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ORIGINAL ARTICLE

Effect of Therapeutic Exercise of Upper Extremity in COPD patients

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Abstract:

Background and Objective: *Chronic obstructive pulmonary disease is one of the major causes of mortality and morbidity in the world. This study aim to determine the effects of home based upper extremity exercises in patients with Chronic Obstructive Pulmonary Diseases.*

Methods: *Experimental study was performed with 30 COPD Patients, they were selected based on the inclusion and exclusion criteria and randomly assigned to 2 groups. All the participants were explained about the study in which Chest expansion measurement was assessed by using inch tape at 3 levels, dyspnea level was graded by using Modified Borg scale, Wellbeing and activity of daily life score was assessed by using CAT questionnaire and those was performed as a pre-test and same tests were repeated as post-test after the training session for a period of 4 weeks. Group A participants were taught to perform the exercise and asked to do at home for 5 days a week for total duration of 4 weeks. Group B - Control group was treated with thoracic mobility exercise, repetition -3sets/10rep and frequency -7days per week.*

Results: *Group A: chest expansion measurements at all 3 levels were improved in post-test compared to pre- test and Group A is higher when compared with Group B. Dyspnea score were reduced in Group A compared to Group B and wellbeing, activity of daily living score improved in both groups, Group A was higher compared to Group B ($P < 0.05$, statistically significant).*

Conclusion: *This study proven that home based upper extremity exercise are effective in improving chest expansion, reduced dyspnea and improved quality of wellbeing and activity of daily living.*

Keywords: *Chronic obstructive pulmonary disease (COPD), Dyspnea, Therapeutic exercise.*

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Introduction

Chronic Obstructive Pulmonary Disease (COPD) represents an important public health challenge that is both preventable and treatable. Many people's suffer from this disease for years, and die prematurely from it or its complications. COPD is a lung disease characterized by chronic airflow limitation of the airways, which can be prevented but cannot be cured. COPD mainly caused by cigarette smoking; air pollution is also considered a risk factor in many developing countries which contributes the disease to both gender whereas COPD is more commonly observed in long term smokers of middle age. The disease symptoms add on the co-morbidities with the age and also due to smoking[1]. COPD is a major cause of mortality and morbidity in the world[2] and it is currently the 4th leading cause of death in world[3]. Globally, the COPD burden is projected to increase in coming decades because of continued exposure to COPD risk factors and aging of population[4]. Individual with COPD are illustrated with various other problems like nutritional deficits, cardiovascular disease, diabetes, osteoporosis. Whereas disease progresses with major changes including airway obstruction, increased dyspnea, hyperinflation, reduced lung functions[5], and peripheral muscle weakness[6] is more predominant which leads to fatigue of the patient when performing their daily activities. Increased chest wall resistance and stiffness causes respiratory muscles tightness and further contributes to mechanical disadvantage of respiratory muscles[7]. Major complaints of COPD are dyspnoea and fatigue especially while doing their routine activities with the use of their upper limbs like combing hair[8]. Dyspnoea during these activities may be due to the irregular and superficial breathing pattern forced by the mechanical effects of arm during arm elevation. Physical activity level is lowered especially when patients use the upper limbs without any support, as well some upper limb muscles such as the sternocleidomastoid and upper trapezius diminish their participation in ventilation as they are recruited to help with the postural support of the arms[1]. Hereby it alters the mechanics of rib cage and abdominal compartments. Generally, accessory muscles are inactive during inspiration at rest in healthy individuals and they act vigorously during physical activity in COPD, ultimately during activities with upper limb, accessory muscles become ineffective in respiration as they perform their major action to sustain the shoulder girdle in position as a consequence, the respiratory work is shifted to the diaphragm which is already at a mechanical disadvantage in patients with COPD[9]. Usage of upper limbs play a major role in daily activities, normal subjects usually perform such activities without noticing the energy lost, but patients with COPD report tiredness when performing them[1]. There is evidence that physical activity is decreased in COPD patients[10]. This leads to a downward spiral of inactivity which predisposes patients to reduce quality of life, increased rates of hospitalization and mortality[11-13]. Disease creates a burden for the sufferers and for the society as the natural history of the disease is progression to disability and death from respiratory failure at a relatively early age[14]. Both upper and lower extremity muscle are impaired in individual with COPD, muscle weakness does not affect all the muscles. As some studies report that quadriceps is more affected than upper limb muscles due to under usage of lower limb among COPD. Whereas strength of upper limb muscles such as pectoralis major, latissimusdorsi, biceps and middle deltoids is also impaired restricting the movement of upper extremity which further limits the thoracic expansion among the COPD[1]. For these reasons upper extremity resistance training is required to enhance the functional performance of upper limbs in daily care. Upper extremity resistance training is also the part of pulmonary rehabilitation. The basic need for this study is to provide the ease of treatment for the patients with COPD; it is difficult for the patients to travel on regular basis to the hospital for exercises, for that reason the patients were taught a simple exercise that enhances their performance in activity of daily living. Hence purpose of this study is to provide a home based upper extremity exercises for the patients with COPD.

