Research Article

Effect of flutter device on airway mucus clearance, physiological parameters, and arterial blood gas analysis in patients with coronary artery bypass grafting during Phase 1 cardiac rehabilitation – A randomized control trial

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ABSTRACT

Background: cardiac surgery is associated with the occurrence of pulmonary complications, which may be defined as any pulmonary condition that occurring during the post-operative period which may produce dysfunction that is clinically significant and may adversely affects the clinical course. **Objective:** The objective of the study was to evaluate the effect of flutter device on airway mucus clearance, physiological parameters, and arterial blood gas analysis in patients with coronary artery bypass graft (CABG) in during Phase 1 cardiac rehabilitation. **Materials and Methods:** A total of 40 patients post-operative CABG surgery were randomly assigned to receive either experimental group along with flutter device and control group received conventional physiotherapy, outcome measure include arterial blood gas analysis, physiological parameters, and sputum amount. **Result:** This control trial of 5 days gave result that flutter device and conventional exercise have an effect on PCO_2 and sputum index both experimental and control group while there was effect on PO_2 in the investigational group and pulse rate in control group. Flutter device when analyzed from baseline to 5th post-operative day sputum score and PCO_2 analysis. Other measures showed no significant differences. **Conclusion:** Flutter device should be incorporated as a routine practices along with other chest physiotherapy techniques during Phase 1 of cardiac rehabilitation, which can have positive results in the quality of life and improving overall functional status in subjects following CABG, thereby minimizing the hospital stay.

KEY WORDS: Coronary Artery Bypass Grafting; Arterial Blood Gas; Airway Clearance, Flutter Device

INTRODUCTION

The occurrence of pulmonary complication is said to be associated with cardiac surgery, which may be described as any pulmonary condition occurring postoperatively. Clinically significant dysfunction may be produced, which may adversely affect the clinical course.

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Post-operative atelectasis is one of the most common pulmonary complications in patients following coronary artery bypass grafting (CABG).[1] A decrease in pulmonary function is a known fact post open heart surgeries. Roentgenological signs of atelectasis are common and various studies have documented the reduction in lung volume and oxygenation in the post-operative period.[2] CABG is an effective and established treatment for reducing the symptoms and mortality with coronary artery disease. Blood gas investigation is an every now and another time utilized test before anesthesia taking in cardiovascular medical approach and in the assessment of post patients onward, blood vessel blood gas examination may have the centrality of predict mortality and post-operative situation

in chronic obstructive pulmonary disease (COPD) patients observation of coronary artery bypass surgery.[3] Roughly 3.5 lakh patients undergo CABG yearly in the United States. The incidence of death generally ranges between 1 and 3% of death is analogous CABG, but in selected population it can exceed 5%.[4] A ruling cause of post-operative pulmonary complications post-cardiac surgery is reduced inspiratory effort reduced functional residual capacity less mucociliary clearance, change in sigh mechanism, decreased pulmonary volumes, and impaired surfactant production.[5]

The aim of the study was to estimate the flutter device on airway mucus clearance, physiological parameters, and arterial blood gas analysis in CABG patients during cardiac rehabilitation.

MATERIALS AND METHODS

The current study is a randomized control trial conducted within the cardiovascular and thoracic department unit. Patients of both genders with the clinical diagnosis of coronary artery disease who underwent CABG with cardiopulmonary bypass, a median sternotomy incision, and use of saphenous vein were included in this study. Exclusion criteria include hemodynamic instability, cardiac arrhythmia, cerebral edema, and diabetic neuropathy.

All the patients were informed about the purpose and procedures of this study and consent form was signed before participation. The study protocol conformed to the principles of the declaration of Helsinki and was approved by the research ethics committee. Patients demographic data were documented along with their initial assessment of outcome measures before their intervention(baseline) and post-intervention (i.e., 5th) and were randomly allocated using the envelope method into two groups: Group A (flutter device along with conventional treatment) and Group B (conventional treatment). Conventional treatment was common in both the groups and was given in the form of deep breathing exercise, coughing and huffing, active movements of upper extremity, and ankle toe movements. The duration of intervention was 5 days, while Group A received flutter device additional to conventional treatment.

The present study had following outcome measure included sputum amount and physiological parameters which include respiratory rate, pulse rate, blood pressure, and arterial blood gas analysis.

