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PILOT STUDY

EFFECT OF STACKED BREATHING EXERCISES ON PEAK EXPIRATORY FLOW RATE IN ABDOMINAL SURGERY PATIENTS – A PILOT STUDY

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ABSTRACT:

Background: Breath stacking is a technique in which multiple consecutive inspirations are taken before expiration, allowing increased lung expansion and improved secretion clearance. This method enhances oxygenation, increases inspiratory tidal volume, strengthens cough, and reduces postoperative pulmonary complications. The aim of this pilot study was to evaluate the effect of stacked breathing exercises on Peak Expiratory Flow Rate (PEFR) in patients undergoing abdominal surgery.

Methodology: Ten participants who met the inclusion criteria were recruited and PEFR was recorded before initiating stacked breathing exercises. The intervention was administered twice daily for the first three postoperative days, and PEFR was reassessed on postoperative Day 3.

Results: The mean PEFR increased from 90.00 ± 27.48 L/min on Day 1 to 111.00 ± 31.43 L/min on Day 3, representing a statistically significant improvement ($p < 0.0001$).

Conclusion: These findings suggest that stacked breathing exercises positively influence expiratory flow in postoperative abdominal surgery patients.

Keywords: Breath Stacking; Abdominal Surgery; Peak Expiratory Flow Rate; Pulmonary Ventilation; Respiratory Physiotherapy; Postoperative Complications

INTRODUCTION:

Abdominal surgery is performed for a wide range of clinical conditions, including trauma, perforations, infections, bleeding, and organ-specific pathologies.[1,2] Depending on the surgical requirement, procedures may involve either laparotomy, which requires a larger incision and is associated with greater postoperative discomfort and recovery time, or laparoscopic techniques, which involve smaller incisions and generally facilitate faster rehabilitation.[1,2] The immediate postoperative period following abdominal surgery is often marked by reduced mobility, pain, and restricted diaphragmatic function, all of which contribute to compromised lung expansion. This physiological limitation predisposes patients to postoperative pulmonary complications such as atelectasis, reduced lung volumes, impaired oxygenation, and inefficient cough.[3]

Breath stacking is a simple yet effective respiratory technique that involves taking consecutive breaths without allowing complete exhalation, thereby increasing inspiratory volume, promoting greater lung expansion. By encouraging slow, successive inhalations with a breath-hold, the technique improves oxygenation, enhances inspiratory capacity, facilitates airway clearance, and increases cough effectiveness.[4,5] Literature suggests that breath stacking can be beneficial after upper abdominal surgeries by reducing respiratory workload, improving pulmonary mechanics, and enhancing overall lung function.

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However, limited research exists evaluating its effect specifically on PEFR in postoperative abdominal surgery patients.[6,7] This study therefore aims to investigate whether stacked breathing exercises significantly influence PEFR during the early recovery period after abdominal surgery. This study aimed to determine the effect of stacked breathing exercises on peak expiratory flow rate in patients who had undergone abdominal surgery.[5,8]

Methodology

This Experimental Pilot Study was conducted at Dr. Vikhe Patil Memorial Hospital, Ahilyanagar, over a period of six months. Ten participants who had undergone laparotomy surgery were selected using purposive sampling. Subjects willing to participate and able to provide written consent were included, while those with hemodynamic instability, pre-existing respiratory or cardiac conditions, neurological deficits, cognitive impairments, or postoperative complications were excluded from the study. Ethical approval was obtained from the Institutional Ethical Committee.

PEFR served as the primary outcome measure and was assessed using a peak flow meter. The stacked breathing exercise was performed with patients placed in semi-fowler or long sitting, and vital parameters such as heart rate, blood pressure, respiratory rate, and oxygen saturation were monitored continuously on the monitor in the ICU. Each subject was instructed to take a deep breath followed by three to five additional breaths stacked on top of the previous inhalation until maximum thoracic expansion was achieved. A breath-hold of up to ten seconds was maintained, followed by slow expiration through pursed lips. Each session consisted of ten repetitions, with a rest interval of 15–30 seconds between repetitions, and the exercise was administered twice daily on postoperative Days 1, 2, and 3. PEFR was measured before initiating the intervention and again after completion of the Day 3 session. Three trials were given to perform PEFR both prior to the intervention and after the intervention, with no rest period between the PEFR trials. The investigator supervised all sessions to ensure correct technique and patient safety.

Figure 1: Peak Flow Meter (L/min).

Figure 2. Shows Subject performing Stacked Breathing Exercise

Figure 3: Shows subject performing PEFR on a Peak Flow Meter (L/Min).

Statistical analysis:

Data was entered into Microsoft excel and was analysed using Graphpad Instat. Mean and SD were calculated for all the given variables. Also, the data was represented in the form of visual impression like pie chart and bar diagram etc. Data was analysed using paired t test.

P-value of <0.0001 was considered significant.

Results:

Table 01: Gender wise distribution of participants.

Gender	No. of Participants
Male	**07**
Female	**03**

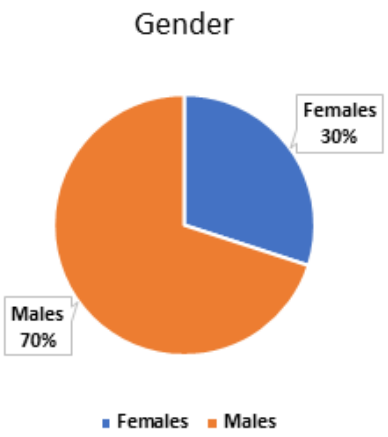

Figure 4: Shows the distribution of participants according to gender, where there are 07 males and 03 females.