Methods:

Experimental study was performed with 30 Subjects randomly assigned to 2 groups. Group

A (Experimental group) and Group B (Control Group). Study was performed at National Institute of Diseases of the Chest & Hospital, Dhaka. All the participants were explained about the study by providing information sheet and Informed consent signed by all the participants prior to initiation of the study. Both male and female Subjects with Mild to Moderate COPD based on GOLD classification, Age group between 30-65 years, Ex-smoker and those with dyspnoea are included. Subjects are excluded if they are known to have Restrictive lung disease, recent thoracic surgery, unstable vital signs, unstable hypertension, Musculoskeletal and neurological disease involving upper limb and thorax. Both the group participants underwent assessment, As a pretest they are assessed for Chest expansion at 3 levels – axillary level, 4th intercostals level and xiphisternal level using inch tape and dyspnoea grade was noted using Borg scale and their wellbeing and activity of daily life score assessed using CAT questionnaire. All these tests were repeated for post test following the treatment period for 4 weeks. Group A- 15 participants were asked to perform Upper extremity exercises at home. All the participants were taught to perform the exercise in OPD and exercise protocol was clearly explained and they were given an exercise regimen chart, and recording chart to follow the frequency of the exercise in which they are asked to record the date whenever the exercise is performed. Participant was asked to come to OPD once in a week along with the recording chart which was verified. Upper extremity exercise includes.

Shoulder front raise with weight

Patient was asked to hold 1 liter water bottle in hands in erect standing posture. Then asked to raise the hands in front of thighs with palms in a neutral position, without bending elbows with co-ordinate breathing exercise. (ie, inspiration during lifting up the hand and expiration during lowering the hand down) and then lower the weights.

Shoulder lateral raise with weight

Patient was asked to hold 1 liter water bottle in hands in erect standing posture. Then asked to raise the hands in front of thighs with the top of each weight pointed away, and then lift arms up by sides without bending elbows with co-ordinate breathing exercise.(i.e., inspiration during lifting up the hand and expiration during lowering the hand down), then lower the arms.

External rotators with weight

Patient should be positioned in supine lying by holding 1 liter water bottle with the shoulder abducted to 90^0 and the elbow bent to 90^0, so the hand points to the roof, patient should rotate the shoulder joint externally so that the hand moves backwards and the palm faces the roof along with co-ordinate breathing exercise.

Internal rotators with weight

Patient should be positioned in supine lying by holding1 liter water bottle with the shoulder abducted to 90^0 and the elbow bent to 90^0, so the hand points to the roof. Patient should rotate the shoulder joint internally so that the hand moves forwards and the palm faces the floor along with coordinate breathing exercise.

Shoulder shrugging exercise

Patient should stand upright, arms should be fully extended to the waist, feet shoulder width apart and head looking forwards, shrug the shoulders up as high as possible, and patient should pause at top of the movement and then relax back down along with co-ordinate breathing exercise.

Treatment Protocol

- Resistance\weight - 1 liter water bottle.
- Frequency-5days per week for a period of 4 weeks.
- 1 session per day.
- 8 to 10 repetitions \ 3 sets.
- Intensity - Borg scale, Rate of perceived exertion of 12-14.
- Total duration for upper extremity exercise is 30 minutes per day same for all the exercises.

Group B

Group B - Control group was treated with thoracic mobility exercise with a repetition of 3sets/10rep and frequency-7days per week.

Thoracic mobility exercises

Position of the subject: Sitting.

Procedure: the patient should exhale while bending forward to touch the floor with arms crossed at the feet then the patient should extend up while taking a deep inspiration and lift the arm up with a frequency of 7days per week and 3 sets of 10 repetitions.

Position of the patient: standing.

