

Effectiveness of Balance Training During Pulmonary Rehabilitation in Moderate Chronic Obstructive Pulmonary Disease Patients

Dr.T.Poovishnu Devi¹, Dr.R.V.Vijayakumar², Dr. Vaishali Krishnat Jagtap³, S.K.Mohanasundari P.Hd⁴,
Dr.Miriam John⁵

Associate Professor, Faculty of Physiotherapy, Krishna College of Physiotherapy, Karad , Maharashtra, India¹.

Professor, Oxford College of Physiotherapy, Bangalore, India².

Lecturer, Faculty of Physiotherapy, Krishna College of Physiotherapy, Karad , Maharashtra, India³.

Nursing Tutor, Faculty of College of Nursing AIIMS-Jodhpur, Rajasthan. India⁴.

Superintendent & HOD of Physiotherapy, Krishna College of physiotherapy, Karad , Maharashtra, India⁵.

ABSTRACT: Introduction:Chronic obstructive pulmonary disease (COPD) often co exist with musculoskeletal and metabolic co morbidities. Balance deficits are increasingly recognised among the important secondary impairments in COPD. Pulmonary rehabilitation (PR) has only minor improvements in functional balance. Therefore, there is need to explore specific balance training in PR.The purpose of the study was to investigate the effects of balance training program on measures of balance with COPD enrolled in PR. **Method:**40 patients with moderate COPD were enrolled in the study The intervention group underwent balance training three times a week for 6 weeks along with pulmonary rehabilitation. The control group received only the 6 weeks PR program. Outcome balance measures were Berg balance scale(BBS), time up and go test(TUG) and six minute walk test(6MWT).40 patients with COPD were enrolled in the study. **Result:**Mean compliance with the balance training program was 85.5%.Compared with the controlled subjects, Scores on BBS ($p<0.01$), TUG($p<0.01$), 6MWT($p= 0.037$) were significantly improved in the intervention group.**Discussion:** Pulmonary rehabilitation with a specific component of balance training had a large effect on functional balance in patients with COPD.The result supports the feasibility and effectiveness of balance training as a part of PR in patients with COPD

KEYWORDS: COPD, Pulmonary rehabilitation, balanced training

I.INTRODUCTION

The global Initiative for chronic lung disease (GOLD) defines chronic obstructive lung disease (COPD) as preventable and treatable disease characterised by persistent airflow limitation that is progressive but not fully reversible. Exacerbation and co morbidities contribute to overall severity of the disease¹.Currently COPD is the fourth leading cause of disease and will raise to third leading cause of death by 2030².The secondary manifestations of COPD arecardiovascular disorders, metabolic diseases (E.g.diabetes mellitus, metabolic syndrome, and obesity), chronic kidney disease, sleep apnoea, anaemia, depression, lung cancer, weight loss, skeletal muscle weakness, and osteoporosis. These comorbidities contribute to a reduced health status, increased healthcare utilization and hospital admission, and mortality³anxiety and depression are among the most well-established systemic effects of COPD.⁴

COPD patients were very inactive during hospitalization for an acute exacerbation and remained inactive even one month after discharge⁵thereby increasing the risk for readmission.Physical inactivity was found to be crucial in the development of skeletal muscle weakness in patients with COPD⁶.

In COPD, skeletal muscle weakness is characterized by reduced muscle strength, reduced muscle endurance, and the presence of muscle fatigue⁷. The estimated overall prevalence of skeletal muscle weakness in patients with

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

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Vol. 6, Issue 6, June 2017

COPD was shown to be 32%⁸. In addition, a trend towards higher prevalence of skeletal muscle weakness with disease severity (GOLD stages) has been reported. Skeletal muscle weakness was shown to contribute to decreased functional capacity, poor quality of life, increased healthcare utilization, and even mortality³, independently of lung function. Falls are a leading public health problem in older adults. One in three adults over the age of 65 fall each year.^{9,10,11} and 20-30% will suffer moderate to severe injuries that increase their risk of morbidity and mortality¹². A large number of studies suggest that deficits in balance are common in individuals with COPD¹³. Pulmonary rehabilitation is a standard recommendation and provides assistance with education, psychological support with exercise. Combined balance training with exercise element of pulmonary rehabilitation could reduce the risk of falling.

Balance Training Program: The program is framed based on American Geriatrics Society guidelines for fall prevention,¹⁴ and consultation with experts. The four balance stations consisted of: 1) Stance exercises (e.g., single leg stance, tandem stance, and standing on uneven surfaces); 2) Transition exercises (e.g., sit-to-stands from chair and floor, stair tapping); 3) Gait exercises (e.g., walking in parallel bars over obstacle courses, walking and kicking a ball, tandem walking) 4) Functional strengthening (e.g., toe and heel raises, squats, step-ups, and core work on stability ball).

