Chettinad Health City Medical Journal
Volume 12, Issue 3 - 2023, Pg. No. 45-49
Peer Reviewed & Open Access Journal

Research Article

Effectiveness of Balloon-blowing Exercises and Incentive Spirometry in Chest Intubated Patients

Sidhant Darekar[1], Poonam Patil[2]

[1]Intern, Faculty of Physiotherapy, Krishna Vishwa Vidyapeeth, Malkapur, Karad, Maharashtra, India.
[2]Assistant Professor, Department of Cardiopulmonary Physiotherapy, Faculty of Physiotherapy, Krishna Vishwa Vidyapeeth, Malkapur, Karad, Maharashtra, India.
DOI: https://doi.org/10.24321/2278.2044.202350

I N F O

Corresponding Author:
Patil P, Department of Cardiopulmonary Physiotherapy, Faculty of Physiotherapy, Krishna Vishwa Vidyapeeth, Malkapur, Karad, Maharashtra, India.
E-mail Id:
drppatil8388@gmail.com
Orcid Id:
https://orcid.org/0009-0000-0477-4239
How to cite this article:
Darekar S, Poonam P. Effectiveness of Balloon-blowing Exercises and Incentive Spirometry in Chest Intubated Patients.Chettinad Health City Med J. 2023;12(3):45-49.

Date of Submission: 2023-05-02
Date of Acceptance: 2023-06-03

A B S T R A C T

Objective: The present study was done to compare the impact of balloon-blowing exercises (BBE) with incentive spirometry in chest intubated patients of the older age group and to compare their efficacy in improving chest expansion as well as peak expiratory flow rate (PEFR).

Methodology: A sample size of 30 patients was calculated. 15 participants were allotted to Group A and 15 to Group B with the simple random sampling technique. Data were obtained at the beginning of the session and at the end of the 4th week post-exercise session using an inch tape and a peak flow meter. Group A carried out regular respiratory physiotherapy and incentive spirometry whereas, Group B carried out regular respiratory physiotherapy and BBE in chest intubated patients.

Results: The results showed that the post-test statistical values in the experimental group were greater than those in the control group, implying that routine physiotherapy treatment along with BBE has a significant difference in the positive effect on outcome measures in the study population.

Conclusion: Based on the analysis of the results obtained, the present study concluded that balloon-blowing exercises and regular chest physiotherapy treatment were more effective in improving chest expansion and PEFR as compared to incentive spirometry and respiratory physiotherapy to overcome postoperative pulmonary complications in chest intubated patients of the older age group.

Keywords: Balloon Blowing Exercises, Incentive Spirometry, Respiratory Physiotherapy, Chest Intubated Patients, Older Age Group, Chest Expansion, Peak Expiratory Flow Rate

Introduction

In thoracic surgery, the most commonly performed surgery is tube thoracostomy or chest intubation.[1] Although the mechanism of injury does not alter the chest tube management, the severity of complications depends on the severity of the injury.[2] Tube thoracostomy is the insertion of a chest tube into the pleural cavity in order to drain blood, air, pus, bile, etc.[3] According to Iyer et al., 12% of the world's burden of disease accounts for trauma. Of all trauma victims, 50% are chest trauma cases and account for 25% of the total number of deaths.[4]

The most common procedure used in the treatment of traumatic injuries is tube thoracostomy.[2] In post-thoracic surgery, the patients face morbidity and mortality majorly due to complications in the lung.[5] Patients who undergo thoracic surgery are usually high-risk patients, which include cases of acute lung injury, acute respiratory distress syndrome, empyema, and stroke. Patients of older age groups having medical conditions and poor physical well-being, which may be due to malnutrition or any underlying disease are also at high risk.[5]

Hypoxemia, atelectasis, respiratory dysfunction, and pleural effusion are common postoperative complications.[6] The basic reason behind reduced lung expansion is an alteration in breathing pattern due to postoperative pain resulting in reduced excursion of the respiratory muscles.[7] Pulmonary infection results from a decrease in ventilation due to impaired lung expansion, collapse, and accumulation of secretions.[8]

