



## Effectiveness of thoracic cage mobilizations on the chronic obstructive pulmonary diseases: A pilot study

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### Abstract

**Background:** A significant contributor to chronic death and morbidity worldwide is chronic obstructive pulmonary disease (COPD), which many people experience for many years before passing away due to its sequelae. As a result of continued exposure to COPD risk factors and population ageing, the burden of COPD is expected to increase globally in the next decades. The goal of this study was to "detect if thoracic cage mobilizations are useful in treating COPD". Five individuals with chronic obstructive pulmonary disease took the part of trial for this reason. They were received thoracic mobilization treatment and conventional treatment. The training was continuing six sessions in intensive care unit "ICU". Each patient received mobilization treatments in addition to planned programmes of physical therapy. Arterial blood gases (ABG), chest expansion, dyspnoea Index, Computerized Tomography "CT" and COPD Assessment Test "CAT" questionnaire were measured before and after the intervention.

**Results:** there was significance variance in chest expansion on the axillary and T<sub>10</sub> level and there was a significance difference on pH  $7.436 \pm 0.028$ . There was a decrease in the percentage of PaCO<sub>2</sub> after the mobilization with mean value  $67.12 \pm 3.12$  mmHg and there was an increase of PaO<sub>2</sub> after the treatment  $65.95 \pm 15.56$  mmHg. The results showed that there was a decrease in the CAT questionnaire after the treatment. This means that; the patient can go to their life without any problems. The mean value of CAT questionnaire pre-treatment was  $28.4 \pm 4.27$  and the mean value of CAT questionnaire post treatment was  $16 \pm 6.63$ .

**Conclusion:** Adding the thoracic cage mobilization to conventional treatment showed the difference in daily life of the patients after the treatment.

This study was registered with registration NCT05448235. July, 2022; <https://clinicaltrials.gov/ct2/show/NCT05448235> at Clinical Trial Registry.

**Keywords:** chronic obstructive pulmonary disease, thoracic cage mobilization, respiratory functions, conventional treatment

### Introduction

Chronic obstructive pulmonary disease (COPD) is a medical form used to describe rising dyspnea and airflow restriction followed on by physiological deterioration. Elderly adults with COPD have worsening thoracic kyphosis, stiffer joints and rib cage connective tissues, and impaired respiratory function. Dyspnea, cough, and sputum production are the greatest persistent symptoms of COPD, while wheezing, lung tightness, and chest congestion are less common. On the other hand, the reported frequency varies according to the patient population and the severity of the illness. COPD is currently the 4<sup>th</sup> leading cause of mortality worldwide, but by 2020, it is anticipated to move up to the 3<sup>rd</sup> spot <sup>[1]</sup>.

About 3.197 million deaths globally and an estimated 10% frequency in the population aged 30-79 in 2019. In adults aged 50 to 74 and 75 and older, respectively, COPD was the third and fourth greatest cause of disability-adjusted life years (DALYs), according to the Global Burden of Disease Study 2019. But the burden of COPD varies greatly between nations, with low- and middle-income nations about 62.6% of global DALYs <sup>[2]</sup>.

With population ageing, urbanization, and their related risks, chronic respiratory diseases will continue to be an increasingly the cause of death and morbidity.

Understanding of COPD-predisposing factors is hampered by significant variance in incidence, progression, and lung function deterioration at various life stages among populations. However, the leading risk factors in the majority of situations have been identified as smoking cigarettes, exposure to indoor air pollution (like those from biomass combustion), ambient air pollution, and environmental contaminants <sup>[3]</sup>.

Chronic obstructive pulmonary disease (COPD) was the primary reason to be caused by tobacco using. However, recognition of the importance of non-smoking-related risk factors for COPD has raised over the past decade, with evidence on the burden, risk factors, and clinical features of COPD in non-smokers. About half of all COPD cases globally are due to non-tobacco-related risk factors, which vary by geographical areas. These factors include air pollution, environmental exposures, poorly controlled asthma, occupational tobacco usage, infectious diseases, and low socioeconomic status <sup>[4]</sup>. Impaired lung growth during childhood, caused by a range of early-life exposures, is associated with a raised risk of COPD.

The possible pathophysiology of COPD in non-smokers include inflammation, airway obstruction, and accelerated lung ageing. in comparison to smokers who take COPD,

non-smokers with Little to no emphysema, reduced airflow limitation, and comparatively few chronic respiratory symptoms are all characteristics of COPD. and less comorbidity; however, Still, exacerbations can happen often. In order to fill in knowledge gaps and improve viable treatments to lessen the burden of COPD in non-smokers, further research, including epidemiological, translational, clinical, and practical studies, is required [5].

