

## Combined Physiotherapy for Airway Clearance in Pneumonia: A Case Report

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### Abstract

**Background:** Pneumonia is a major cause of impaired respiratory function, particularly in older adults, often characterized by secretion retention, reduced ventilation, and decreased functional capacity. Optimizing airway clearance through physiotherapy is essential to improve clinical outcomes.

**Objective:** To evaluate the clinical effectiveness of combined physiotherapy interventions in improving airway clearance and respiratory function in a patient with pneumonia.

**Methods:** A single-case report was conducted in a 66-year-old male with pneumonia presenting with dyspnea and productive cough. The intervention included infrared therapy, myofascial release, postural drainage, and Active Cycle of Breathing Technique (ACBT), administered once daily for four sessions. Outcome measures included dyspnea (Borg Scale), thoracic expansion (cm), and peak expiratory flow (PEF, L/min). Descriptive analysis was used to evaluate changes across sessions.

**Results:** Dyspnea decreased from Borg scale 6 to 2 after four sessions. Thoracic expansion improved across all regions, with upper thoracic expansion increasing from 2.3 cm to 3.8 cm. Peak expiratory flow increased from 320 L/min (63% predicted) to 410 L/min (approximately 80% predicted). Clinical findings showed reduced sputum production, normalization of breath sounds from rhonchi to vesicular, and improvement in percussion from dullness to resonance. These changes indicate clinically meaningful improvements in airway clearance and respiratory function.

**Conclusion:** Combined physiotherapy interventions may effectively enhance airway clearance and respiratory function in patients with pneumonia. However, findings from this single-case report should be interpreted cautiously, and further studies are needed to confirm generalizability.

### Keywords

Airway Clearance Techniques; Physical Therapy Modalities; Postural Drainage; Dyspnea; Respiratory Function; Case Reports

### Introduction

Pneumonia is an acute lower respiratory tract infection characterized by inflammation of the lung parenchyma, commonly resulting from bacterial or viral pathogens. It remains a major global health burden, contributing substantially to morbidity and mortality, particularly among older adults and individuals with comorbid conditions.<sup>1</sup> Recent global estimates indicate that pneumonia accounts for millions of deaths annually, with the highest burden observed in elderly populations due to age-related decline in immune function and increased prevalence of chronic diseases.<sup>2</sup> In addition to its mortality impact, pneumonia is associated with significant functional impairment, prolonged hospitalization, and increased healthcare utilization.<sup>3</sup>

From a pathophysiological perspective, pneumonia disrupts normal pulmonary function through alveolar inflammation, accumulation of secretions, and ventilation-perfusion mismatch.<sup>4</sup> These changes lead to reduced lung compliance, impaired gas exchange, and increased work of breathing. Clinically, patients frequently present with dyspnea, productive cough, decreased thoracic expansion, and ineffective airway clearance.<sup>5</sup> The accumulation of sputum within the bronchial tree not only compromises ventilation but also predisposes patients to complications such as atelectasis, secondary infections, and delayed recovery.<sup>6</sup>

In hospitalized patients, these respiratory impairments are often exacerbated by prolonged bed rest and reduced mobility, which contribute to physical deconditioning, respiratory muscle weakness, and further decline in functional capacity.<sup>7</sup> Early and appropriate supportive management is therefore essential to prevent deterioration and to promote recovery. While pharmacological therapy remains the cornerstone of pneumonia treatment, non-pharmacological interventions, particularly physiotherapy, play a critical adjunctive role in optimizing respiratory function and functional outcomes.<sup>8</sup>

Physiotherapy interventions in pneumonia are primarily aimed at improving airway clearance, enhancing ventilation, and preventing complications associated with immobility. Techniques such as the Active Cycle of Breathing Technique (ACBT), postural drainage, and early mobilization have been widely recommended in clinical practice.<sup>6,8</sup> ACBT, for instance, integrates breathing control, thoracic expansion exercises, and forced expiratory techniques to facilitate mucus clearance and improve ventilation efficiency. Similarly, postural drainage utilizes gravitational positioning to mobilize secretions from peripheral to central airways, thereby enhancing expectoration.<sup>9</sup>

