PILATES EXERCISE ON LUNG FUNCTIONS IN POSTBURN INHALATION INJURY PATIENTS

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Abstract

Objective: to compare the effectiveness of chest physical therapy and Pilates method in improving lung functions in post burn patient with inhalation injury.
Design: A double-blinded randomized, controlled study.
Setting: Inpatient setting.
Participants: Sixty patients with 25-45 years of age presenting post burn inhalation injury, the participants were selected and randomly distributed into control group received traditional chest physiotherapy also medical treatment or the study group, received pilates exercise in addition to their traditional chest physiotherapy and medical treatment.
Intervention: All treatments were administered over the course of four weeks, with three sessions per week.
Outcome measures: lung functions FVC, FEV1 and PEF were evaluated pre and post four-weeks of treatment.
Results: post treatment, both the study and control groups showed statistically significant improvements in FVC, FEV1, as well as PEFR relative to baseline values ($p > 0.001$). The percent of change of FVC, FEV1 and PEFR in study group was 15.86, 13.65 and 14.29% respectively, while that in control group was 10.59, 3.43 and 7.44% respectively.
Conclusion: traditional chest physiotherapy combined with pilates exercise more helpful in improving lung functions in inhalation injury patients.

Keywords: Inhalation injury, lung functions, chest physiotherapy, Pilates, Spirometry.

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1. INTRODUCTION

Smoking inhalation injury are often classified as thermal or chemical irritants. Increases in fluid needs, the prevalence of pulmonary problems, and death have all been linked to smoke inhalation injuries that occur in conjunction with burn injuries (1). Fumes and toxic gas can cause injuries through inhalation. Laryngeal edema, caused by breathing air that is insufficient to damage the bronchus, could block the upper airway and call for immediate intubation. Medical problems including airway mucosal hyperemia, obstructive cast development in the airway, as well as bronchospasm can arise from edema caused by neurogenic inflammation, which narrows the airway lumina (2). Hospitalized patients having large surface burns and inhalation had a 15-25% increased risk of developing pulmonary problems. Complications such as smoke inhalation, infections of the respiratory tract, as well as direct heat damage to the respiratory tract can lead to pulmonary dysfunction. Patients with burn injuries are more likely to survive owing to advancements in acute care, but pulmonary problems remain the leading cause of death. (3). Chest-physiotherapy is a key supplement to treat most chronic respiratory diseases (COPD), neuropathic diseases (muscular dystrophy, cerebral paralysis, spinal cord injury) and during peripheral treatment mainly in upper abdominal surgery. Chest-based physiotherapy is also a major compliant treatment for most respiratory conditions (4). The Pilates approach and exercise programs have many beneficial effects. Regular practice improves both lung capacity and cardiovascular health. Bone density as well as joint health are also enhanced. (5). The Pilates method emphasizes costal breathing, in which the ribs rise and fall with the breath, extending laterally and to the back (6). The Pilates method's focus on breath control during exercise, which is linked to abdominal

strengthening, can help to avoid or counteract responsive drops caused by a decrease in lung capacity (7).

2. MATERIALS AND METHODS

The study was a double-blinded (both patients and assessor), Parallel-group, randomized controlled trial. Sixty patients with 25-45 years of age presenting post burn inhalation injury, the participants were selected from in-patient clinic of Om El Masreen Hospital then allocated into two equal groups. Prior to signing a written consent form, participants received full details regarding the study's nature, goals, and anticipated benefits.

Group (A) thirty patients with inhalation injurywill receive conventional chest physiotherapy (diaphragmatic respiratory exercises, apical breathing exercises, assisted cough, circulatory exercises, also early ambulation) and medical treatment.

Group (B) thirty patients with inhalation injury will receive traditional chest physiotherapy (diaphragmatic respiratory exercises, apical breathing exercises, assisted cough, circulatory exercises, also early ambulation) and medical treatment as well as pilates method.

Criteria for the patient selection:

a) Inclusion Criteria:

patients were included in the study based on the following criteria:

•Age ranged from 25-45 years.
•Both sex.
•All patients presented post-burn inhalation injury.
•Patients with facial burn or upper limb burn.
•All patients will be able to complete the evaluation tests required by the protocol without any problems related to acute or chronic lung disease.
•Informed consent would be obtained from all participants before they became involved in the study.

b. Exclusion Criteria:

patients were excluded from the study based on the following criteria:

•Cardiac diseases.
•Chronic pulmonary disorders.
•Previous or present smoking history.
•Female patients who are pregnant and lactating.
•Post-burn patient on ICU.