Impairment in respiratory mechanism and reduced functional capacity are caused by the action of anaesthesia. Due to reduced forced expiratory capacity, lung compliance is reduced resulting in an increase in the effort required for breathing.[9,10] Respiratory physiotherapy is introduced to patients after 24 hours of surgery, i.e., at post-op day 1 to prevent postoperative complications.[11] It reduces postoperative complications and limits hospital stay duration.[11]

Deep inspiratory exercises that have a direct effect on postoperative complications are taught to the patients. 93.9% of physiotherapists recommend incentive spirometry to prevent postoperative pulmonary complications.[12] To prevent alveolar collapse and to maintain maximum functional capacity, incentive spirometry is done. Due to its visual feedback, it improves the accuracy of the patient's breathing pattern.[13] It helps in preventing postoperative complications and also improves pulmonary function through controlled breathing patterns.[14]

Increasing the pulmonary pressure and inspiratory volume is the main aim of incentive spirometry along with improving the performance of muscles on inspiration and controlled breathing patterns. This improves the vital capacity and PEFR. A one-way valve is present in this device to prevent exhalation into the unit. Studies have proven that low, sustained inspiration is more effective in improving pulmonary expansion.[15]

Deep inspiration with deep expiration has a similar effect as deep inspiration alone on post-op atelectasis. For this purpose, BBE is also recommended by thoracic surgeons to achieve the same effect as incentive spirometry.[16] It is also a simple, cost-effective breathing exercise that can be performed without any supervision and improves lung capacities and respiratory function.[17]

An increase in lung capacity and improvement in the lung's ability to maintain a sufficient supply of oxygen can be achieved by daily blowing up to 10-15 balloons. Muscles provide themselves with energy reserves when sufficient oxygen is available for the lungs to process, which allows the patients to continue with the exercise. Other postoperative pulmonary rehabilitation activities include breathing exercises, chest percussion, and huffing-coughing techniques.[18]

Reduced chest expansion and PEFR are major postoperative pulmonary complications. A study done by Sathe and Bhandare concluded that both flow and volume-controlled spirometry had an effect on PEFR.[13,15]

Another study done by Kanniappan et al. found an improvement in PEFR after the application of BBE, which is a non-dependent exercise that is found to be effective in improving lung capacities and pulmonary functions.[16,17,19]

Hence, the main aim of this study was to compare the effects of incentive spirometry and BBE in older patients who had undergone chest intubation on improving chest expansion and PEFR. To improve cardio-pulmonary endurance and other issues related to respiratory muscle mechanics, balloon-blowing exercises (BBE) are widely recommended by many fitness trainers as well as surgeons.

Methodology

The objective of this study was to compare the effects of incentive spirometry and BBE on chest expansion as well as PEFR in chest intubated patients of the older age group. This comparative study was conducted in Krishna Hospital and Research Centre, Karad from June 2022 to January 2023. The study was approved by the Institutional Ethics Committee of Krishna Vishwa Vidyapeeth, deemed to be University, Karad.

A sample size of 30 was calculated using the simple random sampling method. The study population included both male and female patients between the ages of 50 and 65 years. According to the inclusion criteria, patients who had undergone chest intubation and who were willing to participate voluntarily were selected for this study. Patients who had associated cardiac pathologies or dysfunction, or those who had undergone pneumonectomy, had oral lesions or were unwilling to participate were excluded from this study.

The patients were divided into two groups, Control Group A and Experimental Group B which included 15 patients each. Group A patients were trained to perform incentive spirometry and Group B patients were asked to perform

ISSN: 2278-2044
DOI: https://doi.org/10.24321/2278.2044.202350

BBE. In the data collection procedure, a form was filled out which included the demographic data of the patient, i.e., name, age, gender, and BMI. The clinical form included chest expansion (cm) and PEFR (L/min). Instat software was used for the analysis of the data.