Breathing techniques include active expiration and deep breathing, breathing through pursed lips exercise, relaxation technique, forward trying to bend of the torso, inspiratory and exhalatory muscle training, and diaphragmatic breathing. Improvement of (localized) ventilation and gas exchange, decrease of dynamic hyperinflation, encourage of respiratory muscle function, reduction of dyspnea, and improvement quality of life are some of the aims of these procedures. Both peak exercise tolerance and functional exercise capacity are compromised in people with COPD. Lung hyperinflation, lethargy, hypoxemia, cardiovascular issues, and skeletal muscle abnormalities are other symptoms [6].

With varying degrees of success, earlier research has evaluated the use of manipulative chiropractic treatments, soft tissue methods, myofascial release methods, and spinal joint manipulation (JM). In order to address musculoskeletal issues in COPD patients, the efficacy of muscle energy method (MET) and spinal joint mobility is evaluated. In MET, a sort of manual treatment, the patient tightens voluntarily while being directly counterforce by the therapist [7]. However, no study has looked at thoracic mobilization as a whole, encompassing the ribs, clavicle, and thoracic spinous process. For this reason, the focus of this study was on thoracic mobilization as a whole and how it affected COPD patients' lung function.

## Methodology

### Design

This was a pilot study design. The Faculty of Physical Therapy at Cairo University received ethical committee permission for the study. (NO: P. T. REC/012/003514). This study was registered with registration NCT05448235 at Clinical Trial Registry. Before the study was done, participants' parents and legal guardians submitted written informed consent.

### Participants

The study population consisted of five COPD patients consecutively enrolled to pulmonary rehabilitation unit in Kasr Al Aini medical school in December 2021 to September 2022. The global technique for the diagnosis, management, and prevention of chronic obstructive pulmonary disease's guidelines were followed for making the COPD diagnosis (GOLD). The authors selected the stable exacerbation patients and enrolled at the emergency department with an exacerbation of COPD and had at least a one-year history of persistent dyspnea or cough accompanied sputum production, as well as having previously obtained a COPD evaluation from a doctor. Asthma or atopy diagnoses, hospital enrollment, and use of oral or intravenous corticosteroids during the past 30 days were the exclusion criteria. Each patient received information on the study's objectives, as well as the theory and kind of therapy. Each patient read the informed consent form and signed it. According to the most recent

recommendations for their stage of disease, all patients received regular treatment with inhaled bronchodilators. Throughout the research time, this therapy stayed the same. Patients received both conventional medical care and thoracic cage mobilization.

### Procedure

Demographic data as weight, age, height and BMI were recorded for each patient. ABG, chest expansion, dyspnea index and COPD Assessment Test "CAT" questionnaire were evaluated pre and post the treatment by the same examiner. The treatment sessions were six sessions in ICU.

### Assessment of Blood sample ABG

test measures the acidity (pH), (PaO<sub>2</sub>), (PaCO<sub>2</sub>), Bicarbonate (HCO<sub>3</sub>), Oxygen content (O<sub>2</sub>CT) and oxygen saturation (O<sub>2</sub>Sat) values,

### Assessment Chest expansion with tape measurement

Use a tape to wrap your chest at the nipple level. At the end of deep inspiration and expiration, take measurements.

### Assessment of Dyspnea index

A clinical measure of shortness of breath for determining exertion levels, which may be markedly increased in patients with pulmonary hypertension. shortness of breath levels (SOB); were No SOB, Mild, Moderate, Definite and Severe SOB: unable to count and speak.

### Assessment of CAT Questionnaire

the authors used this questionnaire to Analyze how patients' health status has changed over time asked to rate their general health on a 7-point Likert scale, with "very good" and "very bad" being the extremes.

## Intervention

### Conventional treatment program

The rehabilitation program were performed with: (Pursed-lip breathing breath in from mouth and out from the lips, 8-10 repetitions each cycle, 3-4 times, 5-10 min) the next exercise was (Diaphragmatic exercise; instruct the patient to inhale deeply and tighten his stomach muscles; for exhale; it took 5-10 repetitions each cycle, 3-4 times, 5-10 min) following of using (postural drainage with the percussion on the upper lobe and lower anterior and posterior lobes 30-60 sec for each lobe and total time was 3-5 min) following with a (vibration technique apply gentle pressure and create a rapid, shaking movement without straining to stimulate a productive cough one-time inspiration: 5 times of expiration for 10 times repetition) and the last exercise was (controlled cough to carries mucus through the airways without leading to collapse).

