

Effect of Continuous Positive Airway Pressure in Phase-I Cardiac Rehabilitation after CABG

MEMOONA SALAL¹, SUMAIYAH UBAID², AMENA BATOOL³, MARIA RAZZAQ², MASHAL RANA¹, HANIFA SULEMAN⁴, NADIA ANWER⁵, ATTAULLAH KHAN NIAZI⁶, MUHAMMAD MUNEEB⁶

¹Peshawar Institute of Cardiology, Peshawar

²Riphah International university, Islamabad

³Imran Idrees institute of Rehabilitation Sciences

⁴Bolan University of Medical and Health Sciences, Quetta

⁵Shalamar Institute of Health Sciences

⁶Assistant Professor, Shalamar Institute of Health Sciences

Correspondence to: Memoona salal, Email: moonphysio138@gmail.com

ABSTRACT

Background: Coronary artery bypass surgery is associated with sever alteration of Lung parameters after 1st post-operative day. The purpose of this study to determine The effect of CPAP on, arterial blood gasses, walking time and long term effect on Ejection fraction and quality of life.

Objective: To determine the effect of continues positive airway pressure on arterial blood gasses, walking time, long term effect on ejection fraction and quality of life in post coronary artery bypass grafting patients.

Methods: Randomized control study was conducted in North West General Hospital Peshawar, from July 2019 to December 2019. Patients underwent coronary artery bypass grafting were included in cardiac rehabilitation. 60 patients were randomly divided into two groups with equal half's. Experimental group received exercises with continues positive airway pressure (CPAP) and control group received only exercise. PAP was applied 20 minutes prior to exercise and ABG's test and Vitals were recorded after 5minutes of exercise. Walking time was observed by 6MWT on last day of hospital discharge. Ejection fraction was observed by Echo and quality of life by SF12 questionnaire after four weeks.

Results: mean age in control group was (55.27±8.80) and in experimental group was (4.70±1.535). Mean and standard deviation of post Echo in experimental group was 48.30±1.493 and control group was 46.17±1.191. Both groups showed significant difference P value less than 0.05 in arterial blood gasses PH, HCO₃, and PCO₂. PO₂ showed significant difference only in experimental group. Both groups showed statistically significant difference for 6 MWT. Mean of quality of life in experimental group was 37.4±5.062 and in control was 36.54±4.46.

Conclusion: it is concluded that the use of CPAP in post CABG patients have effective outcome in arterial blood gasses, walking time, ejection fraction and in quality of life.

Keywords: Continuous Positive Airway Pressure, Coronary artery bypass graft surgery, Inpatients rehabilitations.

INTRODUCTION

Coronary artery disease is characterized by atherosclerotic plaques formation in coronary artery which may lead to insufficient blood supply to heart resulting in reduced oxygen supply to heart.¹ Coronary artery disease is managed by conservative treatment with medication and surgical procedure bypass surgery and angioplasty. Coronary artery bypass graft surgery (CABG) incision of median sternotomy the use of internal thoracic artery, saphenous vein, and radial artery grafts continues to be the primary surgical intervention to reduce the symptoms and mortality of patients with coronary artery disease especially with the high risk profile.^{2,3} Thathya V. Ariyaratne et al. conducted a study in 2016 the coronary artery bypass surgery is most effective procedure in treatment of coronary artery disease even if multiple arteries are damaged.⁴

Complications in post CABG surgery are very common, impaired lung function and oxygenation is most common in immediate post-operative period. Atelectasis in basal part of lung has been reported on 1st or 2nd post-operative day.^{5, 6} Post-operatively pneumonia, respiratory failure, pneumothorax, pleural effusion, sternal infection, respiratory muscle fatigue, increased respiratory rate, decreased oxygen saturation are common post-operative problems.⁷

