disease.

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Abstract

Introduction: Coronary artery bypass surgery both conventional method (Conventional Coronary Artery Bypass surgery-CCAB) and off-pump method (Off-pump Coronary Artery Bypass Surgery-OPCAB) are frequently performed operation especially in our National Institute of Cardiovascular Disease and Hospital. Surgical attempts at increasing blood flow to the ischemic myocardium originated a century ago when Alexis Carrel anastomosed a carotid artery segment between the descending aorta and the left coronary artery.

Objective: To evaluate the safety of off-pump coronary artery bypass grafting in patient with left main coronary artery disease.

Patients and Methods: The study was conducted in the department of Cardiovascular Surgery, National Institute of Cardiovascular Disease (NICVD), Dhaka, Bangladesh. A Prospective Non-randomized clinical study From January 2006 to November 2007. Study population the patients with ischemic heart disease with left main coronary artery disease who underwent off pump and on pump CABG in NICVD. Non probability sampling technique. Total Sample Size number of selected patients was sixty. Thirty patients in each group.

Results: This study was performed to reiterate the same inference that OPCAB technique is safe and effective in our country context to treat surgically in patients with left main coronary artery disease. This study was performed in NICVD, Dhaka, Bangladesh which included 60 patients of coronary artery disease with left main stem stenosis. In group I age range from 40 to 70 years with a mean ± SD of 51.5 ± 7.3 years. Total operation time in group I median value is 137.1 ± 30.7 and in group II 241.0 ± 21.6, in chi square test P value was found statistically significant (p<.05) means less time was taken in off pump group to complete entire operation. The median value of total number of graft given in group I is 2.6±0.9 and 3.3±0.5 in group II. Unpaired t test is performed for LVIDd, LVIds, EF value and Chi square test is performed for wall motion abnormality value. No statistically significant(p>.#5) difference is found among two groups in successive three months which means either off pump or on pump technique of CABG do not cause any effect on LVIDd, LVIDs, EF and wall motion abnormality change post operatively in CABG patients.

Conclusion: In our institution more than a decade has almost over since the start of OPCAB surgery with gradual success and integrity. However development of new technology and strategy for off pump bypass surgery eliminated few obstacles in the pathway of progress.

Keywords: CCAB, OPCAB, Risk factors, Off pump CABG, On pump CABG.

Introduction

Coronary artery bypass surgery both conventional method (Conventional Coronary Artery Bypass surgery-CCAB) and off-pump method (Off-pump Coronary Artery Bypass Surgery-OPCAB) are frequently performed operation especially in our National Institute of Cardiovascular Disease and Hospital. So far there are several other modern techniques

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regarding coronary artery bypass surgery are emerging throughout the world, our aim is to practice those side by side with the developed world even within our limited resources and keep ourselves up to date. We should always consider the greater benefit of our patients in respect of economy, time and quick post-operative recovery. Surgical revascularization for atherosclerotic heart disease is one of the great success stories in medicine. Relief of angina after revascularization, improvement in exercise tolerance, and the realization of survival benefit have attended the operation since the early stages of development. The evolution of coronary surgery is a story of focused thought, dedication, courage, collaboration and serendipity [1]. Coronary Artery Bypass Graft (CABG) surgery is well-established treatment modalities in patients with Coronary Artery Diseases (CAD) refractory to medical therapy or when intervention cardiologic procedures (PTCI) are not feasible [2]. Surgical attempts at increasing blood flow to the ischemic myocardium originated a century ago when Alexis Carrel anastomosed a carotid artery segment between the descending aorta and the left coronary artery. Three decades later, Arthur Vineberg started implanting the left internal thoracic artery into the anterior myocardial territory of patients with CAD in order to increase arterial inflow and relieve angina with some experiencing prolonged symptomatic improvement [3]. Coronary surgery moved into modern era in the 1950s. It is not entirely clear to whom credit should be given for the first coronary bypass. The first direct surgical approach to the coronary circulation was likely performed by William Mustard in 1953 in Toronto, who used a carotid to coronary bypass though the patient did not survive the operation [1]. The first reported successful CABG operation took place in 1964 in Leningrad, where Kolesov grafted LIMA to the left anterior descending artery without CBP. Depending on referral patterns, approximately 40-50% of patients who undergo coronary angiography have significant involvement of all three coronary arteries i.e. RCA, LAD and LCX, however 5-10% have stenosis of the left main stem. Approximately 5% of patients have diffuse disease of one or more major coronary branches [3]. Incidence of coronary artery disease is increased in Bangladesh was reported as 11% which was third position after Rheumatic and Heart disease. The ratio of coronary artery disease between male and female is 11:1 [4,5]. 'Another survey in Bangladesh Hossain found that out of 500 population, 4.6% had cardiovascular problem also carried out a survey among 7062 urban and rural people and observed that 2.92% suffered from some sort of heart disease' (Anayetullah & Barman 1991). Recently, there has been a revival of interest in performing CABG on the beating heart. Early results suggest better preservation of left ventricular contraction and mitochondrial function than when cardioplegic arrest is used. In a report from the Cleveland clinics in 1982, left main disease as an independent risk factor for operative mortality after CABG. In agreement with this report, several centers have recorded early survival in patients with LMCA stenosis compared with that in other patients undergoing CABG [6]. The prognostic indications for coronary artery bypass surgery in the present of critical left main stem stenosis are well-established. Medical therapy alone confers a poor survival advantage when compared to surgical revascularization, and percutaneous revascularization techniques for critical left main stem stenosis are at present generally consider unsafe. Recently, there has been renewed interest in potential benefits of off-pump coronary artery bypass surgery with encouraging reports of clinical, angiographic and economic superiority when compared to conventional coronary artery bypass surgery using cardiopulmonary bypass. Even more encouraging are the findings that high risks and elderly patients benefit most from heart surgery in which cardiopulmonary bypass is not used [7]. Significant narrowing of the left main coronary artery puts the patients at high risk, since occlusion of this vessel if unprotected by collateral flow or a patent bypass graft either the left anterior descending or circumflex artery, compromises flow to approximately 75% of the left ventricle. Some similar considerations in terms of ischemic burden apply to left main equivalent disease, which is defined as severe (>70%) proximal LAD and proximal LCX disease. However, the left ventricular mass jeopardized by occlusion of a single vessel in such patients is far less than with a true left main lesion [8]. In Bangladesh, a study of left main coronary artery disease was conducted by [9], shows the rationale and effectiveness of off pump CAB surgery over conventional methods and found promising results of former technique. So, this study is to reiterate the further effectiveness and safety of off pump method side by side with the CCABG surgery in our country context.