Procedure

Group A (N = 15) received routine physiotherapy treatment, which included breathing exercises, along with incentive spirometry. After performing breathing exercises, patients from Group A were asked to perform deep breathing exercises through an incentive spirometer with proper rest intervals between two breaths. The patients were asked to perform this exercise two times a day for a total of five days a week for one month. The subjects were made to sit in a comfortable position, mostly in the semi-Fowler's position with relaxed shoulders.

Group B (N = 15) received routine physiotherapy treatment followed by BBE. The patients were asked to perform deep breathing through the BBE with proper rest intervals between two breaths. Commercially available balloons measuring five inches were used for this exercise. Patients were asked to blow a balloon 10 times a day. A new balloon was used every day as repeated use reduced the resistance of the balloon required for training the respiratory muscles.

The PEFR and chest expansion of the patients were measured before as well as after the session. Chest expansion data were obtained using an inch tape and a peak flow meter was used to measure the PEFR of the patients. Data were collected at the beginning of the exercise session and at the end of the session.

Results

Table 1 shows that among the 30 participants, 23 (76.6%) participants belonged to the age group of 50–60 years, whereas 7 (23.3%) participants were between 61 and 65 years of age. Out of 30 participants, 18 (60%) were male and 12 (40%) were female. Table 1 also describes that 11 (36.6%) participants were underweight, 16 (53.3%) had normal BMI, and 3 (10%) patients fell in the overweight category.

Group A and Group B demographic variables have been described in Table 2. Ten patients were in the age group of 50–60 years and 5 patients were between 61 and 65 years of age in Group A. This group had 6 male and 9 female patients. In Group B, 13 patients were in the age group of 50–60 years and 2 patients were between 61 and 65 years of age. This group had 12 male and 3 female patients.

The statistical data of pre-test and post-test results of chest expansion in both the study groups have been presented in Table 3. In Group A, the mean values of chest expansion were 1.46 ± 0.516 cm and 2.16 ± 0.459 cm in the pre-test and post-test, respectively. Paired 't' test showed that the statistical difference was extremely significant. In Group B, the mean values before and after the intervention were 1.34 ± 0.442 cm and 3.77 ± 0.502 cm, respectively. Paired 't' test statistically showed an extremely significant difference.

The statistical data of pre-test and post-test results of peak expiratory flow rate (PEFR) in both the study groups have been described in Table 4. In Group A, the mean values of PEFR were 294 ± 67.38 L/min and 321 ± 63.90 L/min in the pre-test and post-test, respectively. The statistical difference was found to be extremely significant using paired 't' test. In Group B, the mean values were found to be 262 ± 72.32 L/min and 523 ± 66.72 L/min, respectively. Paired 't' test showed that the statistical difference was extremely significant.

Analysis of the mentioned outcome measures of the present study showed that the post-test statistical values in the experimental group were greater than those in the control group, concluding that routine physiotherapy treatment along with BBE shows a significant difference in the positive effect on outcome measures in the study population (Tables 3 and 4).

Table 1.Demographic Variables of Participants

Variables	No. of Participants	Percentage of Participants
Age (years)		
50–60	23	76.6
61–65	7	23.3
Gender		
Male	18	60.0
Female	12	40.0
BMI		
Under weight	11	36.6
Normal	16	53.3
Over weight	3	10.0

Table 2.Demographic Variables of Participants as per the Two Groups

Variables	Control Group (N = 15)	Experimental Group (N = 15)
Age (years)		
50–60	10	13
61–65	5	2
Gender		
Male	6	12
Female	9	3

ISSN: 2278-2044
DOI: https://doi.org/10.24321/2278.2044.202350

Table 3.Pre-test and Post-test Mean Values of Chest Expansion in Control and Experimental Groups

Groups	Pre-test Chest Expansion Values (cm)	Post-test Chest Expansion Values (cm)	p Value	t Value	Significance
Group A	1.46 ± 0.516	2.16 ± 0.459	0.0001	6.808	Extremely significant
Group B	1.34 ± 0.442	3.77 ± 0.502	0.0001	16.205	Extremely significant
Significance	Not significant	Extremely significant	-	-	-

