EFFECTIVENESS OF PNF OF RESPIRATION TO IMPROVE THE EXERCISE CAPACITY IN PATIENTS WITH COPD: A PILOT STUDY

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ABSTRACT:

Chronic Obstructive Pulmonary Disease (COPD) is described by persistent breathing symptoms and airflow restriction that is due to respiratory system abnormalities usually caused by substantial contact with harmful particles or gasses. This usually leads to increased breathlessness, frequent coughing with or without sputum, wheezing and tightness in the chest and reduced endurance. Limited research has been done on the effects of PNF of Respiration. The present study was a randomized controlled pilot trial that aimed to evaluate if the addition of PNF of Respiration to pursed lip breathing exercise would enhance the treatment effects when compared to the effects of Pursed lip breathing exercise alone in the management of COPD. Fourteen subjects (9 males, 5 females; mean age, 48.3 years; age range, 40–60 years) diagnosed with COPD were recruited from a local thoracic medicine outpatient department. Subjects were randomly allocated to receive either PNF of respiration and pursed lip breathing exercise (Group A) or pursed lip breathing exercise alone (Group B). Outcome measures were distance covered in the six minute walk distance test and Modified Rate of Perceived Exertion (MRPE) during the 6 minute walk test. Between the group analysis showed that the results of Group A was statistically more significant than Group B for both the outcome measures (distance covered in 6 min walk test (t value - 13.62, p value <0.001) and MRPE (t value - 2.95, p value <0.01). Hence, this study concluded that the PNF of respiration was more effective and can be a useful therapy in improving exercise capacity in patients with COPD.

Key Words: Chronic Obstructive Pulmonary Disease (COPD), PNF (Peripheral Neuromuscular Facilitation) of Respiration, Pursed Lip Breathing Exercise, 6 minute walk test, Modified Rate of Perceived Exertion (MRPE)

INTRODUCTION:

Chronic Obstructive Pulmonary Disease (COPD) is described by persistent breathing symptoms and airflow restriction that is due to respiratory system abnormalities usually caused substantial contact to harmful particles or gasses. It is a preventable and treatable disease. The major risk factor for COPD is tobacco smoking, but other environmental exposures such as biomass fuel exposure and air pollution may contribute to the onset of symptoms.
At one time, COPD were common in men, but because of increased tobacco use among women in high-income countries, the disease now affects men and women equally. More than 90% of COPD deaths occur in low and middle-income countries, where there are no effective strategies for prevention and control\textsuperscript{20}. According to COPD estimation, 65 million people have moderate-severe COPD.

This usually leads to increased breathlessness, frequent coughing with or without sputum, wheezing and tightness in the chest and reduced endurance. The goal of breathing exercise interventions is to minimize disabilities resulting from disease and to prevent recurrences. Hence, developing and applying diverse programs to prevent reduction in respiratory activities and promote the functional performance of breathing is very important\textsuperscript{14}.

The largely responsible muscles of respiration are diaphragm, intercostal and abdominal muscles. Many other muscles have an accessory function, including muscles in the neck and perineum\textsuperscript{18}. Breathing exercises aim to improve base, lateral and apical chest wall expansion and diaphragmatic excursion\textsuperscript{17}.

Respiratory muscle strength and endurance can be improved by various breathing exercises such as respiratory muscle training\textsuperscript{17}, pursed lip breathing and diaphragmatic breathing\textsuperscript{18, 19}. A study conducted by Dietz indicated that muscle strength can be improved using three-dimensional spiral large scale resistive exercises using proprioceptive neuromuscular facilitation (PNF)\textsuperscript{6}. Respiratory muscles have mechanoreceptors which have function of central control of breathing. The muscle spindle endings and tendon organs are considered to be the primary receptors\textsuperscript{17}.

The Proprioceptive neuromuscular facilitation technique is defined as a positive functional approach to help patients achieve their highest level of function. Breathing problems can be a result from both disturbed inspiration and expiration phases. To improve breathing, the related structures involving diaphragmatic, sternal and coastal areas should be treated.

The physiological mechanism that enables the initiation of inspiration is thought to be the stretch reflex. The stretch reflex resists the change in muscle length by contracting the stretched muscle fiber via its muscle spindle (proprioceptor). Appropriate resistance during applying for one of the PNF techniques strengthens the muscles and guides the chest motion\textsuperscript{7}.

