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The Impact of Preoperative Physical and Respiratory Therapy on Postoperative Complications and Lung Function in Obese Patients Undergoing Laparoscopic Upper Abdominal Surgery

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ABSTRACT

Background: It has been seen that obese patients experience respiratory muscle dysfunction and inactivity, after laparoscopic upper abdomen surgery.

Objective: To look at how preoperative respiratory and physical therapy affects pulmonary functions and problems following elective laparoscopic upper abdomen surgery in patients who are obese.

Methodology: The present study was conducted in Bacha Khan Medical Complex/Gajju Khan Medical College, Swabi from April 2021 to September 2021. In contrast to the non-engaged group (group II; n = 26), patients were randomly assigned to undergo respiratory and general exercise for two weeks prior to operation (group I; n = 28) and two physical and specialized respiratory treatment sessions per week, each lasting forty minutes. Day two, five, and one month after surgery were recorded as baselines, followed by two weeks of exercise, slow vital capacity (SVC), inspiratory capacity (IC), maximal inspiratory and expiratory pressures (MEP and MEP), and a six-minute walk test. Any pulmonary problems following surgery were noted.

Results: Patients in the intervention group (group I) had higher pulmonary function in all measures than patients in group II ($P < .05$) during all post-operative periods, with statistically significant differences between the groups. Six patients in the intervention group (group I) and 14 patients in the control group (group II) experienced postoperative pulmonary problems ($P < .05$).

Conclusion: In obese patients receiving laparoscopic upper abdomen surgery, preoperative physical and respiratory treatment improved pulmonary functioning and reduced the frequency of postoperative pulmonary problems.

Keywords: Laparoscopic Procedure; Obesity; Respiratory Therapy; Abdominal Surgery

Introduction

About 30% of the patients face pulmonary complications after the surgery. Complications after the abdominal surgery can cause increase risk of mortality, morbidity and increase hospital stay duration. Increased risk of pulmonary problems can be caused by a number of variables, including postoperative discomfort, anesthesia-induced diaphragmatic dysfunction, extended supine position, poor mucociliary clearance, and disturbances of normal respiratory activity with shallow rapid breathing.[1-4] Through investigations have been done for the prevention of such complications and several respiratory interventions such as structured breathing exercises, positive airway pressure breathing and assisted inspiratory flow breathing, have been used for the possible solutions.[5,6]

Upper abdominal surgery is one of the most common surgeries.[7,8] Respiratory muscle dysfunction and inactivity, particularly in obese patients, may lead to postoperative pulmonary problems following laparoscopic upper abdomen surgery.[9,10] Their frequency varies from 12% to 58%.11 The patients' reduced respiratory mechanics and movement were caused by the produced pneumoperitoneum during laparoscopic surgery, anesthetic medications, drains, and postoperative discomfort.[12,13] Pre-habilitation, also known as preoperative respiratory and physical programs, promotes early recovery following abdominal surgery.[14,15] however its ability to avoid postoperative pulmonary problems after surgery is yet unknown.[16]

Patients' respiratory mechanics and movement are impacted by anesthesia, the stress of surgery, and postoperative circumstances such incisions, drains, and catheters. Along with other functional abnormalities, the early postoperative days are linked to restricted ventilatory deficits, tiredness, and limited upright motion.[17] On the other hand, patients who are waiting for elective surgery can benefit from encouragement and the potential for improved physical performance during the preoperative phase. Prehabilitation is a concept that aims to expedite postoperative recovery with prior interventions. It has been studied in patients having orthopedic and colorectal surgery[18]

In keeping with this idea, respiratory muscle training has been demonstrated to decrease hospital stays following cardiothoracic surgery, lower the risk of pulmonary problems following surgery, and lower the incidence of atelectasis following abdominal surgery.[19-21] Preoperative aerobic fitness regimens have also been researched as a possible tactic to lessen functional capacity impairment following surgery and lower the rate of pulmonary problems.[22,23]

The main purpose of this study was to determine the effect of respiratory and general exercises on the lung functioning before the laparoscopic surgery in obese patients. Patients were provided with a comprehensive period of exercises and investigational tests from preoperative to postoperative periods.

