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Effect of Deep Breathing Exercises on Chronic Obstructive Pulmonary Disease: A Case-Based Report

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Abstract:

- ***Background:***
  Chronic Obstructive Pulmonary Disease (COPD) is a progressive pulmonary disorder characterized by airflow limitation and chronic inflammation, significantly impacting quality of life and physical function. Non-pharmacological interventions, such as deep breathing exercises (DBEs), are gaining recognition as effective adjuncts in managing COPD symptoms.

- ***Objective:***
  To evaluate the effect of a structured deep breathing exercise program on pulmonary function, oxygenation, exercise capacity, and dyspnea in a patient with moderate COPD.

- ***Case Presentation:***
  A 65-year-old male with a three-year history of GOLD Stage II COPD presented with exertional breathlessness, chronic cough, and reduced stamina. Baseline spirometry revealed FEV_1 of 58% predicted and a 6-minute walk test (6MWT) distance of 310 meters. A 4-week DBE protocol, including diaphragmatic breathing, pursed-lip breathing, thoracic expansion, segmental breathing, and incentive spirometry, was administered five days per week.

- ***Outcomes:***
  Post-intervention, the patient demonstrated improvements in SpO_2 (from 89% to 94%), FEV_1 (to 64% predicted), 6MWT distance (from 310 to 380 meters), and dyspnea (Borg score reduced from 4 to 2). Subjective reports included reduced breathlessness, improved sleep, and enhanced confidence in physical activity.

- ***Conclusion:***
  The incorporation of DBEs into COPD management resulted in clinically significant improvements in respiratory function, exercise tolerance, and quality of life. DBEs should be considered a valuable component of long-term pulmonary rehabilitation strategies.

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I. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a prevalent and progressive respiratory disorder marked by airflow limitation, persistent respiratory symptoms, and a chronic inflammatory response in the lungs. Globally, COPD remains a leading cause of morbidity and mortality, affecting approximately 384 million people, with an estimated 3.23 million deaths annually [1].

Non-pharmacological interventions, such as pulmonary rehabilitation and breathing exercises, have been recognized as effective adjuncts to medication therapy. Among these, deep breathing exercises (DBEs) are simple, low-cost, and highly beneficial methods to improve ventilation, reduce dyspnea, and promote relaxation [2]. DBEs work by enhancing lung expansion, decreasing dynamic hyperinflation, and increasing alveolar gas exchange. This case study presents the application and effect of DBEs in a patient with moderate COPD over a 4-week intervention period.

II. CASE PRESENTATION

➢ *Demographics and History:*

- Name: Mr. X
- Age: 65 years
- Gender: Male
- Occupation: Retired railway worker
- Medical History: Diagnosed with COPD (GOLD Stage II) three years ago.
- Social History: Chronic smoker (40 pack-years), quit smoking 2 years ago.
- Medications: Inhaled corticosteroids, bronchodilators (tiotropium, salbutamol), mucolytics.
- Chief Complaints: Progressive breathlessness on exertion, frequent coughing, and decreased stamina.

➢ *Physical Assessment:*

- Respiratory rate: 24/min
- SpO_2 (room air): 89%
- Chest: Hyperresonant, bilateral decreased breath sounds
- Body Mass Index: 21.8 kg/m²
- Heart rate: 82 bpm
- Blood pressure: 132/78 mmHg

➢ *Investigations*:

- Spirometry:
- FEV_1: 58% predicted
- FVC: 73% predicted
- FEV_1/FVC: 0.63
- Chest X-Ray: Flattened diaphragm, hyperinflation
- Six-Minute Walk Test (6MWT): 310 meters, moderate dyspnea (Borg scale: 4)

III. INTERVENTION: DEEP BREATHING EXERCISE PROTOCOL

The patient underwent a structured DBE regimen under supervision for four weeks at the outpatient pulmonary rehabilitation center.

➢ *Goals of the Program:*

- Improve pulmonary function and oxygenation
- Reduce dyspnea and respiratory fatigue
- Enhance thoracic mobility and lung compliance
- Improve exercise tolerance

➢ *Program Details:*

Table 1 Program Details:

Exercise	Description	Duration
Diaphragmatic Breathing	Inhale deeply using the diaphragm with abdominal rise; exhale passively	10 mins/day
Pursed-Lip Breathing	Inhale through the nose and exhale slowly through pursed lips (1:2 ratio)	10 mins/day
Thoracic Expansion	Deep inhalation with arm abduction, enhancing chest wall flexibility	5 mins/day
Segmental Breathing	Targeting different lung lobes using tactile stimulation	5 mins/day
Incentive Spirometry	Use of a device to encourage sustained maximal inhalation	3 sessions/day

- Frequency: 5 days/week, for 4 weeks
- Education: Smoking relapse prevention, energy conservation, posture modification, airway clearance techniques.

IV. OUTCOME AND FOLLOW-UP

➢ *Week-by-Week Observations:*

Table 2 Week-by-Week Observations:

Parameters	Baseline	Week 2	Week 4
Respiratory Rate (/min)	24	22	20
SpO_2 (%)	89	91	94
FEV_1 (% predicted)	58	-	64
6MWT Distance (meters)	310	345	380
Borg Dyspnea Score	4	3	2
St. George's Respiratory Score	58	-	45

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➢ *Subjective Feedback:*

- Reported decreased breathlessness during daily tasks
- Improved sleep due to reduced nocturnal cough
- Increased confidence in mobility and social interaction

V. DISCUSSION

The application of deep breathing exercises led to measurable and meaningful improvements in this patient's respiratory function and quality of life. DBEs promote alveolar recruitment, improve ventilation-perfusion (V/Q) matching, and support better CO_2 clearance [3].

➢ *Clinical Evidence Supporting DBEs:*

- Karakoc et al. (2021) demonstrated that diaphragmatic and pursed-lip breathing significantly improved pulmonary function and exercise capacity in COPD patients [4].
- Puhan et al. (2016) in a meta-analysis confirmed that DBEs combined with pulmonary rehab improve HRQoL and reduce hospitalization [5].
- Gosselink et al. (2003) emphasized breathing retraining as a key component of effective COPD management, especially in moderate to severe stages [6].

➢ *Mechanisms of Action:*

- Diaphragmatic Breathing: Reduces accessory muscle usage and promotes efficient ventilation.
- Pursed-Lip Breathing: Prevents airway collapse by maintaining positive expiratory pressure.
- Segmental and Thoracic Exercises: Mobilize the chest wall and promote regional ventilation.

➢ *Limitations of the Case:*

- Single-patient data limits generalizability
- Short-term intervention period
- Reliance on self-reported adherence to home exercise

VI. CONCLUSION

Deep breathing exercises are a cost-effective, evidence-based intervention that can significantly enhance the respiratory outcomes in individuals with COPD. When integrated into pulmonary rehabilitation programs, they promote functional independence, improve gas exchange, and reduce the burden of dyspnea. Continued use and reinforcement of DBEs should be encouraged in long-term COPD care strategies.

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