Procedure

Group A flutter device together with conventional physiotherapy. Relax in sitting position with the patient head tilted slightly back. This will allow smooth flow of air. Slowly breathe faster than a normal breath and for 2–3 s. Hold the flutter horizontal to the floor, so the ball can bounce and roll inside the flutter patient blow out. Put the flutter in the mouth. Position the flutter at the proper angle and blowout a little faster than normal. Repeat steps 5–10 times. Repeat this forceful exhalation. Group B was given in the form of deep breathing exercise, coughing, and huffing, active movements of the upper extremity, ankle toe movements, and mobilization.

Statistical analysis was done using (SPSS) version 20. For this purpose, raw data were entered into a Microsoft Excel sheet, tabulated, and subjected to analysis. The pre- and post-test scores of arterial blood gas, physiological parameters, and mucus clearance were measured using the independent *t*-test. Variables of all the outcomes were compared after 5th day with baseline values.

RESULTS

The findings of the present study are presented in Figures 1-7. The total numbers of 40 subjects were recruited in the present study and were randomly allocated into two groups having 20 subjects (13 males and 7 females) in each group. The mean age and body mass index of the participant were 53.03 ± 11.37 and 24.85 ± 2.13. While comparing the pH

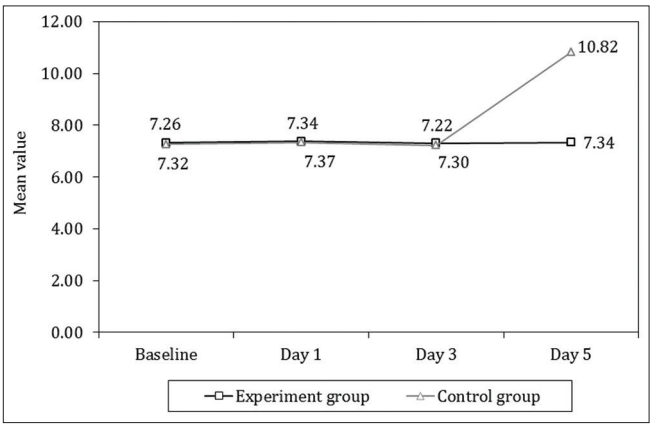

Figure 1: Comparison of experiment group and control group with pH scores at different treatment times

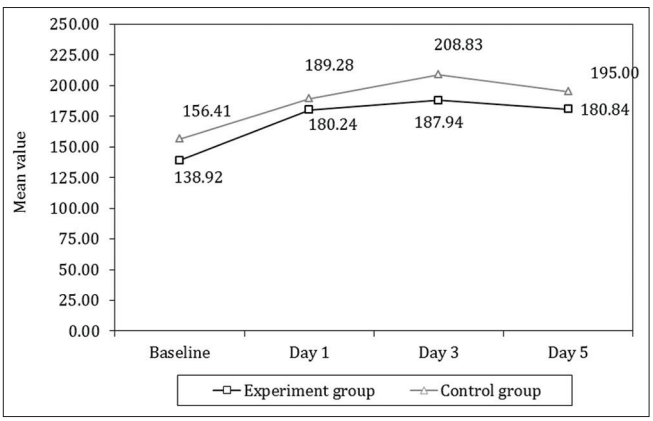

Figure 2: Comparison of experiment group and control group with PO_2 scores at different treatment times

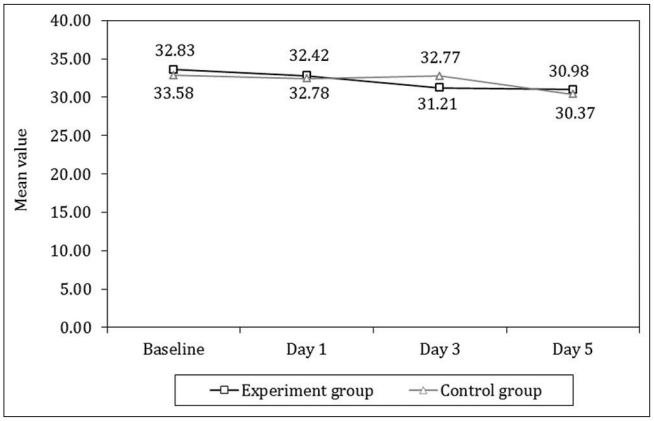

Figure 3: Comparison of experiment group and control group with PCO_2 scores at different treatment times