Physiotherapy protocols are used after post CABG surgery to improve cardiac health and reduce pulmonary complications which includes passive range of motion progress to active assisted to active range of motion, head elevation about 30 degree, chest physiotherapy, deep breathing exercise, bed to chair mobility, early ambulation, stair climbing.⁸ Deep breathing exercises, with or without devices that provide positive expiratory pressure (PEP), is beneficial to prevent lung function impairments.⁹ Non-invasive mechanical ventilation like CPAP has effective means on oxygen saturation increases the surface area of the alveolus, increases

cardiac output, decreases work load on respiratory muscles improve peripheral oxygen saturation, reduce muscle fatigability.⁹

CPAP is initially used with pressure support of 5cmH₂O with 8 to 10cm H₂O of positive end expiratory pressure, 0.5 of FiO₂, when the pressure support is able to maintain normal breathing pattern and respiratory rate is less than 30 breaths per minute so pressure support will increase in steps of 3 to 4 cm of H₂O. During first minute of CPAP, arterial blood gasses will analyze to monitor the treatment. FiO₂ will reduce gradually, to 0.3to 0.4 to maintain oxygen saturation above 90% which is monitored by pulse oximeter. CPAP is administered for 30 minutes and 4 to 6 sessions per day.¹⁰ CPAP is administered in post CABG patients with pressure of 10 cm H₂O for 15minutes from day 1 to day 10.

In early post-operative days CPAP is very beneficial in pulmonary function i.e. it not only improves vital capacities, decrease work of breathing, decrease respiratory rate, improve arterial saturation, and prevent pulmonary complications.¹¹

Fla Vio POS Nery at al. conducted a study in which one post-operative group used CPAP as part of treatment with 10cmH₂O along with deep breathing exercises, while second group only performed deep breathing without CPAP. CPAP group showed greater increase in muscle strength, peak expiratory pressure, arterial blood gasses and greater tolerance to 6minute walk test.¹²

METHODOLOGY

This was a randomized control trial conducted in a coronary unit of Northwest Hospital and research center Hayatabad Peshawar. Male patients after coronary artery bypass surgery, age group between 35 to 60 years from July 2019 to December 2019 were included in the study. Patients were enrolled with post coronary artery bypass surgery and were offered phase I cardiac rehabilitation. All subjects were informed about the purpose and

procedure of the study and informed consent was taken before participation.

60 patients were randomly assigned and divided into two groups through sealed envelope method, each group with 30 patients. They were assessed prior to 1st post op day and at the day of discharge from hospital on following: ABG's was measured during exercise and after 10 minutes of CPAP in ICU, cardiac activity was monitored by ejection fraction (EF), echocardiogram and after four weeks of surgery to evaluate long term effect of CPAP. Walking time was assessed by 6minute walk test on the day of discharge. Pulse oximeter and ECG monitor was used to continuously check SPO₂, BP, HR and RR. After four weeks of study SF12 questionnaire was used to assess the quality of life.

The intervention started after the cardiac surgery and occurred during the stay in the hospital. The step exercise program progressively increased exercise intensity with each post-operative day while monitoring heart rate. If the subject reported any sign and symptoms of fatigue, dyspnea, chest pain, cyanosis, pallor, tachycardia (>120bpm), complex arrhythmias, hypotension etc. exercise intervention was interrupted and subject was sent to on duty doctor.

The exercise intervention of control group was without CPAP, and on first post-operative day general bed mobility, chest physiotherapy, active assistive ROM's of upper and lower limb and ACBT cycle was done. ABGs were analyzed at first minute of exercise and vitals after the therapy. The exercise progressed to bed to chair mobility and on third day walk was done. On fourth and fifth day stair climbing was done. ABGs were recorded and 6 MWT was performed on the day of discharge. Ejection fraction was recorded by echocardiograph after four weeks.

While the experimental group received treatment with CPAP 10 to 12cm H₂O according to tolerance of subject for 20 minutes twice a day.⁹ Exercise intensity is gradually increased starting from bed mobility, ACBT cycle, active assisted ROMs of upper and lower limbs (5reps), ABGs were recorded after one minute of exercise and vitals after exercise. On post-op day two, active range of motion exercise (5reps), bed to chair mobility, was performed and on day three walk (5mins) was added along with same exercises. On day four walking time was increased to 10 minutes and on fifth day stair climbing was done. ABGs were recorded in ICU for 3days. Ejection fraction was recorded on echocardiograph pre-operatively and after four weeks of surgery.

