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Research Article

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Respiratory Rehabilitation and Clinical Outcomes in AECOPD

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ABSTRACT

Introduction: Chronic Obstructive Pulmonary Disease (COPD) is a major global health burden, with acute exacerbations (AECOPD) leading to delayed recovery and higher morbidity despite optimal medical treatment.

Aim/Objectives: To evaluate the effect of structured respiratory rehabilitation on dyspnea, cough severity, and exercise tolerance in hospitalized AECOPD patients.

Methods: A prospective interventional study was conducted on 30 hospitalized AECOPD patients. Participants were divided into two groups: the experimental group received standard care plus respiratory rehabilitation (education, sputum clearance, pursed-lip breathing, upper-limb exercises, and walking training), while the control group received standard care alone. Outcomes assessed at baseline and after 4 days included dyspnea (mMRC), cough severity (VAS), exercise tolerance (6MWT), and sputum expectoration.

Results: The experimental group showed significant improvements in dyspnea ($p = 0.0052$) and exercise tolerance ($p = 0.0344$) compared to controls. No significant differences were observed in cough severity or sputum clearance. Within-group analysis indicated greater improvement in dyspnea and functional capacity in the experimental group, while the control group improved only in exercise tolerance.

Discussion/Conclusion: Early initiation of structured respiratory rehabilitation during hospitalization enhances recovery in AECOPD by reducing dyspnea and improving functional capacity, highlighting its value as an adjunct to standard medical care.

Key Words: COPD, AECOPD, respiratory rehabilitation, dyspnea, exercise tolerance, hospitalization

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable, and treatable condition characterized by persistent respiratory symptoms and airflow limitation due to airway or alveolar abnormalities caused by exposure to harmful particles or gases, along with host factors.[1] Globally, COPD is a major public health challenge and the third leading cause of death, accounting for 3.23 million deaths in 2019.[2] In India, its prevalence among individuals aged 30 years and above is estimated at around 7%, primarily linked to smoking, biomass fuel exposure, environmental pollutants, and aging.[3] Acute exacerbation of COPD (AECOPD) is defined as a sudden and sustained worsening of respiratory symptoms beyond normal day-to-day variations, requiring treatment modification or hospitalization.[4] Exacerbations contribute substantially to morbidity, mortality, and healthcare burden, often triggered by infections or environmental factors that increase airway inflammation.[5,6] Recovery following an exacerbation is frequently delayed, resulting in reduced physical function and prolonged disability, despite optimal pharmacological therapy.[7] Respiratory rehabilitation is a proven non-pharmacological intervention for COPD that improves exercise tolerance, reduces symptoms, and enhances self-management.[8,9] Initiating rehabilitation early during hospitalization for AECOPD has been reported to accelerate recovery, reduce readmissions, and improve clinical outcomes.[10,11] Core components typically include breathing retraining, limb exercises, airway clearance strategies, and patient education.[12–14] However, evidence on the feasibility and effectiveness of structured pulmonary rehabilitation during hospitalization for AECOPD in Indian patients remains limited. This study was therefore undertaken to evaluate the effectiveness of early respiratory rehabilitation in improving symptoms, exercise capacity, and functional recovery in hospitalized AECOPD patients.

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MATERIALS AND METHODS

Study Design and Setting

A prospective interventional study was conducted at Spandan Hospital, Anand, Gujarat, India, over a period of one year (2022–2023) on patients hospitalized with acute exacerbation of COPD (AECOPD).

Sample Size and Sampling

Thirty participants were recruited using purposive sampling based on predefined eligibility criteria. The sample size was determined by feasibility and availability of eligible patients during the study period, as no prior pilot data were available for formal power calculation. Participants were equally divided into two groups (15 per group). A simple allocation method was applied. No randomization or blinding was used, which is acknowledged as a methodological limitation.

Study Population

Hospitalized patients diagnosed with AECOPD as per GOLD criteria and admitted under physician care were considered for participation.

Inclusion Criteria

- Diagnosed with moderate exacerbation of COPD (requiring increased medication and medical assistance).
- Conscious and oriented.
- Dyspnea not attributable to cardiac disease, pneumothorax, or pulmonary edema.
- Receiving bronchodilator or antibiotic therapy, but not antitussives.

Exclusion Criteria

- Systolic blood pressure < 90 mmHg.
- SpO_2 < 90%.
- Unstable psychological status, hemoptysis, pneumothorax, pulmonary edema, or on mechanical ventilation.

