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Effects of Treadmill Training with Rib Cage Mobilization on Dyspnoea and Peak Expiratory Flow Rate in Patients with Chronic Bronchitis

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ABSTRACT

INTRODUCTION: Chronic bronchitis is a type of chronic obstructive pulmonary disease (COPD) that is characterized as more than three months of productive coughing that occurs within two years. Globally, 3.6% to 22% of adults in the general population have chronic bronchitis. The primary goal of the research is to determine how treadmill training combined with rib cage mobilization improves patients' peak expiratory flow rate and dyspnea in individuals with chronic bronchitis.

METHODOLOGY: 30 COPD Patients were selected using convenient sampling method and randomly divided into two groups. Group A (n=15) received treadmill training with rib cage mobilization and Group B (n=15) received rib cage mobilization alone for 3 days in a week for 2 months. The post-test values were obtained through Modified Borg's scale for dyspnea and peak expiratory flow rate (PEFR) values to evaluate the outcome.

RESULTS: There was a statistically significant improvement between the post-test values in group A and group B when evaluated with modified Borg's scale for dyspnea and peak expiratory flow rate (PEFR) at 5% level of significance.

CONCLUSION: The study found that patients with chronic bronchitis who received rib cage mobilization along with treadmill training was more effective in lowering dyspnea and increasing peak expiratory flow rate.

KEYWORDS: Chronic obstructive pulmonary disease (COPD), Chronic bronchitis (CB), Modified Borg's scale (MBS), Peak expiratory flow rate (PEFR).

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Ethics Committee: Ethical Committee of K. Govinda swamy Naidu Hospital.

INTRODUCTION:

Chronic bronchitis is a kind of chronic obstructive lung disease (COPD) that is defined by cough and sputum production for at least three months in each of two consecutive years, according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD). (1)

The symptoms of chronic bronchitis, including shortness of breath, are frequently brought on by inflammation and airway constriction.[1] The estimated pooled

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prevalence of chronic bronchitis was 3.6% (95% CI: 3.1–4.0%) in Pakistan and 5.0% (95% CI: 4.1–6.0%) in India. [2]

The primary cause of chronic bronchitis, despite its many known causes, is exposure to cigarette smoke, whether through active smoking or passive inhalation.

Severe chemicals, pollution, and industrial pollutants are just a few of the respiratory tract irritants that can cause chronic bronchitis by inhalation.

Frequent exposure to airborne substances such as ammonia and sulfur dioxide, as well as environmental toxins like dust, can increase the risk of developing chronic bronchitis. A well-known, though uncommon, cause of chronic bronchitis is persistent gastroesophageal reflux. [3,4]

Mucus metaplasia, or the overproduction of mucus in response to inflammatory signals, is the pathophysiological basis for chronic bronchitis. Due to presents of goblet cells, mucus clearance is decreased, which results in excessive production and hypersecretion.

The mechanisms behind mucus metaplasia are linked to the function of T cells. Although the exact mechanism is still unknown, it is thought to be related to the end production of Th2 cells, which are inflammatory cells, while Th1 inflammatory cells are thought to be responsible for the cellular response. Both Th1 and Th2 cells produce cytokines, which are substances that influence mucus production linked to chronic bronchitis. [5]

This leads to decreased airflow and gas exchange capacity, as well as an increased risk of airway collapse. Mucus hypersecretion is one danger associated with cigarette smoking, bacterial or viral infections, and the activation of inflammatory cells. Clearing secretions become difficult and energy-intensive when distal airway blockage, inefficient coughing, respiratory muscle weakness, low peak expiratory flow rate, and poor ciliary function are combined. [6]

Aerobic exercise is characterized as submaximal, rhythmic, repeated exertion of the major muscles, with inspired oxygen providing the necessary energy. It is a form of exercise that can increase cardiopulmonary endurance and enhance the effectiveness of the aerobic energy generating systems. Ppatients with chronic respiratory disorders can benefit from aerobic training as an evidence-based intervention that increases their physical capacity and lowers dyspnoea. [7]

Joint mobilization is a manual therapy method that restores the joint's arthrokinematics as opposed to its osteokinematics by applying passive motions to the soft tissue and joint capsules. Clinically, joint mobilization is used to improve inspiratory capacity by restoring the chest wall movement. Furthermore, rib motions are required for the chest wall to expand fully during breathing.

