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Original Article

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An observational study on effect of breathing exercise on quality of recovery among postoperative patients

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Abstract

***Background & Aims*:** Breathing exercises after surgery are crucial in avoiding respiratory complications. These exercises have proven highly effective in improving the recovery quality of post-operative patients. Despite their widespread use in patient care, there is a lack of scientific evidence to prove their effectiveness. Therefore, the current study aims to evaluate the influence of deep breathing exercises on the quality of postoperative recovery in the patients who have undergone emergency surgery.

***Materials & Methods*:** A randomized controlled trial was performed to evaluate the efficiency of deep breathing exercises in post-operative patients who had emergency surgery. The study included 200 participants who met the inclusion and exclusion criteria, with 100 assigned to the experimental group as Group-A and 100 to the control group as Group-B. The patients in the experimental group were taught and practiced deep breathing exercises, while those in the control group received standard treatment. Data were gathered and analysed to compare the SpO_2 level, FVC, FEV1, PEFR, FMEF 25/75%, hospital stay, postoperative complications, and quality of recovery between the two groups. SPSS v.21 was used for the appropriate statistical analysis to check statistical differences between the proportions, and $p<0.05$ considered statistically significant.

***Results*:** The FEV1, FVC, and PFER (25-75%) reduced and did not differ significantly between the two groups, whereas SpO2 level at the 5th day and hospital stay were significantly different in Group-B. Patient with deep breathing exercise (Group-B) did not develop any respiratory complication and had a higher postoperative quality of recovery as compared to Group-A.

***Conclusion*:** We found that that incorporating deep breathing exercises after surgery can also increase lung capacity, prevent post-operative complications, shorten recovery time, and enhance overall quality of life.

***Keywords*:** Deep Breathing Exercise, Emergency Surgery, Post-Operative Pulmonary complications, Post-Operative Quality of Recovery

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Introduction

Postoperative patients may experience various symptoms that can hinder their recovery such as: physical discomfort, psychological distress, emotional instability, and pain (1). When a patient is under general anesthesia during surgery, their lungs are not able to fully ventilate. The discomfort from the incision in the abdomen makes it difficult to breathe in, which reduces lung expansion. This can lead to postoperative pulmonary complications (PPCs), especially when surgery is performed in the upper abdominal area (2). These complications are caused by various changes in pulmonary function and respiratory mechanics such as decreased diaphragm mobility, depressed central nervous system, changes in the ventilation-perfusion ratio, reduced cough efficacy, increased respiratory rate, and reduced pulmonary volumes and capacities (3). The most common PPCs are atelectasis, hypoxemia, and pneumonia, which can affect up to 80% of patients undergoing upper abdominal surgery. These complications increase hospital stay and treatment costs and contribute significantly to mortality (4–8).

Every phase of the postoperative period is crucial, including the immediate care following the surgery, as it sets the groundwork for recuperation and rehabilitation. Regardless of the nature of the operation, recovery after surgery is a critical component of the patient's journey. Therefore, it is necessary to recognize the factors that promote the patient's recovery, beginning from the postoperative recovery unit (9).

Nowadays, different techniques of chest physiotherapy are utilized to boost lung volume, enhance oxygenation, and reduce the likelihood and severity of respiratory complications following surgery (10–12).

Breathing exercises are designed to correct improper breathing, restore a normal breathing pattern, increase diaphragm activity, boost alveolar ventilation, reduce energy expenditure during breathing, and alleviate the shortness of breath experienced by patients after surgery (13, 14). Deep breathing exercises involve specific patterns of breathing that can be combined with movements of the upper limbs and trunk, as well as manipulations of the thoracic cage. The main objective of these exercises is to improve the patient's breathing pattern and increase lung expansion, respiratory muscle strength, functional residual capacity, and inspiratory reserve volume (8, 15).

Despite the widespread use of deep breathing exercises in patient care, there is a lack of scientific evidence supporting their effectiveness (12, 16). Therefore, this study aims to assess the impact of deep breathing exercises on postoperative recovery quality of the patients after surgery.

