

Postoperative Outcomes Following Preoperative Respiratory Muscle Exercises in Patients Undergoing Abdominal Surgery: A Narrative Review

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ABSTRACT

Abdominal surgeries are the most common operative procedures including a wide range of both emergency and elective surgical interventions. Postoperative Pulmonary Complications (PPCs) following upper abdominal surgery are the most common surgical complications. The combined effect of surgical trauma and anaesthesia results in reduced lung volumes and respiratory muscle dysfunction. Chest physical therapy is widely recommended to prevent and treat PPCs, using a wide variety of techniques and devices, including incentive spirometry, continuous positive airway pressure, positive expiratory pressure, intrapulmonary percussive ventilation and Inspiratory Muscle Training (IMT) using a pressure threshold device that targets the muscles of inspiration. The present narrative review aimed to determine the available literature to evaluate whether preoperative respiratory muscle training is effective on pulmonary function test, Respiratory Muscle Strength (RMS) and preventing PPCs after abdominal surgery. A computer-based literature search was done using the PubMed, PubMed Central, Science Direct and Google Scholar. Relevant articles with full text published in English from 1995 to 2021 were screened and included. Studies were included which had preoperative physiotherapy techniques on patients undergoing abdominal surgery. Editorials, commentaries, discussion papers, conference abstracts, reviews and duplicates were excluded. After screening, only studies with full text articles were included that comprised of nine relevant articles. It is imperative to discover the probable outcome of preoperative respiratory exercises training. Hence, a review could be helpful in delivering a perception about which exercises program could cause improved and enhanced postoperative outcome.

Keywords: Pulmonary function test, Postoperative pulmonary complications, Respiratory muscle strength, Vital capacity

INTRODUCTION

Respiration is a process facilitated by thoracic and abdominal movements. There is division of abdominal muscles in its surgery resulting in pain, limited movements accompanied with alterations in diaphragmatic function and lung atelectasis [1,2]. The most common surgical complications after upper abdominal surgery are Postoperative Pulmonary Complications (PPCs). Hence, the collective consequence of surgical trauma and anaesthesia causes reduced lung volume, dysfunction and atelectasis of respiratory muscle [3,4]. These further replicate into decreased total pulmonary capacities and volumes, reduced Forced Vital Capacity (FVC) and Forced Expiratory Volume in first second (FEV1) of expiration [5].

The abdominal muscles attributes to about 20% of breathing. These muscles help to pull on the rib margins and also increase the intra-abdominal pressure. The abdominal muscle contraction leads to decrease in the thoracic volume and transpulmonary pressure, thus reducing the lung volume. There is lateral chest wall expansion during inspiration, wherein anterior stability of abdomen is attained which act as fulcrum for the diaphragmatic action thus, maintaining the zone of apposition [6,7].

Upper abdominal surgery is associated with a decrease in maximum inspiratory and expiratory muscle pressure [8]. The Vital Capacity (VC) and Functional Residual Capacity (FRC) is lessened by 60% and 30%, respectively. There is reduction in the diaphragmatic activity during the postoperative period involving a shift from mostly abdominal to thoracic breathing. The VC is seen to remain low for at least 10 to 14 days along with a restrictive pattern and reduced Inspiratory Capacity (IC), VC, and also a decrease in FRC after abdominal surgery. This decreased efficiency of pulmonary functions is mostly observed after open abdominal surgery than laparoscopic procedure [8].

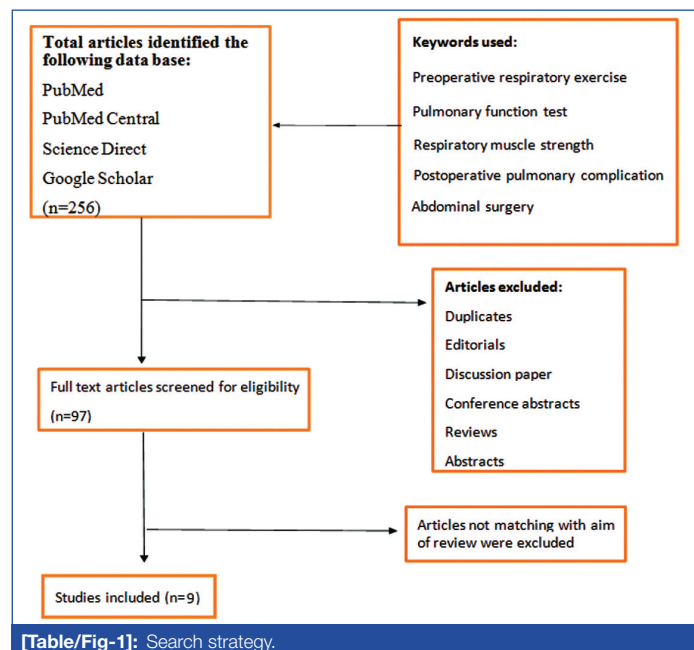
Maximum Inspiratory Pressure (MIP) is recorded by asking the patient to inhale deeply after exhaling to Residual Volume (RV). The lowest pressure achieved and detained for at least one second is documented. The respiratory muscles' capability to produce force during a short quasi-static reduction is depicted by these maximal respiratory forces like MIP [9]. The assessment of RMS is, hence, of utmost clinical importance. A simple, quick and non invasive clinical procedure inclusive of the measurement of MIP to recognise inspiratory muscle strength in both healthy subjects and in patients with pulmonary or neuromuscular diseases [10]. The present study is a narrative review on the effect of preoperative respiratory exercises on RMS, pulmonary function and PPC in patients undergoing abdominal surgery.

