

Active Cycle Breathing Technique for Ineffective Airway Clearance in a COPD Patient: A Case Study

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ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD) is a chronic respiratory disease that commonly causes ineffective airway clearance due to excessive mucus production and sputum retention. Active Cycle Breathing Technique (ACBT) is a breathing exercise used to facilitate secretion mobilization and improve airway clearance. **Objective:** This study aimed to describe the implementation of ACBT in a patient with ineffective airway clearance associated with COPD. **Methods:** A descriptive case study design was used involving one COPD patient hospitalized in Melati Ward, Bangil Regional Hospital. The intervention consisted of breathing control, thoracic expansion exercises, and forced expiration techniques administered once daily for three consecutive days. Clinical indicators observed included respiratory rate, oxygen saturation, cough effectiveness, dyspnea, breath sounds, and sputum characteristics. **Results:** The results showed progressive improvement during the intervention period. Respiratory rate decreased from 25 to 20 breaths/minute, oxygen saturation increased from 98% to 99%, dyspnea resolved, cough effectiveness improved, and sputum became thinner and easier to expectorate. **Conclusion:** These findings indicate that ACBT, administered alongside standard pharmacological management, contributed to improved airway clearance and respiratory status. ACBT can be recommended as a complementary nursing intervention for patients with ineffective airway clearance due to COPD.

Keywords: active cycle breathing technique; COPD; ineffective airway clearance

Background

Chronic Obstructive Pulmonary Disease (COPD) is a chronic respiratory disorder characterized by persistent airflow limitation that is usually progressive and associated with chronic inflammatory responses in the airways and lungs (1). COPD remains one of the leading causes of morbidity and mortality worldwide, resulting in significant health, social, and economic burdens (2). Cigarette smoking, environmental pollution, and occupational exposure are recognized as major risk factors contributing to the development of COPD (3).

One of the most common clinical manifestations experienced by patients with COPD is excessive mucus production. Chronic inflammation causes hypersecretion of mucus and impaired mucociliary clearance, leading to sputum retention within the airways (4). This condition frequently results in ineffective airway clearance, which is characterized by ineffective cough, difficulty expectorating sputum, dyspnea, abnormal breath sounds, and increased respiratory effort. If not managed appropriately, retained secretions may worsen airway obstruction, impair gas exchange, and increase the risk of respiratory complications (5)(6).

Ineffective airway clearance is a common nursing problem among patients with COPD and requires both pharmacological and non-pharmacological management. One non-pharmacological intervention that can be implemented is the Active Cycle Breathing Technique (ACBT) (7). ACBT consists of breathing control, thoracic expansion exercises, and forced expiration techniques designed to mobilize secretions from peripheral airways to central airways, making sputum easier to expectorate (8). Previous studies have reported that ACBT can improve sputum clearance, reduce dyspnea, enhance cough effectiveness, and improve respiratory function in patients with chronic respiratory diseases (9)(10).

Based on the clinical importance of airway clearance management in COPD patients, this case study aimed to describe the implementation of Active Cycle Breathing Technique (ACBT) in improving

ineffective airway clearance in a patient with Chronic Obstructive Pulmonary Disease treated at Bangil Regional Hospital.

Methods

This study used a descriptive case study design involving one patient diagnosed with Chronic Obstructive Pulmonary Disease (COPD) who experienced ineffective airway clearance in Melati Ward, Bangil Regional Hospital. Data collection was conducted from 24 to 26 April 2026 through interviews, observation, physical examination, and documentation review. Oxygen therapy was administered at a constant flow rate via nasal cannula throughout the three days of monitoring to ensure that changes in oxygen saturation reflected the effect of the intervention rather than variations in supplemental oxygen delivery.