Rib cage mobilization was used to increase the range of motion in the costovertebral joint and the costotransverse joint. [8,9] by improving the mobility of the rib cage joints in the pump and bucket handles. [10]

Evidence regarding the effects of treadmill training with rib cage mobilization for respiratory parameters is still lacking. So, the present research is design to study the efficacy of treadmill training with rib cage mobilization on patients with chronic bronchitis.

MATERIALS AND METHODOLOGY

An ethics committee at KG Hospital was informed of the study's goal, and their consent was acquired. After getting approval from the ethical committee the study was planned to conduct at Out Patient Department of KG Hospital, Coimbatore.30 individuals were chosen using a convenient sample technique in accordance with the selection standards. Inclusion was between 45 and 55 years old, regardless of gender, Individuals who meet the GOLD criteria for moderate to severe airway obstruction: GOLD 2 (Moderate) & GOLD 3 (Severe),

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hemodynamically stable individuals. Exclusion criteria include patients with orthopaedic problems, Recent thoracic surgery, Patients with infectious disease like tuberculosis and pneumonia, Malignancy of lung, Chest wall deformity, fracture of rib, history of cardiovascular problems, neurological disorder, patients with GOLD 1-(Mild) and GOLD 4 (Very severe) airway obstruction.

Informed consent was obtained and clear explanation prior to their participation in the study was given. With a random number generator, the participants were split into two groups for this pre test, post-test experimental research method. Treadmill training combined with rib cage mobilization was administered to Group A (n = 15), while rib cage mobilization alone was administered to Group B (n = 15). The total duration of the study was 6 months and each patients received treatment for a duration of 8 weeks, 3 days in week on alternative days.

Peak Flow Meter was used to measure the patient's peak expiratory flow rate (PEFR), and the Modified Borg's scale was used to measure dyspnea. The first day of therapy was used for pre-test evaluation, and the last day of treatment was used for post-test evaluation.

TECHNIQUES:

TREADMILL TRAINING:

Aaerobic exercise training program consisted of treadmill walking. Training session consisted of Warm up period, Aerobic training, Cool down period. The patients warmed up for five minutes by stretching before starting the workout. The patient was encouraged to walk on the electrical treadmill until they were exhausted, and digital monitoring equipment were used to assess their vital signs.

Using the modified Bruce protocol, the treadmill was first configured for a 3-minute run at 1.7 mph and 0° elevation. Depending on the patient's capacity and tolerance, the pace was progressively raised every three minutes.

The training program was terminated at the patient's request or in response to significant changes in vital signs, and the participants were under close monitoring. Cool down period was given for a period of 5 minutes. After completion of the training program patients' vitals were evaluated.

RIB CAGE MOBILIZATION:

Rib cage mobilization was applied in group A with the treadmill training in three different positions: In sitting position, Side lying and supine lying.

TECHNIQUE - 1 FOR 10th THROUGH 6th RIB:

Patient Position:

The patient was Positioned in right side lying.

Therapist Position and Hand Placement:

Therapist was standing at the head of the table. Therapist left hand's radial side of index finger and thumb's web is palpating the intercostal space. Right hand stabilizing the patient from proximal humerus.

Procedure:

When the patient breaths out, fixates the lower rib and as the patient breaths in, the operator brings the rib cage into the right-side bending using the proximal humerus. Applied a quick release pressure with left hand.

TECHNIQUE - 2 FOR 10th THROUGH 2nd RIB:

Patient Position:

The patient was Positioned in sitting at the edge of the table.

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Therapist Position and Hand Placement: Therapist was standing behind the patient. Therapist left hand grabs the patient's right upper extremity and right-hand thumb and index finger press over lower rib.

Procedure:

Hold back the lower rib and pulls upper rib cranially with inspiration. Hold for approx. 7-10 sec and repeat several times.