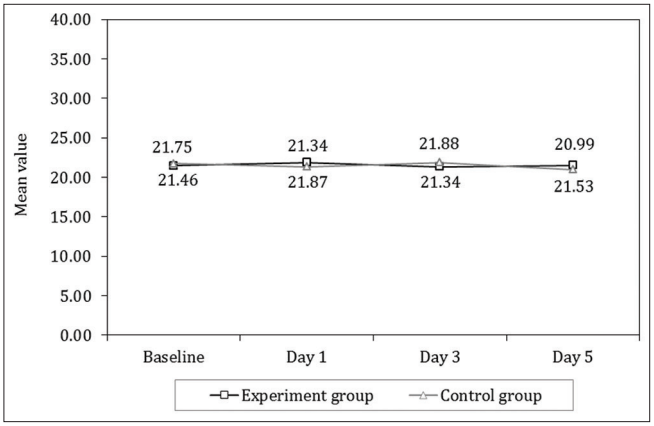

Figure 4: Comparison of experiment group and control group with HCO_3 scores at different treatment times

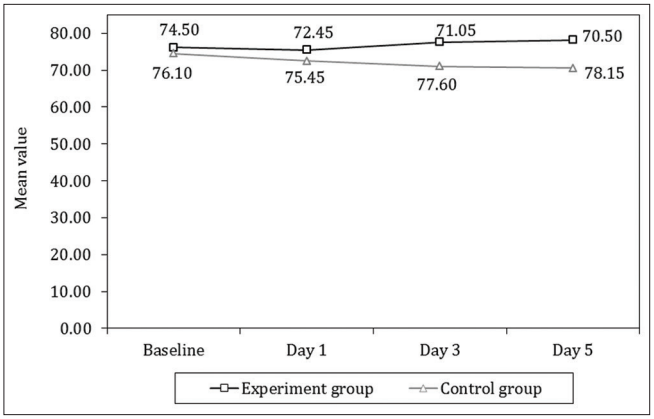

Figure 5: Comparison of experiment group and control group with PR b/min scores at different treatment times

in between the groups, it was not significantly changed after the treatment ($P \geq 0.05$). Similarly, comparing the PO_2 values between the groups, it was significantly improved in both the groups but more in the experimental group after the intervention ($P \leq 0.05$). The comparison of PCO_2 between the groups, it was significantly improved in both groups. The results showed no significant difference in HCO_3. PR was seen significantly changed in the control group but not in the experimental group. Similarly, the relative risk was

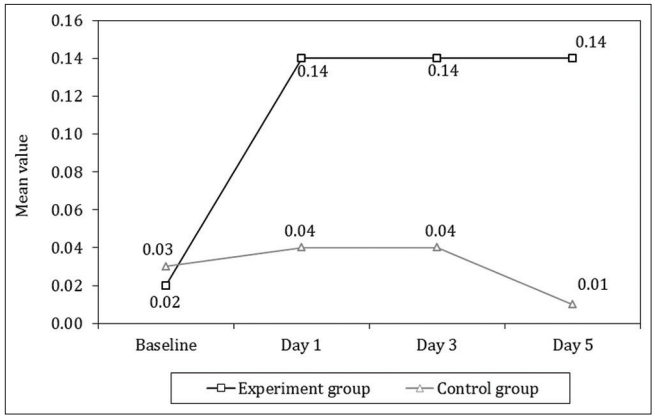

Figure 6: Comparison of experiment group and control group with sputum scores at different treatment times

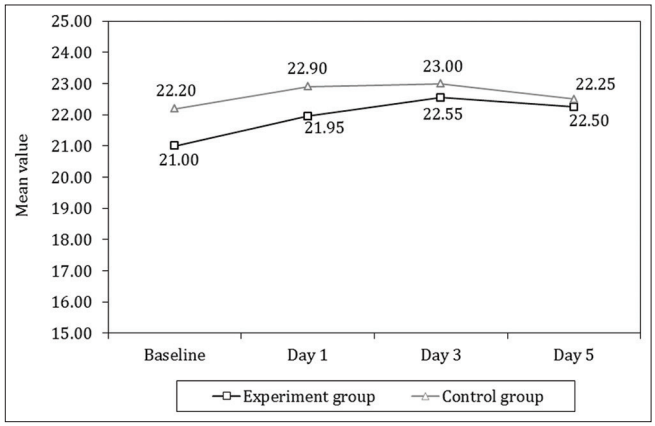

Figure 7: Comparison of experiment group and control group with relative risk b/min scores at different treatment times

significantly changed in experimental while sputum was significantly higher in the experimental group.