Procedures of the study:

The study's methodology has been divided down into two distinct parts: -

1-Measurement procedures:

The evaluation was conducted before and after the study protocol.

Procedures of spirometer:

computerized spirometer (ZAN 100 Hany 11-TB 100 E006):

Forced vital capacity "FVC" Every patient was directed to take a slow, deep breath in, and then exhale as quickly and forcefully as possible. A minimum of three trials were conducted on the patient, and the results from the best performance were analyzed (8).

Forced expiratory volume in 1 minute (FEV1) is a measurement of how much air you were able to exire of your lungs in the 1st second of a forced inspiration. Peak flow rate measurement achieved with a maximally forced effort from a position of maximal inspiration (9)

2-Therapeutic procedures:

- **Traditional chest physical therapy:**

while the patient in a long sitting position, the physical therapist applied bilateral pressure (proprioceptive feedback) to the patient's lower ribs as well as upper abdomen. The physical therapist's instructions and supervision centered on a technique of bilateral expansion, with an emphasis on minimizing the raising of the upper chest and shoulders and increasing the expansion of the lower chest diameters throughout inspiration (with a three-second end inspiratory holding), which was followed by a relaxed exhalation.

- **Pilates method:**

The Pilates technique, which stretched laterally and to the back, stressed costal breathing, in which the ribs climb and drop throughout the ventilatory stream. To prevent abdominal distention, strengthen the diaphragm to facilitate lower rib movement, and increase diaphragmatic excursion, the transverse abdominis muscle had to function harder. During the expiratory phase, its contraction was linked to that of the multifidus muscle as well as the contraction of the pelvic floor. (10) .

- **Physical therapy program for both groups:**

step 1. deep diaphragmatic breathing using both flow or volume incentive spirometry for three sets of five breaths each.

step 2. try some huffing and/or coughing to clear your airways.

step 3. to improve circulation, you should do 10 sets of the foot-ankle pump and the hip-knee flexion every hour.

step 4. Thoracic Expansion Training, with the patient positioned in long/High Sitting at Bedside.

step 5. mobility a) sit out from bed for an hour twice a day. b) brisk walking; three times daily. c) Up and down stairs right before being discharged (11).

STATISTICAL ANALYSIS

The characteristics of the participants were compared between groups using an unpaired t-test. The distribution of genders among groups was analyzed using the Chi-squared test. The Shapiro-Wilk test was used to ensure that the data followed a normal distribution. Levene's test for homogeneity of variances was performed to examine the homogeneity among group. The mean values of FVC, FEV1, as well as PEFR were compared between the study and control groups using an unpaired t-test. A paired t-test was used to compare each group's results before and after treatment. All statistical tests were

conducted with a p-value of less than 0.05 considered significant. The Windows version of IBM's Statistical Package for the Social Sciences (SPSS) version 25 (IBM SPSS, Chicago, Illinois, USA) was used for all statistical analysis (12).

3. RESULTS

- Subject characteristics:

Table (1) showed the subject characteristics of study and control groups. There was no significant difference between groups in age, weight, height, BMI and sex distribution ($p > 0.05$).

Table (1): Comparison of subject characteristics between study and control groups

	Study group	Control group	p-value
	Mean ± SD	Mean ± SD	
Age (years)	34.43 ± 6.41	33.40 ± 6.20	0.52
Weight (kg)	80.30± 8.54	81.36 ± 7.61	0.61
Height (cm)	167.53 ± 8.19	168.2 ± 6.03	0.72
BMI (kg/m²)	28.75 ± 3.73	28.78 ± 2.61	0.97
Sex			
Females	19 (63%)	17 (57%)	0.59
Males	11 (37%)	13 (43%)	

SD, standard deviation; **p value,** probability value

Impact of treatment on FVC, FEV1 and PEFR:

- Within group comparison:

There was a significant increase in FVC, FEV1 and PEFR post treatment compared with that pre treatment in study and control groups ($p > 0.001$). The percent of change of FVC, FEV1 and PEFR in study group was 15.86, 13.65 and 14.29% respectively, while that in control group was 10.59, 3.43 and 7.44% respectively. **(table 2).**

- Between groups comparison:

There was no significant difference between groups pre-treatment ($p > 0.05$). Comparison between groups post treatment revealed a significant increase in FVC, FEV1 and PEFR of study group compared with that of control group ($p > 0.01$). (table 2).