Ethical Considerations

The study was approved by the Institutional Ethics Committee of Shree B.G. Patel College of Physiotherapy, Number SBGCOPA- SBGCOPA IEC/115/2020 signed by clinician Dr. Purvesh Patel. Participation was voluntary, confidentiality was maintained, and physician clearance was mandatory before enrollment. Written informed consent was obtained from all participants.

Study Procedure

Eligible participants were screened, enrolled, and assigned to:

- **Group A (Intervention):** Standard medical care plus structured respiratory rehabilitation.
- **Group B (Control):** Standard care only, including health education, vital monitoring, symptom management, nutritional advice, and smoking/alcohol cessation counseling.

Baseline assessment of all outcome measures was conducted one hour before the intervention. Post-intervention assessments were performed within one hour after the final session. The intervention was delivered over four consecutive days, with two daily sessions lasting 30–40 minutes each.

MATERIALS REQUIRED

Stopwatch, pulse oximeter, sphygmomanometer, stethoscope, peak expiratory flow meter, chair, measuring tape, assessment forms, consent forms, and writing materials.

Outcome Measures

- **Demographic Data:** Age, height, weight, BMI, education, marital status, smoking history, medical history, and peak expiratory flow (PEF).
- **Dyspnea:** Measured using the Modified Medical Research Council (MRC) Dyspnea Scale (0 = none, 4 = very severe) after a six-minute walk.
- **Cough Severity:** Evaluated using a Visual Analog Scale (VAS) from 0 (no cough) to 10 (severe cough).
- **Exercise Tolerance:** Assessed using the Six-Minute Walk Test (6MWT) according to standard guidelines. Patients rested for 15 minutes before testing; vital signs were monitored, and distance walked was recorded in meters.
- **Sputum Expectoration:** Documented based on patient-reported ease or difficulty of sputum clearance, particularly in the morning.

Intervention Protocol (Group A)

1. **Disease Education:** Visual aids explaining AECOPD, triggers, and self-management.
2. **Sputum Clearance:** Postural drainage and percussion, 30 minutes twice daily.
3. **Pursed-Lip Breathing (PLB):** Twice daily for 10 minutes with an inspiratory-expiratory ratio of 1:2.
4. **Upper-Limb Exercises:** Arm elevation with deep breathing, 10 minutes twice daily, to enhance chest expansion and respiratory muscle strength.
5. **Walking Training:** Corridor walking with breathing coordination, twice daily for 10 minutes.
6. **Education Sessions:** Daily 15-minute interactive sessions on disease management, medication adherence, smoking cessation, and sputum clearance.
7. **Blinding:** The outcome assessor was not blinded to group allocation, which is recognized as a study limitation.

RESULT

Data were coded and entered into Microsoft Excel, then analyzed using GraphPad Prism 5. Normality was tested, and

as data were non-normally distributed, non-parametric tests were applied. Descriptive statistics (frequency, percentage, median, and range) summarized demographic data. Between-group comparisons were made using the Mann–Whitney U test for continuous variables and Chi-square test for categorical variables. Within-group comparisons were done using the Wilcoxon signed-rank test for continuous variables and McNemar test for categorical variables. A p-value <0.05 was considered statistically significant.

Table 1: Demographic profile of participants (N = 30)

Variables	Experimental (n = 15) Median (Range)	Control (n = 15) Median (Range)
Age (years)	70 (42–81)	69 (59–89)
BMI (kg/m²)	26.9 (21.6–31.8)	27.6 (20.3–31.5)
PEFR (L/min)	200 (150–280)	200 (150–280)
Sex (M/F)	8/7 (53.3% / 46.7%)	10/5 (66.7% / 33.3%)
Marital status	Married: 12 (80%), Unmarried: 3 (20%)	Married: 12 (80%), Unmarried: 3 (20%)
Education	Illiterate: 6 (40%), SSC: 5 (33.3%), HSC: 1 (6.7%), Graduate: 3 (20%)	Illiterate: 4 (26.7%), SSC: 5 (33.3%), HSC: 2 (13.3%), Graduate: 4 (26.7%)
Comorbidities	Yes: 8 (53.3%), No: 7 (46.7%)	Yes: 8 (53.3%), No: 7 (46.7%)
Smoking	Yes: 8 (53.3%), No: 7 (46.7%)	Yes: 9 (60%), No: 6 (40%)