Procedure: The patient should stand with his knees straight, the patient instructed to exhale while bending forward to touch the floor with arms; then the patient should extend up by lifting his hands simultaneously taking a deep inspiration. 10 repetitions/ set – 3 sets with a frequency of 7 days per week. Both the groups will be advised to continue their normal activity and follow their inhalers and medications prescribed by the chest physicians

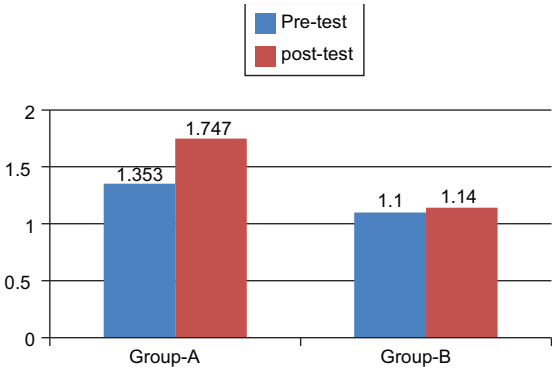

Fig.-1: *Comparison of pre test and post test values of Chest expansion measurements at Axillary level for Group A& Group B.*

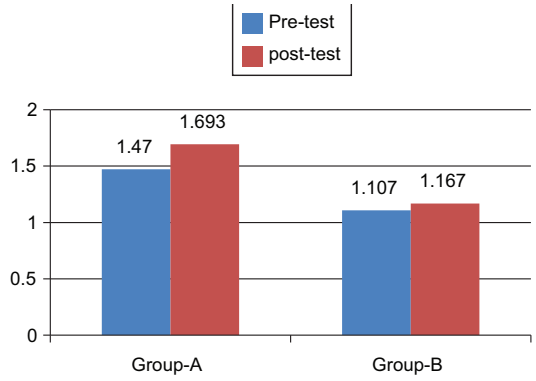

Fig.-2: *Comparison of pre test and post test values of Chest expansion measurements at 4th Intercostal level for Group A& Group B.*

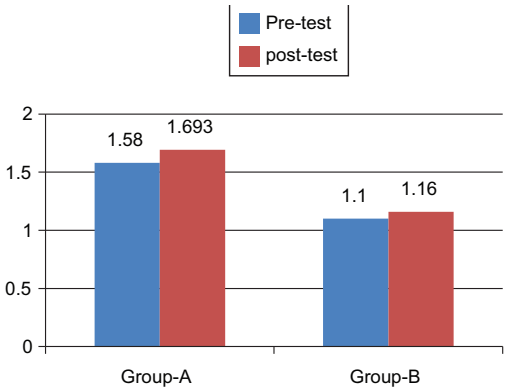

Fig.-3: *Comparison of pre test and post test values of Chest expansion measurements at Xiphi sternal level for Group A & Group B.*

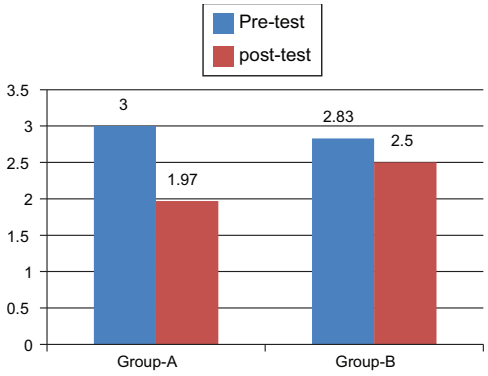

Fig.-4: *Comparison of pre test and post test values for Modified Borg scale between Group A and Group B.*

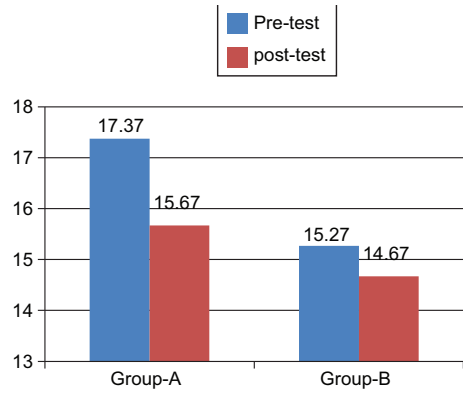

Fig.-5: *Comparison of pretest and post test values of CAT questionnaire between Group A & Group B.*

Test	Group-A				Group-B			
	Mean		Standard deviation		Mean		Standard deviation	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Modified Borg Scale	3.00	1.97	1.195	1.157	2.83	2.50	1.358	1.296
CAT questionnaire	17.33	15.67	3.885	3.395	15.27	14.67	3.173	3.222

In this unpaired t test df 28 at 5% level of significance, in the table critical value is 1.70. Test statistics (2.55) is greater than critical value (1.70). So, $P < 0.05$

Table1: Comparison of pre test and post test values between Group A and Group B for Modified Borg scale and CAT questionnaire.

