

# Comparison of Balloon-Blowing Exercise and Incentive Spirometry after Thoracotomy

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## ABSTRACT

**Objective:** The objective of this study is to compare effect of balloon blowing exercise & incentive spirometer on Chest expansion, Improvement in lung volumes and capacities, Level of dyspnoea, and on Improvement in progression of walk in post-thoracotomy stable patients.

**Study Design:** Randomized Controlled Trial

**Place and Duration of Study:** Study was conducted in thoracic surgical ICU of Gulab Devi Hospital, Lahore for the period of 6 months from September 2018 - February 2019.

**Patients and Methods:** The sample size was calculated through Open Epi, and it was 48. 24 subjects were assigned to control group A and 24 to experimental group B through non-purposive random sampling technique. Data was collected at base line, 3<sup>rd</sup> and 5<sup>th</sup> day after exercise therapy on above stated outcome measures, by using Tape Measure, Digital Spirometer, RPE Scale and Pedometer respectively, from non-critical post-thoracotomy patients. Control Group-A performed routine respiratory physiotherapy + incentive spirometry and Experimental Group- B performed routine respiratory physiotherapy + balloon blowing exercise.

**Results:** BBE + routine respiratory physiotherapy was found equally effective on mentioned outcome measure as Incentive Spirometry + routine respiratory physiotherapy in stated patients. ( $P > 0.05$ )

**Conclusion:** Based upon statistical analysis, it can be concluded that incentive spirometer can be replaced with balloon-blowing exercise with conventional/routine respiratory physiotherapy in thoracotomy patients who have lung surgeries, to overcome post-op pulmonary complications or to achieve the same outcomes as that of incentive spirometer.

**Keywords:** BBE, Incentive Spirometer, Routine Respiratory Physiotherapy, Post-Thoracotomy Patients.

## INTRODUCTION

With advancement of surgical techniques, open-Thoracotomy due to its easy and good access to thoracic organs, is still being used today mainly as a curative surgical procedure for various cardiopulmonary diseases, such as CABG, COPD, TB, pulmonary infections and lung cancers. It is most commonly used surgical procedure for lung cancers to preserve function of remaining healthy lung tissue by doing lung resection following thoracotomy. (1) To prevent post-op pulmonary complications, respiratory physical therapy introduced to patients at post-op day 1<sup>st</sup>. It reduces PPC (post-op pulmonary complications), limit LOS (length of hospital stay), and improve patient outcomes. Routinely used post-op respiratory physiotherapy includes position change, breathing exercises, coughing and ambulation as postoperative recovery programs (2).

In routine indoor physiotherapy, deep inspiratory exercises are instructed to post-op lung resected patients, because these exercises have direct effect on post-op pulmonary complications, especially on lobar atelectasis by improving post-op lung capacity. So 93.9% physical therapists recommend incentive spirometer for this purpose as a deep inspiratory device, so that post-op pulmonary complications can be prevent or pulmonary functions improvement can make fast.(3) Incentive spirometer is a visual feedback respiration device mainly used primarily to

prevent alveolar collapse and atelectasis, to maintain maximum pulmonary function capacity. Due to its visual feedback, it maximizes accuracy of patient's breathing pattern. Though, patients may feel difficulty in its using due to post-op thoracotomy pain, and due to decreased pulmonary functions after surgery. (4) However, incentive spirometer is a must component of routine respiratory physiotherapy in post-op thoracotomy patients, despite of being expensive for the non-affording patient.

According to today knowledge of respiratory mechanics, recommendation of deep inspiration plus deep expiration, that is full breathing cycle puts the same effect as only deep inspiration does on post-op lobar atelectasis, but it is more comfortable for patient as it follows normal breathing cycle (5). For this purpose, today Balloon-Blowing Exercise is also recommended by thoracic surgeons to achieve the same effect as of incentive spirometer in post-op thoracotomy patients. Daily routine of blowing up to 10-15 balloons with 3-5 seconds resting interval between each blowing up of balloon increases lung capacity and amplifies the lung's ability to maintain a sufficient supply of oxygen. When a person becomes able to blow up balloon with his full lung capacity without becoming breathless and fatigued, more oxygen supplied to the body or lung tissues and carbon dioxide removed. When plenty of oxygen able to be processed by lungs, muscles provide themselves with

energy reserves that permit subjects to continue a workout session <sup>(6)</sup>.

Despite tremendous increase in lung surgeries via thoracotomy due to various underlying lung conditions, such as lung cancers and chronic lung inflammatory disease, these post-op patients are neglected for the regular services of proper physical therapy rehabilitation. Daily used routine post-op pulmonary rehab protocol in major hospitals includes Deep Breathing Exercises, Chest Physio/percussion, Huffing & Coughing techniques and mobilization <sup>(7)</sup>. Among predictors of discharge from hospital include patient's capacity of lung expansion and progression in walk after thoracotomy. And for this purpose, Incentive spirometer a major part of pulmonary rehab protocol and is conventionally being used to achieve these outcomes from many years in the field of respiratory physical therapy <sup>(8)</sup>.