LITERATURE SEARCH

For this narrative review, the available literature was searched and evaluated to appraise the result of preoperative respiratory muscle exercises. All patients undergoing elective major abdominal surgery were the subjects of main concern in the study. The interventional studies included the preoperative respiratory exercises rather than the regular care (no training program). The effect of preoperative respiratory muscle exercises on postoperative pulmonary function, RMS and pulmonary complications were recorded as the outcomes of the procedure. The various training programs and likelihood to device such plans in day-to-day practice were also assessed.

A total 256 articles were acknowledged by a complete computerised search on Google Scholar, PubMed Central and Science Direct, National Library of Medicine from 1995 to 2021. Studies were included which had preoperative physiotherapy techniques on patients undergoing abdominal surgery. The keywords that were used included preoperative respiratory exercises, pulmonary

function test, RMS, PPC, abdominal surgery. Furthermore, the reference list was also searched to augment the search accuracy, as far as possible. Out of total articles, duplicates, editorials, discussion papers, conference abstracts, reviews and abstracts were excluded, hence, 97 full text articles were screened for eligibility. Out of 97 articles, those not matching with the aim of review were excluded. Articles in which management included preoperative respiratory muscle exercises such as breathing exercises, incentive spirometry exercises with IMT device and chest physiotherapy were included. Finally, 9 articles were reviewed [Table/Fig-1] [11-19].



PREOPERATIVE RESPIRATORY EXERCISES ON PULMONARY FUNCTION TEST AND RMS

Kulkarni SR et al., carried out a study to estimate the consequence of preoperative IMT on respiratory variables particularly in major abdominal surgery patients. The RMS including MIP and Mouth Expiratory Pressure (MEP) and the pulmonary functions were recorded approximately two weeks' prior major abdominal surgery in 80 patients. The authors equated four groups with dissimilar training schedules: A: control; B: deep breathing exercises; C: incentive spirometry and D: specific IMT. The groups B, C and D consisted of patients who were requested to train twice daily with each session of 15 minutes for at least two weeks prior to surgery. The results showed that in groups A, B and C the MIP did not rise from baseline level to preoperative evaluations. However, in group D, there was a rise in MIP from 51.5 cmH₂O (median) before training and to 68.5 cmH₂O (median) after training preoperatively with p-value <0.01. Groups A, B and C presented a decreased MIP from baseline p-value <0.01, p-value <0.01 and p-value=0.06, respectively. Although, no such substantial decrease in postoperative MIP was observed in group D (p-value=0.36). These results were made instantly pre and postoperatively. It was thus, concluded that preoperative specific IMT improves the MIP preoperatively and conserves it postoperatively [11].

A study performed by Gehan A et al., examined the consequences of preoperative physical and respiratory therapy on pulmonary functions and also assessed the difficulties after upper abdominal elective laparoscopic surgery in obese patients. The study comprised of two groups: Group I performed respiratory and general exercises for two weeks prior to surgery and Group II was the control group. Slow Vital Capacity (SVC), IC, MIP and MEP and 6-minute walk test were documented as baseline data, after two weeks of exercises and one month postoperative (complications were also noted). The intervention group patients had improved pulmonary function during postoperative period with respect to all parameters than the control

group. PPCs occurred in 15 (62%) and 7 (27%) patients in the control group and intervention group respectively. These authors concluded that the pulmonary functions enhanced due to the preoperative physical and respiratory therapy and the occurrence of PPCs reduced [12].

Soares SM et al., investigated the consequences of preoperative physical therapy on pulmonary function and also assessed the physical performance pre and postupper abdominal surgery. Preoperative physical therapy procedure comprised of deep breathing, respiratory muscle exercises, active exercises of the extremities, walking and relaxation. Patients were skilled to use an inspiratory threshold loading device (Threshold IMT, Respironics, NJ, USA) for a time period of 15 minutes daily for respiratory muscle training. This study deduced that patients in the intervention group had higher inspiratory strength and respiratory muscle stamina than control group during the preoperative period [13].