Objective

To look at how preoperative respiratory and physical therapy affects pulmonary functions and problems following elective laparoscopic upper abdomen surgery in patients who are obese.

Methodology

A prospective randomized controlled trial (RCT) was conducted for this investigation between July 2020 to July 2021 at Department of Surgery, Lady Reading Hospital, Peshawar. Strict inclusion and exclusion criteria were followed for this study. Patients with no prior upper abdominal surgical procedures (laparoscopic biliary surgery, hiatus hernia repair, gastrectomy, splenectomy), a body mass index (BMI) of greater than 30; no prior elective upper abdominal surgery and overall, with good health condition were included. Patients with comorbidities such as cerebrovascular disease, heart issues, with any chest diseases, or medications that impair muscle strength were excluded from the study.

Every patient was asked for their informed consent and was free to decline at any point. The Institutional Ethical Committee granted ethical approval for this study. Two groups of patients were created: group I, known as the treatment group who underwent respiratory and physical therapy sessions preoperative for two weeks, while group II (control group) did not get any preoperative care. Preoperative data were evaluated prior to surgery, and every patient was admitted to the hospital at least one day beforehand. In the post-operative period, both groups underwent physical and respiratory therapy up until the third- or fifth-day after the surgery (Figure 1).

The preoperative therapy program, which includes both respiratory and general therapy, consists of two 40-minute physical therapy sessions each week. The sessions involved stretching exercises, trunk rotation, active upper and lower extremity exercises, walking, and relaxation techniques. Patients were directed to inflate air into the balloons for 15 min. They also did diaphragmatic breathing training two times daily for respiratory muscle training. The walking phase of the protocol involved a 10-minute walk on flat ground faster than normal manner of walk, limited by felt dyspnea. At home, they were instructed to do walking and respiratory muscle training twice daily and four times weekly. During the preoperative phase, none of the physical therapy interventions were administered to the Group II (control group) patients.

The postoperative therapy program included both the groups (I and II) and consisted of daily physical therapy (two 15-minute sessions per day) starting on day two after

Table 1. Protocol of investigations, respiratory and general exercises

Day	Investigations and Exercise
1st Visit	Baseline SVC, IC, MIP, MEP, along with 6-min walk test + chest X-ray Consultation from Chest Specialist Physiotherapy
Day 1 post-surgery (after 2 weeks of physical and respiratory exercises)	preoperative investigations + Pulmonary Function tests and chest radiology Consultation from Chest Specialist Physiotherapy
Day 2 post-operative	CBC + chest radiology + specific investigations for the operation (if required) + Pulmonary Function Tests Complications Assessment and Physiotherapy
Day 5 post-operative	X-ray chest + Pulmonary Function Tests + CBC Consultation from Chest Specialist Physiotherapy
1-month post-operative	Pulmonary Function tests

surgery (if stable) and continuing until day five or until discharge. After that, patients were asked to follow the same protocol of respiratory therapy at home for at least a week following surgery (under the supervision of a physiotherapy specialist). Coughing was done after deep breathing exercises as part of this respiratory therapy. Active upper and lower extremity activities (similar to those included in the preoperative program) were then conducted while seated.

In this study, 28 patients were included in group I (treatment group), which got physical and respiratory therapy prior to and following surgery, while 26 patients were assigned to group II (control group), which did not get any physical or respiratory exercise before surgery. A physiotherapy specialist administered physical respiratory therapy. A spirometer (Spiroanalyzer ST-90 supplied by Fukuda Sangyo, Tokyo, Japan) was used to measure the following parameters related to pulmonary functions, including spirometry: slow vital capacity (SVC), inspiratory capacity, IC, maximum inspiratory and expiratory pressures (MEP and MEP), and a 6-minute walk test. They were measured before and after the surgery, before starting the exercises, after 2 weeks of the exercises, 2nd day, 5th day and 4th week after the surgery. Up until the fifth postoperative day, postoperative pulmonary problems were documented based on clinical, laboratory, and imaging findings (chest x-ray and CT chest, if necessary) as well as pulse oximetry and ABG.