DISCUSSION

The present study trial aimed to study the effect of flutter device on airway mucus clearance, physiological parameters, and arterial blood gas analysis in patients with CABG during Phase 1 cardiac rehabilitation. The intervention included conventional physiotherapy to one group and flutter along with conventional physiotherapy to another group. The intervention was given once on 1st, 3sd, and 5sh days post-CABG to see the effect on airway mucus clearance by examining the quantity of sputum, physiological parameters included were respiratory rate, pulse rate, and blood pressure improvements in arterial blood gas values was seen. In the present study, there was no significant difference change in pH within and between groups. PO_2 increased significantly on day 3 in the experimental group. There was a significant change in PCO_2 within and between groups. HCO_3 did not show any difference in either group. There was a change in pulse rate in the control group only, whereas respiratory rate was significantly different within the experimental group. Sputum production was significantly high in experimental

group, i.e., within group and between group. The present finding was in accordance with another study conducted were 88.4% males underwent CABG, whereas only 11.6% females underwent CABG. Hence, we conclude males are more prone then females having heart disease[6] subjects were not obese in either group.

In the present study, a flutter device seems to increase sputum production. This increase in secretion can be due to changes in sputum rheology. A study was conducted which proposed reduction of sputum viscoelasticity, thereby increasing the sputum clearance, which was similar to the present study, which showed increased secretion of sputum following CABG in our experimental group. Another study was conducted to see the effect of a flutter on respiratory mechanics and sputum production in bronchiectasis patients and concluded that flutter device helps in mucus clearance.[7] A review was conducted to study respiratory changes after open-heart surgery. The study concluded that breathing frequency is increased by 42% in recumbent position, whereas it increases by 31% in semi-Fowler's position. The change in respiratory rate can be due to direct effect of general anesthesia, mechanical ventilation, and surgical trauma during CABG procedure.[8] In present study, there was significant increase in respiratory rate within experimental group. A review was conducted which compared the effect of flutter device versus autogenic drainage on peak expiratory flow rate, oxygen saturation, and respiratory rate in COPD patients; it was concluded that flutter is as effective as autogenic drainage in improving the respiratory rate and peak expiratory flow rate in patients with obstructive respiratory condition.[9] A previous study concluded that pre-operative respiratory physiotherapy is significantly related to lower incidence of atelectasis in CABG surgery. Respiratory physiotherapy and deep breathing maneuver with or without mechanical devices are frequently used during post-operative phase of heart surgery. In the present study, there are only two reported cases of atelectasis after surgery. Both the cases underwent off-pump CABG. Off-pump complications are atelectasis, pleural effusions, pulmonary edema, bronchospasm, cough, and respiratory failure as reported in the earlier study.[10] There are some studies that suggest standard chest physiotherapy essentially diminished the occurrence of pneumonic confusions real stomach and thoracic medical procedure. A study demonstrated breathing activity and motivation spirometer altogether improved PaO_2 and SaO_2 on the post CABG.

The strength of the study was study had control group. Flutter device is valid and reliable therapeutic approach in improving functional status decreasing post-operative complications which were first of its kind used in present study, especially following CABG and the limitations that we observed was that durations of intervention was short which could have been prolonged for better long-term results and the effect of flutter on quality of life was not quantified and its effect on overall hospital stay was not determined.

Future Scope

Multicenter trials can be carried out to generalize the results. Studies utilizing other outcome measure like 6 min walk test, pulmonary components such as PFT and oxygen saturation can be done. Studies comparing on pump with off pump can be planned.

CONCLUSION

Hence, flutter device is a simple and effective method in improving functional outcomes decreasing pulmonary complications following CABG, thereby minimizing the hospital stay. Flutter device should be incorporated as a routine practice along with other chest physiotherapy techniques during Phase 1 of cardiac rehabilitation which can have positive results in quality of life and improving overall functional status of the subjects following CABG. Flutter device when analyzed from baseline to 5^{sh} post-operative day a sputum score, PCO_2 analysis. Other outcome measures show no significant differences. Hence, flutter device should be incorporated as a routine practice along with other chest physiotherapy techniques during Phase 1 of cardiac rehabilitation which can have positive result in quality of life and improving overall functional status in subjects following CABG, thereby minimizing the hospital stay.

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