TECHNIQUE - 3 FOR 1st RIB:

Patient Position:

The patients were positioned in supine lying, head rotated to right or left side.

Therapist Position and Hand Placement: Therapist stood at the head of the table facing patient. Therapist left hand web space of left thumb & index finger was placed at the top of patient's 1st rib. Therapist right hand maintaining cervical rotation

Procedure:

Presses the left 1st rib downward, medially and anteriorly in the line with the patient right greater trochanter during exhalation and maintain for 7-10 sec.

STATISTICAL ANALYSIS & RESULTS

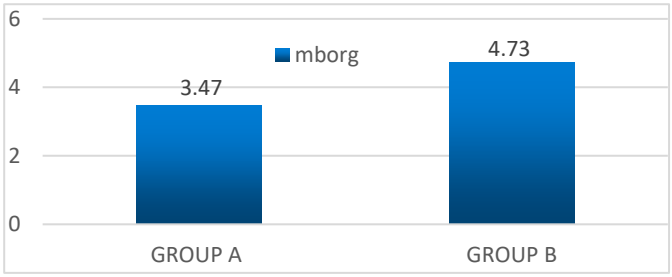
TABLE NO: 1 Pretest analysis of group A and group B

Parameter	Pre-Mean Value		Standard Deviation		Cal. t value
	Group A	Group B	Group A	Group B	
MBS	4.60	0.74	0.74	0.86	2.04
PEFR (L/min)	275.33	287.33	14.57	17.10	2.06

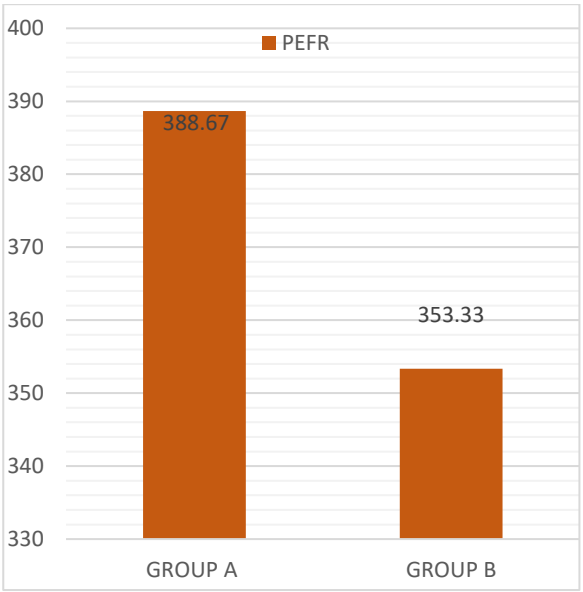
TABLE NO: 2 Post test analysis of group A and group B

Parameter	Post-Mean Value		Standard Deviation		Cal. t value
	Group A	Group B	Group A	Group B	
MBS	3.47	4.73	1.13	0.70	3.69
PEFR (L/min)	388.67	353.33	31.14	37.35	2.81

GRAPH NO: 1 Graphical representation of Post test values for Modified Brog Scale (MBS) in group A and group B



GRAPH NO: 2 Graphical representation of Post test values for Peak expiratory flow rate (PEFR) in group A and group B



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DISCUSSION:

The goals of rib cage mobilization procedures include enhancing respiratory function and chest wall mobility through manual therapy or respiratory physiotherapy exercises. Because chronic bronchitis is characterized by mucus production and persistent inflammation, the process of rib cage mobilization in people with the illness may be different from that of persons with normal respiratory function. In individuals with normal respiratory function, rib cage mobilization techniques typically focus on enhancing the flexibility of the ribs, intercostal muscles, and thoracic spine. This can help optimize lung expansion and improve respiratory efficiency. In chronic bronchitis, several factors may alter the mechanism of rib cage mobilization.