The statistical analysis of the results was conducted using SPSS version 22 (SPSS Inc., Chicago, IL, USA). Parametric data were subjected to the student's t test. A P value of less than equals to 0.05 was deemed significant.

Results

This study comprised 54 patients, who were randomly divided into two groups: 26 patients in group II (control group) and 28 patients in group I (treatment group). Table 1 demonstrates the investigations that were done pre-operatively and post-operatively. On first visit of the patient the investigations of slow vital capacity (SVC), inspiratory capacity (IC), maximum inspiratory pressure (MIP), maximum expiratory pressure (MEP) and chest X-ray was done, along with the pulmonary function tests and chest radiology on the day 1post-operatively. On day 2 of post-surgery chest-radiology, CBC and day 5 chest x-ray and pulmonary function test was done. Table 2 represents the data regarding the age, gender, clinical and surgery in both groups I and II. In Group I, 13 were males and 15 were females while in group II 11 were males and 15 patients were females. Out of 18 patients in group I, 22 patients and 9 patients of group II had BMI between 30 to 40. Patients 20 of group I and 18 patients of group II had cholecystectomy surgery.

No statistically significant difference has been found in the baseline pulmonary function tests measurements between the groups, as the P-values were greater than

Table 2. Data regarding age, clinical and surgery in both group I and group II

	Group I (28 patients)	Group II (26 patients)
Age yrs. (Median) Males Females	54.8 (49-65) 13 (46.4%) 15 (53.5%)	51 (48-66) 11 (42.3%) 15 (57.7%)
Body Mass Index 30-40 >40 Smokers	 22 (78.57%) 6 (21.42%) 5 (17.85%)	 19 (73.07%) 5 (19.23%) 4 (15.38%)
Type of Laparoscopic Surgery Hiatus Hernia Gastric Sleeve Splenectomy Cholecystectomy	 1 (3.57%) 4 (14.28%) 3 (10.71%) 20 (71.42%)	 3 (11.53%) 3 (11.53%) 2 (7.69%) 18 (69.23%)
Operative time (min) (Median)	134 (35-212)	133 (31-223)
American Society of Anesthesia classification I II III	 18 (64.28%) 5 (17.85%) 5 (17.85%)	 17 (65.38%) 5 (19.23%) 4 (15.38%)
Hospital Stay Duration	6 days (3-11)	8 days (3-16)

0.05. This indicated that two groups were similar. Maximum inspiratory pressure was 84.75 in case of group I at baseline as compared to the group II which had 85.75. After 1 month of the surgery, group I showed higher values for MIP 92.10 as compared to the group II. High significant difference was observed between the two groups on 2nd day, 5th day and 1 month post-operatively in case of group I, as they were exposed with physical and respiratory therapy (Table 3).

Discussion

In the current study, study cases were divided into two groups, the treatment group (group I) who received respiratory and general exercise for a period of two weeks and the control group (group II) who did not receive any exercise pre-operatively. According to this study, there was no statistically significant variation in the baseline pulmonary functioning values between the groups under investigation. This indicates that there was a functional similarity between the two groups.

Preoperative values of group I were higher than group II before surgery, on the 2nd day, 5th day and 1st month after surgery, and the difference was significant ($p < .05$). The first group received physical and breathing therapy for two weeks pre-operatively. Postoperative pulmonary complications were observed in 14 patients in group II and 6 patients in group I on the fifth postoperative day ($P = .035$). In the first stage, it was found that in patients on respiratory therapy, the respiratory muscles were higher and stronger compared to group II; this translated into a higher Pulmonary Function Tests measurement.