The intervention consisted of Active Cycle Breathing Technique (ACBT), including breathing control, thoracic expansion exercises, and forced expiration techniques. The intervention was implemented once daily for three consecutive days with a duration of approximately 15 minutes for each session. Clinical indicators observed during the study included respiratory rate, oxygen saturation, dyspnea, cough effectiveness, breath sounds, and sputum characteristics. Patient progress was monitored daily, and the findings were analyzed descriptively to evaluate changes in airway clearance following the implementation of Active Cycle Breathing Technique.

Results

This study involved one patient diagnosed with Chronic Obstructive Pulmonary Disease (COPD) who experienced ineffective airway clearance and was hospitalized in Melati Ward, Bangil Regional Hospital. The patient was a 56-year-old male with a history of active smoking since adolescence, who was admitted for an acute exacerbation of COPD. Although spirometry data were not available during the acute phase, the clinical presentation and history were consistent with moderate to severe COPD. The patient had no reported comorbidities, such as heart failure or diabetes, that could independently affect dyspnea and oxygen saturation. During the initial assessment, the patient complained of productive cough with difficulty expectorating sputum, shortness of breath, and fatigue during activities.

Physical examination revealed ineffective cough, retained sputum, rhonchi in the lower right lung field, respiratory rate of 25 breaths per minute, and oxygen saturation of 98% while receiving oxygen therapy. Based on the assessment findings, the patient was diagnosed with ineffective airway clearance related to airway hypersecretion.

The patient received Active Cycle Breathing Technique (ACBT) intervention once daily for three consecutive days. The intervention consisted of breathing control, thoracic expansion exercises, forced expiration technique (huffing), and effective coughing exercises. Clinical indicators were monitored daily to evaluate changes in airway clearance status.

Table 1. Monitoring of airway clearance during Active Cycle Breathing Technique intervention

Day	Respiratory Rate (x/min)	Oxygen Saturation (%)	Dyspnea	Cough Effectiveness	Breath Sounds
Day 1	25	98	Present	Ineffective	Rhonchi present
Day 2	22	99	Reduced	Improved	Rhonchi decreased
Day 3	20	99	Absent	Effective	Rhonchi reduced

The results in Table 1 indicate gradual improvement in airway clearance following the implementation of Active Cycle Breathing Technique. On the first day, the patient continued to experience dyspnea, ineffective cough, retained sputum, and rhonchi. Following the second intervention session, the patient demonstrated improved ability to expectorate sputum, reduced dyspnea, and

decreased respiratory rate.

By the third day of intervention, substantial clinical improvement was observed. The patient was able to perform effective coughing and expectorate secretions independently. The respiratory rate showed a clinically meaningful decrease from 25 breaths per minute on Day 1 to 20 breaths per minute on Day 3, moving from mild tachypnea to the upper boundary of the normal range. Meanwhile, oxygen saturation remained stable at 98% to 99%; while this 1-percentage-point change falls within the typical measurement variability of pulse oximetry, the maintenance of normal saturation alongside the resolving tachypnea indicates stable gas exchange. Furthermore, sputum characteristics improved from thick yellowish secretions to thinner and clearer sputum, accompanied by a reduction in rhonchi and complete resolution of dyspnea.

These findings suggest that Active Cycle Breathing Technique contributed to improved airway clearance and respiratory status in the patient with Chronic Obstructive Pulmonary Disease.

Discussion

Chronic Obstructive Pulmonary Disease (COPD) is characterized by persistent airway inflammation that leads to structural changes in the respiratory tract, mucus hypersecretion, and airflow limitation (6)(11). Excessive mucus production and impaired mucociliary clearance frequently result in sputum retention, causing ineffective airway clearance (12)(13). Patients commonly experience productive cough, dyspnea, abnormal breath sounds, and increased respiratory effort. In this case, the patient presented with ineffective cough, difficulty expectorating sputum, dyspnea, rhonchi, and increased respiratory rate, which are consistent with the clinical manifestations commonly observed in COPD patients during an acute exacerbation.