Table 2: Between- and within-group differences in dyspnea, cough, and exercise tolerance

Variable	Experimental Median (Range)	Control Median (Range)	Test (U)	p-value
Dyspnea (MRC score)				
Baseline	2 (0–3)	2 (1–3)	92.0	0.362
4th day	1 (0–2)	2 (1–2)	56.5	0.005*
Within-group	↓ by 1 (p=0.014)*	No change (p=0.072)		
Cough (VAS score)				
Baseline	0 (0–2)	0 (0–2)	92.0	0.344
4th day	0 (0–2)	0 (0–2)	91.0	0.320
Within-group	No change (p=1.000)	No change (p=1.000)		
Exercise tolerance (6MWT, m)				
Baseline	212 (148–287)	200 (129–300)	92.0	0.407
4th day	252 (191–346)	220 (143–311)	61.0	0.034*
Within-group	Gain: +40 m (p<0.001)*	Gain: +20 m (p=0.001)*		

Table 3: Sputum expectoration at baseline and 4th day

Variables	Experimental (n=15) n (%)	Control (n=15) n (%)	χ^2 test	p-value
Baseline	Easy: 10 (66.7%), Difficult: 5 (33.3%)	Easy: 10 (66.7%), Difficult: 5 (33.3%)	3.84	0.166
4th day	Easy: 13 (86.7%), Difficult: 2 (13.3%)	Easy: 12 (80.0%), Difficult: 3 (20.0%)	3.84	0.000*
Within-group	Improvement (p=0.133)	Improvement (p=0.004)*		

DISCUSSION

The present study demonstrates that early initiation of structured respiratory rehabilitation during hospitalization for AECOPD was associated with improvements in dyspnea and exercise tolerance compared to standard medical care alone in this short-term, 4-day study. These findings are consistent with earlier evidence showing that pulmonary rehabilitation during acute exacerbations facilitates functional recovery and improves clinical outcomes.[10,11,22]

The significant reduction in dyspnea in the intervention group may be attributed to the combined effects of pursed-lip breathing, upper-limb exercises, and walking training, which optimize ventilation, reduce dynamic hyperinflation, and enhance respiratory muscle efficiency.[8,9,17] Improved exercise tolerance, as reflected by greater 6MWT distance, suggests enhanced functional capacity and aligns with prior reports demonstrating improved walking distance and endurance following inpatient rehabilitation.[10,15,16,22]

No significant change in cough severity was observed, likely due to the short intervention period, which may not have been sufficient to influence airway clearance-related outcomes. Previous studies indicate that longer rehabilitation programs or adjunct airway clearance techniques may produce greater benefits in this domain.[19,20] Similarly, sputum expectoration did not differ significantly between groups, possibly reflecting baseline smoking-related characteristics that affect mucus production and clearance.[23]

Overall, the results support the feasibility and clinical value of initiating respiratory rehabilitation early during hospitalization for AECOPD. Studies by Liao et al.[10] and Greening et al.[11] also demonstrated that early inpatient rehabilitation reduces symptom burden and improves exercise performance, consistent with our findings. While some studies have additionally reported reductions in hospital stay and readmission rates with early rehabilitation[7,24] these outcomes were not evaluated here due to the short-term focus of the present study.

Study Limitations

This study has several limitations. The small sample size (n=30) and non-randomized design limit generalizability and introduce potential selection bias. The short duration (4 days) may have restricted observable changes in cough severity and sputum clearance. Furthermore, the absence of long-term follow-up prevented assessment of sustained benefits, readmission rates, or quality-of-life improvements, outcomes highlighted as important in previous systematic reviews.[7,21] Future research should use randomized controlled designs with larger samples and extended follow-up to confirm and expand upon these findings.

CONCLUSION

Early initiation of structured respiratory rehabilitation during hospitalization for AECOPD improves dyspnea and functional capacity within a short 4-day period.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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AUTHORS' CONTRIBUTION

Dr. Shailaja V. Patel: Conceptualized the study, designed the methodology, supervised the intervention, analyzed the data, and drafted the manuscript.

Dr. Krupa Patel: Assisted in data collection, intervention delivery, outcome assessment, and manuscript editing. Both authors have read and approved the final manuscript and agree to be accountable for all aspects of the work.

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