Kundra P et al., designed comparative study to assess the effects of preoperative and postoperative incentive spirometry on lung functions following laparoscopic cholecystectomy in 50 normal healthy adults by the closed envelope method. The study comprised of following two groups: control group (group PO, n=25) and study group (group PR, n=25). The lung functions were recorded at the time of preanaesthetic evaluation, on the day prior to surgery, postoperatively at 6, 24, and 48 hours, and at the time of discharge. Improvement in the lung functions was observed following preoperative incentive spirometry. Lung functions decreased by the time of discharge. Nevertheless, it was seen that lung functions were better preserved in the groups preoperatively at all times. Hence, the lung functions were thought to be well preserved with preoperative incentive spirometry [14].

Fagevik Olsen M et al., observed greater oxygen saturation in patients who were administered prophylactic chest physiotherapy before major abdominal surgery on postoperative days (i.e., day 1, p-value <0.001; days 2 and 3, p-value <0.05). It was seen that there was no difference in peak expiratory flow rate or FVC among both the groups [15].

Kalil-Filho FA et al., performed a study to enhance the physiotherapeutic and muscular capability in chronic obstructive pulmonary muscular inspiration (during preoperative preparation stage of abdominal surgeries). For the bronchial clearance, group A performed slow expiration with an open glottis, acceleration of expiratory flow and forced expiration; for the strengthening of the respiratory muscles, the threshold IMT was performed. Group B performed traditional techniques such as high frequency chest compression, postural drainage and tapping and the flow encouraging Respiro® was performed for the strengthening of the respiratory muscles. There were enhanced MIP values in both the groups after different treatment protocols. Group A showed a greater change during the intervals and an increased substantial rise in the MIP values relative to the regular pre and post-treatment values. Though, after calculating the variance and standard deviation of the samples, it was seen that group B produced best results with more homogeneity. The contemporary and traditional bronchial clearance methods allied with IMT were both highly efficient in obtaining inspiratory muscle strength with augmented MIP. Hence, they could be applied in the preoperative preparation of patients with chronic obstructive pulmonary disease and also to patients suggested for abdominal surgeries [16].

PREOPERATIVE RESPIRATORY EXERCISES AND POSTOPERATIVE COMPLICATIONS

Fagevik Olsen M et al., suggested that there appears to be substantial variance in PPCs in prophylactic chest physiotherapy patients before any major abdominal surgery (study group consisted of 6% patients with PPCs and in the control group it was 27%) [15]. Dronkers J et al., designed a randomised controlled pilot study

on the prevention of pulmonary complications following upper abdominal surgery by preoperative intensive IMT. They observed that there were no hostile or deleterious consequences of preoperative IMT and the patients were satisfied with IMT method. The authors suggested that preoperative IMT is well accepted and valued and could decrease the occurrence of atelectasis in patients planned for elective abdominal aortic aneurysm surgery [17].

Chumillas S et al., explored the effectiveness of respiratory restoration in preventing PPC and also defined the benefits of the patients. Preoperative and postoperative clinical evaluation, spirometry, arterial blood gas analysis and simple chest X-rays were recorded from two to three days prior to surgery until the discharge period. The exercises were done for 10 to 15 minutes for four times in a day. The frequency of PPC was seen to be 7.5% in the rehabilitation group and 19.5% in the control group. Respiratory reintegration shields against PPC is thought to be more efficacious in moderate and high risk patients, although there is no effect on surgery induced functional changes [18].

Boden I et al., evaluated the efficiency of a single preoperative physiotherapy session to decrease the PPCs following upper abdominal surgery. Using the Melbourne group score, PPC within 14 days of postoperative care was assessed daily. The study results showed that among the general population group in whom elective upper abdominal surgery was performed, a 30-minute preoperative physiotherapy session provided within prevailing hospital status reduces the frequency of PPCs, especially hospital acquired pneumonia [19].

Even though we have identified most of the available data, there might be many unpublished results and results not available online. We accessed only PubMed, PubMed Central, Science Direct and Google Scholar. Further reviews including data from other databases can be conducted in future.

CONCLUSION(S)

Preoperative respiratory exercises training facilitates to enhance the pulmonary function in elective abdominal surgical procedures. However, the consequences on RMS and postoperative difficulty remain indistinct. Owing to the increased number of postoperative complications, it is imperative to discover the probable outcome of preoperative respiratory exercises training. Hence, a randomised controlled trial could be helpful in delivering a perception about which exercises program could cause improved and enhanced postoperative outcome.

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