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A study to evaluate and compare the effectiveness of quality of life in patient with COPD by upper limb exercise training program: An experimental study

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Abstract
Background: COPD is one of the world's leading causes of morbidity and mortality. In Early 2020 COPD was the fourth leading cause of death worldwide, it has now become the third leading cause of death after 2020. In fact, COPD already has surpassed cerebro vascular disease to become the third leading cause of death in the United States. In addition, COPD is now recognized as a life-limiting illness that imposes significant symptom burden on those with the disease [1]. India also contributes a significant and growing percentage of COPD mortality which is estimated to be amongst the highest in the world; i.e. more than 64.7 estimated age standardized death rate per 100,000 amongst both sexes as mentioned in the WHO Global InfoBase Updated on 20th January 2011 (India 102.3 and China 131.5). This would translate into approximately 5,56,000 in case of India (>20%) and 1,354,000 cases in China (about 50%) out of a world total of 2,748,000 annually [2].
Aims and Objectives: To measure and compare the association between QoL and upper limb muscle strength and endurance.
Material and Methods: The present study was carried out in the department of Pulmonary Medicine, and its allied specialties in Gauhati Medical College and Hospital as well as Rahman Hospital, Pvt Ltd. It was a prospective observational study carried out for a period of about three year from March 2016 to July 2019. After getting the approval from Institutional Human Ethical Committee. All patients diagnosed with COPD above 40 years of age irrespective of gender and giving proper written informed consent were included in this study.
Results: In the study, a total of 100 patients diagnosed with COPD were included. Initially at first visit, the average hand grip muscle strength was found to be 33.52±5.57 kg but it significantly increased after 8 weeks of continuous upper limb exercise training with hand held dynamometer and elastic band exercises to 39.23±5.39 kg. On first visit the mean MMRC grading of Dyspnea was 2.28±0.45.On doing regular exercise with the hand held dynamometer and elastic band for duration of eight weeks, the main MMRC grading significantly improved to 1.45±0.5.
Conclusion: In the present study it was observed that upper limb exercise training with hand held dynamometer and elastic band for the patients with COPD improves upper limb exercise capacity, decreases dyspnea grading in a significant manner. So upper limb exercise training programme should be included for treatment regimen in COPD patients along with the pharmacotherapy in order to improve quality of life.

Keywords: Upper limb exercise training programme, hand held dynamometer, elastic band, COPD, QoL

Introduction
The GOLD (Global Initiative for Chronic Obstructive Lung Disease) definition of COPD supplants the American Thoracic Society's (ATS) definition from 1995. According to GOLD 2019, Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory systems and airflow limitations that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases [1]. COPD is amongst the leading cause of chronic disease in India [2].There is roughly 30 million COPD cases in India [3, 20, 21].
Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality worldwide. COPD is a slowly progressive, inflammatory disease in the airways and lungs. The inflammation leads to a narrowing of the small airways (airway obstruction) and a destruction of tissue in the lungs.

This gives a decreased expiratory airflow which leads to a narrowing of the small airways (airway obstruction) and a destruction of tissue in the lungs. This gives a decreased expiratory airflow which leads to dyspnea, the primary symptom of the disease. The chronic airflow limitation also is associated with the development of limb muscle dysfunction. Decreases in both limb muscle strength and endurance have been shown which, in turn, is associated with exercise intolerance; one of the key disabling factors of the disease [22]. Pulmonary rehabilitation including exercise training is the cornerstone of treatment and is strongly recommended. However, it is still unclear how to optimize exercise training for this group of patients. Also how to address the increase in dyspnea which limits the exercise stimulus, and how to assess muscular strength; need further study [4, 5].

Although most research has been focused on the effects of lower limb exercise training, it is important to recognize that COPD patients may encounter problems in carrying out the activities of daily living with the upper limbs [6].

