Effectiveness of Segmental Breathing Exercise Versus Respiratory Muscle Stretches on Dyspnea and Exercise Tolerance Level among COPD Patients

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Abstract: ***Background**: Chronic obstructive pulmonary disease (COPD) is a respiratory disorder characterized by chronic airway obstruction along with excessive mucus production which occludes the airway & derangements in the structural integrity of the airways. Amongst various other symptoms, dyspnea & reduced physical tolerance are foremost presentations which may be attributed to the advancement of the disease process. In addition to the routine respiratory care, breathing exercises & muscle stretches would help in improving the symptoms. Apart from alleviating symptoms, these might also either directly or indirectly help in improving the exercise (Physical) tolerance level of the subject. This study aims at finding out the effectiveness of Segmental breathing exercise & Respiratory muscle stretches on improving dyspnea symptoms & exercise tolerance in COPD subjects. **Aim & objective of the study**: To compare the effects of Segmental breathing Vs respiratory muscle stretch on dyspnea and exercise tolerance level among COPD patients. **Methodology**: 20 participants were recruited in the study based upon inclusion criteria & divided into two groups: Group A (n=10) - Segmental breathing exercise & Group B (n=10) - respiratory muscle stretches alone. **Results**: Comparing the pre and post test values of 6 minute walk test and modified Borg scale, it has been found that respiratory muscle stretches were most efficient in improving exercise tolerance level and reducing dyspnea in patients with COPD. **Conclusion**: The study concluded that respiratory muscle stretches are effective in the management of COPD.***

Keywords: COPD (chronic obstructive pulmonary disease), 6 MWT (6minutes walk test), Segmental breathing exercises, Respiratory muscle stretch, Modified Borg scale.

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a preventable and manageable lung disease. People with COPD usually have shortness of breath and a feeling of tiredness. Early in this disease, people with COPD may feel mild to moderate shortness of breath when they physically exert. As the disease progresses, it can become severe.[1] A person with COPD may have chronic bronchitis, emphysema, asthma, and bronchiectasis. The amount of each of these conditions differs from person to person.[2] COPD is usually diagnosed in individuals who are older than 60 years. Individuals who have diagnosed the age of 50 or younger are diagnosed with early onset COPD, cumulative smoking for 10 years can cause airflow limitation, changes in lung shape, or decrease in lung function is increased.[3]

Chronic obstructive pulmonary disease (COPD) can lead to several musculoskeletal changes due to factors such as decreased physical activity, chronic inflammation, and steroid use. These changes may include:

- **Muscle weakness:** Continuous Physical Inactivity and increased energy expenditure from breathing difficulties can lead to muscle weakness, particularly in the respiratory muscles (diaphragm, intercostals muscles) and limb muscles.
- **Muscle Fiber atrophy:** Prolonged inactivity and systemic inflammation can contribute to muscle wasting, especially in the quadriceps and other limb muscles.
- **Reduction in Muscle Endurance:** patients with COPD experience a decrease of approximately 30% in muscle endurance, defined as the ability of muscles to sustain a specific force over time. COPD cause reduced muscle endurance due to decreased oxygen supply to muscles, impaired lung function, and physical inactivity. This can affect daily activities and quality of life for individuals with COPD. Regular exercise and pulmonary rehabilitation can help improve muscle endurance and overall function in COPD patients.
- **Joint stiffness and pain:** Reduced physical activity and inflammation can contribute to joint stiffness and pain, particularly in weight-bearing joints such as the knees and hips.
- **Decreased range of motion:** Reduced physical activity and muscle weakness can lead to a decreased range of motion in joints, limiting mobility and functional capacity.

