

Effect of Stacked Breathing Technique to Reduce Postoperative Pulmonary Complications and Improve Pulmonary Functions: A Brief Review

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ABSTRACT

Patients with postoperative complications have high risk of generating respiratory complications such as atelectasis, pneumonia, respiratory dysfunction and pleural effusion. Physiotherapy has been widely used as a means of improving postoperative pulmonary function and reducing complications. Several methods have been studied such as: intermittent positive pressure ventilation, exercises with deep breathing, incentive spirometry and chest physiotherapy. Stacked Breathing is an exercise used to improve the size of breath in one take. This technique is useful when respiratory muscles are weak and when deep breathing can be difficult to breath.

Keywords: Stacked Breathing, Postoperative Pulmonary Complications, Pulmonary Functions

INTRODUCTION

The number of surgeries has exponentially grown in recent years and, among these, abdominal surgery is prominent.¹ Abdominal surgery and cardiac surgery has become an integral part of global health care.² The associations between thoracic and abdominal surgeries and the high incidence of respiratory complications are already well documented in the literature.³

The basic mechanism of post operative complications (PPCs) is a lack of lung inflation that occurs because of a change in breathing to a shallow, monotonous breathing pattern without periodic sighs, prolonged recumbent positioning and temporary diaphragmatic dysfunction.³ There is a reduction in functional residual capacity (FRC), inspiratory reserve volumes (IRV) and expiratory reserve volumes (ERV) and vital capacity (VC), also causing a reduction in expiratory flow, probably due to the reduced diaphragmatic activity.⁴ It also reduces the efficiency of efforts to cough for as long as one week and also fall in a oxygen arterial pressure and in oxygen-hemoglobin saturation.⁵ Diaphragm is the main muscle that is affected during upper abdominal surgery. Due to the effect of anaesthesia and pain suppresses the action of diaphragm leads to reduction in its strength which limits the normal breathing and forceful expiratory maneuver. This causes the occurrence of post-operative pulmonary complications, such as a reduction in lung compliance, an increased respiratory effort, an increased pulmonary the retention of secretion, pneumonia and areas of atelectasis, which may extend the period of hospitalization.⁶

Impairment of pulmonary function is one of the most significant postoperative pulmonary complications (PPCs) of upper abdominal surgery¹ and cardiac surgery through a sternotomy. It has deleterious effects on the function of the respiratory muscle action and the chest wall. Patients develop restrictive respiratory abnormalities with reduced lung volumes and impaired gas exchange in the early postoperative period. Atelectasis, bronchospasm, dyspnea, cough, pneumonia, respiratory failure, and exacerbation of lung disease have all been reported as complications.⁵ post-operative pulmonary complications are very common in upper abdominal surgery with the incidence of 22 to 40% than lower abdominal surgery with 2-5%.⁴

Post pulmonary complication presents high rate of morbidity, mortality and prolonged hospital stay predominantly in abdominal, cardiac and thoracic surgeries. Its incidence varies according to the previous diagnosis of the candidates for surgery; the type of surgery. According to some authors, surgery lasting for more than 210 minutes is a risk factor for postoperative pulmonary complications.⁷

Physiotherapy has been widely used as a means of improving postoperative pulmonary function and reducing complications. Several methods have been studied such as: intermittent positive pressure ventilation, exercises with deep breathing, incentive spirometry and chest physiotherapy, nevertheless, a meta-analysis confirmed that all studied protocols and methods were equally effective in reducing the frequency of pulmonary complications after upper abdominal surgery.⁸

Stacked Breathing Technique

In 1986, Marini and colleagues described an alternative method to estimate vital capacity (VC) in low cooperative individuals, called stacked breathing.⁷ Stacked breathing exercise (SBE) is a breathing exercise which helps to improve and maintain the volume of breath take and can be used regularly to

clear mucus from airway (secretion clearance). It helps to improve depth of breathing, aids secretion clearance, helps improve rib cage mobility and flexibility, stretches respiratory muscles, improves cough strength and effectiveness.⁴ This method proved to be effective for the proposed purpose and also made maximum lung expansion possible with minimum patient cooperation.