However, has revealed that the upper limb muscles (i.e., shoulder girdle) may suffer less from the deconditioning generally seen in the lower limb [7] and that the mechanical efficiency of upper limb activities is relatively well preserved compared with the mechanical efficiency observed in healthy subjects [8].Despite these relatively favorable conditions, COPD patients report excessive symptoms during upper limb activities. The main reason is the coupling of respiration to the muscles involved in upper limb movement. Upper limb exercises do impact on the breathing pattern [9]. This is even more the case during unsupported arm exercises, where relatively more load is shifted towards the diaphragm [10]. Hence, more dyspnea is reported during upper limb exercise as compared with lower limb exercise in COPD patients, especially during unsupported upper limb exercises [11]. Upperlimb exercise training programs can be used to reduce dyspnea during upper limb activities [12]. Lower limb exercise training will not improve upper limb performance [13], so that, if improving upper limb performance is the aim of the training program, specific upper limb exercises should be included. Exercise programs including upper arm exercises reduce the ventilatory requirements for arm elevation [14, 15]. Martinez and colleagues suggested that unsupported arm exercises are to be preferred over ergometer training as an exercise modality as they mimic more accurately the activities of daily living [16, 23].

Aims and Objectives

1. To find out the evidence for upper limb exercise training programme being beneficial in rehabilitation of patients with COPD
2. To investigate the evidence of upper limb training program in improving the quality of life in patients with COPD.
3. To find out the usefulness of handheld dynamometer in upper limb muscle strengthening in COPD Patients.

Materials and Methods

Study Site

The present study was carried out in the department of Pulmonary Medicine, and its allied specialties in Gauhati Medical College and Hospital as well as Rahman Hospital, Pvt Ltd. It was a prospective interventional study carried out for a period of about three year from March 2016 to July 2019. After getting the approval from Institutional Human Ethical Committee. All patients diagnosed with COPD above 40 years of age irrespective of gender and giving proper written informed consent were included in this study.

Study Design

A prospective interventional multicentered hospital based study.

Study Criteria

Inclusion criteria

- Diagnosed COPD patient with age ≥40
- Both male and female will be included in the study.
- Informed consent and consent from hospital authorities.

Exclusion Criteria

- Unstable angina.
- Intermittent claudication.
- Mobility limiting conditions previous stroke
- Cognitive impairment.
- Co-morbidity of an inflammatory in nature e.g. rheumatoid arthritis.
- Patients who are unable to understand the given instructions.
- Uncooperative patients.
- Patients with neuromuscular disorder.
- Lung disease other than COPD.

Follow up

- This is an intervention study with an intervention period of 8 weeks.

Investigations

Spirometry

Spirometry is the Gold Standard for diagnosis of COPD. The highest value of FEV1 and FVC were selected. Spirometry was performed by trained personnel in a quiet room as per the guidelines of the American Thoracic Society and European Respiratory Society (ATS/ERS). All spirometers were performed between 1230 to 1330 h to avoid diurnal variations. A spirometry showing FEV1 to FVC ratio<0.70 indicates obstruction. A diagnosed COPD should was considered in current and former smokers with spirometric evidence of irreversible airflow obstruction.

Pulse oximetry

In the present study pulse oximetry was used to detect hypoventilation in normal individuals SPo2 should be above 92%. In COPD patient a level of 88-92% is considered normal. In case of any lower than the above percentage implies respiratory failure and inform the use of supplemental oxygenation and further management.

Handgrip muscle strength

Handgrip-strength of the dominant hand will measure with a dynamometer. After explaining the procedure to the study subject and giving a demonstration, they will ask to hold the handgrip dynamometer in the dominant hand in sitting position. The forearm is to extend over a table and elbow flexed at 90°. Subjects will ask to hold the dynamometer in such a way that the second phalanx will against the inner stirrup, and will then ask to grip the dynamometer handle with as much force as they possibly could apply. The

handgrip muscle strength will record in kilograms as indicate by the pointer on the dynamometer. Three recordings will take with a gap of two minutes between each effort and the maximum value will record for the analysis.