Measuring tools used were arterial blood gases (ABGs) which measured oxygen, carbondioxide and PH levels in your blood. Walking time was measured by 6 min walk test, it tells about the functional performance in post CABG patients. Ejection fraction was also measured to check the pumping capacity of heart. For quality of life SP 12 questionnaire was used.

Collected data was entered and analyzed by statistical package 21. Parametric test: paired t-test was applied for within group analysis and independent t-test, repeated measure test for between group analysis was applied to some variables. For non-parametric test, fried men and 2 independent samples test was applied on within and between group analysis respectively.

RESULTS

Total 60 male patients were included in the study; mean age of experimental group was (4.70±1.535) and control group was (55.27±8.80) years. BMI of experimental group showed mean and standard deviation (28.996±3.791) and control group showed (30.56±3.3459). Pre-Echo mean and standard deviation of experimental group was (40.60±8.877) and control group was (42.10±10.125) and p value was 0.090. Post Echo mean and standard deviation of experimental group was (48.30±8.180) and control group was (46.17±10.508) and p value was 0.030. The P value showed that result is significant in both experimental and control group. P value less than 0.05 in arterial blood gases, PH, HCO₃, and PCO₂. PO₂ showed significant difference only in experimental group. For 6MWT experimental group had Mean rank 43.43 and control group was mean rank 17.57. Result show

significant difference between two groups P value less than 0.05. The P value of systolic and diastolic BP was 0.838 and 0.155 respectively. The P value for RR was 0.318. HR and RPE showed statistically significant results (p<0.05).

Table 1: Result of HR mean rank and P value between control and experimental group

Variable	Experimental group Mean rank	Control group Mean rank	P value
1 st post op HR	26.72	34.28	0.093
7 th postop HR	25	36	0.015

Mann Whitney test, *p-value significant at 0.001

Table 2: Shows result of RPE mean rank and P value between control and experimental group

Variable	Experimental group Mean rank	Control group Mean rank	P value
2 nd post RPE	22	39	<0.001*
7 th post RPE	18.68	18.68	<0.001*

Mann Whitney test, *p-value significant at 0.001

DISCUSSION

The objective of current study was to find out the effect of CPAP on post CABG patient in phase I cardiac rehabilitation. There are very few studies available in literature which mainly focuses on effect of CPAP on arterial blood gases, systolic and diastolic blood pressure, ejection fraction, walking time and quality of life.

In this study, it was demonstrated that the use of CPAP in post CABG patients have greater impact on systolic, diastolic blood pressure and heart rate improved greatly. A similar study was conducted by Vuori M.D. et al. which supported our study that the use of CPAP in post CABG patients is effective haemodynamically as well as in oxygen transport. The results showed that CPAP with the pressure of 10 cm H₂O increases oxygen transport as well as ABG's are improved greatly.¹³

M.Reza Afazel et.al. Conducted a study in 2017 and it concluded that after open heart surgery, CPAP have positive effects on systolic, diastolic blood pressure and heart rate. The results were statistically significant (p<0.05).¹⁴ In recent study experimental group showed positive results with improvement in systolic and diastolic pressure.

Flavio POS Nery et al divided participants into two groups; one group received CPAP with pressure of 10 cm H₂O, twice daily for 30 minutes, the other group didn't receive CPAP. Between groups analysis showed statistically significant results in experimental group (p<0.05).¹²

High blood pressure is a common problem in post CABG patients, a study was conducted by Yumei Dong et al. in 2015 on effect of CPAP on blood pressure in post CABG patients. CPAP group's systolic BP improved greatly with no change in diastolic BP as compared to control group.¹⁵ While in this study there was improvement in both systolic as well as diastolic BP.

