Evaluation of Pulmonary Function after Off-pump Coronary Artery Bypass Grafting in Patients Treated with Preoperative Bronchodilator

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Key Words : *Bronchodilator, impaired pulmonary function, CABG, Coronary artery disease.*

Abstract:

Background: *Bronchodilators, by dilatation of bronchial tree through relaxation of bronchial smooth muscle increases the vital capacity, tidal volume and total lung capacity and reduces gas trapping. This study was conducted to assess the pulmonary function after off-pump coronary artery bypass graft (CABG) surgery between patients with impaired pulmonary function treated with or without preoperative bronchodilator. We also compared duration of mechanical ventilation and days spent in the surgical intensive care unit (ICU) after CABG in both group of patients.*

Methods: *This prospective cohort study was carried out in the department of Cardiac Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from July 2009 to April 2011. This study included 50 patients (25 patients in each group) with multi-vessels coronary artery disease with impaired pulmonary function who underwent off-pump CABG.*

Results: *Spirometry was done in both groups of patients after admission, day before operation and on 7th post-operative day. The difference in Forced vital capacity (FVC) and Forced expiratory volume in 1st second (FEV_1) between two groups were not statistically significant after admission ($P>0.05$). On the day before surgery the values of FVC and FEV_1 were increased (more in Group-I who were treated with bronchodilator) and 7th postoperative day the values were decreased (more in Group-II who were not treated with bronchodilator). The results were found statistically significant in between groups ($P<0.05$).*

Conclusion: *Bronchodilator should be considered pre-operatively in all patients having impaired pulmonary function undergoing off-pump CABG for better preservation of postoperative pulmonary function.*

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Introduction:

Coronary artery bypass grafting is one of the procedures with the highest impact in the history of medicine. CABG constitutes the keystone of adult cardiac surgery and it is the most common adult cardiac surgical procedure performed all over the world.[1,2] However among the post cardiac surgical complications, respiratory complications remain a leading cause of postoperative morbidity and can prolonged hospital stays and increase costs. In a study that used an administrative database of 51,351 patients who underwent CABG from 1999-2002 in 76 hospitals in the United States, 0.78% had pneumonia, 4.86% had adult respiratory distress syndrome/pulmonary edema and 2.96% had other respiratory complication (total 8.60%).[3] Pulmonary impairment after cardiac surgery is believed to be multifactorial and reflects the combined effects of general anaesthesia, surgical factor (median sternotomy, pleurotomy and harvesting of internal mammary artery (IMA)) and cardiopulmonary bypass (CPB); that produce hypoxia, atelectasis, pleural effusion and dysfunction of the diaphragm.[4] Coronary artery bypass grafting performed without CPB results in less inflammatory response and hence pulmonary function is better preserved postoperatively. To reduce postoperative pulmonary complications respiratory physiotherapy and bronchodilator are used preoperatively which improve patient's pulmonary status. Bronchodilator (salbutamol) dilates bronchial tree through relaxation of

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bronchial smooth muscle and by this it increases the vital capacity, tidal volume and total lung capacity and reduces gas trapping. Bronchodilator also inhibit histamine release by stabilization of mast cell membrane, inhibit microvascular leakage and increase mucocilliary transport by increasing cilliary activity or by affecting the composition of mucous secretion.[5] In this study, we have tried to evaluate the role of bronchodilator in relation to pulmonary function and respiratory outcome after of OPCAB.

Methods:

This prospective cohort study was carried out in the Department of Cardiac Surgery, BSMMU, Dhaka, Bangladesh, from July 2009 to April 2011. Patients admitted in the department of Cardiac Surgery, BSMMU for off-pump CABG were taken as study population. Pulmonary function test was done pre-operatively and patients having mild to moderate impaired pulmonary function were included in this study. Sampling technique was purposive. 50 randomly selected off-pump CABG patients were enrolled in the study all having mild to moderate impaired pulmonary function. Pulmonary function was assessed by FVC, FEV1 and FEV1 to FVC ratio. Normal pulmonary function was defined as, FVC and FEV1 greater than or equal to 80% of predicted value and the FEV1 to FVC ratio more than 75-80%.[9] Impairment of pulmonary function was defined as follows:

- Mild - FVC and/or FEV1 70-79% of predicted value.
- Moderate - FVC and/or FEV1 60-69% of predicted value.
- Moderately severe - FVC and/or FEV1 50-59% of predicted value.
- Severe - FVC and/or FEV1 35-49% of predicted value.

