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ORIGINAL ARTICLE

Off-pump Versus On-pump CABG: In Hospital Clinical Outcome

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Abstract:

Throughout the world, as well as in Bangladesh, CABG operations are done in two procedures: conventional CABG (CCAB) and off-pump CABG (OPCAB). OPCAB surgery is being performed since 1997 in NICVD and then other cardiac centers in Bangladesh. But only one comparative study regarding clinical outcome between OPCAB and CCAB was performed in Bangladesh at NICVD, which was merely an initial experience of CABG on beating heart (Ahamed et al. 1988). So, a research work on this particular issue it strongly demanded to determine which technique we should adopt for better patient outcome .This is why we conducted a prospective observational study during the period of July/2014 to December/2016 to compare in-hospital clinical outcome of randomly selected patients divided into two groups: OPCAB and CCAB groups, each group having 60 patients with similar preoperative base line characteristics.

This study clearly demonstrated that OPCAB procedure is safe and is associated with some better short term clinical outcome in respect to CCAB procedure.

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Definitions:

(i) Off-pump CABG (OPCAB): Coronary artery bypass graft (CABG) done on beating heart without cardiopulmonary bypass (CPB).

(ii) On-pump CABG i.e. conventional CABG (CCABG): Coronary artery bypass graft (CABG) done under CPB on cardioplegic arrested heart.

Introduction:

Coronary artery bypass grafting (CABG) is well established as the most effective operation for atherosclerotic coronary disease.

Before the era of cardiopulmonary bypass (CPB) (1950—1960), coronary endarterectomy and CABG were performed on beating heart[1]. But this early development was hindered by crude instrumentation, limited exposure and limited technical development and skill.

Since 1968, the widespread adoption of CPB and cardioplegia (CP) greatly facilitated coronary artery operations and then farther efforts to operate on beating heart have almost been forgotten[2]. Since then CABG under CPB has become the conventional method of myocardial revascularization.

Techniques of CPB have been refined for decades but some problems with CPB have been well documented.

To overcome the problems (morbidity and mortality) associated with CPB, renewed interest in CABG without CPB i.e., off-pump CABG (OPCAB) has raised lately and several series of CABG without CPB have been reported[3,4], showing better clinical outcome and cost effectiveness.

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Materials and method:

This was a prospective study carried out in the Department of Cardiovascular Surgery, National Institute of Cardiovascular Diseases, Dhaka, Bangladesh during the period July, 2014 to December, 2016.

Patients scheduled for elective cardiac surgery requiring CABG operation were selected considering inclusion and exclusion criteria.

Data were collected from each participant using predesigned questionnaire and data collection form. The source of data was clinical information, hospital records and investigations.

A total number of 120 patients were studied. They were randomly selected. They were divided into two equal groups i.e. 60 patients in each group: off-pump group (subjected to OPCAB) and on-pump group (subjected to CCAB).

The patients of both groups were evaluated using specific evaluation criteria. These criteria were listed in (i) Demographic and preoperative variables, (ii) Per operative and (iii) postoperative variables.

Data were analyzed using standard statistical method.

Results and observations:

Demographic and preoperative baseline characteristics, peroperative and postoperative variables for evaluation and comparison of clinical outcomes were demonstrated in the tables (i) to (ix).

Table-I

Age distribution of the patients between the groups

Age of the patients (yrs.)	GROUP		p-value
	Off-pump CABG	On-pump CABG	
Mean age (yrs.)	50.15 ± 1.49	51.30± 1.33	0.972

Any p-value ,0.05 was considered significant. (Student's t-test).

Table-II

Sex distribution of the patients between the groups.

sex	GROUP		P-values
	Off-pump	On-pump	
Male	56(93%)	57(95%)	0.500
Female	4(7.0%)	3(5.0%)	

Any p-value <0.05 was considered significant. (Fisher's exact test).

Table-III

Distribution of NYHA functional class.

NYHA CLASS	Group		p-value
		On-pump CABG	
Class I	4(6.0%)	3(5.0%)	0.949
Class II	30 (50.0%)	27 (45.0%)	
Class III	26(44.0%)	30 (50.0%)	

Any p-value <0.05 was considered significant. (Chi-square test).

Table-IV

Comparison of risk factors between the groups

Risk factors	Group				p-values
	Off-pump CABG		On-pump CABG		
	Yes	No	Yes	No	
Current smoking	36(60%)	24(40%)	33(55%)	27(45%)	0.500
Diabetes mellitus	24(40%)	36(60%)	21(35%)	39(65%)	0.500
Hypertension	24(40%)	36(60%)	21(35%)	39(65%)	0.500
Hyperlipidaemia	15(25%)	45(75%)	9(15%)	51(85%)	0.347
Family history of CAD	(15%)	51(85%)	12(20%)	48(80%)	0.500

Any p-value <0.05 was considered significant.(Chi-square test).

Table-V

Comparison of number of coronary artery involved

No. of coronary arteries	Group		p-value
	Off-pump CABG (n=60)	On-pump CAB (n=60)	
Double vessel	30(50%)	36(60%)	
Tripple vessel	30(50%)	24(40%)	

Table-VI

Comparison of preoperative cardiac and pulmonary functional status:

Cardiopulmonary functional status	Group		p-value
	Off-pump CABG	On-pump CABG	
Ventricular Ejection Fraction (%)(Mean ± SEM)	54.2± 1.59	55± 1.42	0.678
FVC(L)Mean ± SEM)	2.96 ± 0.09	3.07 ± 0.11	0.461
FEV_1	2.48 ± 0.09	2.70 ± 0.07	0.049[s]

S=significant; any p-value Â0.05 was considered significant. (Mann Whitney test).