Effect of exercise based cardiac rehabilitation was observed by Fatemeh Esteki Ghashghaei et al in 2012. Cardiac activity and hemodynamics i.e. heart rate, systolic and diastolic BP, ejection fraction, within group P value less than 0.05. While between groups it shows improvement in systolic, diastolic BP, ejection fraction and 6MWT in experimental group.¹⁶ In current study experimental group showed similar results, i.e. improvement in ABGs, cardiac activity, systolic and diastolic BP as compared to control group.

Kristin E et al. conducted a study on post CABG patients and assessed their quality of life. 64 patients were included in the study, and SF12 was used pre and postoperatively (after 3 months of surgery). There was significant difference in pre and post SF12 questionnaire in both physical and mental component score.¹⁷ The present study used SF12 questionnaire only after 4 weeks while in previous study SF12 questionnaire was used preoperatively and after 7th week of surgery and compared the difference. While in present study it only observes effect on quality of life.

Two protocols mentioned in this study showed improvement in post CABG patients, but the interventional group showed additional improvement in primary outcome variables. Hence the use of CPAP along with other physiotherapy protocols can give additional benefits and fast recovery which can reduce the duration of hospital stay.

CONCLUSION

This study concluded that exercise in combination with CPAP in post CABG patients have positive outcome and can improve arterial blood gasses, walking time, blood pressure, rate of perceived exertion and has a long term effect on quality of life when applied in inpatients cardiac rehabilitation program. Functional status of patients was not measured preoperatively. Irritability of patients after using CPAP. Level of PO₂ dropped after 5 minutes of CPAP application.

Conflict of interest: This study has no conflict of interest to be declared by any author.