Review of Literature

Historically Arthur Vineberg in 1946 started implanting LIMA to anterior myocardial territory with coronary artery disease in order to increase arterial inflow and relieve angina. Then Alexis Carrel anastomosed a carotid artery segment between the descending aorta and the left coronary artery in dog. Surgery on the coronary arteries was introduced clinically in 1958 by William Longmire, who reported on the use of endarterectomy in five patients operated without cardiopulmonary bypass. The first reported successful CABG operation took place in 1964 in Leningrand, where Kolesov grafted LIMA to the left anterior descending artery without CPB. The world's first CABG program started 3 years later in Cleveland, as Favaloro began to routinely use reversed saphenous veins for aorto-coronary grafting. The CABG procedure was then rapidly adopted and developed world wide. [3]. First clinical description of the left main coronary artery was made by Herrick in 1912, numerous studies have been shown that stenosis of the left main coronary artery is of critical prognostic importance. Observational studies of medically and surgically treated patients with LMCD support widely accepted belief that in general, coronary artery bypass graft surgery lessens symptoms and significantly prolongs survival [10,11], studied eight hundred twenty three patient of bypass grafting for left main coronary artery. One hundred patients were re-vascularized without the use of cardiopulmonary bypass and compared with a 723 patients who underwent grafting with the aid of cardiopulmonary bypass. There was one death in off pump grafting as compared with a 30 day mortality of 4.7% in the on-pump group. In

their study patients re-vascularized without cardiopulmonary bypass were significantly less likely to require post-operative inotropic support and transfusion, and it also revealed that cardiopulmonary bypass was an independent risk factor for mortality and came to a conclusion that coronary artery bypass grafting using off-pump techniques is safe and effective in left main coronary artery disease [11]. However it was already proved by the several studies that excessive peri-operative bleeding continues to complicate cardiopulmonary bypass. Management of the abnormal bleeding often requires re-operation and frequently is associated with excessive, and sometimes inappropriate, blood product administration that occasionally exceeds the available supply. [12]. In one study a total of 1988 of 10,647 patients who underwent a first isolated CABG at the Karolinska Hospital in Stockholm, Sweden, during 1970-1999 had significant left main coronary artery stenosis. The proportion of patients with LMCA stenosis of all CABG patients increased from 7% during the 1970s to 26% in 1999. During 1970-1984 early mortality was 5.8% in patients with LMCA stenosis compared with 1.5% in patients without LMCA stenosis the corresponding rates during 1995-1999 were 2.0% *versus* 2.2%. Five-year survival in males was 88% after operations performed during 1994-1999 compared with 82% after CABG performed during 1970-1984. Five-year mortality, exclusive of early deaths, during 1970-1984 was higher in patients with LMCA stenosis than in those without. During 1970-1999 there was a decrease of early and five-year mortality in patients with LMCA stenosis after CABG despite increase of patient age and risk factors. The continuous decline of mortality during three decades most likely reflects improvement of the peri- and postoperative management of patients undergoing CABG during this period. [6]. In another study shows that 1,197 consecutive patients with critical left main stem stenosis (>50%) underwent coronary surgery. Two hundred and fifty-nine (21.6%) of these patients had off-pump coronary surgery, while 938 (78.4%) received on-pump coronary surgery. The requirement for inotropic support or a prolonged length of stay was significantly reduced after receiving off-pump coronary surgery. There was a trend to suggest that off-pump patients had a lower incidence of stroke and chest infection. The adjusted freedom from death in off-pump patients at 2 years was 94.6% compared with 93.6% for on-pump patients [13]. In significant left main coronary artery stenosis coronary bypass on the beating heart is a safe and effective alternative to the conventional method with the same or better early results [14].

Aims and Objectives

General objective

To evaluate the safety of off-pump coronary artery bypass grafting in patient with left main coronary artery disease.

Specific objective

To compare short term outcome between off- pump and on pump coronary artery bypass grafting in left main coronary artery.