Materials & Methods

The present prospective and observational study was conducted in the Department of General Surgery Gandhi Medical College and associated Hamidia Hospital, Bhopal M.P., India. The study included 200 patients who underwent emergency surgeries between January 1, 2021 to September 30, 2022. Approval was obtained from the Institutional Ethics Committee, and the patients were fully informed by the investigator in their mother tongue about the aim and objective of the study. Informed consent was taken before their voluntary participation in the study. We included patients without any chronic respiratory complications, operated under general anesthesia, and with Covid negative results at the age group of 18-60 years. Patients on ventilator and iono-tropic support, having chronic respiratory complications, operated under spinal anesthesia, past history of chest trauma, any cardiothoracic and pulmonary related complications, and the patients not giving consent for study were excluded. All the patients were divided in two groups, in Group-A patients received Spirometry, nebulization, chest physiotherapy, and burping, whereas Group-B patients received deep breathing exercises pranayama, Spirometery, nebulization, chest physiotherapy, and burping.

The following tools, instrumentation and procedure were used:

Pulmonary Function Test, Tape measure, Pulse oximeter, Height scale, Weighing machine.

Spirometer: Micro loop spida 5 can measure more than 30 parameters with automatic test interpretation. It has a turbine flow sensor which needs no calibration. It gives results in Balanced Time Perspective Scale (BTPS), because it has its own temperature sensor. The accuracy of the instrument is +/-3%. To ATS recommendations, standardization of spirometry was updated for flows and volumes. A separate sterilized mouth piece was used for every subject.

Pulse oximeter: L&T Pulse oximeter with Nellcore probe was used to record oxygen saturation.

Incentive Spirometry Exercises: Patient should be in an upright sitting position. The incentive spirometer has to be positioned upright for it to show accurate flows. The patient is instructed to exhale to functional residual capacityand then, put the mouthpiece in the mouth and inhale slowly. Ask patient to inhale, so that the ball stays at the top for as long as possible. This exercise is performed 10 times every hourly while awake.

Diaphragmatic Deep Breathing Exercises: Patient was put in one half to three quarters upright sitting position with head and back fully supported, with a pillow under the knees for relaxation of the abdominal wall. Patient's dominant hand should be over mid rectus abdominal area and non-dominant hand on the midsternal area. Patient has to inhale slowly through the nose and is encouraged to direct air so that, dominant hand gradually rises as inspiration continues. Excessive movement should be avoided under the non-dominant hand. This exercise should be performed 10 times every hourly while awake.

Chest Expansion: Chest expansion was measured in a sitting position using a cloth tape at two different levels of the thoracic region, upper and lower part. The hemi-thorax technique was used to measure chest expansion. An assessor fixed the tape measurement at the anterior anatomical marker and another assessor pulled the end of the tape away from subjects' bodies to the posterior maker and keep the cloth tape flat against the subjects' skin. The assessor measured chest expansion at the peak inhalation and peak exhalation for three times in each level. The instruction for chest expansion measurement was "breathe in maximally and make yourself as big as possible" and "breathe out maximally and make yourself as small as possible". The chest expansion was calculated from the end of maximum inspiration minus the end of maximum expiration. The maximum value of the three chest expansion measurement was selected and recorded (17).

Outcome Measures were Forced vital capacity (FVC), Forced Expiratory Volume exhaled in the first second (FEV1), Peak Expiratory Flow Rate (PEFR), and Oxygen Saturation (SpO2).

Postoperative quality scale:

A 40-item questionnaire intended to measure quality of recovery, with items on a five-point Likert scale (for positive items, 1 to none of the time, 5 to all of the time, and for negative items the scoring was reversed). The items were then grouped according to various aspects (dimensions) of recovery: emotional state (n=9), physical comfort (n=12), psychological support (n=7), physical independence (n=5), and pain (n=7).

The total quality of recovery (QoR) score was calculated. Score < 60% of total quality of recovery scores (< 120 scores) considered as "Low quality of recovery", 60-75% of total quality of recovery scores (< 120-150 scores) as "Moderate quality of recovery", and >75% of total quality of recovery scores (> 150 scores) as "High quality of recovery".

Statistical Analysis:

The collected data were noted on a predesigned proforma and compiled in a Microsoft Excel sheet and subsequently analyzed statistically. Descriptive and inferential statistical analyses were carried out in the present study. Results on continuous measurements were presented on Mean ± SD (Min. to Max.) and categorical measurements were presented in Number (%). Quantitative variables were compared using unpaired t-test between the two groups. Qualitative variables were compared using Chi-Square test. The statistical software SPSS version 21 was used for the appropriate statistical analysis to check statistical differences between the proportions, and $p<0.05$ considered as statistically significant level.