Pulmonary Rehabilitation: It consists of 6-week inpatient multi-disciplinary program⁴¹ consistent with clinical rehabilitation program and has four main components:

1. Training emphasized interval-type exercise; periods of high intensity exercise were alternated with rest periods. Exercise duration was progressed until patients were able to tolerate 20-30 minutes of endurance exercise.
2. Lower and upper-extremity strength training three times per week. Exercises were completed in lower extremity with ankle weights for resistance. Upper extremity strength training included biceps, triceps and deltoids using free weights and pectoral muscles using a Theraband.
3. Breathing exercises daily. Patients received a daily 30-minute class including stretching of major muscle groups and instruction on diaphragmatic and pursed lip breathing.
4. Self management education and psychological and social support were provided through lectures, relaxation classes and recreational activities at least twice a week for 30 minutes.

II. MATERIALS AND METHODS

The quantitative approach and true experimental study design were adopted for this study. The target population were COPD patient and accessible population were patient visiting to Krishna hospital, Karad. pulmonary rehabilitation alone and other group received pulmonary rehabilitation along with balance training and treated for 60 minutes for 3 days/week for six weeks. pulmonary rehabilitation alone and other group received pulmonary rehabilitation along with balance training and treated for 60 minutes for 3 days/week for six weeks.

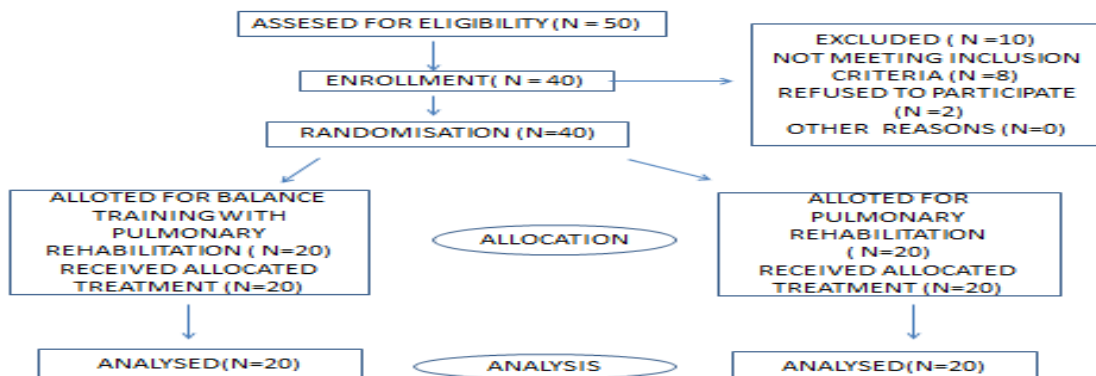


Figure: 2.1 Flow chart of the sample selection

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

In sampling 40 patients were selected for the study by simple random sampling (Table method) and their baseline values for balance assessment tests were noted and randomised in to two groups in which one group received pulmonary rehabilitation alone and other group received pulmonary rehabilitation along with balance training and treated for 60 minutes for 3 days/week for six weeks .

Inclusion criteria: 1.Age \geq 40 -65 years. 2.Both male and female. 3.A self-reported decline in balance, or fall in the last 5 years, or a recent near fall.4. c. 5.Smoking history greater than 10 pack years6.Ability to provide informed consent. Exclusion criteria: 1.Co-morbid conditions thought to jeopardize their safety or influence their balance. 2.Inability to communicate because of language skills, hearing or cognitive impairment 3.Evidence of a neurological or musculoskeletal condition that severely limited mobility and postural control4.Symptomatic cardiovascular problems.

Ethical clearance: Ethical clearance was obtained from concerned institutional ethical committee, and informed consent were obtained from patient after explaining the purposes and objectives of the study.

Development and description of the tool/ Outcome Measures:

The outcome of the study was measured by using the following standard tools.

i) Berg Balance Scale (BBS): The 14-item BBS scale which is widely accepted and psychometrically robust clinical measure of balance for older adults ^{15,16}.Activities such as transfers, reaching, turning around and single legged stance are graded on a scale ranging from 0 (unable/unsafe) to 4 (independent/efficient/safe), with higher scores indicating greater balance control.

ii) Balance Evaluation Systems Test (BEST): Recently developed comprehensive, and evaluates six subsystems of balance control,it allows therapists to focus their rehabilitation strategy on the most affected set of balance deficits ^{17, 18}.

iii) The Six-Minute Walk Test (6MWT): It is a valid, responsive and interpretable self-paced test that quantifies functional exercise capacity in terms of the distance walked in six minutes in patients with COPD ¹⁹.