In recent years, there has been increasing interest in combining multiple physiotherapy modalities to achieve synergistic therapeutic effects. Interventions such as myofascial release may improve chest wall mobility and reduce muscle tension, while infrared therapy may promote local circulation and muscle relaxation, potentially facilitating more effective breathing patterns.<sup>17</sup> The integration of these modalities with conventional airway clearance techniques represents a more comprehensive and patient-centered approach to respiratory rehabilitation.<sup>10</sup> However, despite the growing use of such combined interventions in clinical practice, the evidence supporting their effectiveness, particularly in the context of individual clinical cases, remains limited.<sup>11</sup>

Most existing studies focus on isolated physiotherapy techniques or are conducted in controlled experimental settings, which may not fully reflect real-world clinical complexity.<sup>12</sup> Furthermore, there is a lack of detailed case-based evidence that explores the

clinical reasoning, individualized response, and practical implementation of combined physiotherapy interventions in patients with pneumonia. This gap is particularly relevant given the heterogeneity of patient presentations and the need for tailored therapeutic strategies in clinical practice.

Therefore, this study aims to explore the clinical effectiveness of a combination of physiotherapy interventions, including infrared therapy, myofascial release, postural drainage, and Active Cycle of Breathing Technique (ACBT), in improving airway clearance and respiratory function in a patient with pneumonia. By presenting a detailed case report, this study seeks to provide clinically relevant insights into the integration of multiple physiotherapy modalities, contributing to evidence-informed practice while acknowledging the inherent limitations of single-case designs. This case report is novel in demonstrating the integrated application of multiple physiotherapy modalities, including ACBT, myofascial release, infrared therapy, and postural drainage, within a single clinical framework for pneumonia management, an approach that remains underreported in current literature.

**Methods**

This study was designed as a CARE-compliant single-case report to explore the clinical effectiveness of combined physiotherapy interventions in a patient with pneumonia and airway clearance impairment. The report was structured in accordance with established case report guidelines to ensure transparency, completeness, and clinical relevance. The study was conducted at a pulmonary referral hospital in Yogyakarta, Indonesia, during the patient’s hospitalization period. Data collection and intervention were carried out over four consecutive physiotherapy sessions within a short-term inpatient care setting.

The study population consisted of patients diagnosed with pneumonia presenting with respiratory dysfunction. The sample in this report was a 66-year-old male patient selected using purposive sampling based on clinical relevance. Inclusion criteria comprised: (1) confirmed diagnosis of pneumonia based on clinical and radiological findings, (2) presence of airway clearance impairment indicated by productive cough and abnormal breath sounds, (3) hemodynamic stability, and (4) ability to follow physiotherapy instructions. Exclusion criteria included: (1) unstable cardiovascular status, (2) severe cognitive impairment limiting cooperation, and (3) contraindications to chest physiotherapy techniques.

The primary variables observed in this study included dyspnea level, thoracic expansion, and peak expiratory flow (PEF), along with supporting clinical findings such as breath sounds, sputum production, and percussion characteristics. Dyspnea was assessed using the Borg Scale, a validated instrument for measuring perceived exertional breathlessness. Peak expiratory flow was measured using a peak flow meter, which has demonstrated acceptable reliability in assessing expiratory function. Thoracic expansion was measured using a standard measuring tape (meterline) at upper, middle, and lower thoracic levels to evaluate chest wall mobility.

Differential diagnoses considered included chronic obstructive pulmonary disease exacerbation and residual pulmonary impairment from previous tuberculosis. However, the acute onset of symptoms, presence of infection-related signs, and radiological findings supported the diagnosis of pneumonia as the primary condition.

Prior to intervention, a comprehensive clinical assessment was conducted, including patient history, vital signs, inspection, palpation, percussion, and auscultation. Radiological findings from chest X-ray supported the diagnosis, revealing increased bronchovascular markings and structural changes consistent with pulmonary pathology. Clinical reasoning was applied to identify physiotherapy problems based on the International Classification of Functioning, Disability, and Health (ICF) framework, encompassing impairments in body structure and function, activity limitations, and participation restrictions.

The Borg Scale has been widely validated as a reliable tool for assessing perceived dyspnea, while peak expiratory flow measurement using a peak flow meter demonstrates acceptable reliability in evaluating expiratory function. Based on clinical assessment and the ICF framework, the physiotherapy diagnosis was identified as impaired airway clearance related to mucus retention and reduced thoracic mobility, accompanied by increased work of breathing. To enhance clarity, patient characteristics and baseline clinical findings are summarized in Table 1.