REFERENCES

- Azambuja AC, Souza MA, Ranzoni EP, Wioppiold JS, Muzykant LMP, Costa PO, et al. Volumetric incentive spirometer and positive pressure after cardiac surgery. *Journal of Respiratory and Cardiovascular Physical Therapy*. 2015;4(1):21-8.
- Savarese G, Lund LH. Global public health burden of heart failure. *Cardiac failure review*. 2017;3(1):7.
- Chen H, Li M, Liu L, Dang X, Zhu D, Tian G. Monocyte/lymphocyte ratio is related to the severity of coronary artery disease and clinical outcome in patients with non-ST-elevation myocardial infarction. *Medicine*. 2019;98(26).
- Ariyaratne TV, Yap C-h, Ademi Z, Rosenfeldt F, Duffy SJ, Billah B, et al. A systematic review of cost-effectiveness of percutaneous coronary intervention vs. surgery for the treatment of multivessel coronary artery disease in the drug-eluting stent era. *European Heart Journal-Quality of Care and Clinical Outcomes*. 2016;2(4):261-70.
- Pettersson H, Faager G, Westerdahl E. Improved oxygenation during standing performance of deep breathing exercises with positive expiratory pressure after cardiac surgery: A randomized controlled trial. *Journal of rehabilitation medicine*. 2015;47(8):748-52.
- Siddiqui KM, Samad K, Jonejo F, Khan MF, Ahsan K. Factors affecting reintubations after cardiac and thoracic surgeries in cardiac intensive care unit of a tertiary care hospital. *Saudi journal of anaesthesia*. 2018;12(2):256.
- Ji Q, Mei Y, Wang X, Feng J, Cai J, Ding W. Risk factors for pulmonary complications following cardiac surgery with cardiopulmonary bypass. *International journal of medical sciences*. 2013;10(11):1578.
- Epstein NE. A review article on the benefits of early mobilization following spinal surgery and other medical/surgical procedures. *Surgical neurology international*. 2014;5(Suppl 3):S66.
- Pantoni CBF, Di Thommazo-Luporini L, Mendes RG, Caruso FCR, Mezzalana D, Arena R, et al. Continuous positive airway pressure during exercise improves walking time in patients undergoing inpatient cardiac rehabilitation after coronary artery bypass graft surgery: a randomized controlled trial. *Journal of Cardiopulmonary Rehabilitation and Prevention*. 2016;36(1):20-7.
- Ampatzidou F, Boutou AK, Karagounis L, Marczin N, Gogakos A, Drossos G. Noninvasive ventilation to treat respiratory failure after cardiac surgery: predictors of application and outcome. *Respiratory Care*. 2019;64(9):1123-31.
- Abd El-Kader SM. Blood Gases Response to Different Breathing Modalities After Coronary Artery Bypass Graft. *European Journal of General Medicine*. 2011;8(2):85-91.
- Nery FP, Lopes AJ, Domingos DN, Cunha RF, Peixoto MG, Higa C, et al. CPAP increases 6-minute walk distance after lung resection surgery. *Respiratory care*. 2012;57(3):363-9.
- Vuori A. Effects of the level of CPAP on central haemodynamics and oxygen transport. *Acta Anaesthesiologica Scandinavica*. 1980;24(4):295-8.
- Afazel M, Nadi F, Pour-Abbasi M, Azizi-Fini I, Rajabi M. The effects of continuous positive airway pressure mask on hemodynamic parameters after open heart surgery: a randomized controlled trial. *Nursing and Midwifery Studies*. 2017;6(3):109-14.
- Dong Y, Dai Y, Wei G, Cha L, Li X. Effect of continuous positive airway pressure on blood pressure in hypertensive patients with coronary artery bypass grafting and obstructive sleep apnea. *International Journal of Clinical and Experimental Medicine*. 2014;7(11):4308.
- Ghashghaei FE, Sadeghi M, Marandi SM, Ghashghaei SE. Exercise-based cardiac rehabilitation improves hemodynamic responses after coronary artery bypass graft surgery. *ARYA atherosclerosis*. 2012;7(4):151.
- Sandau KE, Lindquist RA, Treat-Jacobson D, Savik K. Health-related quality of life and subjective neurocognitive function three months after coronary artery bypass graft surgery. *Heart & Lung*. 2008;37(3):161-72.
- Westerdahl E, Olsén MF. Chest physiotherapy and breathing exercises for cardiac surgery patients in Sweden—a national survey of practice. *Monaldi Arch Chest Dis*. 2011;75(2).
- Mendes RG, Simões RP, Costa FDSM, Pantoni CBF, Di Thommazo L, Luzzi S, et al. Short-term supervised inpatient physiotherapy exercise protocol improves cardiac autonomic function after coronary artery bypass graft surgery—a randomised controlled trial. *Disabil Rehabil*. 2010;32(16):1320-7.
- Filbay SR, Hayes K, Holland AE. Physiotherapy for patients following coronary artery bypass graft (CABG) surgery: limited uptake of evidence into practice. *Physiotherapy theory and practice*. 2012;28(3):178-87.
- Pattanshetty RB, Gaude G. Effect of multimodality chest physiotherapy in prevention of ventilator-associated pneumonia: a randomized clinical trial. *Indian journal of critical care medicine: peer-reviewed, official publication of Indian Society of Critical Care Medicine*. 2010;14(2):70.
- Carvalho CR, Paisani DM, Lunardi AC. Incentive spirometry in major surgeries: a systematic review. *Brazilian Journal of Physical Therapy*. 2011;15(5):343-50.
- Freeman R, Maley K. Mobilization of intensive care cardiac surgery patients on mechanical circulatory support. *Crit Care Nurs Q*. 2013;36(1):73-88.
- Tariq MI, Khan AA, Khalid Z, Farheen H, Siddiqi FA, Amjad I. Effect of Early 3 Mets (Metabolic Equivalent of Tasks) of Physical Activity on Patient's Outcome after Cardiac Surgery. *Journal of the College of Physicians and Surgeons Pakistan*. 2017;27(8):490-4.
- Westerdahl E. Optimal technique for deep breathing exercises after cardiac surgery. *Minerva Anestesiologica*. 2015;81(6):678-83.