Table (2): Mean FVC, FEV1 and PEFR pre and post treatment of study and control groups

	Study group	Control group	MD	t- value	p value
	Mean ± SD	Mean ± SD			
FVC (L)					
Pre treatment	3.91 ± 0.32	3.87 ± 0.29	0.04	0.38	0.70
Post treatment	4.53 ± 0.27	4.28 ± 0.32	0.25	3.28	0.002
MD	-0.62	-0.41			
% of change	15.86	10.59			
t- value	-10.51	-6.89			
p value	***p = 0.001***	***p = 0.001***			
FEV1 (L)					
Pre treatment	3.15 ± 0.31	3.21 ± 0.22	-0.06	-0.98	0.33
Post treatment	3.58 ± 0.28	3.32 ± 0.21	0.26	4.06	0.001
MD	-0.43	-0.11			
% of change	13.65	3.43			
t- value	-10.91	-9.43			
p value	***p = 0.001***	***p = 0.001***			
PEFR (L/sec)					
Pre treatment	3.43 ± 0.43	3.36 ± 0.36	0.07	0.63	0.52
Post treatment	3.92 ± 0.42	3.61 ± 0.32	0.31	3.17	0.002
MD	-0.49	-0.25			
% of change	14.29	7.44			
t- value	-15	-13.36			
p value	***p = 0.001***	***p = 0.001***			

SD, standard deviation; MD, mean difference; p-value, probability value

4. DISCUSSION

post treatment, both the study and control groups showed statistically significant improvements in FVC, FEV1, as well as PEFR compared to pre-treatment values ($p > 0.001$).

post treatment, the study group exhibited a statistically significant improvement in their FVC, FEV1, as well as PEFR compared to the control group ($p > 0.001$).

When you breathe in fumes or toxic gas, you could suffer an inhalation injury. Laryngopharyngeal edema, caused by breathing air that is too hot to be safe for the bronchi, blocks the upper airway therefore requires immediate intubation. (Schweickert et al., 2009)13.

The purpose of the present study to compare the effectiveness of chest physical therapy and Pilates method in improving lung functions in post burn patient with inhalation injury.

The majority of previous studies has examined the positive effects of Pilates on musculoskeletal disorders; however, to the authors' knowledge, no study has examined the impact of Pilates on lung functions in individuals who have suffered an inhalation injury.

Patients with burn injuries have been demonstrated to have impaired pulmonary functions, as well as diminished functional exercise capability, grip strength, as well as physical activity, according to the previous studies (14).

The Pilates Method (PM) is a form of exercise that emphasizes awareness of body, leading to enhanced self-perception and a resulting integration of the body and the mind. Prevention, rehabilitation, physical training, as well as the development of a mindfulness are just some of the wellness-related purposes for which PM-based workouts have been put to use (15).

This study shown that after 48 weeks of the original kinetic program, patients showed significant improvement in their chest expansion, clinical as well as functional AS-related indicators. To further enhance pain, spinal mobility, physical functioning, in addition to pulmonary function, we advise that patients with AS regularly participate in a complex training program including Pilates, McKenzie, in addition to Heckscher exercises (17).

The results of this study suggest that Pilates and home exercises can help patients with AS improve their respiratory parameters as well as functional capacity. Pilates exercises, despite the absence of equipment and with no extra exercises, are beneficial for enhancing respiratory functions and alleviating disease-concerned symptoms (18).

This study shows promising early results that treatments using Pilates and yoga can increase respiratory muscle strength and reduce perceived walking difficulties. Clinical Pilates training also improved individuals' gait speed, range of motion, quality of life, as well as cognitive ability. When comparing yoga to clinical Pilates with regard to of its effects on balance, walking speed, as well as quality of life, Pilates came out on top. (19).

This study recommends that physiotherapy is a useful tool for ensuring the general health of the elderly population as well as preserving their quality of life as well as their functional capacity. The Pilates Studio approach has been proved to be useful for this purpose, especially when combined with technological equipment that permits a more in-depth evaluation and treatment of pulmonary problems, muscular strength, functional capacity, and range of motion. The results of their study indicate that Pilates-based inspiratory muscle training can help enhance lung function and physical fitness in elderly people. (20).

Based on the findings of the present study, physiotherapists and other medical practitioners need to consider the benefits of including pilates into the rehabilitation process after a burn inhalation injury. Additional studies is required, note, before conclusive efficacy can be stated.

CLINICAL MESSAGE

The results of the study suggest that including Pilates into conventional physical therapy can help preserve lung function and function as a valuable preventative tool following inhalation injury.

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