Patients and methods

Place of study: The study was conducted in the department of Cardiovascular Surgery, National Institute of Cardiovascular Disease (NICVD), Dhaka, Bangladesh.

Study design: Prospective Non-randomized clinical study.

Period of study: From January 2006 to November 2007.

Ethical consideration: Prior to the study research protocol was approved by the institutional protocol committee and patients had explained about the purpose and importance of the study. Informed and written consent was taken from the participants.

Study Population and sampling

Study population: Study population the patients with ischemic heart disease with left main coronary artery disease who underwent off pump and on pump CABG in NICVD.

Sampling techniques: Non probability sampling technique.

Sample size: Total number of selected patients was sixty. Thirty patients in each group.

Population group: The total number of study population was divided into two groups based on the procedure of surgery. Each group has thirty populations.

i) Group I: CABG under cardiopulmonary bypass (On-Pump).

ii) Group II: CABG without cardiopulmonary bypass (Off-Pump).

Selection criteria of the patients

a) Inclusion criteria: Patients with LEFT MAIN Coronary Artery Disease undergoing CABG both off pump and on pump.

b) Exclusion criteria:

1. Patient having coronary artery disease other than left main disease.
2. Patients having EF < 35%.
3. Patients with unstable angina, MI, and other significant ischemia events within 1 1/2 month.
4. Concomitant procedures including valvular operations.
5. Has history of renal, respiratory or hepatic failure, stroke/ TIA or coagulopathy.

Patient's demographic characteristics

1. Age
2. Sex
3. Pre-operative Factors: In preoperative factor thorough history was taken to find out any Risk Factors like HTN, DM, Hyperlipidaemia, COPD, PVD, Smoking present or not.

Patients clinical characteristics

1. Chest pain
2. NYHA functional class I, II, III and IV

Echocardiographic examination

Two dimensional Echo was performed pre-operatively to see-LVIDd in millimeter, LVIDs in millimeter, EF in percentage and Wall motion abnormality.

Coronary angiogram

Left heart catheterization with coronary angiogram, aortogram and left ventriculography was done in all patients to see the:-

LMCA, LAD LCX, RCA, PDA, Ejection Fraction (EF) %, Graftable vessels (A 50% diameter loss is considered significant in left main coronary artery disease.)

Measures of variables

1. Intraoperative Variables:
2. Extra corporeal circulation time if applicable
3. Aortic cross clamp time if applicable
4. Number of grafts
5. Total operation time in minute

Technical aspects: Surgical Procedures: Most of the patients operated for coronary artery disease have two vessel and extensive three vessel disease, often with important stenosis in four arteries. Surgical treatment of atherosclerotic coronary artery disease has evolved from the treatment of primarily patients with stable coronary syndromes undergoing elective operation to treatment of more heterogeneous groups of patients with various clinical syndromes. At presents CABG with the use of total cardiopulmonary bypass through a full median sternotomy as well as without CPB and mid-sternotomy used here in the study groups. [15].

Preoperative preparation: Patients first prepared preoperatively and proper assessment done for fitness of surgery. Many patients come to CABG taking p-blockers or calcium channel blocking agents, angiotensin converting enzyme inhibitor, digitalis, antiarrhythmic medication and platelet aggregating inhibitor drugs. They were advised in most circumstances to continue P-blockers and calcium channel blocking agents. As well as angiotensin converting enzyme inhibitor up to the time of operation. Digitalis preparation as well as aspirin and clopidegrol were discontinued according to protocol.

Operating room preparation: Patients were taken to operating room after proper counseling and taking written informed consent. After induction and muscle relaxant given, skin was scrubbed and proper draping done before giving median sternotomy incision. Patients were selected preoperatively whether they would go for off pump CABG or on pomp method. [15].

Maintaining haemodynamic stability during OPCAB surgery: Hemodynamic stability during manipulation of the heart was preserved by several maneuvers. These include the patients head down position, which increases preload by redistributing blood volume, rotating operative table. A few patient required temporary pacing support for prolong bradycardia, or inotrop support for low blood pressure and extra volume give intraoperatively for maintaining haemodynamic stability. Myocardial protection was maintained by using intracoronary shunts [15].

Follow up: All patients had been followed up after one moth of discharge from hospital and subsequent two months in every one moth interval. In follow up period thorough clinical assessment, and Echocardiographic findings were checked to evaluate patient's post-operative cardiac function and surgical outcomes.

Data collection: All relevant data for each participant where collected on redesigned Questionnaire (Appendix B)

Statistical analysis: Data were collected by personal interview and hospital records. The collected data were compiled and a data file was constructed. This data were analyzed by unpaired student t test and Chi square test (yf) using SPSS (Statistical Program for Social Science). The analyzed data were presented by crossing of variables in the form of tables, and graph etc. A p value equal to or less than 0.05 was considered significant.

Observation and Results

Among 60 patients the mean age group I was 51.5 ± 7.3 and that of group II patient was 54.7 ± 6 years. The mean age difference was not statistically significant ($p>0.05$) in unpaired t test

Group I: Off-pump CABG in left main coronary artery Disease. Group II: On-pump CABG in left main coronary artery Disease, p value reached from unpaired t test $p=0.063(p>0.05)$. Unpaired t test performed for statistical analysis. Among 60 patients 52 patients were male and 8 patients were female the percentages were 83.3% and 16.7% in group I and 90.0% and 10.0% in group II respectively. Male female ratio is 6.5:1. The male female differences was not statistically significant ($p>0.05$) in chi square test (Table 1).

