

# The Role of Respiratory Therapists in Implementing Bronchoscopy-Assisted Airway Clearance Techniques in ICU Patients: A Prospective Study

Wafa M. Al-Malack<sup>1</sup>, Eman M. Alanizi<sup>2</sup>, Saja A. Almarhoun<sup>3</sup>,  
Hoda A. Khoutan<sup>4</sup>

Respiratory Therapist  
Health affairs at the ministry of National Guard

## Abstract

**Objective:** This study explores the role of respiratory therapists in implementing bronchoscopy-assisted airway clearance techniques in ICU patients and assesses its effectiveness in improving patient outcomes.

**Methods:** A prospective study was conducted involving 50 ICU patients undergoing bronchoscopy-assisted airway clearance. Data were collected on procedure effectiveness, patient tolerance, and respiratory outcomes. Qualitative interviews with respiratory therapists provided insights into procedural challenges and the role of their expertise.

**Results:** The bronchoscopy-assisted technique significantly improved airway clearance and reduced incidences of ventilator-associated pneumonia. Key challenges included procedure complexity and patient discomfort. Respiratory therapists reported that specialized training and skill development were crucial for successful implementation. Patient outcomes included improved respiratory function and reduced ICU and ventilation duration.

**Conclusions:** Bronchoscopy-assisted airway clearance is an effective technique for managing airway secretions in ICU patients. The involvement of respiratory therapists is vital for optimizing the procedure and enhancing patient outcomes. Ongoing training and addressing procedural challenges are essential for maximizing the benefits of this technique.

**Keywords:** bronchoscopy, airway clearance, ICU, respiratory therapy, ventilator-associated pneumonia, patient outcomes

## Introduction

Airway clearance is a critical component of patient management in the Intensive Care Unit (ICU), particularly for patients with conditions that lead to excessive mucus production or compromised airway patency (Papadakis and Lachmann, 2007). Effective airway clearance can significantly impact patient outcomes by reducing the risk of respiratory complications, improving oxygenation, and enhancing overall respiratory function (Klompas, 2019).

Bronchoscopy-assisted airway clearance techniques have emerged as advanced methods for managing complex airway conditions in ICU patients (Weinberger et al., 2017). These techniques utilize bronchoscopy to facilitate the removal of secretions and debris from the airways, offering a more targeted approach compared to conventional methods such as manual chest physiotherapy or mechanical suctioning (Espinoza et al., 2015). The implementation of these techniques requires specialized skills and coordination, emphasizing the critical role of respiratory therapists in the ICU setting.

Respiratory therapists are pivotal in the application of bronchoscopy-assisted techniques, given their expertise in both the operation of bronchoscopic equipment and the management of airway clearance protocols (Li et al., 2012). Their involvement includes patient assessment, performing the procedure, and monitoring outcomes, which collectively contribute to the effectiveness of the intervention (Saran et al., 2019). Despite

their significant role, there is a limited understanding of the specific impact of respiratory therapists in this context and how these techniques influence patient outcomes.

This study aims to investigate the effectiveness of bronchoscopy-assisted airway clearance techniques in ICU patients and to explore the role of respiratory therapists in optimizing these interventions. By focusing on both the clinical outcomes and the contributions of respiratory therapists, this research seeks to provide a comprehensive evaluation of this advanced airway management strategy.

## Literature Review

**Airway Clearance Techniques in the ICU:** Effective airway clearance is crucial for managing critically ill patients, especially those with excessive mucus production or obstructive airway conditions. Various techniques are employed in the ICU to achieve this, including manual chest physiotherapy, mechanical suctioning, and more advanced methods such as bronchoscopy-assisted airway clearance (Klompas, 2019). Manual chest physiotherapy, which involves techniques such as percussion and postural drainage, has traditionally been used to help mobilize secretions. However, its efficacy in the ICU setting has been questioned due to limitations in application and effectiveness in critically ill patients (Wang et al., 2018).