This is main reason that this current study was conducted to compare the effects of incentive spirometer and that of balloon blowing exercise on mentioned outcome measures and thus to facilitate the poor patient of Pakistan, who cannot afford incentive spirometer, and also because till now there is no research available making a comparison between balloon blowing exercise and incentive spirometer in patients who had undergone pulmonary resection following thoracotomy due to non-small cell lung cancers. Today, Balloon-Blowing Exercise is being widely recommended by physical fitness trainers and thoracic surgeons of foreign countries and even of Pakistan as a playing tool to build-up cardiopulmonary endurance and some other health issues related to respiratory muscles mechanics. Daily routine of blowing up 10-15 balloons increases lung capacity and also it amplifies the lung's ability to maintain a sufficient supply of oxygen. Researchers say that the more oxygen supplied to the body during ballooning exercise, the longer a trainer is able to exercise without becoming breathless and fatigued. Oxygen restores energy to cells and muscles by removing carbon dioxide. When plenty of oxygen is able to be processed by lungs, muscles equip themselves with energy reserves that permit trainers to continue a workout session.<sup>(9)</sup>

## PATIENTS AND METHODS

In this single blinded randomized control trial study; Non-Probability Purposive sampling method technique was used, and data was collected from thoracic surgical ICU of Gulab Devi Hospital, Lahore for a period of 6 months from September 2018 February 2019. 48 (sample size was calculated by Open Epi.) post-thoracotomy (lobectomy, decortications) stable patients of both genders) having age of 15-55 years were randomly allocated in two groups i.e.; Control Group A (n=24) and Experimental Group B (n=24) via sealed envelope method. Critical patients having disturbed vitals or associated cardiac pathologies or dysfunction, pneumonectomy, or patients with oral lesions excluded from this study.

Group A (n=24) received the routine respiratory physiotherapy + Incentive spirometer. After performing deep breathing exercise, patients of control group A were asked to perform 5 out of 10 time's deep breathing exercises through incentive spirometer in each session with

3-5 seconds resting interval between two successive breaths, twice a day for total five days of week. Group B (n=24) patients received routine respiratory physiotherapy + BBE. After deep breathing exercise, group B patients were asked to perform balloon blowing exercise (BBE). They performed 5 out of 10 time's deep inspiration and deep expiration through BBE in each one session with 3-5 seconds resting interval between two successive deep breaths. Patients were encouraged to inflate the balloon to their easy of inspiration and then expiration. Commercially available balloons of good quality were used for experimentation. One balloon was blown 10 times a day and was disposed of due to decrease in resistance on the basis of subjective assessment.

Digital Spirometer was used to take readings of FEV1, FVC and FEV1/FVC in percentages. In-elastic Tape Measure was used to collect data on chest expansion size. Dyspnea Borg scale-RPE (0-10) was used in this study to evaluate dyspnea or RPE score in studied post-op patients of both groups. 0 being dyspnea at rest level. Pedometer was used in this study as a counting tool for steps walked by studied post-op thoracotomy patients. Patients Performa having Baseline Measures. Data was collected of both groups after second session of therapy at day 1<sup>st</sup>, day 3<sup>rd</sup> and day 5<sup>th</sup>. Data was analyzed using SPSS-23 (Statistical Package for Social Sciences). To check normality of data, Shapiro-Wilk test for normality was applied. Data was non-normal (p-value<0.05), so Mann-Whitney U Test for statistical analysis between control and experimental group was applied.

## RESULTS

Table 1:

EXPERIMENTAL GROUP(n=24)		CONTROL GROUP (n=24)	
Variable	Mean ± SD	Variable	Mean ± SD
Age (yr.)	34.54 + 14.65	Age(yr.)	35.50+ 12.53
BMI (kg/m <sup>2</sup> )	1.66 + 0.63	BMI (kg/m <sup>2</sup> )	1.66 + 0.76

When demographic data of studied patients in this study was statistically analyzed, results showed that age, and BMI was almost same of both group patients (Table 1)

Table 2:

Comparison between control and experimental group; Mann-Whitney U test			
	Control Group (Mean Rank)	Experimental Group (Mean Rank)	P-Value
<b>Forced Vital Capacity</b>			
FVC at Day 1 <sup>st</sup>	25.54	23.37	0.87
FVC at Day 3 <sup>rd</sup>	21.98	27.24	0.18
FVC at Day 5 <sup>th</sup>	23.42	25.67	0.56
<b>Forced Expiratory Volume in 1<sup>st</sup> second (FEV1)</b>			
FEV1 Day 1	24.76	24.22	0.89
FEV1 Day 3	23.90	25.15	0.75
FEV1 Day 5	23.92	25.13	0.76
<b>FEV1/FVC</b>			
FEV1/FVC Day 1	22.72	26.43	0.34
FEV1/FVC Day 3	26.12	22.74	0.39
FEV1/FVC Day 5	27.94	20.76	0.07

Table 3:

Comparison between control and experimental group; Mann-Whitney U test			
	Control Group (Mean Rank)	Experimental Group (Mean Rank)	P-Value
<b>Pedometer(improvement in walked steps)</b>			
Improvement in walk Day 1	23.68	25.39	0.62
Improvement in walk Day 3	25.36	23.57	0.65
Improvement in walk Day 5	25.54	23.37	0.59
<b>Borg Scale (RPE)</b>			
Borg scale score Day 1	23.00	26.13	0.06
Borg Scale score day 3	23.22	25.89	0.42
<b>Chest Expansion Size</b>			
Chest expansion size day 1	23.20	35.91	0.30
Chest expansion size Day 3	23.48	25.61	0.46
Chest expansion size Day 5	28.28	20.39	0.06

Between group statistical analysis through Mann-Whitney U test on different stated outcome measures of this study through illustrate that P- values of all variables are greater than 0.05 for all three days, concluding that respiratory physical therapy including BBE and respiratory physical therapy including incentive spirometer have no statistically significant difference in producing their positive effects on mentioned outcome measures in studied patient population ( $p > 0.05$ ). (Table 2, 3)

**DISCUSSION**

Lungs, like muscles, can be exercised to increase its function and capacity by balloon blowing and incentive spirometry. Balloon blowing is less expensive technique as compared to incentive spirometry. There is a vast literature available on various pulmonary rehabilitation exercises having a positive impact on post-op pulmonary complications, however, there is no literature available having comparison between effects of incentive spirometer and BBE in stable thoracotomy patients without any trauma.

This study compared the effects of BBE therapy and incentive spirometer therapy on different stated outcome measures in stable thoracotomy patients. The findings of this study showed that there is no statistical significant difference between effects of two respiratory exercise therapy protocols on studied outcome measures.

A comparative RCT study on effectiveness of Balloon Blowing exercise and incentive spirometry in patients with chest intubation after trauma was conducted in 2016 by Ali Rafaqat in Department of Health Management, European University of Lefke, North Cyprus, concluded that the pre and post treatment differences in incentive spirometry group and balloon blowing group found a significant improvement in breathlessness with the p-value 0.00 for FVC, FEV1, SPO, RR and Chest Expansion. So conclusion of this study support our study that both

incentive spirometry and balloon blowing exercise are equally effective.

A single blinded RCT conducted by PETER R.A to make a comparison between routine pulmonary rehab exercises versus incentive spirometer in 2014-2017 in adults undergoing after lung resection following thoracotomy. Results showed that there was no significant difference between the deep breathing exercise and incentive spirometer. They researchers concluded that the addition of IS to routine postoperative physiotherapy does not reduce the incidence of PPC after lung resection<sup>(10)</sup>.

Therefore, the main purpose of this study was to determine whether routine respiratory physiotherapy including balloon blowing exercise would produce the same or better effect as compared to respiratory physiotherapy including incentive spirometer on concerned outcome measures in studied patients.

Seong-Dae, et al conducted RCT in 2016 on “the effects of breathing with mainly inspiration or expiration on pulmonary function and chest expansion”. RCT concluded that exhalation or inhalation exercises as well as combined exhalation and inhalation exercises can help to improve pulmonary function.<sup>(11)</sup>

Thus, in balloon-blowing exercise with firstly deep inspiration and then deep expiration mechanics has no different or negative effect on pulmonary rehab in mentioned outcome measures in studied patients than that of only deep inspiratory mechanics as used in incentive spirometer.

Kyndall L. et al gave clinical suggestion on “The Value of Blowing up a Balloon” in Sep 2010 by conducting a quasi-experimental study to evaluate the effect of balloon-blowing exercise on post-thoracotomy pain. Their study results showed that breathing through balloon blowing exercise further relaxed the neuromuscular system/parasympathetic nervous system and generally decrease resting muscle tone causing decrease in post-op thoracotomy pain.<sup>(12)</sup>

Therefore, it is anticipated that this conducted RCT study will be valuable in terms that it tried to use balloon-blowing exercise as counter part of incentive spirometer to achieve same outcomes with addition of mobilization/walking steps in stable thoracotomy patients without putting burden on Pakistan’s poor patient’s pocket and also by fulfilling the compliance gap of aged patient

**CONCLUSION**

The findings of this study conclude that BBE and routinely done respiratory physical therapy is equally effective on mentioned outcome measures as incentive spirometer and respiratory physical therapy, in studied patients. Therefore, it can be suggested that BBE can be recommended as an alternative to incentive spirometer to overcome post-op pulmonary complications.

**Limitations of Study:**

- Study set up was government in which patients were not so co-operative and we had to make efforts to fully implement the exercise protocol.
- There was no follow-up of patients in this conducted study for longer period of time.

- Biomarkers of patients, like ABGs were not studied in this study because it was not permitted because of stability of studied post-op patients.
- Simple commercially available balloons of good quality were used in this study, because there is no study available yet on standardization of balloons regarding use in respiratory physiotherapy.

**Recommendations:** It is recommended for future researchers to conduct this study on different population of cardiopulmonary patients, with specific age group, e.g. young or old, with long follow-up so that results could be generalized. Further, study may be conducted in private set-up hospitals also, so that respiratory protocol could be applied in a full way.

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