Active Cycle Breathing Technique (ACBT) was implemented as a non-pharmacological nursing intervention to facilitate airway clearance. ACBT consists of breathing control, thoracic expansion exercises, and forced expiration techniques (14). Breathing control helps reduce bronchospasm and respiratory muscle fatigue, while thoracic expansion exercises increase lung volume and promote airflow behind retained secretions. The forced expiration technique generates sufficient airflow to mobilize mucus from peripheral airways toward larger airways, allowing secretions to be expelled more effectively through coughing (15).

The results of this case study demonstrated progressive improvement in airway clearance during the three-day intervention period. Respiratory rate and oxygen saturation showed a consistent improving trend across the intervention period, indicating enhanced airway patency and gas exchange. In addition, dyspnea was reduced, cough effectiveness improved, and sputum became thinner and easier to expectorate. These findings suggest that ACBT facilitated the mobilization and removal of retained secretions, resulting in improved respiratory function.

The improvement observed in this study is consistent with previous research reporting the effectiveness of ACBT in patients with chronic respiratory disorders. Several studies have shown that ACBT improves sputum clearance, reduces dyspnea, enhances cough effectiveness, and promotes better ventilation (16)(18). The combination of breathing control and forced expiration techniques enables patients to clear secretions more efficiently while minimizing excessive energy expenditure during coughing (19)(20).

The patient's clinical improvement occurred in the context of ACBT administered alongside standard pharmacological management, suggesting a possible complementary role for ACBT in airway clearance. Besides the implementation of ACBT, the patient's clinical improvement may also have been influenced by concurrent medical treatment, including oxygen therapy, bronchodilators, and nebulization. These therapies help reduce airway obstruction and facilitate secretion mobilization. Therefore, the combination of pharmacological treatment and ACBT may provide synergistic effects in improving airway clearance and respiratory status among patients with COPD.

This study has several limitations that should be acknowledged. First, the single-case descriptive design without a control group limits the ability to isolate the specific contribution of ACBT from the effects of concurrent pharmacological treatments and the natural clinical course of a treated acute exacerbation. Second, the short three-day observation period restricts the evaluation of long-term outcomes. Third, clinical indicators such as dyspnea, cough effectiveness, and breath sounds were assessed using unscaled qualitative descriptors rather than validated standardized instruments (e.g.,

mMRC Dyspnea Scale or Borg CR10 Scale), which may introduce subjectivity in measurement. Finally, the absence of spirometry data limits the precise classification of COPD severity and the generalizability of the findings to patients with different disease stages.

The findings of this case study indicate that Active Cycle Breathing Technique can be incorporated into nursing care for patients with ineffective airway clearance associated with COPD. The intervention is simple, non-invasive, cost-effective, and can be performed independently after adequate instruction. Therefore, nurses play an important role in educating and assisting patients in performing ACBT to optimize airway clearance and prevent respiratory complications.

Conclusions and Recommendations

The implementation of Active Cycle Breathing Technique (ACBT) improved airway clearance in a patient with Chronic Obstructive Pulmonary Disease (COPD) who experienced ineffective airway clearance during an acute exacerbation. Clinical improvements were observed through a reduction in respiratory rate, an increase in oxygen saturation, reduced dyspnea, improved cough effectiveness, decreased rhonchi, and thinner, more easily expectorated sputum. These findings indicate that ACBT, used as a complementary intervention alongside standard medical therapy, contributed to better airway patency and respiratory status. Therefore, ACBT can be recommended as a complementary nursing intervention for patients with ineffective airway clearance associated with COPD. Nurses are encouraged to provide education and assistance in performing ACBT to support optimal airway clearance and prevent respiratory complications. Future studies with controlled designs, longer observation periods, and standardized assessment instruments are recommended to further validate these findings.

Ethical Consideration and Competing Interest

Before the patient was admitted to the hospital, the patient's family signed a General Consent Form. The researcher guaranteed confidentiality through the principle of confidentiality, by keeping the subject's name and personal information confidential. Ethical approval for this study was obtained from the Ethics Committee of the Faculty of Nursing, University of Jember (No. 171/UN25.1.14/KEPK/2026).

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