**Bronchoscopy-Assisted Airway Clearance:** Bronchoscopy-assisted airway clearance techniques involve the use of a bronchoscope to visualize and remove secretions directly from the airways (Weinberger et al., 2017). This method offers several advantages over traditional techniques, including the ability to target and remove thick or obstructive secretions more effectively (Lee et al., 2015). Studies have shown that bronchoscopy-assisted techniques can significantly improve patient outcomes by reducing the incidence of ventilator-associated pneumonia (VAP) and enhancing overall respiratory function (Menditto et al., 2021). The procedure can be performed using various tools, including rigid and flexible bronchoscopes, and may be complemented by adjunctive therapies such as mucolytics and suction devices (Li et al., 2012).

**Role of Respiratory Therapists:** Respiratory therapists play a critical role in the implementation of bronchoscopy-assisted airway clearance techniques. They are responsible for patient assessment, performing the procedure, and post-procedure monitoring (Saran and Dooley, 2019). Their expertise in airway management and bronchoscopy is essential for ensuring the safety and efficacy of these techniques. Research highlights that respiratory therapists' involvement in bronchoscopy-assisted airway clearance leads to improved procedural outcomes and enhanced patient comfort (Papadakis and Lachmann, 2007). They also contribute to the development of protocols and best practices for airway management, which further optimizes patient care (Espinoza et al., 2015).

**Clinical Outcomes of Bronchoscopy-Assisted Techniques:** Several studies have evaluated the clinical outcomes associated with bronchoscopy-assisted airway clearance. For instance, a study by Wu and Liu (2021) found that the use of bronchoscopy for airway clearance in ICU patients led to a significant reduction in the duration of mechanical ventilation and a decrease in the incidence of VAP. Similarly, research by Menditto et al. (2021) demonstrated that bronchoscopy-assisted techniques improved overall respiratory mechanics and patient outcomes, including reduced ICU length of stay. These findings underscore the potential benefits of integrating bronchoscopy-assisted techniques into standard ICU care practices.

In summary, bronchoscopy-assisted airway clearance techniques represent a valuable advancement in the management of airway obstructions in ICU patients. Respiratory therapists are integral to the successful implementation of these techniques, contributing to improved patient outcomes and enhanced care quality. Further research is needed to explore the optimal application of these techniques and to evaluate their impact on long-term patient outcomes.

## Methodology

**Study Design:** This research utilized a prospective observational study design to evaluate the effectiveness of bronchoscopy-assisted airway clearance techniques in ICU patients and to assess the role of respiratory therapists in implementing these techniques.

**Setting:** The study was conducted in the Intensive Care Units (ICUs) of a large tertiary hospital. The hospital's ICUs cater to a wide range of critically ill patients requiring advanced respiratory support.

## Participants

**Inclusion Criteria:**

- Patients aged 18 years or older
- Admitted to the ICU with indications for airway clearance (e.g., excessive secretions, risk of ventilator-associated pneumonia)
- Patients who provided informed consent or whose legal representatives provided consent for participation

**Exclusion Criteria:**

- Patients with contraindications for bronchoscopy (e.g., severe coagulopathy, uncorrectable airway anomalies)
- Patients who were not suitable for bronchoscopy-assisted techniques due to clinical instability

**Sample Size:** A total of 100 ICU patients were included in the study. This sample size was determined based on power calculations to ensure adequate statistical power for detecting significant differences in outcomes.

**Intervention:** Participants received standard ICU care, which included daily assessments by respiratory therapists. For those who met the criteria for bronchoscopy-assisted airway clearance, the following procedures were performed:

- **Bronchoscopy-Assisted Airway Clearance:** A flexible bronchoscope was used to visualize and aspirate secretions directly from the airways. This was performed by a trained respiratory therapist under the supervision of an attending intensivist.
- **Frequency of Procedure:** The frequency of bronchoscopy-assisted airway clearance was determined based on clinical need, ranging from daily to every other day, depending on the patient's condition and secretion load.

**Data Collection****1. Patient Outcomes:****Primary Outcomes:**

- Reduction in airway secretions, measured via bronchoscopic visual assessment.
- Improvement in respiratory parameters, including oxygenation and ventilation indices.

**Secondary Outcomes:**

- Incidence of ventilator-associated pneumonia (VAP), assessed through clinical and microbiological criteria.
- Length of ICU stay and mechanical ventilation duration.

**2. Respiratory Therapist Contributions:**

- Documentation of the respiratory therapists' involvement in the procedure, including pre-procedural preparation, execution of bronchoscopy, and post-procedural care.
- Collection of qualitative feedback from respiratory therapists regarding their experiences with the procedure.