Moreover, numerous treatment protocols, and workouts have been tried to improve the exercise capacity whereas, no studies have tested the effects of PNF of respiration to improve the exercise capacity in patients with COPD. Hence, there is a need for this study to evaluate the effects of such techniques for improvement of exercise capacity induced by direct respiratory muscle training through PNF of respiration in patients with COPD.

**METHODOLOGY:**

**Subjects:**

Fourteen subjects (9 males, 5 females; mean age, 48.3 years; age range, 40–60 years) who were diagnosed with COPD were recruited from a local thoracic medicine out-patient department. The criteria for inclusion were both males and females gender, people > 45 years of age, ex-smokers and clinically stable patients (i.e., no exacerbations in the previous 6 weeks), Post bronchodilators measurement of FEV1 <80%, FEV1/FVC <0.7, inadequate ventilation and limited chest expansion. The exclusion criteria were BMI > 30 kg/m2, FEV1 <50, other cardiopulmonary diseases and musculoskeletal abnormalities, previous thoracic surgery and recent abdominal surgery, lack of consent and inability to understand the commands.

**Study Protocol:**

A single-blinded, randomized controlled pilot study was done. After informed consent was obtained, demographic data including age, gender and duration of COPD were recorded. Subjects were randomly allocated to receive either PNF of respiration and pursed lip breathing exercise (Group A) or pursed lip breathing exercise alone (Group B). Participants were blinded as to whether they received PNF of respiration and pursed lip breathing exercise or pursed lip breathing exercise alone.

**Procedure:** Pre-intervention evaluation form consisted of 6 minute walk distancetest scoreand Modified Rate of Perceived Exertion (MRPE) during the 6 minute walk test. The procedure was explained to the participants and the interventions were given over a period of twelve weeks with 3 sessions per week comprising of 5 repetitions of each technique. It was left to the choice of the participant to follow the technique at home. After a period of 12 weeks, the participants were reassessed with 6 minute walk test for distance covered and MRPE. The findings were recorded and compared and analysed with the pre intervention scores.

**Pursed lip breathing:** It consists of inhaling through nose with mouth closed and exhaling through tightly pressed (pursed) lips. It helps to create a back – pressure inside airways to splint them open and for moving air with less effort.

**PNF for Respiration:** It comprises of a variety of techniques such as Peri oral stimulation, vertebral pressure of the upper and lower thoracic spine, co – contraction of abdomen, intercostal stretch and anterior stretch basal lift are applied to enhance respiration.

1. Peri – oral pressure: Stimulation is provided by applying firm pressure to the patient’s upper lip which is maintained over a length of time. This causes a brief period of apnea followed by increased epigastric excursion (approximately 5 secs).
As the stimulus is maintained the epigastric excursion may increase so that the movement is transmitted to upper chest and the patient appears to be in deep breathing.

2. Vertebal Pressure: With the patient in supine position, a firm pressure is applied to the uppermost thoracic vertebrae to increase the epigastric excursion in the presence of a relaxed abdominal wall and pressure is applied to the lower thoracic vertebrae to improve the inspiratory movement of the apical thorax. The pressure should be firm enough to provide intrafusal stretch.

3. Co-contraction of abdomen: In this the pressure is directed across the abdomen to produce intrafusal stretch, thus activating the muscle spindle contralateral to the pressure applied. As those muscles stretch and shorten, they stretch the intrafusal fiber of the opposite muscle and the cycle goes on. This technique helps in improving the epigastric movements and in increasing the tone of the abdominal muscles thereby activating the diaphragm.

4. Intercostal Stretch: This is provided by applying pressure to upper border of the rib in order to stretch the intercostal muscles in a downward direction. Application of stretch should be timed with exhalation. This causes reflex activation of the diaphragm by intercostal afferents and its margins.

5. Anterior stretch basal lift: This technique is done by placing the hands under the ribs of the supine patient and gently lifting upwards. It can be done unilaterally or bilaterally. As the lift is sustained stretch is maintained and increasing movement of the ribs in a lateral and posterior direction can be seen and felt. This in turn causes obvious epigastric movement.
Data Analysis and Results:

Unpaired ‘t’ test was used to compare the significance between Group A and Group B. The level of significance was set at \( p<0.01 \).