Results

A total of 200 cases (Group-A and Group- B; 100 patients in each group) undergone surgery were involved in the study. Table 1 and Table 2 display the baseline characteristics of the patients in both designed groups. At the baseline, all the data of the study participants from both the groups were statistically equal, and distribution among groups with respect to age (p=0.3744), sex (p=0.1272), type of surgery (p=0.7507), smoking habits (p=0.8527), diagnosis (p=0.0536), complications (p=0.4459), chest Auscultation Bilateral Lung Air Entry (p=0.1591), chest auscultation any added lung sounds (p=0.7347), height (cm) (p=0.5441), weight (kg) (p=0.2567), SpO_2 (%) at 1st day (p=0.3559), respiratory rate (per min) (p=0.0840), and BMI (Kg/cm^2) (p=0.0976) were comparable. Hence, patients' characteristics did not influence in the intervention of the study.

Table 1. Patient Characteristics at baseline

Characteristics		Group-A (n=100)	Group-B (n=100)	Total	P* value
Age (Year)	<20 years	4 (4.0)	2 (2.0)	6 (3.0%)	0.3744
	21-30 years	4 (4.0)	8 (8.0)	12 (6.0%)	
	31-40 years	28 (28.0)	34 (34.0)	62 (31.0%)	
	41-50 years	64 (64.0)	56(56.0)	120 (60.0%)	
Sex	Female	36 (36.0)	26 (26.0)	62 (31.0%)	0.1272
	Male	64 (64.0)	74 (74.0)	138 (69.0%)	
Smoking history	No	82 (82.0)	83 (83.0)	165 (82.5%)	0.8527
	Yes	18 (18.0)	17 (17.0)	35 (17.5%)	
	Mean	**SD**	**Mean**	**SD**	**P^a**
Height (cm)	165.04	8.53	165.82	9.58	0.5441
Weight (kg)	60.50	8.98	62.12	11.04	0.2567
BMI (Kg/cm2)	22.84	3.47	23.71	3.96	0.0976
SpO_2 (%) at 1st day	94.34	1.57	94.1400	1.47	0.3559
Respiratory rate (Per min)	16.68	0.95	16.92	1.00	0.0840

P* - Chi square test, P^a T-test

Table 2. Type of Surgery, Diagnosis, and Complications between groups

Characteristics		Group-A (n=100)	Group-B (n=100)	P value
Type of Surgery	Emergency	74 (74.0)	72 (72.0)	0.7507
	Routine	26 (26.0)	28 (28.0)	
Diagnosis	Blunt trauma abdomen	22 (22.0)	38 (38.0)	0.0536
	CA bladder	12 (12.0)	8 (8.0)	
	obstructed umbilical hernia	10 (10.0)	10 (10.0)	
	perforation peritonitis	10 (10.0)	10 (10.0)	
	SAIO with Koch's abdomen	8 (8.0)	12 (12.0)	
	SAIO with perforation	12 (12.0)	8 (8.0)	
	SAIO with SMA thrombosis	16 (16.0)	4 (4.0)	
	Splenomegaly	10 (10.0)	10 (10.0)	

Characteristics		Group-A (n=100)	Group-B (n=100)	P value
Complications	Pleural Effusion	4 (40.0)	2 (20.0)	0.4459
	Post op lung atelectasis	0 (0.0)	2 (20.0)	
	Pulmonary Edema	4 (40.0)	4 (40.0)	
	Pulmonary Pneumonia	2 (20.0)	2 (20.0)	

P - Chi square test

Comparison of the Groups:

Table 3 displays the comparative characteristics of the patients between the groups. In the present study, mean Blood Oxygen Saturation level (SpO_2 %) in Group-A and B, were 94.34% and 94.14%, respectively. In group-A, mean FVC, FEV1, PEFR and FMEF (25/75%) were observed as 3.28, 3.79, 7.51, and 3.32, respectively, whereas in group-B, these were 3.31, 3.79, 7.47, and 3.23, respectively. The two groups with regard to SpO_2 % at 3rd day (p=0.0668), FVC (p=0.5531), FEV1 (p=0.3522), PEFR (p=0.7550), and FMEF (25/75%) (p=0.3402) were statistically insignificant (p>0.05), so the data were comparable between groups. Statistically significant difference was observed in mean SpO_2 % at 5th day (Group-A, 95.86±1.38; Group-B, 96.31±1.29; p=0.0668) and hospital stay days (Group-A, 5.76 days and Group-B, 5.51 days; p=0.0193). The postoperative quality of recovery score among the studied patients revealed that 16% of group-A and 30% of group-B patients had a high score of quality of postoperative recovery (Figure 1). In majority, moderately scores were observed in 37% and 52% of the patients in both groups respectively, whereas 47% and 18% had low quality score respectively. The difference between two groups with regard to the quality of postoperative recovery was statistically significant (p<0.0001).