**Table 1. Patient Characteristics and Baseline Clinical Findings**

Variable	Description
Age / Sex	66 years / Male
Anthropometry	Weight 58 kg; Height 160 cm
Main complaints	Dyspnea, productive cough (yellowish sputum)
Medical history	Previous pulmonary tuberculosis (treated), hypertension
Vital signs	BP 140/77 mmHg; HR 108 bpm; RR 19 breaths/min; SpO <sub>2</sub> 96%; Temp 36.6°C
Respiratory findings	Rhonchi in left lower lobe; dull percussion; decreased fremitus
Thoracic expansion	Upper: 2.3 cm; Middle: 2.1 cm; Lower: 2.0 cm
Peak expiratory flow	320 L/min (63% predicted)
Dyspnea (Borg Scale)	Level 6

The physiotherapy intervention consisted of a combination of infrared therapy, myofascial release, postural drainage, and Active Cycle of Breathing Technique (ACBT). The selection of these interventions was based on clinical reasoning and evidence indicating their roles in improving airway clearance, reducing muscle tension, and enhancing respiratory mechanics. Infrared therapy was applied to reduce muscle tension and promote relaxation of accessory respiratory muscles. Myofascial release targeted the upper trapezius and sternocleidomastoid muscles to decrease muscle spasm and improve chest wall mobility. Postural drainage was used to facilitate gravitational mobilization of pulmonary secretions. ACBT was implemented to optimize airway clearance through breathing control, thoracic expansion exercises, and forced expiratory techniques. The intervention protocol was administered once daily over four sessions. Details of the intervention protocol are presented in Table 2.

**Table 2. Physiotherapy Intervention Protocol (FITT Principle)**

Intervention	Frequency	Intensity	Time	Type / Purpose
Infrared therapy	1×/day	Patient tolerance	15 min	Muscle relaxation
Myofascial release	1×/day	Patient tolerance	5 min	Reduce muscle spasm
Postural drainage	1×/day	Patient tolerance	10–15 min	Airway clearance
ACBT	1×/day	Patient tolerance	5–10 min	Breathing exercise and secretion mobilization

Patient adherence to the intervention was monitored during each session, and no adverse events were observed throughout the treatment period. The intervention protocol remained consistent across sessions without modification. Outcome measurements were recorded at baseline (T0) and after each intervention session (T1–T4) to evaluate progression over time. Descriptive analysis

was used to assess changes in clinical outcomes, given the single-case design. Clinical significance was interpreted based on observable functional improvements, trends in outcome measures, and normalization of respiratory findings.

The selection of combined physiotherapy interventions in this case was based on clinical reasoning tailored to the patient's impairments. The presence of excessive sputum, reduced thoracic expansion, and increased use of accessory respiratory muscles indicated the need for airway clearance and chest mobility optimization. ACBT and postural drainage were prioritized to facilitate mucus mobilization, while myofascial release and infrared therapy were applied to reduce muscle tension and improve chest wall compliance. This multimodal approach was intended to address both respiratory mechanics and musculoskeletal limitations simultaneously. Ethical considerations were addressed by obtaining written informed consent from the patient prior to participation. The study protocol was conducted in accordance with ethical principles for clinical research. To enhance transparency and align with CARE reporting standards, the clinical course of the patient from symptom onset to post-intervention outcomes is summarized in a structured timeline.

**Table 3.** Clinical Timeline of Patient Management

Phase	Description
Onset	Patient experienced fever for 1 week followed by dyspnea and productive cough
Hospital admission	Presented with dyspnea, productive cough, and fatigue
Diagnosis	Pneumonia confirmed by clinical and radiological findings
Baseline assessment (T0)	Borg 6; PEF 320 L/min; reduced thoracic expansion
Intervention	Combined physiotherapy (IR, myofascial release, postural drainage, ACBT)
T1–T4	Progressive improvement across sessions
Final outcome (T4)	Borg 2; PEF 410 L/min; normalized breath sounds; no sputum

**Results**

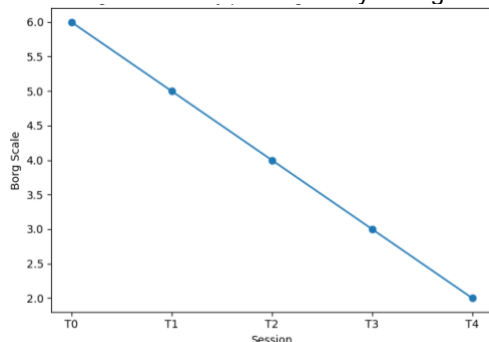
The results are presented longitudinally to illustrate changes in the patient's clinical condition before and after physiotherapy interventions across four treatment sessions. Measurements were obtained at baseline (T0) and after each intervention session (T1–T4). To provide a structured overview of the primary outcomes, quantitative data are presented in Table 4.