Chi value =0.58, DF=l, p=0.353 Male female ratios: 6.5:1 Group I: Off-pump CABG in left main coronary artery Disease. Group II: On-pump CABG in left main coronary artery Disease, p value reached from chi square test $p=0.353(p>0.05)$. Chi square test is performed for statistical analysis. This table reveal that smoking diabetic's mellitus and hypertension were highest among the risk factors in both group (60%, 60% and 40% among group I, 46.7%, 80.0% and 60% among group II respectively). Smoking Diabetics mellitus was followed by Hypertension, Hyperlipidaemia, and PVD. No COPD patient was found among groups. No statistically significant difference of risk factors for coronary artery disease was observed between two groups of patients ($p>0.05$) (Figure 1). Table 2 depicts the NYHA functional class in the study groups. The figure shows that the preoperative NYHA functional class I, II and III occupied 13.3%, 60%, 26% respectively in group I. In group II preoperative NYHA functional class I, II and III occupied 0.0%, 53.3% and 46.7% respectively and the difference was not shown statistically. And there was no class IV group was found between two groups. The table also depicts pre-operative chest pain among patients, which is 10 (33.3%) In Group I and 14(46.7%) in group II respectively.

Table 1. *Age distribution of the patients between the groups.*

Age in years	Group I N	%	Group II N	%	P Value
45-50	20	66.7	10	33.3	
51-55	4	13.3	12	40.0	
56-60	2	6.7	0	0.0	
61-65	0	0.0	8	26.7	
>65	4	13.3	0	0.0	
Mean age (yrs)	51.5	±7.3	54.7	±6.0	0.063
t value = 1.89, df^58, p=0.063					

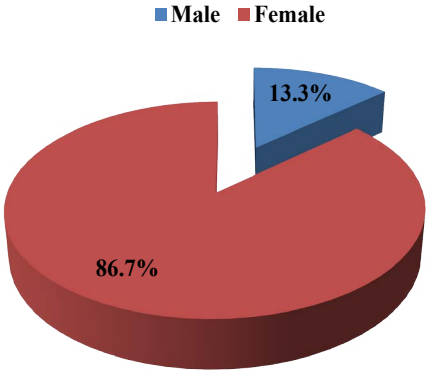

Figure 1. *Distribution of Sex.*

Table 2. *Preoperative NYHA functional Class & Chest pain.*

NYHA Class	Group I N	%	Group II N	%
Class I	4	13.3	0	0.0
Class II	18	60.0	16	53.3
Class III	8	26.7	14	46.7
Chest pain	10	33.3	14	46.7

Group I: Off-pump CABG in left main coronary artery Disease. Group II: On-pump CABG in left main coronary artery Disease. Following tables depicts the value of pre-operative echocardiogram in the two study group. The table shows LVIDd in group I median value is 47.5 ± 1.1 and in group II 47.1 ± 1.7, t test were performed and p value found statistically not significant (p>0.05). Median value of LVIDs in group I is 30.3 ± 1.4 and in group II 31.1 ± 1.8, unpaired t test was done in between group and p value found statistically not significant (p>0.05). In case of LVEF median value was found in group I 59±2 and in group II 58±2, students t test were performed in between group, which was statistically not significant (p>0.05). Wall motion abnormality in echocardiography revealed in 6(20%) patients in group I and 8(26.7%) patient in group II, chi square test was performed in between groups and p>0.05 which is not significant (Table 3).

Group I: Off Pump CABG with Left Main Coronary Artery Disease. Group II: CCABG with Left Main Coronary. Artery Disease. Pre-operatively angiogram was done by referring cardiologist before admission into the Surgery ward. The data was collected from the report and viewing the angiogram recorded in the CD. As the patients who have left main coronary artery disease was included in this study all patients in Group I and II were significant left main coronary artery disease along with other arterial system involvement. Out of them 18 (60%) of them had LAD main trunk involvement, 11 (36.7%) Dl branch disease, 6 (20%) D2 disease, 7 (23.3%) were LCX main trunk involvement, 6 (20%) OM1 disease, 77 (23.3%) OM2 disease, 5 (16.7%) were RCA main trunk involvement, 4 (13.3%) PDA involvement in group I Patient. On the other hand them 17 (56.7%) of them had LAD main trunk involvement, 9 (30%) Dl branch disease, 5 (16.7%) D2 disease, 8 (40%) were LCX main trunk involvement, 6 (20%) OM1 disease, 5 (16.7%) OM2 disease, 6 (20%) were RCA main trunk involvement, 3 (10.0%) PDA involvement in group II Patient. After Chi square test performed the values were found statistically not Significant (p>0.05) between groups (Table 4).

Group I: Off Pump CABG in Left Main Coronary Artery Disease. Group II: On Pump CABG in Left Main. Coronary Artery Disease. Chi Square test performed with Yates correction and Fisher's exact test. Ns not significant – Significant. Chi square test and df degree of freedom. Following shows the total cross clamp and ECC time in group II conventional -CABG patient. The median value of XCT is 90.0 ± 10.1 min and ECCT is 144.0 ± 12.8 min (Table 5).