**3. Patient Comfort and Safety:**

- Assessment of patient comfort during and after the procedure using a standardized questionnaire.
- Monitoring for any adverse events related to bronchoscopy-assisted airway clearance.

**Data Analysis****Quantitative Data Analysis:**

- Descriptive statistics were used to summarize patient demographics, clinical characteristics, and procedural outcomes.
- Comparative analysis of primary and secondary outcomes was performed using paired t-tests or Wilcoxon signed-rank tests for continuous variables and chi-square tests for categorical variables.

- Statistical significance was set at a p-value of  $<0.05$ .

### Qualitative Data Analysis:

- Thematic analysis was conducted on qualitative feedback from respiratory therapists to identify recurring themes and sub-themes related to their experiences with bronchoscopy-assisted airway clearance.
- Data were coded and analyzed using NVivo software to facilitate the identification of key themes.

### Ethical Considerations

The study was approved by the ethics committee. All participants (or their legal representatives) provided informed consent prior to inclusion in the study. Confidentiality was maintained throughout the research process, and data were anonymized for analysis.

### Findings

**Participant Demographics:** A total of 100 ICU patients were included in the study. The demographics and baseline characteristics of the participants are summarized in Table 1.

**Table 1: Participant Demographics and Baseline Characteristics**

| Characteristic                                 | Value (N=100)         |
|--|-----------------------|
| Age (mean $\pm$ SD)                            | 62.3 $\pm$ 15.2 years |
| Gender   |                       |
| - Male   | 60 (60%)              |
| - Female                                       | 40 (40%)              |
| Primary Diagnosis                              |                       |
| - Chronic Obstructive Pulmonary Disease (COPD) | 30 (30%)              |
| - Pneumonia                                    | 25 (25%)              |
| - Acute Respiratory Distress Syndrome (ARDS)   | 20 (20%)              |
| - Other  | 25 (25%)              |
| Mechanical Ventilation (days)                  | 10.5 $\pm$ 4.3        |

### Primary Outcomes

**1. Reduction in Airway Secretions:** The effectiveness of bronchoscopy-assisted airway clearance in reducing airway secretions was assessed through bronchoscopic visual assessments. The findings are presented in Table 2.

**Table 2: Reduction in Airway Secretions**

| Measurement                    | Pre-Procedure (N=100) | Post-Procedure (N=100) | p-value  |
|--------------------------------|-----------------------|------------------------|----------|
| Airway Secretions Score (0-10) | 7.2 $\pm$ 1.8         | 3.1 $\pm$ 1.5          | $<0.001$ |
| Secretions Quantity (ml)       | 12.5 $\pm$ 4.3        | 5.7 $\pm$ 3.0          | $<0.001$ |

**2. Improvement in Respiratory Parameters:** Improvements in respiratory parameters following bronchoscopy-assisted airway clearance were analyzed, as shown in Table 3.

**Table 3: Improvement in Respiratory Parameters**

| Parameter                                | Pre-Procedure<br>(N=100) | Post-Procedure<br>(N=100) | p-value |
|--|--------------------------|---------------------------|---------|
| PaO <sub>2</sub> /FiO <sub>2</sub> Ratio | 210 ±50                  | 270 ±60                   | <0.01   |
| PaCO <sub>2</sub> (mmHg)                 | 55.2 ±10.4               | 48.3 ±9.2                 | <0.01   |
| Respiratory Rate<br>(breaths/min)        | 24.5 ±4.2                | 22.0 ±3.5                 | <0.05   |

## Secondary Outcomes

**1. Incidence of Ventilator-Associated Pneumonia (VAP):** The incidence of VAP before and after the implementation of bronchoscopy-assisted airway clearance was evaluated. Results are detailed in Table 4.

**Table 4: Incidence of Ventilator-Associated Pneumonia (VAP)**

| Time Period       | Pre-Intervention<br>(N=50) | Post-Intervention<br>(N=50) | p-value |
|-------------------|----------------------------|-----------------------------|---------|
| VAP Incidence (%) | 28%                        | 14%                         | <0.05   |

**2. Length of ICU Stay and Mechanical Ventilation Duration:** Data on the length of ICU stay and duration of mechanical ventilation are shown in Table 5.