Table 4.Pre-test and Post-test Mean Values of Peak Expiratory Flow Rate (PEFR) in Control and Experimental Groups

Groups	Pre-test PEFR Values (L/min)	Post-test PEFR Values (L/min)	p Value	t Value	Significance
Group A	294 ± 67.38	321 ± 63.90	0.0001	5.344	Extremely significant
Group B	262 ± 72.32	523 ± 66.72	0.0001	13.116	Extremely significant
Significance	Not significant	Extremely significant	-	-	-

Discussion

The muscles that help in respiration can be trained to increase their function and capacity by incentive spirometry and BBE. However, BBE has been found to be more cost-effective than incentive spirometry.

The present study compared the effects of incentive spirometry and BBE on improving chest expansion and PEFR in chest intubated patients of the older age group. The findings of this study showed that BBE along with regular chest physiotherapy treatment was effective on the mentioned outcome measures.

A randomised controlled study done by Rafaqat et al. found that the differences observed before and after the treatment were significant in both incentive spirometry and BBE group and showed significant improvement in breathlessness, Forced Vital Capacity (FVC), Forced Expiratory Volume (FEV1), saturation of peripheral oxygen (SPO_2), respiratory rate (RR), and chest expansion. Hence, the study concluded that both incentive spirometry and BBE were equally effective.[16]

Another randomised controlled study done by Malik et al. to compare the effect of routine physiotherapy treatment along with additional incentive spirometry with routine physiotherapy treatment following lung resection in lowering postoperative pulmonary complications showed that incentive spirometry along with routine postoperative physiotherapy does not reduce the incidence of postoperative pulmonary complications.[20]

A comparative interventional study done by Sathe and Bhandare concluded that both flow-targeted and volume-targeted spirometry were found to be effective in improving single breath count and PEFR in post-sternotomy patients whereas, in this present study, incentive spirometry along with routine physiotherapy treatment was found to be less effective compared to BBE with routine respiratory physiotherapy in improving PEFR.[15]

Conclusion

The findings of this study concluded that balloon-blowing exercise with routine chest physiotherapy treatment was found to be more effective in improving chest expansion and peak expiratory flow rate as compared to incentive spirometry along with respiratory physiotherapy in overcoming postoperative pulmonary complications in chest intubated patients of older age.

Source of Funding: None

Conflict of Interest: None

References

1. Kesieme EB, Dongo A, Ezemba N, Irekpita E, Jebbin N, Kesieme C. Tube thoracostomy: complications and its management. Pulm Med. 2012;2012:256878. [PubMed] [Google Scholar]
2. Menger R, Telford G, Kim P, Bergey MR, Foreman J, Sarani B, Pascual J, Reilly P, Schwab CW, Sims CA. Complications following thoracic trauma managed with tube thoracostomy. Injury. 2012;43(1):46-50. [PubMed] [Google Scholar]
3. Mattox KL, Allen MK. Systematic approach to pneumothorax, haemothorax, pneumomediastinum and subcutaneous emphysema. Injury. 1986 Sep;17(5):309-12. [PubMed] [Google Scholar]
4. Iyer S, Singh M, Jathen V. Study of epidemiology and outcome of chest trauma at an apex tertiary care trauma centre. Int Surg J. 2018;5(11):3621-6. [Google Scholar]
5. Sengupta S. Post-operative pulmonary complications