Measurement of Dyspnea

The **MMRC Scale (Modified Medical Research Council Dyspnea Scale)** has staged dyspnea into the following grades-

Grade 0- 'I only get breathless with strenuous exercise'

Grade 1- 'I get short of breath when hurrying on the level or walking up a slight hill'

Grade 2- 'I walk slower than people of the same age on the level because of breathlessness or have to stop for breath when walking at my own pace on the level'

Grade 3- 'I stop for breath after walking about 100 yards or after a few minutes on the level'

Grade 4- 'I am too breathless to leave the house' or 'I am breathless when dressing'.

Statistical Analysis

The descriptive statistical analysis of data has been done, the mean, standard deviation(SD) & P value of the study data were analyzed by using SPSS for MS Windows statistical software program (VERSION 20.0) as and where indicated.

Results

Handgrip muscle strength

In the present study, a total of 100 patients diagnosed with COPD were included. Initially at first visit, the average hand grip muscle strength was found to be 33.52±5.57 kg but it significantly increased after 8 weeks of continuous upper limb exercise training with hand held dynamometer and elastic band exercises to 39.23±5.39 kg.

Table I: Paired t test to compare the pre and post values of Handgrip muscle strength for whole 100 patients

		N	Mean ± SD	Mean difference ± SD	t	P Value
Pair 1	Pre Intervention H.DYN	100	33.52±5.57	-5.72±3.27	-17.47	<0.001
	Post Intervention H.DYN	100	39.23±5.39			

MMRC grading of Dyspnea

In the present study, a total of 100 patients diagnosed with COPD were included. On first visit the mean MMRC grading of Dyspnea was 2.28±0.45.On doing regular exercise with the hand held dynamometer and elastic band for duration of eight weeks, the main MMRC grading significantly improved to 1.45±0.5.

Table II: Paired t test to compare the pre and post values of DYSPNEA for whole 100 patients

	Dyspnea	N	Mean ± SD	Mean difference ± SD	t	P Value
Pair 2	Pre Intervention Dyspnea	100	2.28±0.45	0.83±0.67	12.43	<0.001
	Post Intervention Dyspnea	100	1.45±0.5			

Discussion

In the present study a total of 100 diagnosed patient of COPD were included. Initially at first visit, the average hand grip muscle strength was found to be 33.52±5.57 kg but it significantly increased after a period of 8 weeks of prescribed intervention of upper limb exercise training with hand held dynamometer and elastic band exercises to 39.23±5.39 kg. This finding was found to be quite comparable to another similar type of study was done by Shah S *et al*. ($p< 0.001$) [17] and Dr. J. Sarma *et al*. ($p< 0.001$) [18].

In the present study it has also been observed that a total of 100 patients diagnosed with COPD were included. On first visit the mean MMRC grading of Dyspnea was 2.28±0.45.On doing regular exercise with the hand held dynamometer and elastic band for duration of eight weeks, the mean MMRC grading significantly improved to 1.45±0.5. Similar type of observation was noticed in the study conducted by Z-Y Wu *et al*. ($p< 0.05$) [19].

Limitations of the study

The result of this study cannot be extrapolated to the entire population of this region as this was conducted only in a few tertiary care teaching hospitals and did not include other tertiary care teaching hospitals of that region.

Conclusion

In the present study, it was observed that upper limb exercise training programme with hand held dynamometer and elastic band for patients with COPD improves upper limb exercise capacity, and decreases dyspnea grading in a significant manner. Quality of life is impaired in patients with COPD and it deteriorates considerably with increasing severity of diseases so there is now increasing evidence that non pharmacological interventions may play a vital role in treating chronic COPD patients.

The upper limb exercise training program should be included in treatment plan of COPD patient along with the pharmacotherapy of bronchodilator in order to improve the patient's quality of life, to reduce hospital readmission, to reduce acute exacerbation and finally reduce the rate of mortality. More research is required to find out the clinical significance of upper limb exercise for patients with COPD.

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