**Table 5: Length of ICU Stay and Mechanical Ventilation Duration**

| Measurement                            | Pre-Procedure<br>(N=50) | Post-Procedure<br>(N=50) | p-value |
|--|-------------------------|--------------------------|---------|
| ICU Length of Stay (days)              | 15.3 ±5.0               | 12.2 ±4.1                | <0.05   |
| Mechanical Ventilation Duration (days) | 11.0 ±3.8               | 8.5 ±2.9                 | <0.05   |

## Qualitative Findings

The qualitative analysis of respiratory therapists' experiences with bronchoscopy-assisted airway clearance in ICU patients revealed several key themes and sub-themes. These insights were gathered from in-depth interviews and focus groups with 15 respiratory therapists working in ICU settings. The themes, sub-themes, and representative participant quotes are summarized below:

### Theme 1: Effectiveness of the Procedure

#### Sub-theme 1.1: Improvement in Airway Clearance

##### Participant Quotes:

- "Bronchoscopy-assisted airway clearance is highly effective. We see a significant reduction in airway secretions, which helps improve patient oxygenation."
- "The visual confirmation of reduced secretions during the procedure confirms that this technique works well for managing severe cases."

#### Sub-theme 1.2: Impact on Ventilator-Associated Pneumonia (VAP)

##### Participant Quotes:

- "Since implementing this technique, the incidence of VAP has noticeably decreased in our ICU."

- "We've had fewer VAP cases, which suggests that improving airway clearance directly benefits infection control."

## **Theme 2: Challenges in Implementation**

### **Sub-theme 2.1: Procedure Complexity**

#### **Participant Quotes:**

- "The procedure requires a lot of skill and precision. Not all staff are equally adept at performing bronchoscopy-assisted airway clearance."
- "It's complex, and sometimes the technique can be technically challenging, especially in very sick patients."

### **Sub-theme 2.2: Patient Tolerance**

#### **Participant Quotes:**

- "Some patients find the procedure uncomfortable and may require additional sedation or analgesia."
- "Patient tolerance varies; some do well with the procedure, while others may experience significant discomfort."

## **Theme 3: Benefits for Patient Outcomes**

### **Sub-theme 3.1: Enhanced Respiratory Function**

#### **Participant Quotes:**

- "Patients show marked improvement in respiratory function following the procedure. Their oxygen levels and CO2 levels stabilize better."
- "We see improvements in gas exchange and respiratory mechanics, which is critical for ICU patients."

### **Sub-theme 3.2: Shorter ICU and Ventilation Duration**

#### **Participant Quotes:**

- "The overall length of ICU stay and duration of mechanical ventilation often decrease, which is beneficial for patient recovery."
- "Faster recovery times and reduced need for prolonged ventilation are significant advantages of this technique."

## **Theme 4: Training and Skill Development**

### **Sub-theme 4.1: Need for Specialized Training**

#### **Participant Quotes:**

- "Ongoing training is essential for maintaining proficiency in performing bronchoscopy-assisted airway clearance."
- "The procedure requires specific skills and knowledge, which necessitates regular updates and hands-on practice."

### **Sub-theme 4.2: Impact on Staff Competency**

#### **Participant Quotes:**

- "Increased competency in performing the procedure improves overall team confidence and patient outcomes."
- "With proper training, staff become more adept at managing complex airway issues."

## **Discussion**

This study aimed to evaluate the role of respiratory therapists in implementing bronchoscopy-assisted airway clearance techniques in ICU patients, focusing on its effectiveness and the challenges involved. The findings from this research provide valuable insights into the impact of this advanced technique on patient outcomes and the role of respiratory therapists in its execution.

**Effectiveness of Bronchoscopy-Assisted Airway Clearance:** The study found that bronchoscopy-assisted airway clearance is highly effective in improving airway clearance and reducing the incidence of ventilator-associated pneumonia (VAP). Respiratory therapists reported significant improvements in airway secretion management and overall respiratory function following the procedure. This aligns with existing literature that highlights the benefits of direct visualization in managing airway secretions and preventing complications



like VAP (Menditto et al., 2021). The ability to visually confirm reduced secretions during the procedure enhances the accuracy of airway management and contributes to better patient outcomes.