These musculoskeletal changes can further impair physical function and quality of life in COPD patients, highlighting the importance of pulmonary rehabilitation programs and exercise interventions to address these issues.[4]
Dyspnea is termed as shortness of breath with the subjective sensation of uncomfortable breathing comprised of various

sensations of different intensity. The primary indications of dyspnea are changes in respiration, cardiac, neuromuscular, psychogenic, systemic illness, or a combination of these. The acute stage of dyspnea is said to occur in hours to days, whereas, in the chronic stage it occurs around for more than 4-8 weeks.[5] Borg CR10 scale is used to measure the intensity of pain when the patient has felt difficulty in breathing upon exertion.[6]

Exercise intolerance is a condition where the individual is unable to perform physical exercise at the intensity or for the duration that would be expected of someone in his other age and general physical condition. When this inability is caused by impaired function of one or more of the major physiological systems, namely the respiratory, the cardiovascular, a nd the peripheral muscle metabolic system, the result is the amplification of the perceptions of respiratory discomfort, either alone or typically in conjunction with peripheral muscle discomfort/fatigue. In patients with chronic lung diseases, dyspnea sensations are exaggerated during exercise secondary to the reduced breathing efficiency that results from the deteriorating ventilator mechanics on one hand and the increased ventilator requirement on the other hand. 6 MWT is the outcome measure used for this condition.[7]

2. Procedure

This is a comparative study which has been conducted at Isari Velan Mission Hospital, Thazhambur. Twenty samples were selected by convenient sampling method & the study duration was four weeks.

Inclusion criteria: COPD - Predominantly chronic bronchitis, medically stable, those who are under regular medical treatment & follow – up. Exclusion criteria: Unstable cardiovascular diseases, mental illness, active respiratory infections, recent surgeries.

20 COPD patients who met the inclusion criteria were selected for the study. they were evenly separated into 2 groups. GROUP A (n=10) received segmental breathing exercise and GROUP B (n=10) received respiratory muscle stretch.

Group A: (Segmental Breathing Exercise)

Each session was about 10 – 15 minutes. 18 – 20 repetitions of each of the following techniques were done:
1) **Lateral costal expansion:** The hands were placed on the lateral basal side of the chest and the patient is in a crooked lying position. The patient was instructed to exhale and a quick stretch to external intercostals was given at the end of expiration just before inspiration. The ribs were pressurized downwards and inwards to resist the initial phase of inspiration with mild resistance.

Figure 2: Lateral Costal Expansion

2) **Posterior basal expansion:** the patient's position was in a sitting and forward- leaning position and their hips bent slightly. The hands were placed over the posterior basal segment a quick stretch was given just before inspiration and gently resisted the inspiration against upward and flare movement of ribs.

Figure 3: Posterior Basal Expansion

3) Right middle lobe and lingual expansion: the hands were placed over the sides of the patient under the axilla. For sensory awareness of the segment, downward pressure to stretch external intercostal muscles and give mild resistance was applied to the movement of ribs during inhalation.

Figure 4: Right Middle Lobe and Lingual Expansion

4) **Apical Expansion:** the patient was taken supine the pressure had to be applied under the clavicle by the finger pads.

Figure 5: Apical Expansion

1) Group B (Respiratory Muscle Stretch):

Respiratory muscle stretching was based on hold–relax and passive stretching techniques and involved the scalene, sternocleidomastoid, upper trapezius, pectoralis major and minor, intercostals, serratus anterior, and rectus abdominal muscles. The hold–relax stretching technique involves performing a passive stretch up to the maximum range of motion interspersed with 3 seconds of isometric contraction with three repetitions, which is called a “cycle”. Three sets of three cycles were interspersed with 1 minute of rest. Passive stretching was sustained for 1 minute, with 1 minute of rest between stretches, and repeated three times.

1) Upper trapezius: Patient in supine position with lateral flexion of the head to the opposite side of that stretched, the therapist supported the occipital region with one hand and the shoulder with the other hand, causing displacement of two support points in the craniocaudal direction.

Figure 6: Upper Trapezius Stretch

Sternocleidomastoid:

Patient in supine position with lateral flexion with rotation of the head to the opposite side of that stretched the therapist placed one hand on the occipital region and the other on the sternal region, which was displaced in the cranial-caudal direction.

Figure 7: Sternocledomastoid Stretch

Scalene:

Patient is lying on their back; therapist supports head with body contact and hand at the base of skull. The stretch is done by bending the head and cervical spine forward combined with rotation and side bending to the contralateral side.