Table 3. Comparison of lung functions and Hospital stay between the groups after breathing exercises

Variable		Group-A (n=100)	Group-B (n=100)	P Value
SpO_2 Level (%)- 3rd day		95.15±1.42	95.51±1.38	0.0668 [a]
SpO_2 Level (%)- 5th day		95.86±1.38	96.32±1.29	0.0158 [a,*]
FVC		3.288±0.33	3.31±0.30	0.5531[a]
FEV1		3.79±0.25	3.832±0.26	0.3522[a]
PEFR		7.51±0.95	7.47±0.98	0.7550[a]
FMEF 25/75%		3.32±0.67	3.24±0.65	0.3402[a]
Hospital Stay (No. of days)		5.76±0.71	5.51±0.78	0.0193 [a,*]
Chest auscultation Bilateral Lung Air Entry	B/L equal	53 (53.0)	42 (42.0)	0.1591[b]
	B/L Reduced	37 (37.0)	40 (40.0)	
	Decrease on Lt side	10 (10.0)	18 (18.0)	
Chest auscultation any added lung sounds	Crepts	24 (24.0)	26 (26.0)	0.7347[b]
	No	64 (64.0)	59 (59.0)	
	Whizzes	12 (12.0)	15 (15.0)	

[a] T-test, [b] Chi square test, * Significant

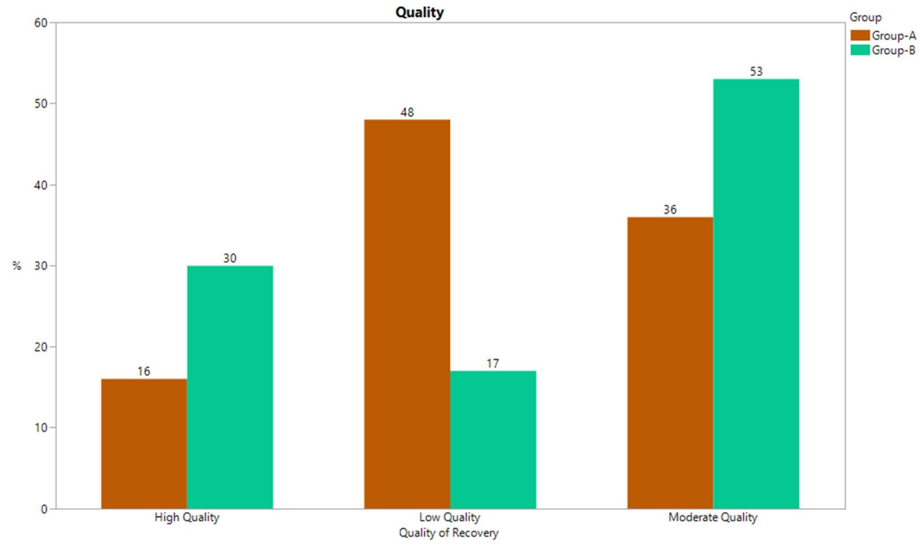

Fig. 1. Comparison of quality of recovery between the groups

Discussion

Respiratory problems after surgery are frequent and can be challenging and expensive to treat. Research has shown that certain techniques, such as deep-breathing exercises, incentive spirometry, and continuous positive airway pressure, when continued after surgery, may reduce the likelihood of postoperative lung complications. This suggests that using these strategies could be beneficial for the speedy recovery of patients (18).

The purpose of deep breathing exercises is to correct breathing problems, restore proper breathing patterns, enhance diaphragm function, increase alveolar ventilation, reduce energy consumption during breathing, and alleviate postoperative patients' breathlessness. These exercises are utilized as an alternative therapy to improve postoperative pulmonary function by teaching patients to use more of their lungs. At their most basic level, breathing exercises involve lengthening and slowing down inhalation and exhalation to enable patients to take deeper breaths and increase their oxygen intake, as opposed to taking shallow breaths that utilize only the upper portion of their lungs (1).

Our study found no significant differences between the two groups in terms of age, gender, smoking status, surgery type, weight, height, body mass index, and SpO2 levels at 1st day. These findings are consistent with other studies that have also reported similar results (1, 9, 19). The significance of these results lies in the ability to compare the actual effects of deep breathing exercises.