**Table 1: Data analysis of group A (PNF of respiration and pursed lip breathing exercise)**

<table>
<thead>
<tr>
<th>Within the group analysis</th>
<th>Group A ( N=7 )</th>
<th>**</th>
<th>**</th>
</tr>
</thead>
<tbody>
<tr>
<td>**</td>
<td>Pre-Test (Mean ± SD)</td>
<td>Post-Test (Mean ± SD)</td>
<td>t-value</td>
</tr>
<tr>
<td>6min walk test (distance covered)</td>
<td>194 ± 22</td>
<td>243 ± 24</td>
<td>17.17</td>
</tr>
<tr>
<td>6min walk test (MRPE)</td>
<td>5.7 ± 1.4</td>
<td>3.4 ± 1.3</td>
<td>8</td>
</tr>
</tbody>
</table>

**Table 2: Data analysis of Group B (Pursed lip breathing exercise alone)**

<table>
<thead>
<tr>
<th>Within the group analysis</th>
<th>Group B ( N=7 )</th>
<th>**</th>
<th>**</th>
</tr>
</thead>
<tbody>
<tr>
<td>**</td>
<td>Pre-Test (Mean ± SD)</td>
<td>Post-Test (Mean ± SD)</td>
<td>t-value</td>
</tr>
<tr>
<td>6min walk test (distance covered)</td>
<td>178±40</td>
<td>183 ± 44</td>
<td>3.21</td>
</tr>
<tr>
<td>6min walk test (MRPE)</td>
<td>6.8 ± 1.0</td>
<td>5.7 ± 1.3</td>
<td>4.38</td>
</tr>
</tbody>
</table>

**Table 3: Data analysis between Group A and Group B**

<table>
<thead>
<tr>
<th>Between the group analysis</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>6min walk test (distance covered)</td>
<td>13.62</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>6min walk test (MRPE)</td>
<td>2.95</td>
<td>&lt;0.01*</td>
</tr>
</tbody>
</table>

**Figure: 4**

**Graphical Representation**

Distance Covered in Six Minute Walk Test
Between the group analysis showed that the Group A was statistically very significant than the Group B for both the outcome measure (distance covered in 6min walk test (t value - 13.62, p value <0.001) and MRPE (t value - 2.95, p value <0.01) see table 3.

DISCUSSION:

A facilitator stimulus in the form of proprioceptive neuromuscular facilitation (PNF) respiration is adopted to create reflex respiratory movement responses. It modifies the rate and depth of breathing, improving compliance and thereby improving the exercise capacity. PNF techniques are those which involve the application of external proprioceptive and tactile stimuli that produce reflex respiratory movement responses that appear to alter the rate and depth of breathing⁷. Peri-oral stimulation, vertebral pressure of the upper and lower thoracic spine, co-contraction of abdomen, intercostal stretch and anterior stretch basal lift are the PNF techniques routinely used.

The effects of the muscle mechanoreceptors, muscle spindle endings and tendon organs, are the proprioceptors participating in regulation of the level and timing of the respiratory function. Muscle proprioceptors may also involve in increasing the ventilation during the early stages of exercise. Tendon organs are sensitive to changes in force of muscle contraction and have an inhibitory effect on inspiration. They may be important in coordination of respiratory muscle contraction during breathing⁵.

When the respiratory muscles are activated, they change the thoracic volume by providing movement of joints in the thorax thereby improving the chest wall mobility and exercise capacity in COPD patients¹². According to Guilherme P, T. Arias et al, effect of upper extremity proprioceptive neuromuscular facilitation combined with elastic resistance band had a positive impact on respiratory muscle strength. There was an improvement in Maximal Expiratory Pressure (MEP) and Maximal Inspiratory Pressure (MIP) after the interventions in healthy adults. On the other hand, a study conducted by CB Kim, it was proved that chest expansion resistance exercise on chest improves maximal expiratory pressure in elderly with inspiratory muscle weakness.

Kyochul SEO et al showed that there was a significant improvement in TV, ERV, and VC after 4 weeks of Proprioceptive neuromuscular facilitation respiration pattern exercise in normal adults. In PNF breathing exercise the mobility of the patient’s chest wall increases, which leads to improvement in pulmonary function. The present study also showed the similar effects of the PNF of respiration on respiratory muscles in improving exercise capacity in patients with COPD.

CONCLUSION:

From the findings of this study, it was concluded that group A (PNF of respiration and pursed lip breathing exercise) showed significant improvement in exercise capacity than group B (pursed lip breathing alone) with COPD. Hence, this study suggested that the addition of PNF of respiration to the pursed lip breathing exercise program was a more effective and useful therapy in improving the exercise capacity in patients with COPD.
REFERENCES:

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