In 1990, one group of authors reported that postoperative patients were able to inhale greater volumes and maintain inspiration for a long period of time using a one-way valve device to promote the summation of successive inspiratory volumes while expiration was avoided. This technique is known as breath stacking (BS).⁸

Stacked breathing is a breathing exercise to help improve and maintain the size of the breath. Stacked breathing exercise is a breathing technique which helps to improve and maintain the volume of breath and can be used regularly to clear mucus from airway (secretion clearance), It helps in rib cage mobility and felicity of respiratory muscles. It also improves cough strength and effectiveness. Some studies have also showed that stacked breathing exercise can improve peak cough flow or peak expiratory flow rate in various neuromuscular conditions and also post cardiac surgery. Various researches have reported that stacked breathing could be more effective than deep breathing exercises and incentive spirometry in improving gas exchange during the postoperative period.⁹

The patient is positioned in a long sitting position on the bed with continuous monitoring of hemodynamic parameters. The patient is instructed to take a deep breath and take 3-4 breath one over another till the fullness of chest experience and then he/she is asked to hold the breath for a maximum of 10 seconds and expire by pursed lip breathing or splinted coughing (if secretions are present). There is a gap of 15-30 seconds in each repetition to allow relaxation, 10 repetitions.²

Authors, Journal, Year	Objectives	Design	Characteristics of participants sample size	Methods	Outcome measures	Results
Dias CM et al. 2008 ³	Comparison of incentive spirometry and breath stacking exercise on effects on the inspiratory capacity of abdominal surgery patients.	Crossover study	N = 12 First Post operative day	Incentive Spirometer group to take deep breath through spirometer Stacked breathing group to make successive inspiratory efforts using a facemask. This technique was performed with a one-hour interval for five times	FVC FEV1 FVC/FEV1	Stacked breathing has been effective and better than incentive spirometry for generating and sustaining inspiratory volumes.
Dias CM et al. 2011 ¹⁰	To evaluate inspiratory volume in patients undergoing cardiac surgery and to determine the effects that incentive spirometry (IS) and the breath stacking (BS) technique	Randomized clinical trial	N=35 undergoing cardiac surgery three groups: exercise control (EC), Incentive Spirometry group (IS) Breath Stacking Group.	IS group to take long breaths using an incentive spirometer BS group performing the successive inspiratory efforts using a facial mask coupled to a unidirectional valve.	FVC MIV SpO2	The BS technique could be used safely and, when compared with IS, promoted higher inspiratory volumes in low-risk postoperative cardiac patients
Marbate et al. 2019 ⁴	To evaluate the immediate effect of Stacked Breathing Exercise (SBE) on Peak Expiratory Flow (PEFR) in cardiac surgery patient	Pilot study	N=11 with age 40- 70yrs cardiac surgery patient	Stacked Breathing Exercise (SBE) on Post-Operative Day (POD) 1, 2 and 3 twice daily. Pre-exercise and post-exercise values for PEFR was collected in six treatment session.	Peak Expiratory Flow Meter	Stacked breathing exercise is significantly effective in improving PEFR. Hence can be an effective tool to help in improving lung function
Fernandes et al. 2021 ¹	To evaluate the effects of the breath stacking technique after upper abdominal surgery	Randomized clinical trial	N=34 divided two groups Control group (n=16) and breath stacking group (n=16).	Control group treated with conventional physiotherapy only. Breath stacking group treated with conventional physiotherapy and breath stacking. Two daily sessions from post operative day 2 until discharge.	FEV1 FVC FEV1/ FVC PEF FEF	Breath Stacking has proven to be safe and effective for recovering pulmonary function; improving lung volumes, reducing respiratory work during the postoperative period after upper abdominal surgery.
Marbate et al. 2022 ¹²	To evaluate the immediate effect of Stacked Breathing technique on Peak Expiratory Flow rate [PEFR] and Oxygen Saturation [SpO2] in Cardiothoracic surgery Patient.	Experimental Study	N=105 Cardiac surgery patient	Stacked Breathing was performed by the patient twice daily [Morning and Afternoon] for 1st, 2nd and 3rd postoperative days termed as six-session	Oxygen saturation (SpO2) PEFR	Stacked Breathing Technique is significantly effective in improving Peak Expiratory Flow Rate and Oxygen Saturation.

CONCLUSION

The stacked breathing technique has been revealed to be effective and superior when compared to many other techniques. Stacked breathing has proved to be a safe for the recovery of pulmonary function, improving lung volumes, maximal respiratory pressures, and peripheral oxygenation, as well as reducing respiratory

work of patients. Stacked Breathing exercise can be an effective tool to improve patients expiratory flow rate and thereby improve the strength of cough and promote easy airway clearance. Stacked Breathing Technique is significantly effective in improving Peak Expiratory Flow Rate and Oxygen Saturation.

Declaration by Authors

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