**Challenges and Barriers:** Despite its effectiveness, several challenges were identified in the implementation of bronchoscopy-assisted airway clearance. The complexity of the procedure and variations in patient tolerance were notable concerns. The procedure requires a high level of skill and precision, which may limit its effectiveness if not performed correctly. Additionally, some patients experience discomfort, necessitating careful management of sedation and analgesia. These findings are consistent with other studies that emphasize the technical difficulties and patient discomfort associated with bronchoscopy in critically ill patients (Menditto et al., 2021).

**Impact on Patient Outcomes:** The study also revealed that bronchoscopy-assisted airway clearance contributes to improved respiratory function and shorter durations of ICU stay and mechanical ventilation. This is significant, as efficient airway clearance can expedite recovery and reduce the overall burden on the healthcare system. The observed benefits in respiratory function and reduced need for prolonged ventilation are supported by previous research demonstrating that effective airway management can lead to faster patient recovery and decreased ICU length of stay (Lee et al., 2015).

**Training and Skill Development:** The need for specialized training in performing bronchoscopy-assisted airway clearance emerged as a crucial factor in ensuring the technique's success. Respiratory therapists highlighted that ongoing training and skill development are essential for maintaining proficiency and improving patient outcomes. This is consistent with findings from other studies that emphasize the importance of training in complex procedures to enhance staff competency and patient safety (Miller, 2017).

### Implications for Practice

The results of this study have several implications for clinical practice. First, the effectiveness of bronchoscopy-assisted airway clearance underscores the importance of integrating this technique into routine ICU care for patients with severe respiratory conditions. Second, addressing the challenges related to procedure complexity and patient tolerance through targeted training and support can enhance the overall effectiveness of this intervention. Finally, continuous evaluation of the procedure's impact on patient outcomes can help optimize its use and improve ICU care.

### Limitations and Future Research

This study's limitations include the potential for selection bias and the subjective nature of qualitative data. Future research should include larger sample sizes and longitudinal studies to validate these findings and explore additional aspects of bronchoscopy-assisted airway clearance. Investigating the long-term effects of this technique on patient outcomes and exploring strategies to mitigate the identified challenges could further enhance its implementation and effectiveness.

### References

1. Espinoza, A., Neumann, K., Halvorsen, P. S., Sundset, A., Kongerud, J., & Fosse, E. (2015). Critical airway obstruction: challenges in airway management and ventilation during therapeutic bronchoscopy. *Journal of Bronchology & Interventional Pulmonology*, 22(1), 41-47.
2. Klompas, M. (2019). Ventilator-associated events: what they are and what they are not. *Respiratory care*, 64(8), 953-961.
3. Menditto, V. G., Mei, F., Fabrizzi, B., & Bonifazi, M. (2021). Role of bronchoscopy in critically ill patients managed in intermediate care units-indications and complications: A narrative review. *World Journal of Critical Care Medicine*, 10(6), 334.
4. Papadakos, P. J., & Lachmann, B. (2007). *Mechanical ventilation e-book: Clinical applications and pathophysiology*. Elsevier Health Sciences.
5. Lee, A. L., Burge, A. T., & Holland, A. E. (2015). Airway clearance techniques for bronchiectasis. *Cochrane Database of Systematic Reviews*, (11).

6. Li, J., Zhan, Q. Y., Liang, Z. A., Tu, M. L., Sun, B., Yao, X. L., ... & Wang, C. (2012). Respiratory care practices and requirements for respiratory therapists in Beijing intensive care units. *Respiratory Care*, 57(3), 370-376.
7. Saran, J. S., & Dooley, J. W. (2019). Advanced and difficult airway management in the ICU. *Adult Critical Care Medicine: A Clinical Casebook*, 249-266.
8. Wang, T. H., Wu, C. P., & Wang, L. Y. (2018). Chest physiotherapy with early mobilization may improve extubation outcome in critically ill patients in the intensive care units. *The clinical respiratory journal*, 12(11), 2613-2621.
9. Weinberger, S. E., Cockrill, B. A., & Mandel, J. (2017). *Principles of Pulmonary Medicine E-Book*. Elsevier Health Sciences.
10. Wu, L., & Liu, B. (2021). The clinical effect of a bronchofiberscope in treating severe ventilator-associated pneumonia. *American Journal of Translational Research*, 13(6), 6966.