Results

The collected data was used for statistical analysis, Paired 't' test was used to compare the data of pre and post within the groups for chest expansion measurement. Wilcoxon rank test was used to compare the data of pre and post within the groups for Borg's scale and CAT questionnaire. Independent 't' test was used to compare the data between the groups for chest expansion measurement. Mann whiteny U test was used to compare the data between the groups for Borg scale and CAT questionnaire. Graph 1 shows the difference in pre test and post test values between Group A and Group B for chest expansion measurement at axillary level. Group A difference in pre and post values are greater than Group B. Graph 2 shows the difference between Group A and Group B in pre test and post test values at 4th Intercostal level and similar difference was seen in xiphisternal level shown in Graph 3. Graph 2 & 3 shows higher difference between pre and post test values of Group A. Graph 4 given that Dyspnea score rated with Modified Borg scale was comparatively lower in post test than pre test which shows that dyspnea is reduced well in group A than Group B also seen in Table 1. Graph 5 shows the wellbeing and activity of daily living score which improved in post test in both groups. Whereas score is higher in group A compared to group B, shown in Table 1($P < 0.05$).

Discussion

COPD is the commonest heterogeneous pulmonary condition and it is the major cause of morbidity and mortality among the pulmonary patients. This disease is usually characterised by dyspnea, and a small proportion of excessive secretions particularly during exacerbation[15]. COPD patients also develop peripheral muscle dysfunction that further contributes to exercise intolerance. These impairments limit the independence of the patient in daily life and simple activities of daily care becomes difficult and it affects the health related quality of life[16]. COPD patients poorly tolerate activities involving upper limb compared to lower limb. Upper limb movements are associated with ventilatory strategies thereby it increases metabolic demand it has been observed that at arm elevation at rest significantly decreased vital capacity and functional residual capacity[17]. But during upper limb activities arm fatigue is reported as a common limiting symptom. Supported upper limb activity increases the functional residual capacity due to the passive stretch of thoracic muscles imposed on the rib cage when the arms are raised with weights it strengthens the upper limb muscles[1] and concluded that supported arm activity improves the endurance and quality of life[17]. Stefaniacostie et al stated that unsupported upper extremity exercise results in ventilator constraints, concluded that more studies are recommended to prove the benefits of supported arm exercise and unsupported upper extremity exercise, whereas unsupported arm exercise may determine progressive restriction of the activities performed with the arm, where the diaphragm is functionally compromised[18]. Thereby our study performed with supported arm exercises along with co-ordinated breathing exercise that reduces the rate of dyspnoea and improves the ability to perform the arm activities without restriction. Sarah Bernard et al described the effects of Aerobic and strength training in patients with COPD and concluded that the combination of strength training in

aerobic training showed significant improvement in patients with COPD[19]. Unsupported arm exercise poses a unique challenge for patients with COPD, because upper limb muscles acts as accessory muscle for respiration. During arm activities the participation of accessory muscles in ventilation decreases and shifts the respiratory work to diaphragm due to which activities with upper limb in daily living becomes difficult. Further it causes thoracoabdominaldyssynchrony. It has been proved that upper limb exercise training improves work capacity and endurance and reduces oxygen consumption during workload[20]. Ganesan et al reviewed the effects of upper extremity exercises in COPD and reported that arm strength training should be included in pulmonary rehabilitation protocol and it showed that unsupported arm training improved arm endurance capacity in majority of people with COPD. And arm training positively influenced peak arm exercise capacity, metabolic and ventilatory demands and also improved activities of daily living[21]. For these reason this study focuses on upper extremity exercises which helps and encourages thoracic movements and expands the thoracic cage and also strengthens the upper limb muscles which eases the way to perform daily activities by reducing the rate of dyspnoea increasing the chest expansion and improving the wellbeing and activity of daily living.

Conclusion:

From the results, this study concludes that home based upper extremity exercise are effective in improving chest expansion, reduced dyspnea and improved quality of wellbeing and activity of daily living. Thereby this study recommends the need to involve the upper limb exercises as a part of rehabilitation program. Pulmonary Rehabilitation is appropriate for patients with COPD and it should be considered part of integrated patient management.

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