**Table 4.** Changes in Clinical Outcomes Across Intervention Sessions

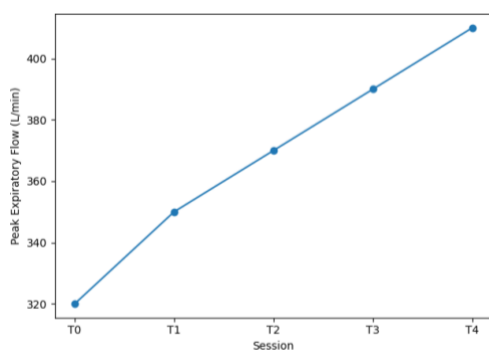
Outcome	T0	T1	T2	T3	T4
Dyspnea (Borg Scale)	6	5	4	3	2
Thoracic expansion – Upper (cm)	2.3	2.5	3.0	3.4	3.8
Thoracic expansion – Middle (cm)	2.1	2.4	2.8	3.2	3.6
Thoracic expansion – Lower (cm)	2.0	2.3	2.6	3.0	3.4
Peak Expiratory Flow (L/min)	320	350	370	390	410

Note: T0 = baseline; T1–T4 = after sessions 1 to 4.

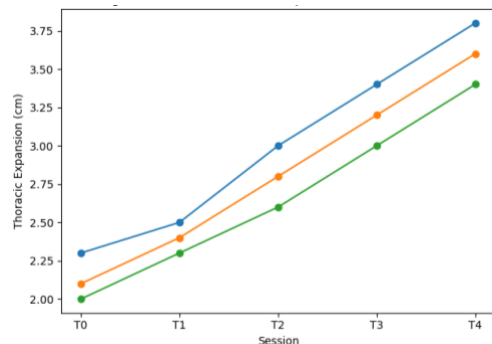
To further illustrate the longitudinal changes in clinical outcomes across intervention sessions, graphical representations are provided. As shown in Figure 1, dyspnea measured using the Borg Scale demonstrated a consistent decline from baseline to the final session. Figure 2 illustrates the progressive increase in peak expiratory flow, indicating improvement in expiratory function over time. Meanwhile, Figure 3 presents the trend of thoracic expansion across upper, middle, and lower regions, showing a steady enhancement in chest wall mobility throughout the intervention period.



**Figure 1.** Trend of Dyspnea (Borg Scale) Across Sessions



**Figure 2.** Trend of Peak Expiratory Flow Across Sessions



**Figure 3.** Trend of Thoracic Expansion Across Sessions

Descriptively, all measured parameters demonstrated progressive improvement over time. Dyspnea decreased consistently from a Borg Scale score of 6 at baseline to 2 after the fourth session, with a steady reduction observed at each session. Thoracic expansion improved across all regions. Upper thoracic expansion increased from 2.3 cm to 3.8 cm, middle thoracic expansion from 2.1 cm to 3.6 cm, and lower thoracic expansion from 2.0 cm to 3.4 cm. These increases followed a consistent linear trend throughout the intervention period. Peak expiratory flow also showed a gradual increase from 320 L/min at baseline to 410 L/min at the final session. The improvement occurred incrementally, with an approximate increase of 20–30 L/min per session. The magnitude of change observed in dyspnea and peak expiratory flow suggests clinically meaningful improvement, although minimal clinically important difference (MCID) values were not formally calculated in this case.

In addition to quantitative outcomes, clinical findings demonstrated notable changes. At baseline, auscultation revealed rhonchi in the left lower lobe, indicating the presence of airway secretions. Following the intervention, breath sounds progressively normalized to vesicular without rhonchi by the final session. Percussion findings initially indicated dullness in the left lower lobe, which improved to resonance after completion of the intervention, suggesting enhanced lung aeration. Sputum production decreased progressively over the treatment sessions. The patient initially presented with productive cough and significant sputum, which gradually diminished until no sputum was observed at the final session.