Table-VII

Comparison of peroperative variables between groups

preoperative variables	Groups		P-values
	Off-pump CABG	On-pump CABG	
Total operative time (hours)(Mean ± SD)	5.1 ± 0.51	5.6 ± 0.59	0.005[s]
No. of distal anastomosis (Mean ± SD)	2.50 ± 0.11	3.10 ± 0.23	0.081
Amount of blood loss (units) (Mean ± SD)	2.0 ± 0.16	2.9 ± 0.16	0.001[s]

S=significant; any p-value Â0.05 was considered significant. (Student's t-test and Mann Whitney test).

Table-VIII

Comparison of postoperative variables between groups

postoperative variables	Group		P-values
	Off-pump CABG	On-pump CABG	
Period of mechanical ventilation(hours) (Mean ± SEM)	7.55 ± 0.58	16.5 ± 0.45	Â 0.001s
ICU-Stay(hours) (Mean ± SEM)	37.2 ± 8.62	68.2 ± 4.75	Â 0.001s
Total hospital stay(days) (Mean ± SEM)	9.25 ± 0.25	10.6 ± 0.33	0.001s
Amount of blood required at ICU (units) (Mean ± SEM)	1.5 ± 0.14	2.8 ± 0.32	Â 0.001s

S=significant; any p-value Â0.05 was considered significant. (Mann Whitney test).

Table-IX

Comparison of complications between groups

complications	Group	
	Off-pump CABG (n=60)	On-pump CABG (n=60)
Re-exploration for bleeding	00	5 (8%)
Pulmonary complications:		
Pulmonary oedema	00	2(3%)
Atelactasis	00	2(3%)
Pleural effusion	00	2(3%)

Discussion:

National Institute of Cardiovascular Diseases, Dhaka, Bangladesh, has been performing central role in the field of cardiac surgery countrywide. NICVD is one of the best referral hospitals for coronary artery bypass graft (CABG) operation. The first CABG (on-pump) surgery was done at NICVD, Bangladesh, in 1985. OPCAB is being performed since 1997 in NICVD[5,6] and subsequently in other cardiac centers in Bangladesh. From 1st July, 2014 to 31st December, 2016, a total of 275 CABG was performed of which 48 (17·45%) were performed off-pump rest 227 (82·55%) were performed under conventional method (CCAB) i.e. under cardiopulmonary bypass.

This study, carried out at NICVD, included a total of 120 patients divided into two groups – off-pump group and on-pump group having 60 patients in each group.

From the tables we can see that age, sex, NYHA functional class and common risk factor distribution for coronary artery disease are almost uniform in both OPCAB and CCAB groups.

As regards to the number of coronary artery involvement, either group included only double and triple vessel disease. Though the distribution of involved vessels was not uniform, the difference was not statistically significant.

Preoperative cardiopulmonary functional status was compared using ventricular ejection fraction (EF%), FVC, and FEV_1. Data analysis showed that none but FEV_1 was significantly better on OPCAB group compared to CCAB group.

It is now clear that preoperative patient characteristics were almost similar in the study groups. So, those features should have no significant influence on peroperative and postoperative clinical outcomes. These preoperative patient characteristics were comparable to the study series of Boyd et al., 1999[7].

Comparison of peroperative variables between groups demonstrates that total operative time in OPCAB group (5.1±0.51 hours) is significantly less than that of CCAB group (5.6±0.59 hours). The amount of blood requirement in OPCAB group (2.0±0.16 units) was significantly less than CCAB group of patients (2.9 ±0.16 units).

Several postoperative variables were compared between the groups. Mean (mean± SEM) ventilation period in off-pump group was 7.55 ±0.58 hours and that in on-pump group was 16.50 ±2.01 hours. Average ICU-stay period in OPCAB group 37.3 ±5.88 hours and that in CCAB group was 68.2±4.75 hours. Total postoperative stay in hospital averaged 9.25 ± .25 days in OPCAB group and 10.60 ±0.33 days in CCAB group respectively. The mean blood requirement in OPCAB group during the postoperative period was 1.5±0.14 units and that in CCAB group was 2.80 ± 0.32 units. That total transfusion requirement in OPCAB procedure is much less is supported by many studies[8,9].

Thus the mean period of mechanical ventilation, ICU-stay period, total postoperative stay in hospital and amount of blood required at ICU during postoperative period all were significantly greater in CCAB group as opposed to OPCAB group.

All these reflect definite clinical advantage associated with OPCAB group of patients over CCAB group of patients.

The distribution of postoperative complications between the study groups was compared using appropriate statistical tests (table ix). Postoperative complications were relatively less in OPCAB group, although not statistically significant. But this might be significant if larger sample would have been taken. Mortality was nil in either group of patients.

Conclusion: CABG operation is increasing in our country and it is the most effective operation for CAD .In our country this operation is being performed through CCAB (conventional) and OPCAB procedure. This study clearly demonstrates that OPCAB procedure is safe and is associated with some better short term clinical outcome in respect to CCAB procedure. Therefore, continuing use of OPCAB procedure for myocardial revascularization is clearly justified whenever feasible and all cardiac surgeons should develop skill in this procedure.

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