Group-I patients were given bronchodilator preoperatively and Group-II patients were not (25 patients in each group). Bronchodilator (Salbutamol) was given preoperatively after admission in group-I patients, orally (suspension form) at a dose 2 mg four times daily upto pre-operative day (at least for 7 days). Postoperatively salbutamol was given in group-I patients at a same preoperative dose up to 7th postoperative day. Excluded from the study were patients having normal (FVC and/or the FEV1 80% or more of predicted value) or severely impaired (FVC and/or the FEV1 less than 50% of predicted value) pulmonary function preoperatively, patients who were converted off-pump to on pump CABG peroperatively, patients with intraoperative complications (uncontrolled ventricular tachycardia, pleurotomy) or postoperative complications (wound dehiscence, re-open cases), patients with NYHA functional class-IV and patients undergoing emergency CABG.

Results:

There were no statistically significant differences between these groups regarding age, sex and risk factors. Preoperative NYHA functional class in both groups of patients was not statistically significant, nor was the extent of coronary artery disease. Total operation time and total numbers of distal anastomosis were almost equal in both groups and were not found statistically significant differences (p=0.404 and p=0.535 respectively). Mean ± SE value of mechanical ventilation time after operation in Group-I was 14.25±0.85 hours and in Group-II was 16.88±0.93 hours (Table-I). Mean ± SE value of ICU stay after surgery was 98.64±2.07 hours in Group-I and 110.56±2.36 hours in Group-II (Table-II). Both the results were statistically significant (p=0.042 and p=0.001 respectively).

Table-I

Comparison of mechanical ventilation time after operation in study groups (n=50).

Ventilation time (hours)	Group I (n=25)	Group II (n=25)	p value
Mean ± SE	14.25 ± 0.85	16.88 ± 0.93	0.042s

Table-II

Comparison of total ICU stay after operation in hours in study groups (n=50).

ICU stays (hours)	Group I (n=25)	Group II (n=25)	p value
Mean ± SE	98.64 ± 2.07	110.56 ± 2.36	0.001s

Spirometry was done in both groups of patients after admission, day before operation and on 7th post-operative day. Spirometric indices were compared in between groups. The FVC and FEV_1

after admission were not statistically significant (P>0.05). On the day before surgery the values of FVC and FEV_1 were increased (more in Group-I who were treated with bronchodilator) and 7th postoperative day the values were decreased (more in Group-II who were not treated with bronchodilator). The results were found statistically significant in between groups (P<0.05). FEV_1/FVC ratio was not statistically significant all over the study period in between groups (Table-III).

Mean ± SE value of post-operative hospital stay in Group-I was 8.88±0.24 days and in Group-II was 10.14±0.43 days. It was found statistically significant difference in respect to hospital stay in days between two Groups (p=0.014) (Table-IV). Post-operative pulmonary complications were found in both groups of patients. In Group-I, one (4%) patient was found with pleural effusion and one (4%) patient with atelectasis. But in Group-II, one (4%) patient was found with pleural effusion and five (20%) patients were found with atelectasis (Fig. 1).

Table-III

Comparison of spirometric indices in study groups (n=50).

Spirometric indices		Group I (n=25)	Group II (n=25)	p value
FVC (%)	After admission	63.88±1.16	66.12±0.96	0.142^{NS}
	Day before operation	73.00±0.96	67.48±1.11	0.001^{S}
	7th Post Operative day	57.64±1.09	48.56±1.31	0.001^{S}
FEV1(%)	After admission	68.28±1.73	70.40±1.59	0.371 ^{NS}
	Day before operation	79.28±2.30	72.92±1.86	0.037^{S}
	7th Post Operative day	58.76±1.02	49.02±2.19	0.001^{S}
FVC/FEV1 (%)	After admission	106.18±1.69	106.67±2.06	0.854^{NS}
	Day before operation	108.42±3.24	107.76±2.02	0.864 ^{NS}
	7th Post Operative day	101.65±1.49	100.90±2.95	0.821 ^{NS}

Table-IV

Comparison of post-operative hospital stay in study groups (n=50).