Table 2: BMI wise distribution of abdominal surgery patients:

BMI	No. of Participants
Underweight (Below 18.5)	0
Normal (18.5-24.9)	06
Overweight (25.0-29.9)	04
Obese (Above 30)	0

Table 02. Shows the distribution of participants according to the BMI subcategories , where 06 participants are normal weight and remaining 04 are overweight

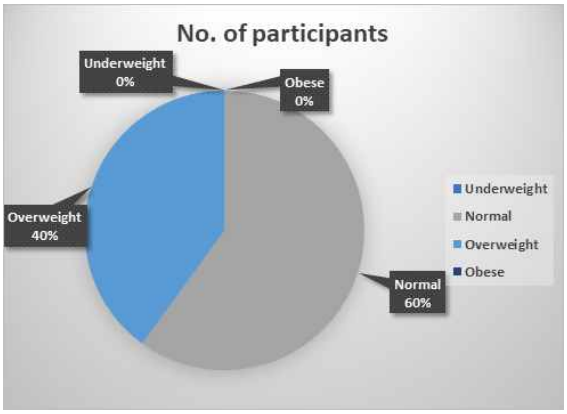

Figure 5: Shows the distribution of participants according to the BMI subcategories , where 06 participants are normal weight and remaining 04 are overweight.

Table 03: PRE and POST Exercise PEFR readings of the subjects.

Subjects	Pre-exercise (DAY1)	Post-exercise (DAY3)
1	60	70
2	80	100
3	140	170
4	60	70
5	110	120
6	80	100
7	120	140
8	90	120
9	60	90
10	100	130

Table 3. Shows the Pre-exercise and Post-exercise PEFR readings of the subjects.

Table 04: Results of the PEFR readings

Sr. No	Mean±SD	P Value	Significance
DAY1 PRE	90.00±27.487	< 0.0001	Significant
DAY3 POST	111.00±31.429		

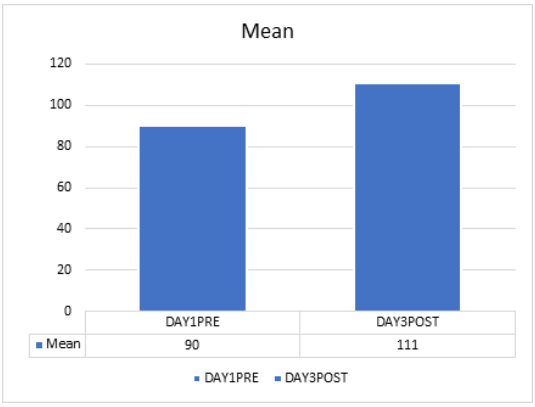

Figure 6: Results of the PEFR readings

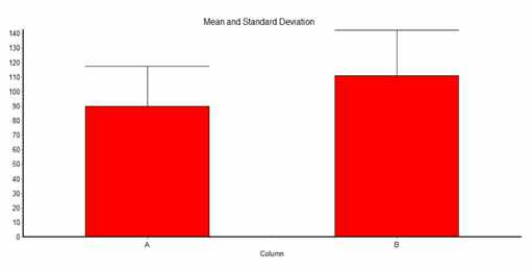

Figure 7: Mean and Standard Deviation

Discussion

Ten patients who underwent laparotomy were included in the study, comprising seven males and three females. BMI categorization revealed that six participants were within the normal weight range while four were overweight. Baseline PEFR values recorded on postoperative Day 1 averaged 90.00 ± 27.48 L/min. After completion of the stacked breathing intervention on Day 3, the mean PEFR increased to 111.00 ± 31.43 L/min. Statistical analysis using a paired t-test demonstrated that this improvement was highly significant ($p < 0.0001$), indicating that stacked breathing exercises contributed to enhanced expiratory flow capacity in postoperative abdominal surgery patients. The results were presented using tabulated data and graphical representations for clarity.

Débora da Luz Fernandes et.al. conducted a similar study in which Breath stacking proved to be a safe and good alternative when combined with routine physiotherapy, for the recovery of pulmonary function, improving lung volumes, maximal respiratory pressures, and improving oxygenation, as well as reducing respiratory work of patients during the postoperative period.[4]

Antonio Sarmento et.al. conducted a study on Air Stacking: A Detailed Look into Physiological Acute Effects on Cough Peak Flow and Chest Wall Volumes of Healthy Subjects, breath stacking increases cough peak flow immediately after the maneuver; exceed inspiratory capacity, reaching the maximum capacity; increase chest wall tidal volume with no significant changes in end-expiratory volumes; modifies the breathing pattern; and increases the shortening velocity index of respiratory muscles.[11]

CONCLUSION

This study shows that stacked breathing exercises have a significant positive effect on PEFR in patients recovering from abdominal surgery. Incorporating this technique early in postoperative physiotherapy may enhance expiratory performance, reduce pulmonary complications, and support overall respiratory function. The findings advocate for routine inclusion of breath stacking as part of early rehabilitation in abdominal surgery patients.

Limitations

Postoperative pain may have influenced participant's expiratory efforts and PEFR readings. Although sessions were supervised, individual differences in patient understanding, motivation, and effort during stacked breathing exercises and PEFR testing may have influenced the results.

Future scope

Future studies could incorporate larger and more diverse samples, explore the technique's effect specifically on upper abdominal surgery patients, and compare stacked breathing with other respiratory interventions.

Objective measurement of pain and respiratory mechanics may further clarify the technique's long-term benefits.

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Conflict of interest

The authors declare no conflict of interest.

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