There is a challenge to reduce the respiratory complications after the upper abdominal surgery through health improvement pre-operatively.[24] The times frames in this study were similar to the once used in the case of abdominal and cardiothoracic surgery.[21,25] However, respiratory muscle function was poor in both groups due to postoperative discomfort, drainage, and pneumoperitoneum. Inspiratory muscle strength increased in the treatment group five days after surgery. The purpose of exercise training is to increase the oxygen and cardiovascular system in order to evaluate the body and capacity required after surgery. A previous study determined the effect of preoperative cardiorespiratory fitness in patients who underwent thoracic surgery. The exercises included

Table 3. Comparison of both groups regarding the Pulmonary Function Test

	Groups		Test of significance	P-value
	Group I No = 28 Mean ± SD	Group II No = 26 Mean ± SD		
MIP (mmHg)				
Baseline	-84.75 ± 6.90	-85.75 ± 8.01	0.50	0.614
Pre-operative	-96.59 ± 2.29	-85.75 ± 8.01	5.79	<0.001*
Post-operative				
• Day 2	-72.79 ± 8.88	-51.49 ± 5.90	10.19	<0.001*
• Day 5	-84.36 ± 5.27	-63.00 ± 5.50	12.01	<0.001*
• Month 1	-92.10 ± 4.13	-80.89 ± 7.20	5.67	<0.001*
MEP				
Baseline	84.79 ± 7.79	80.50 ± 9.88	0.39	0.659
Pre-operative	114.88 ± 9.80	57.00 ± 7.20	20.44	<0.001*
Post-operative				
• Day 2	84.29 ± 6.90	57.00 ± 7.20	10.88	<0.001*
• Day 5	97.71 ± 8.01	62.50 ± 5.17	16.10	<0.001*
• Month 1	112.88 ± 9.06	64.62 ± 3.06	22.21	<0.001*
SVC (liter)				
Baseline	3.01 ± 0.63	3.03 ± 0.39	0.02	0.988
Pre-operative	3.59 ± 0.32	3.03 ± 0.39	6.99	<0.001*
Post-operative				
• Day 2	3.10 ± 0.28	2.17 ± 0.50	9.09	<0.001*
• Day 5	3.50 ± 0.27	2.18 ± 0.49	8.88	<0.001*
• Month 1	3.49 ± 0.28	3.83 ± 0.47	8.79	<0.001*
IC (liter)				
Baseline	3.01 ± 0.38	3.23 ± 0.44	1.47	0.129
Pre-operative	2.47 ± 0.42	3.23 ± 0.43	4.02	<0.001*
Post-operative				
• Day 2	2.87 ± 0.39	1.89 ± 0.34	9.01	<0.001*
• Day 5	2.01 ± 0.39	1.90 ± 0.35	8.78	<0.001*
• Month 1	3.29 ± 0.39	2.20±0.33	4.89	<0.001*
6 min walk test (meters)				
Baseline	412 ± 0.88	419 ± 0.39		0.901
Preoperative	438 ± 0.44	341 ± 0.30		<0.001*
5th Day post-op	390 ± 0.42	312 ± 0.52		<0.001*
1-month post-op	427 ± 0.39	387 ± 0.37		<0.001*

(*P value significant >0.05)