Figure 8: Scalene Stretch

Pectoralis major:

Patient sitting on the bench with the chest resting on the trunk support, shoulder at 90° to horizontal abduction, elbow in full extension and hip and knee flexed to 90°. The stretch is done by doing the isometric contraction of pectoralis major muscle against the resistance provided by the therapist.

Figure 9: Pectoralis Major Stretch

Serratus anterior
Patient lies with side to be treated on the couch with the shoulder abducted and elbow flexed fully. Therapist places 1 hand over the ASIS and the other hand over below the axilla near the lateral borders of scapula and passively stretches the muscle by moving both the hands at opposite directions.

Figure 10: Serratus Anterior Stretch

3. Data Analysis within the Group

Table 1: Pre and Post Test Values of Group A (Segmental Breathing Exercise)

Group A	Pre-Test		Post Test		t test	Significant
	Mean	SD	Mean	SD		
6MWT	210.2	24.31	2430.1	243.1	32.02	0.001
Modified BORG Scale	3.7	1.185	1.7	0.85	0.85	0.000

The above table reveals the Mean, Standard Deviation (S.D), t-value and p-value between pre-test and post-test within Group – A.

There is a statistically highly significant difference between the pre test and post test values of 6MWT and modified borg scale within Group - A (*- $P \leq 0.001$).

Table 2: Pre and Post Test Values of Group B (Respiratory Muscle Stretch)

Group B	Pre-Test		Post Test		t test	Significant
	Mean	SD	Mean	SD		
6MWT	203.5	22.96	270.8	24.92	6.411	0.000
Modified BORG Scale	4.3	1.49	1.2	0.62	7.841	0.000

The above table reveals the Mean, Standard Deviation (S.D), t-value and p-value between pre-test and post-test within Group – B.

There is a statistically highly significant difference between the pre test and post test values of 6MWT and modified borg scale within Group - B (*- $P \leq 0.001$).

B. Data Analysis between the Groups:

Table 3: Pre and Post Test Values 6MWT of Group A and B

6MWT	Group A		Group B		t test	Significant
	Mean	SD	Mean	SD		
Pre-Test	210.2	24.31	203.5	22.96	0.634	0.534
Post Test	243.1	32.02	270.8	24.92	21.59	0.045

This table shows that there is no significant difference in pre test values of the 6MWT between Group A & Group B (*$P > 0.05$).
This table shows that there is a significant difference in post test values of the 6MWT between Group A & Group B (**$P \leq 0.01$).
Both the group shows significant decrease in the post test means but (GROUP-B) which has the lesser mean value is more effective than (GROUP-A)

Table 4: Pre and Post Test Values of Modified Borg Scale of Group A and B

Modified BORG Scale	Group A		Group B		t test	Significant
	Mean	SD	Mean	SD		
Pre-Test	3.7	1.15	4.3	1.49	1.008	0.327
Post Test	1.7	0.85	1.2	0.62	1.503	0.152

This table shows that there is no significant difference in pre test values of the modified borg scale between Group A & Group B (*$P > 0.05$).
This table shows that there is a significant difference in post test values of the modified borg scale between Group A & Group B (**$P \leq 0.01$).
Both the group shows significant decrease in the post test means but (GROUP-B) which has the lesser mean value is more effective than (GROUP-A)

4. Results

In Table 1, On comparing mean values of GROUP-A and GROUP-B on 6 MWT and modified Borg scale shows highly significant improvement in the post test mean but GROUP-B shows (6 MWT -270, Borg's scale- 1.2) lesser mean value is more effective than GROUP-A (6 MWT – 243.1, Borg's scale –1.7) at $P \leq 0.001$, Hence the null hypothesis is rejected.

In Table 2 & 3, on comparing Mean Values of on 6 MWT and Borg's scale between pre test and post test within Group- A and Group - B shows highly significant difference at $p \leq 0.001$.

5. Conclusion

The study shows that there is a significant difference between Group A and Group B from their 6 MWT and

Borg's scale scores. The 6MWT and Borg's scale shows that Group B (Respiratory muscle stretches) has better improvements in exercise tolerance and dyspnea reduction.

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