Post Op Hospital Stay (days)	Group I (n=25)	Group II (n=25)	p value
Mean ± SE	8.88 ± 0.24	10.14 ± 0.43	0.014s

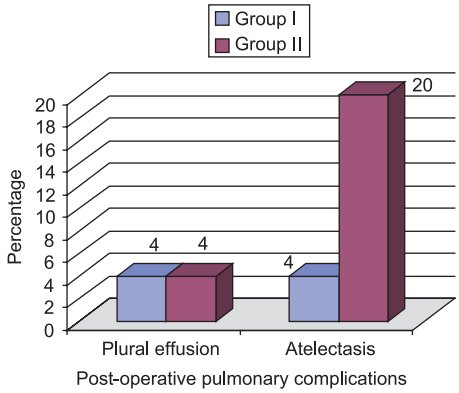

Fig.-1: *Comparison of post-operative pulmonary complications in study groups*

Discussion:

Coronary artery bypass grafting is performed to alleviate blockages or stenosis in coronary arteries, have come a long way since the mid-1960s. It remains a major operation with significant complications and surgeons have sought new ways of reducing the insult to the patient. Aim of this prospective study was to define the efficacy of bronchodilator in relation to improve the pulmonary function and to reduce the pulmonary complication after OPCAB. The age difference between the two groups were not statistically significant (p=0.258) which are consistent with the study done by Lizak and colleagues, Manganas and colleagues. [6,7]

In Group-I, 52% patients were smoker, 56% had hypertension, 28% had DM, 24% had hyperlipidemia and 32% had family history of IHD. In Group-II, 60% patients were smoker, 44% had hypertension, 32% had DM, 28% had hyperlipidemia and 44% had family history of IHD. The mean difference of risk factors were not statistically significant in between groups (p= 0.569, p=0.396, p=0.757, p=0.747 and p=0.382 respectively) which are consistent with the study done by Lizak and colleagues, Hulzebos and colleagues.[6,8]

Regarding NYHA functional class, in Group-I, three (12%) patients were belonged to NYHA class-I, thirteen (52%) patients were belonged to class-II and nine (36%) patients were in class-III. In Group-II, two (8%) patient were belonged to NYHA class-I, fourteen (56%) patients were belonged to class-II and nine (36%) patients were in class-III. Data showed no statistically significant differences between two groups of patients in relation to NYHA functional class (p=0.826).

The mechanical ventilation time after operation was observed in hours in both groups of patients. The mean ± SE value of ventilation time in Group-I was 14.25±0.85 hours and in Group-II was 16.88±0.93 hours (Table-I). The value of mechanical ventilation time was found statistically significant in between groups (p<0.5).

The mean ± SE value of total ICU stay after operation in Group-I was 98.64±2.07 and in Group-II was 110.56±2.36 hours respectively (Table-II). In statistical analysis significant difference was found in two groups in respect to ICU stay in hours (p<0.5).

The mean values of FVC in between groups after admission were not statistically significant (p >0.05). The mean values of FVC were more increased in Group-I (after treated with bronchodilator) on the day before operation and the values between groups were statistically significant (P<0.05). The mean values of FVC were more decreased in Group-II (not treated with bronchodilator) on 7th post-operative day and the values between groups were statistically significant (p<0.05). The mean values of FEV_1 in between groups after admission were not statistically significant (p>0.05). The mean values of FEV_1 were more increased in Group-I (after treated with bronchodilator) on the day before operation and the values between groups were statistically significant (p<0.05). The mean values of FEV_1 were more decreased in Group-II (not treated with bronchodilator) on 7th post-operative day and the values between groups were statistically significant (p<0.05). The FEV_1/FVC was not statistically significant all over the study period in between groups (Table-III). The results were consistent with the study done by Mehrparvar and colleagues, Omata and colleagues.[9,10]

Postoperative hospital stay in days in both groups of patients was observed. The mean ± SE value was 8.88±0.24 days in Group-I and 10.14±0.43 days in Group-II (Table-IV). There was found statistically significant differences in respect to hospital stay in days between two groups (p<0.5).

Early postoperative pulmonary complications were found in both groups of patients. In Group-I, one (4%) patient was found with pleural effusion and one (4%) patient with atelectasis. But in Group-II, one (4%) patient with pleural effusion and five (20%) patients with atelectasis were found (Fig-1).

Conclusion:

In this study, it can be concluded that use of bronchodilator pre-operatively in patients undergoing off-pump CABG with impaired pulmonary function leads to reduce mechanical ventilation time, ICU stay after surgery; as well as better preservation of post-operative pulmonary function, reduction of post-operative pulmonary complications and reduces hospital stay after surgery.

Conflict of Interest - None.

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