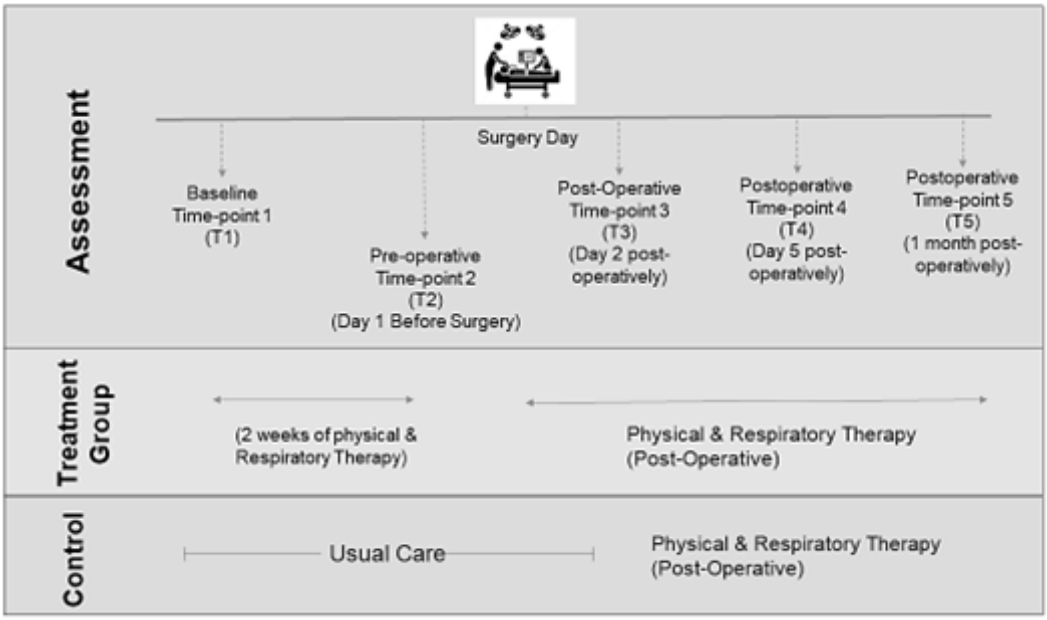

Figure 1. Schedule of Physical and Respiratory Exercises for both the groups pre- and post-operatively

five endurance cycle ergometry sessions at intensities along with 6-minute walk and measurements of pulmonary function tests at baseline and immediately preoperatively and 1 month post-operatively. Patients who attended the sessions had increased VO_2 peak 3.3 $mL \cdot kg^{-1} \cdot min^{-1}$[26]

According to Oris, the risk of pneumonia on the first day after laparoscopic surgery will be less than that of laparoscopic colon surgery.[27] According to the findings of Oslen,[28] deep breathing and antibiotic use help reduce lung function after abdominal surgery. Previous studies have been conflicting about the ability of preoperative lung cancer screening to predict lung surgery complications. Different results may depend on various factors such as sample size, patient characteristics, and design.[23] Preoperative respiratory training may reduce the risk of postoperative pneumonia by reducing the decrease in muscle tone after laparotomy.[29]

According to Nguyen, the recovery period after surgery for the sole can be long and the type of physical therapy used before and after the surgery affects the cost of the surgery.[30] All individuals were functionally stable before surgery. However, for the first 24 hours after surgery, all members of both groups were on top of each other. The working ability of the treatment group improved in the postoperative period. The above results indicate that the treatment group found a response to postoperative intubation and catheterization limitations, which could be attributed to the improvement in their previous physical condition.

The 6-Minute Walk Test measures aerobic endurance, coordination, respiratory and motor skills, in addition to required walking, at a level at least equivalent to water activities in daily life.[31] Therefore, it has been accepted as an indicator of the body's healing and breathing during the pre- and post-operative stages.[32]

One of the main limitations of this study is the use of low-intensity activities in the pre-existing physical therapy program. However, we continue with these activities because previous studies of patients who underwent colectomy and received walking and breathing exercises showed more effective postoperative outcomes and fewer complications than patients who underwent a treatment cycle.[33]

Conclusion

Preoperative respiratory and general exercisers have better postoperative pulmonary functioning and fewer problems related to the lungs. To improve the results of elective surgery in obese patients and reduce pulmonary complications, a multidisciplinary team comprising surgeons, physiotherapists, and chest specialists should organize a special, universally approved respiratory and general physical therapy program. This program will be used both pre- and post-operatively during upper abdominal surgeries.

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