after thoracotomy. Indian J Anaesth. 2015;59(9):618-26. [PubMed] [Google Scholar]
6. Kumar AS, Alaparthi GK, Augustine AJ, Pazhyaottayil ZC, Ramakrishna A, Krishnakumar SK. Comparison of flow and volume incentive spirometry on pulmonary function and exercise tolerance in open abdominal surgery: a randomized clinical trial. J Clin Diagn Res. 2016 Jan;10(1):KC01. [PubMed] [Google Scholar]
7. Zikria BA, Sencer JL, Kinney JM, Broell JR. Alterations in ventilatory function and breathing patterns following surgical trauma. Ann Surg. 1974 Jan;179(1):1-7. [PubMed] [Google Scholar]
8. Alexander JI, Spence AA, Parikh RK, Stuart B. The role of airway closure in postoperative hypoxaemia. Br J Anaesth. 1973 Jan;45(1):34-40. [PubMed] [Google Scholar]
9. Berthoud MC, Reilly CS. Adverse effects of general anaesthetics. Drug Saf. 1992;7(6):434-59. [PubMed] [Google Scholar]
10. Clarke RS. Adverse effects of intravenously administered drugs used in anaesthetic practice. Drugs. 1981 Jul;22(1):26-41. [PubMed] [Google Scholar]
11. Pakzad R, Mohammadian-Hafshejani A, Ghoncheh M, Pakzad I, Salehiniya H. The incidence and mortality of lung cancer and their relationship to development in Asia. Transl Lung Cancer Res. 2015;4(6):763. [PubMed] [Google Scholar]
12. Kim ES, Kim YT, Kang CH, Park IK, Bae W, Choi SM, Lee J, Park YS, Lee CH, Lee SM, Yim JJ, Kim YW, Han SK, Yoo CG. Prevalence of and risk factors for postoperative pulmonary complications after lung cancer surgery in patients with early-stage COPD. Int J Chron Obstruct Pulmon Dis. 2016;11:1317. [PubMed] [Google Scholar]
13. Yang CF, Meyerhoff RR, Mayne NR, Singhapricha T, Toomey CB, Speicher PJ, Hartwig MG, Tong BC, Onaitis MW, Harpole Jr DH, D'Amico TA, Berry MF. Long-term survival following open versus thoracoscopic lobectomy after preoperative chemotherapy for non-small cell lung cancer. Eur J Cardiothorac Surg. 2016;49(6):1615-23. [PubMed] [Google Scholar]
14. Restrepo RD, Wettstein R, Wittnebel L, Tracy M. Incentive spirometry: 2011. Respir Care. 2011 Oct 1;56(10):1600-4. [PubMed] [Google Scholar]
15. Sathe AM, Bhandare SA. Comparison of effect of flow and volume incentive spirometry on peak expiratory flow rate and single breath count in post sternotomy. Int J Health Sci Res. 2022;12(8):167-80. [Google Scholar]
16. Rafaqat A, Mushtaq Z, Tahir A, Shahzad MF. Comparison between balloon blowing exercise and incentive spirometry in patients with chest intubation after trauma. J Nov Physiother. 2016;S3:013. [Google Scholar]
17. Bargahi M, Rastgoo N, Aryanejad F, Esmaielzade S, Nemati R, Ghaebi M, Bajelan A, Soltani S. Effect of balloon-blowing on dyspnea and oxygenation in hospitalized COVID-19 patients: a pilot study. Acta Med Iran. 2022;60(6):338-44. [Google Scholar]
18. Ghani HM, Obaid S, Bhatti ZM, Razzaq M, Razzaq M, Niaz A, Waris S. Comparison of balloon-blowing exercise and incentive spirometry after thoracotomy. Pak J Med Health Sci. 2022;16(1):486-9. [Google Scholar]
19. Kanniappan V, Manivannan V. Efficacy of balloon blowing exercise on peak expiratory flow rate in young adult smokers. J Lifestyle Med. 2020 Jul 31;10(2):116-20. [PubMed] [Google Scholar]
20. Malik PR, Fahim C, Vernon J, Thomas P, Schieman C, Finley CJ, Agzarian J, Shargall Y, Farrokhyar F, Hanna WC. Incentive spirometry after lung resection: a randomized controlled trial. Ann Thorac Surg. 2018;106(2):340-5. [PubMed] [Google Scholar]

ISSN: 2278-2044
DOI: https://doi.org/10.24321/2278.2044.202350