Group II: On-pump CABG. Following table is a predictor of operation time took and total numbers of graft were able to give in two groups of patients during operation. The observed value was calculated and tested by the unpaired t test and found significant differences between groups. Total operation time in group I median value is 137.1 ± 30.7 and in group II

Table 3. *Pre-operative Echo Cardiogram.*

Variables	Group I N	Group II	t/chi Value	df	P Value
LVIDd (mm)	47.5±1.1	47.1±1.7	1.08	58	[a]0.319[ns]
LIVDs (mm)	30.3±1.4	31.1±1.8	1.92	58	[a]0.0.61[ns]
LVEF (%)	59±2	58±2	1.94	58	[a]0.058[ns]
Wall motion abnormality	6 (20.0)	8 (26.7)	0.37	1	[a]0.548[ns]
aUnpaired t-test, bChi square test, ns-not significant, s-significant					

Table 4. *Coronary Angiogram.*

Name of vessel involved	Group I N	%	Group II N	%	x^2 value	df	P Value
Left Main CAD	30	100	30	100	-	-	-
LAD Main trunk	18	60.0	17	56.7	.07	1	0.793[ns]
D1	9	30.0	11	36.7	.3	1	.583[ns]
D2	5	16.7	6	20.0	.11	1	.738[ns]
LCX main trunk	8	40.0	7	23.3	.09	1	0.765[ns]
OM1	6	20.0	6	20.0	-	-	-
OM2	5	16.7	7	23.3	.42	1	.518[ns]
RCA	6	20.0	5	16.7	0.11	1	0.738[ns]
PDA	4	13.3	3	10.0	.16	1	.500[ns]

Table 5. *Cross clamp time and ECCT in group II.*

Intra operative variables	Group II (Mean±SD)
Cross clamp time (min)	90.0±10.1
ECCT (min)	144.0±12.8

241.0 ± 21.6, in chi square test P value was found statistically significant (p<0.05) means less time was taken in off pump group to complete entire operation. The median value of total number of graft given in group I is 2.6 ± 0.9 and 3.3 ± 0.5 in group II, in unpaired t test the p value is statistically significant (p<0.05) in between group which means complete revascularization can be perform in two groups but more graft can be given in conventional method (Table 6).

Group I: Off Pump CABG in Left Main Coronary Artery Disease. Group II: On Pump CABG In Left Main. Coronary Artery Disease. Unpaired t test performed. S=Significance; P-value<0.05 was considered significant. (Student's t-test). Following table shows that median value of ventilation time in hour in group I is 10.0 ± 5.7 hr. and in group II is 17.2±2.6 hr. in unpaired t test revealed that this value is statistically significant (p<0.05) in two group which means off pump patients' needs less mechanical ventilation than on-pump conventional CABG. Where as in case of ICU stay median value in hour in group I patient is 32.4 ±7.0 hr and in group II is 51.2 ± 5.5 hr and unpaired t test signified that this value is statistically significant (p<0.05) in groups of off pump and conventional CABG patients with left main coronary artery disease, which means off pump patients require less ICU stay than conventional patient (Table 7).

Group I: Off Pump CABG in Left Main Coronary Artery Disease. Group II: On Pump CABG In Left Main. Coronary Artery Disease. S=Significance; P-value<0.05 was considered significant. (Student's t-test). Following table predicts the percentage and number of both groups of patients who require postoperative reintubation after successful extubation in the ICU when patient met criteria for extubation and successfully weaned from mechanical ventilation. Total number of patient in group I who required re-intubation is 1(3.3%) and not required 29(97.7%) and in group II reintubation required in 0(0.00%) and not required in 30(100%). These values are not shown statistically (Table 8).

Group I: Off Pump CABG in Left Main Coronary Artery Disease. Group II on Pump CABG in Left Main. Coronary Artery Disease. Following table predicts the value of total amount of blood loss in two groups. Which shows that there is statistically significant(p<.05) difference after performing unpaired t test for the values, which means off pump group of CABG require less blood transfusion post operatively than On pump group (Table 9).

Group I: Off Pump CABG in Left Main Coronary Artery Disease. Group II: On Pump CABG In Left Main. Coronary Artery Disease. Unpaired t test performed. df degree of freedom. P<0.05 considered as statistically significant. Among 60 patients in the study group in group I out of 30 patients none required (0.0%) any reoperation due post-operative blood loss in the ICU. In the Group II 2 patient out of 30 patient required reoperation due to excessive bleeding (6.7%) and rest of the patient 28(93.3%) did not require reoperation. These values are not shown statistically (Table 10).

Group I: Off Pump CABG in Left Main Coronary Artery Disease. Group II: On Pump CABG In Left Main. Coronary Artery Disease. Unpaired t test performed. df degree of freedom. P<0.05 considered as statistically significant. The following table shows the value of inotropic support between groups of post-operative CABG patient. The average value of inotrop requirement in group I is 21.9±11.3 hr and in group II 90.0 ± 26.3 hr. After testing these values by unpaired t test

Table 6. *Intra operative observation of total operation time and graft number between groups.*

Intra operative variables	Group I (Mean±SD)	Group II (Mean±SD)	t value	df	P-value
Operation time (min)	137.1±30.7	241.0±21.6	15.12	58	0.001[s]
No. of graft	2.6±0.9	3.3±0.5	3.39	58	0.002[s]

Table 7. *Post-operative observation of ventilation time and ICU stay in hour between groups.*