Pilot study: It was conducted with 10% of total sample size. The tool and study was found to be feasible.

Data collection:The samples selected were randomised into two groups and were explained about the treatment protocol. The pre test values were assessed for balance and the intervention is given and then post tests were taken after 6 weeks . The treatment was based according to the protocol described by the American Thoracic Society²⁰.

Analysis and interpretation: Data analysis is blinded .The effectiveness of the intervention with in the group was analysed by Independent t- test and effectiveness between the groups was analysed by Dependent t test.

III.RESULTS

| Note: * Significant | Control group | | | Interventional group | | Change | Mean difference (95% CI) | P value |
|---------------------|------------------|------------------|-----------------|----------------------|-------------------|-----------------|---------------------------|---------|
| | Pretest | Post test | Change | Pre test | Post test | | | |
| BBS | 45.7 \pm 7.1 | 47.7 \pm 4.9 | 2 \pm 4.9 | 44.1 \pm 6.0 | 53.7 \pm 2.7 | 9.6 \pm 6.5 | 7.6(1.4-13.7) | <0.01* |
| BEST | 67.9 \pm 12.1 | 74.4 \pm 9.8 | 6.5 \pm 5.1 | 65.7 \pm 5.1 | 84.8 \pm 5.3 | 19.1 \pm 10.8 | 12.6(3.9-21.3) | <0.01* |
| 6 MWT | 295.5 \pm 84.2 | 355.8 \pm 92.0 | 60.3 \pm 19.7 | 264.4 \pm 103.3 | 339.5 \pm 113.3 | 75.1 \pm 18.1 | 14.8-(3.6-33.3) | 0.037* |

Table: 3.1: Pre and Post test score mean, mean difference, and level of significance

From the above table it was inferred that in BBS the mean improvement in control group is 2 ± 4.9 and mean improvement in interventional group is 9.6 ± 6.5 and In BEST the mean improvement in control group is 6.5 ± 5.1 and mean improvement in interventional group is 19.1 ± 10.8 and the p value is <0.01 which proves that the improvements were statistically significant. in BEST the p value is <0.01.In 6MWT the mean improvement in control group is 60.3 ± 19.7 and mean improvement in interventional group is 75.1 ± 18.1 and the p value is 0.037 which proves that the improvements were statistically significant

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Vol. 6, Issue 6, June 2017

IV.DISCUSSION

Skeletal muscle weakness and osteoporosis are two among the comorbidities of COPD that is most likely co-exist together which contribute to loss of balance and risk of fall²¹. Balance training as part of the pulmonary rehabilitation program also improved balance performance, muscle strength, and physical function in patients with COPD²². From the above table it was inferred that in BBS the mean improvement in control group is 2 ± 4.9 and mean improvement in interventional group is 9.6 ± 6.5 and In BEST the mean improvement in control group is 6.5 ± 5.1 and mean improvement in interventional group is 19.1 ± 10.8 and the p value is <0.01 which proves that the improvements were statistically significant. In BEST the p value is <0.01 . In 6MWT the mean improvement in control group is 60.3 ± 19.7 and mean improvement in interventional group is 75.1 ± 18.1 and the p value is 0.037 which proves that the improvements were statistically significant

Impairments in balance are increasingly recognised as an important physical functional limitation in moderate COPD patients. Our preliminary findings indicates that addition of balance exercise proved significant measures of functional balance compared to pulmonary rehabilitation alone. In addition a three weekly addition of balance exercises proved to be feasible and well tolerable in patients in moderate COPD patients. In addition, we found the thrice-weekly training program was feasible and well-tolerated for patients with moderate to severe COPD undergoing pulmonary rehabilitation. Study results suggest that balance training along with pulmonary rehabilitation is associated with superior gains in the balance tests and in exercise tolerance tests. This study provides compelling support for inclusion of balance training as a part of PR for optimising gains in physical functioning in patients with COPD.

IV.CONCLUSION

This study emphasized that addition of balance exercise as a component in pulmonary rehabilitation has helped COPD patients in improving the balance. Limitations: Not able to comment on the long-term persistence of these effects. Given the diminishing effect of exercise training in patients with COPD in the year following pulmonary rehabilitation²³. Recommendations: Future work with longer-follow-up and greater exercise dose will be necessary. We targeted at-risk patients and exclusively those enrolled in pulmonary rehabilitation.

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