### Thoracic cage mobilization

Mulligan concept thoracic Sustained Natural Apophyseal Glides The same physical therapist applied both the standard physical treatment protocol (SNAG) and SNAG. During the initial screening session, patients who reported no worsening or shown improvement in pain and range of motion (ROM) were determined to be excellent candidates for SNAG treatment. Patients who did not see an instant improvement were thought to be safe using the procedure. The patient would have been removed from the trial if adverse effects persisted following the application of SNAG

even after alterations to its direction, force, or handling. The patient was first placed in three positions: side lying to mobilize the upper six ribs in a downward direction, then the lower six ribs, then Thoracic flexion forward and rotation in the middle. The patient was then instructed to switch directions to supine resting in order to mobilize the sternum and clavicle. Finally, the patient was asked to sit down and place his hand on his hip. As depicted in figure below.

### Results

Five patients were included and received conventional treatment and thoracic cage mobilization. The data represented their mean age was  $55.6 \pm 10.45$  years, mean weight was  $87.3 \pm 33.45$  kg, mean height was  $174.2 \pm 6.379$  cm and mean BMI was  $28.35 \pm 9.24$  kg/m<sup>2</sup>. There was significance varies in chest expansion on the axillary and T<sub>10</sub> level and there was a significant difference on pH  $7.436 \pm 0.28$ , there was a decrease in the percentage of PaCO<sub>2</sub> after the mobilization with mean value  $67.12 \pm 3.12$  mmHg and there was an increase of PaO<sub>2</sub> after the treatment  $65.95 \pm 15.56$  mmHg.

### Discussion

In terms of how well the thoracic cage mobilization affects COPD patients' (chest expansion, oxygen saturation, CAT, and Dyspnea Index), The results of the current study's data analysis showed that there is a difference in chest expansion and ABG levels. As well there was an improvement of CAT questionnaire after the session. On the other hand, Stretching the thoracic cage had an effect on lung capacity, spinal curve, and spinal mobility in a particular COPD patient with thoracic kyphosis [8].

In therapeutic practice, the rib mobilization technique is utilized to increase rib cage movement and control the autonomic nervous system (ANS). There is inconsistent evidence in the literature about the rib mobilization technique's effects on patients with COPD, despite some authors' suggestions that it does so by activating the proximal ganglia of the thoracic sympathetic chain at the costotransverse joint. Additionally, no research has been done on how the diaphragm release technique affects the ANS [9].

As well in other study After three months of joint mobilization, the angle of a geriatric woman's thoracic curve with osteoporosis and thoracic kyphosis reduced from  $52.52.2^\circ$  to  $49.12.0^\circ$ , and her posture clearly improved, which is consistent with the results of our study. The spine extensor muscles become less functional when thoracic kyphosis develops [10].

According to Wang, 2015; that Analyzed the influence of thoracic cage stretching and joint mobilization on pulmonary function, spinal movement, and curve in a single COPD patient with thoracic kyphosis. that The patient's respiratory function (FVC, FEV<sub>1</sub>, FEV<sub>1</sub>/FVC) did not change noticeably. The results of our investigation did not match those of the study, which indicated that COPD patients' lung capacity was increased when a hold-relax technique was applied to the pectoralis major muscle. Because of the patient's advanced age, thoracic kyphosis, the prolonged duration of her illness (over 10 years), and her underweight condition in terms of BMI, the research suggests that her respiratory function did not alter noticeably [10].

According to Cruz-Montecinos *et al.*, 2017; their study showed that in patients with severe and very severe COPD, a single application of a soft tissue mobilization method (MT) protocol that focuses on the soft tissues of the chest wall has the opportunity to result in immediate improvements in lung function. Additionally, because the reduction in residual volume just above threshold for a minimally important difference, it might be clinically significant [11].

### Conclusion

The patients with COPD showed that there is an improvement of lung function and capacity after the treatment which assessed by chest expansion measurement, ABG levels and CAT questionnaire. The patients can return to their life without needing of bronchodilators or oxygen support also.

**Table 1:** List of abbreviations

Abbreviation	Meaning
ABG	Arterial blood gases
ANS	Autonomic nervous system
BMI	Body mass index
CAT	COPD Assessment Test
COPD	chronic obstructive pulmonary disease
GOLD	global strategy for the diagnosis, management and prevention of chronic obstructive lung disease
JM	Joint manipulation
MET	Muscle energy technique
PaCO <sub>2</sub>	Partial pressure of carbon dioxide
PaO <sub>2</sub>	Partial pressure of oxygen
SNAG	Sustained Natural Apophyseal Glides
SOB	Shortness of breath

**Declarations of interest:** none

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