Post-operative variables	Group I (Mean±SD)	Group II (Mean±SD)	t value	df	P-value
Ventilation time (hour)	10.0±5.7	17.2±2.6	6.32	58	0.001[s]
ICU stay (hours)	32.4±7.0	51.2±5.5	2.85	58	0.006[s]

Table 8. *Status of reintubation between groups.*

Age in years	Group I N	%	Group II N	%
Required	1	3.3	0	0.0
Nor required	29	97.7	30	100

Table 9. *Total blood loss between groups.*

	Group I Mean±SD (range)	Group II Mean±SD (range)	t value	df	P-value
Total blood	446.7±197.4	1199.3±218.0	13.91	58	0.001[s]
loss (ml)	(220,700)	(900,1600)			

Table 10. *Reoperation requirement between groups.*

Reoperation	Group I N	%	Group II N	%
Required	0	0.0	2	6.7
Nor required	30	100	28	93.3

a significant difference($p<0.05$) was found in two groups of CABG patients, which revealed that off pump CABG patients with left main coronary artery disease require less inotropic support than On pump conventional CABG patient (Table 11).

Group I: Off Pump CABG in Left Main Coronary Artery Disease. Group II: On Pump CABG in Left Main. Coronary Artery Disease. Unpaired t test. df degree of freedom. $P<0.05$ considered as statistically significant. Following tables depicts the occurrence of low output syndrome after off-pump and on-pump CABG. It shows that there were 8 patients (26.7%) in group I and 26(86.7%) in group II suffered post-operative low output syndrome after post-operative period in ICU. When Chi square test is performed it reveals that there is statistically significant difference ($P<0.05$) between groups which means off pump group suffered less low output syndrome than on pump group (Table 12).

Group I: Off Pump CABG in Left Main Coronary Artery Disease. Group II: On Pump CABG in Left Main. Coronary Artery Disease. Chi Square test performed. df degree of freedom. $P<0.05$ considered as statistically significant. Following table depicts the post-operative length of hospital stay between groups. The mean value in group I is 8.3±3.4 days and in group II is 13.6 ± 4.2 days. When unpaired t test is performed, it reveals that there is statistically significant ($P<0.05$) difference among groups in respect to post-operative hospital stay which means off pump group needs less post-operative hospital stay than on pump CABG groups (Table 13).

Group I: Off Pump CABG in Left Main Coronary Artery Disease. Group II: On Pump CABG in Left Main. Coronary Artery Disease. Unpaired t test performed. DF degree of freedom. $P< 0.05$ considered as statistically significant. Following table shows the post-operative NYHA changes among CABG patients between two groups. When chi square test is performed there is no statistically significant ($p>.05$) changes between groups observed in 1st month, 2nd month and third month respectively (Table 14).

Group I: Off Pump CABG in Left Main Coronary Artery Disease. Group II on Pump CABG in Left Main. Coronary Artery Disease. Chi Square test performed. ns not significant. S significant, $p>0.05$ (Table 15).

Group I: Off Pump CABG in Left Main Coronary Artery Disease. Group II: On Pump CABG in Left Main Coronary Artery Disease. Chi Square test performed. Unpaired t test performed. df degree of freedom, Chi square test, $p>0.05$. Following table depicts the post-operative echocardiographic changes in between two groups of CABG patients in three successive months. These are LVIDd, LVIDs, EF and wall motion abnormality. Unpaired t test is performed for LVIDd, LVIds, EF value and Chi square test is performed for wall motion abnormality value. No statistically significant($p>.#5$) difference is found among two groups in successive three months which means either off pump or on pump technique of CABG do not cause any effect on LVIDd, LVIDs, EF and wall motion abnormality change post operatively in CABG patients (Table 16).

Table 11: *BT requirement between groups.*

	Group I (n=6) Mean±SD	Group II (n=30) Mean±SD	t value	df	P-value
BT requirement (Unit)	1.3±0.5	2.7±0.7	10.9	58	0.001[s]

Table 12. *Inotrop support required between groups.*

	Group I (n=30) Mean±SD (range)	Group II (n=24) Mean±SD (range)	t value	df	P-value
Inotrop support (hours)	21.9±11.3 (25,32)	90.0±26.3 (36,135)	13.02	58	0.001[s]

Table 13. *Low output syndrome between groups.*

LOS	Group I n	%	Group II N	%	x^2 value	df	P Value
Yes	8	26.7	26	86.7	21.99	1	0.001
No	22	73.3	4	13.3			

Table 14. *Hospital stay between groups.*

	Group I Mean±SD (range)	Group II Mean±SD (range)	t value	df	P-value
Hospital stay (days)	8.3±3.4 (5,13)	13.6±4.2 (9,18)	5.372	58	0.001[s]

Table 15. *Change in NYHA functional Class post operatively.*

NYHA Class	Group I (n=28) n	%	Group II (n=29) n	%	x^2 value	df	P Value
1 month							
Class I	18	64.0	13	46.4			
Class II	12	40.0	17	56.6	1.67	1	0.196[ns]
2 months							
Class I	18	64.0	14	46.7			
Class II	12	40.0	16	53.3	1.07	1	0.300[ns]
3 months							
Class I	19	63.3	14	46.7			
Class II	11	36.7	16	53.3	1.68	1	0.194[ns]