We observed that pulmonary oxygen saturation levels (SpO2%) insignificantly improved on the third day ($p=0.0668$), but significantly improved by the fifth day ($p=0.0158$). These findings are consistent with the studies by Tripathi and Sharma (1), Taha et al. (9), and Karayiannakis et al. (20).

The initial days after surgery are crucial for patients due to the loss of pulmonary function. It is important to detect any respiratory deterioration early (5). In a study by Karayiannakis et al. (20), patients who underwent open cholecystectomy showed a significant reduction in FEV1, FVC, and PFER (25-75%) by 21%, 38%, and 34%, respectively. The test that measures lung function including forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and peak expiratory flow rate (PEFR), reduced and did not differ significantly between the two groups in this study. It had been explained previously that the decrease in lung function parameters may be caused by general anesthesia, the location and length of the incision, postoperative pain leading to rib and diaphragm constriction, and diaphragmatic dysfunction (21–23). Fairshter and Williams (24) noted that major abdominal or thoracic surgeries result in a restrictive breathing pattern characterized by significant reductions in vital capacity and functional residual capacity (FRC).

We also assessed the patients for post-operative complications, specifically by checking for the presence of bilateral lung air entry and any added lung sounds during chest auscultation. We found no significant difference in these parameters between the studied groups, which contradicts the findings of previous studies by Shashi and Rakesh (1), Hussein and Taha (9), and Wren et al. (25). This discrepancy could be due to the fact that we did not include a control group of healthy individuals in our study.

The majority of techniques promote or compel patients to take deep breaths, which mimics the sigh mechanism described by Duggan and Kavanagh (26). Tahir et al. (27) discovered that during deep breathing exercises, ventilation was distributed more uniformly between upper and lower zones. In a study by Chutter et al. (28), the effect of breathing maneuvers on ventilation was indirectly assessed using inductive plethysmography, and deep breathing exercises were found to enhance regional ventilation. Our observations are partly consistent with these findings. Furthermore, Deniz Inal et al. (29) suggested that the use of deep breathing could have a beneficial impact on patient care, and that pulmonary function could be improved even further with deep breathing exercises compared to diaphragmatic breathing exercises alone. These findings support our observations.

The present study found that Group-B had a higher postoperative quality of recovery compared to Group-A, which is consistent with the findings of Shashi and Rakesh (1), and Hussein and Taha (9). Although lung function did not improve significantly, the improvement in postoperative quality of recovery may be due to an improvement in emotional status. The level of anxiety and distress was reduced, which supports the findings of Stessel et al. (30), who analyzed the prevalence and predictors of QOR after surgery day on the fourth postoperative day and found that anxiety is a significant psychological determinant in predicting post-operative pain. Patients who are highly anxious may appear to be more distressed and affected by pain, while improvement in physical comfort, psychological support, and physical independence can help patients feel more relaxed and comfortable, which can subsequently improve their level of recovery quality.

The results of this study are consistent with the findings of Bozorg-Nejad et al. (31) that rhythmic breathing can effectively reduce pain as a non-pharmacological intervention. Relaxation can reduce pain and anxiety by releasing endorphins (9). The study also found a significant difference between the two groups in terms of hospital stay, with Group-B showing a significant improvement and requiring fewer days to be discharged compared to Group-A. Similar results were also reported by Hussein and Taha (9), who found a highly significant difference between the intervention and control groups with regard to the length of hospital stay.

The study achieved improvements in pulmonary function parameters, but failed to demonstrate statistical differences among the groups, likely due to the absence of a control group. Moreover, the administration of oxygen was not under our control since it was prescribed by the anesthetist, and some subjects received it for longer periods, especially in Group-B (4 cases). This lack of uniformity in oxygen administration may have introduced some statistical variability. In conclusion, deep breathing exercises could be more beneficial for patients with pre-existing respiratory dysfunction compared to solely practicing spirometry, nebulization, chest physiotherapy, and burping.

Conclusion

Respiratory insufficiency after surgery is a frequent occurrence that can be complicated, expensive, life-threatening, and financially burdensome for patients. However, our study found that incorporating deep breathing exercises after surgery can also increase lung capacity, prevent post-operative complications, shorten recovery time, and enhance overall quality of life.

Author's Contribution:

AC- Concept and design of the study, **DS-** Prepared first draft and coordination, revision of the manuscript. **SS-** Interpreted the results; **MS-** Collection and compilation of data, **SS-**Reviewed the literature **NP-** Statistical analysis and manuscript preparation; **MK-** Interpretation of data

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Conflict of interest

None

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