The main feature of chronic bronchitis is bronchial tube inflammation, which increases mucus production and obstructs airflow. Fibrosis and stiffness of the chest wall can develop over time as a result of persistent inflammation and recurring infections in the bronchial tubes. People with chronic bronchitis may experience inefficient respiratory habits, such as shallow breathing or difficulty in breathing. In these instances, rib cage mobilization methods may be used to improve coughing efficacy or encourage drainage from the affected airways in an effort to aid mucus clearance.

Gentle stretching and mobilization may be the main goals of rib cage mobilization procedure to reduce stiffness and increase the flexibility of the components that make up the chest wall. Breathing exercises to promote deeper, more efficient breathing patterns and lessen the utilization of supplementary muscles frequently observed in chronic bronchitis are examples of rib cage mobilization treatment.

As per the findings of Yilmaz Yelvar et al., individuals with restricted rib cage space who had been prescribed frequency therapy had an increase in both inspiratory and expiratory pressures after the treatment. These findings are consistent with our own research. This is believed to be caused by the joints' repetitive motion as well as the absence of chemical or mechanical stimuli. [(11)] As a result, the paralyzed area's respiratory muscles become more rigid and toned, and the rib cage's range of motion is expanded, along with the chest's flexibility. Joint mobilization of the rib cage led to an increase in maximal pressures during inhalation and exhalation. [(12)]

According to Kriel et al., mobilizing the rib cage joints results in an increase in inspiration and the rib cage's volume. Flexibility of the rib cage and relaxed muscles improved muscular function and reduced breathing difficulty. Increased rib cage movement and diaphragm contraction are the results of parasympathetic nerve activity and sympathetic nerve inhibition. [(13)]

In therapeutic practice, the rib mobilization method is utilized to improve rib cage mobility and modify the autonomic nervous system (ANS). According to some writers, the rib mobilization approach activates the proximal ganglia of the thoracic sympathetic chain at the costotransverse joint, which in turn affects autonomic nervous system activity. [(14-16)]

Treadmill training, a form of aerobic exercise, helps improve cardiovascular fitness by increasing heart rate and enhancing the efficiency of the heart and circulatory system. This is accomplished by engaging in consistent aerobic activity, which enhances blood circulation and strengthens the heart muscle. Because treadmill training increases

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oxygen demand during exercise, it helps develop respiratory muscles, such as the diaphragm and intercostal muscles. This might lead to better respiratory efficiency and function. Frequent treadmill exercise can improve oxygen uptake and use, which can increase lung capacity. This is accomplished by inhaling deeply when exercising, which aids in lung expansion and improves oxygen exchange in the alveoli.

Exercise on a treadmill can help manage the symptoms of chronic bronchitis, such as fatigue and shortness of breath, by improving cardiovascular fitness and respiratory muscle strength. Excessive frequency and intensity of exacerbations can be decreased with regular exercise as well. Chronic bronchitis patients can breathe easier and have less congestion by engaging in aerobic activity, such as treadmill training, which stimulates the mucus clearance systems in the airways. Those who suffer from chronic bronchitis might gradually increase their exercise tolerance and endurance with treadmill training. Their disease could not limit them as much and they could be able to participate in daily activities with less effort.

Research carried out by Murray et al. examined the physiological and perceptual reactions of COPD individuals during exercise on an ergocycle and treadmill. The exercise session on the treadmill was shown to have a considerable increase in oxygen demand (VO2). [17] Carter et al. discovered that following treadmill exercise, oxygen intake resulted in a noticeably larger rise in VO2 max as opposed to ergo cycle training. [18]

According to statistical analysis, the study's findings show that, when combined with treadmill training, rib cage mobilization considerably increases peak expiratory flow rate and decreases dyspnea in patients with chronic bronchitis, as compared with being done alone.

LIMITATIONS:

- ✧ Sample size was small
- ✧ Patient may feel painful because of a quick stretch
- ✧ Time consuming one

SUGGESTIONS:

- ✧ A larger sample size is necessary to provide further insight into the efficacy of rib cage mobilization.
- ✧ A regular home and follow-up program may also be implemented
- ✧ Future studies can be done by using other reliable assessment tool.

CONFLICT OF INTEREST:

The author states that the content does not include any conflicts of interest.

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