Table 16. *Changes in Echocardigraphic variable between groups.*

Variables	Group I	Group II	t/chi value	df	P-value
1 month					
LVIDd (mm)	47.5±1.1	47.1±1.7	1.08	58	[a]0.319[ns]
LIVDs (mm)	30.3±1.4	31.1±1.8	1.92	58	[a]0.061[ns]
LVEF (%)	59±2	58±2	1.94	58	[a]0.058[s]
Wall motion abnormality	2 (6.7%)	3 (10.2%)	0.22	1	[a]0.500[ns]
2 month					[a]0.379[ns]
LVIDd (mm)	47.2±1.2	46.9±1.4	0.89	58	[a]0.080[ns]
LIVDs (mm)	30.1±1.3	30.8±1.7	1.79	58	[a]0.058[ns]
LVEF (%)	60±2	59±2	1.94	58	[a]0.500[ns]
Wall motion abnormality	1 (3.3%)	2 (6.7%)	0.35	1	
3 months					
LVIDd (mm)	46.9±1.1	46.6±1.3	0.96	58	[a]0.341[ns]
LIVDs (mm)	30.0±1.4	30.5±1.6	1.29	58	[a]0.198[ns]
LVEF (%)	62±2	61±2	1.94	58	[a]0.058[ns]
Wall motion abnormality	1 (3.3%)	1 (3.3%)	-	-	-

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Discussion

Since the beginning of Coronary artery bypass surgery in our National Institute of Cardiovascular Disease and Hospital, Dhaka, Bangladesh in 1979 our competent professors and surgeons had been engaged in performing the pivotal rule in the field of on pump coronary artery bypass surgery in this country. They however gradually acquired the confidence to start off pump coronary artery bypass surgery in the year 1997 with tremendous success and achievement in the era of new technology. With further development of new devices like suction stabilizer and their availability in our country they conquered the enhanced skill of performing off pump CABG in our institute. In all over the world surgeon and cardiologist were bewared about the risk of managing coronary artery disease with left main stem stenosis, because it possess additive risk for the patients performing any kind of intervention like CABG or PCI. [6]. But several studies done by Louagie et al. and Cartier et al. [13] revealed that Off-pump CABG in patients with LMS disease, this technique is feasible and safe compared to conventional on-pump CABG. Another study conducted by discovered that myocardial revascularization in the presence of critical left main stenosis can be safely and effectively achieved using OPCAB technique. This study was performed to reiterate the same inference that OPCAB technique is safe and effective in our country context to treat surgically in patients with left main coronary artery disease. This study was performed in NICVD, Dhaka, Bangladesh which included 60 patients of coronary artery disease with left main stem stenosis. In group I age range from 40 to 70 years with a mean ± SD of 51.5 ± 7.3 years. The majority of the patients are in age group 45-50 years. In group II the age ranged from 40 to 70 years with a mean ± SD of 54.7 ± 6 years, majority of the patients are in 51-55 years. There is no significance difference in age among groups. Similar type several studies done by [13,14] there was no significant different between two groups. Regarding distribution of sex among patients, there were 25 male and 5 female in group I and 27 male and 3 female in group II. Chi square value reveals that there is no significance difference in between male and female. But female sex may be an independent predictor of early mortality and morbidity in the group of patients undergoing CABG surgery due to left main stenosis. Further study is needed to prove this [16]. Risk factor considering in both group I and group II patients are smoking, Diabetes Mellitus, Hypertension, hyperlipidaemia, COPD, PVD. There were 18 patients (60%) who had history of smoking, 18 patients were DM (60%), 12 were Hypertensive, 4(13.3%) were hyperlipidaemic, none were COPD and 1 patient found as PVD in group I, in group II and 14 (46.7%) who had history of smoking, 26(80.0%) patients were DM, 18(60.0%) were Hypertensive, 5(16.7%) were hyperlipidaemic, none were COPD and 2(13.3%) concomitant PVD patients. However it is quite possible that sometimes left main coronary artery disease present with concomitant carotid artery and lower limb artery stenosis. In one study conducted by [17] showed that 17(28%) patients with LMS had extracranial carotid artery stenosis which causes post-operative stoke, embolization ultimately increases post-operative morbidity. But here in our study only one patient was found with concomitant left carotid artery stenosis in group II and underwent carotid endarterectomy along with CABG and two patients out of which 1 in group I and 1 in group II found concomitant external iliac and common femoral artery stenosis. Pre-operative angiographic data was evaluated among two groups of patients. All patients had significant left main coronary artery disease. Significant means >50% stenosis in the luman. And all patients had multi vessel disease along with left main disease. Out of them LAD main trunk involvement in group I were 18 and in group II 17 patients, the branches of LAD Dl and D2 respectively also involves in two groups, LCX main trunk involvement were in group I and II 8 and 7 patients respectively and its branches OM1 and OM2 also involved, RCA involvement in two groups were 6 and 5 patients and PDA involvement were 4 and 3 patients respectively in between two groups. The involvements of disease in the coronary arteries were not statistically significant in both groups. Most of the stenosis vessels were graftable, but few had diffuse disease without any scope of placement of a graft. In pre-operative echocardiogram study there is mean value of LVIDd in group I is 47.5 ± 1.1 mm and in group II 47.1 ± 1.7 mm, LVIDs in group I is 30.3 ± 1.4mm and in group II 31.1 ± 1.8mm, LVEF in group I 59 ± 2% and in group II 58 ± 2% respectively. There is no statistically significant difference between groups. Wall motion abnormality also predicted by the Echo which shows only 6(20%) of patients in group I and 8(26.7%) of patients in group II patients possess it which is also statistically not significant. In our study we did not include those patients whose preoperative EF< 35%. In two studies lower limit of EF was 40% [11] but several other study included even < 30% ejection fracton. [6,13,14,18,19]. In this study total cross clamp time and extracorporeal circulation time in on pump group was 90±10 min and 144 ± 12.8 min respectively. Total operation time and number of graft given has been calculated and compared between groups. The mean operation time in group I is 137 ± 30.7 min and in group II 241 ± 21.6. Which signifies this value between two group statistically, means off pump CABG in left main coronary artery disease less time consuming than its counterpart on-pump CABG. Several other studies also support this observation [7,11,14,20]. Number of graft was quiet less in case of OPCAB group i.e. mean graft number in group I is 2.6 ± 0.9 and in case of group II 3.3±.5, when unpaired t test is performed it reveals statistically significant difference between two group, which means in conventional CABG more graft can be given and a little bit good revascularization can be done. This is a drawback of OPCAB surgery. Several other study articles have the same observation result [11,13,14,20-23]. But some studies show different results in which number of graft was not significantly different in between two groups [9,19]. Total ventilation time and length of ICU stay were calculated in between two groups and statistical analysis was performed. The mean ventilation time in group I is 10.0 ± 5.7 hour and in group II is 17.2 ± 2.6 hour. There was statistically significant difference was found in two groups. Which means off pump group require less mechanical ventilation support than on pump group? Similar type of studies shows that ventilation time in OPCAB group is 315 ±

231min, 7.5 ± 4.3 hour, 8% and in On pump group is 565 ± 380 min, 8.6 ± 3.6 hour, 14% respectively [14,24,25]. On the other hand length of ICU stay in our study group I mean value is 32.4 ± 7 hour and in group II is 51.2 ± 5.5 hour. There is statistically significant difference among two groups which means off pump groups require less ICU stay than on pump group. If we go through several other studies we could predict the same results which strongly support our study. The length of ICU stay in these studies is in OPCAB group 5.31 ± 12.79 days, 7.6%, 6 days, 24 ± 10 hour and in On Pump group 6.57 ± 3.46 days, 9.5%, 7 days, 26 ± 9 hour respectively [14,13,25]. Post-operative reintubation may be need after cardiac surgery in the ICU if the patient is unable to perform adequate ventilation after extubation. There is only one patient in our study group I needed reintubation and no patients in group II required that. Post-operative blood loss is a dire consequence of coronary artery bypass surgery, especially in case of on-pump CABG. In our study there is mean blood loss in group I patients is 446.7 ± 197.4 ml and in group II 1199.3 ± 218.0 ml respectively. There is statistically significant difference in two groups, which means that post-operative blood loss through IT tube is less in off pump CABG patients than on pump group. Other studies reiterate the same observation. One study done by [26] out of 64 patients underwent OPCAB in left main coronary artery disease and IT tube blood loss only 356±254 ml which value is almost similar to our study value. In another study by [14] the mean value of blood loss in OPCAB group is 415 ± 231 and in on pump group is 589 ± 344 respectively, which is statistically significant value and supports our current study. Similar results were found in other studies [14,27]. As discussed by [12] in their article that cardiopulmonary bypass causes significant bleeding tendency both in peri and post operatively due to some mechanisms, which can be obviously avoided by the OPCAB technique. In this study post-operative low output syndrome also observed in some patients with CABG. In group I there is 8 patients (26.7%) suffered from LOS whereas in group II 26 (86.7%) suffered from mild to moderate LOS in the ICU. Off pump CABG patient less suffer from post-operative LOS then on pump patients. Similar study supports this observation also. [13,14,20]. Mean value of post-operative hospital stay in group I patient is 8.3 ± 3.4 days and in group II is 13 ± 4.2 days. It means OPCAB patients need less post-operative hospital stay than on pump group. In one study done by [20] found that mean value of post-operative hospital stay in OPCAB group with left main stenosis is 7.9 ± 5.46 and in On pump group is 8.3 ± 5.11 which is also statistically significant result and almost similar to our result. Some other study also reflects this study observation as well. [14,13,26-29]. Post-operative NYHA changes observed in two groups. The is no significant differences between groups, but it is obvious that either technique is effective in reduction of NYHA status among coronary artery disease patients.

Conclusion

In our institution more than a decade has almost over since the start of OPCAB surgery with gradual success and integrity. However development of new technology and strategy for off pump bypass surgery eliminated few obstacles in the pathway of progress. Moreover our surgeon's confidence and skilled manipulation enhance the tremendous success regarding off pump technique which superseded the conventional technique in every day practice. Most of the surgeons are now performing this technique with appreciable success and outcome. All this observation and their significance test depict the proof of safety of OPCAB over on pump surgery. I have tried my best to evaluate the data more cautiously and minutely to come up a conclusion whether we are able to perform OPCAB surgery in these high risk individual. But the observation was so precise that we could make an inference about the off pump coronary artery bypass surgery is the procedure of choice in patients with left main coronary artery disease due to its safety and effectiveness over conventional methods.

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