No adverse events were reported during the intervention period. The patient demonstrated good adherence to all physiotherapy procedures across sessions. Overall, the results indicate a consistent and progressive improvement in respiratory parameters and clinical findings throughout the intervention period, without significant variability between sessions.

## Discussion

This case report demonstrates that a combination of physiotherapy interventions was associated with consistent improvements in respiratory function and airway clearance in a patient with pneumonia. The observed reductions in dyspnea, increases in thoracic expansion, and improvements in peak expiratory flow (PEF) suggest a clinically meaningful enhancement in ventilatory efficiency and secretion clearance. These findings align with the established role of physiotherapy as an important adjunctive intervention in the management of respiratory conditions characterized by mucus retention and impaired ventilation.<sup>6</sup>

The progressive reduction in dyspnea observed across sessions reflects improved breathing efficiency and reduced work of breathing. Dyspnea in pneumonia is primarily driven by ventilation–perfusion mismatch, airway obstruction due to secretions, and increased respiratory muscle demand.<sup>3</sup> The improvement in Borg Scale scores in this case may indicate enhanced airway patency and improved respiratory mechanics following intervention. Similar findings have been reported in previous studies demonstrating that pulmonary rehabilitation and chest physiotherapy can significantly reduce dyspnea and improve functional capacity in patients with pneumonia and other respiratory disorders.<sup>13,14</sup>

The increase in thoracic expansion observed in all regions suggests improved chest wall mobility and lung compliance. Restricted thoracic movement is commonly associated with muscle stiffness, pain, and reduced ventilation in pneumonia.<sup>5</sup> The application of myofascial release and infrared therapy in this case may have contributed to reduced muscle tension in the accessory respiratory muscles, thereby facilitating greater chest wall excursion.<sup>15</sup> This is consistent with previous evidence indicating that soft tissue mobilization techniques can enhance musculoskeletal flexibility and indirectly support respiratory function.<sup>16</sup>

The improvement in peak expiratory flow further supports the effectiveness of the intervention in enhancing expiratory function and airway clearance. PEF reflects the ability to generate effective expiratory force, which is essential for clearing airway secretions. The increase from 63% to approximately 80% of predicted values suggests improved expiratory flow dynamics.<sup>17</sup> The use of Active Cycle of Breathing Technique (ACBT) likely played a central role in this improvement. ACBT integrates breathing control, thoracic expansion, and forced expiratory techniques, which together facilitate mucus mobilization from peripheral to central airways, enabling effective expectoration.<sup>8</sup>

Postural drainage also contributed to secretion mobilization by utilizing gravitational forces to assist mucus movement. The combination of ACBT and postural drainage may have produced a synergistic effect, enhancing the efficiency of airway clearance compared to single-modality approaches.<sup>18</sup> Previous studies have highlighted that combining airway clearance techniques can improve clinical outcomes by addressing multiple physiological mechanisms simultaneously, including airflow optimization, secretion mobilization, and respiratory muscle coordination.<sup>9</sup>

An important aspect of this case is the integration of multiple physiotherapy modalities based on individualized clinical reasoning. Unlike controlled trials that often isolate single interventions, real-world clinical practice frequently requires combining techniques tailored to patient-specific impairments.<sup>12</sup> The observed improvements in this case may therefore reflect the cumulative and interactive effects of the intervention components rather than a single modality. This highlights the importance of a comprehensive and patient-centered approach in physiotherapy management.

From a clinical perspective, these findings suggest that early implementation of combined physiotherapy interventions may support faster recovery and reduce the risk of complications such as secretion retention and impaired ventilation. The absence of adverse events and good patient adherence further indicate that the intervention protocol was safe and feasible in a clinical setting. These results are consistent with current recommendations emphasizing early mobilization and airway clearance strategies in respiratory care.<sup>19</sup>

The observed improvements in dyspnea, thoracic expansion, and peak expiratory flow appear to be interrelated. Enhanced thoracic expansion likely contributed to improved lung ventilation, which in turn facilitated more effective airway clearance and

increased expiratory flow.<sup>20</sup> This relationship suggests that improvements in chest wall mobility may play a key role in reducing dyspnea and optimizing respiratory function.

Potential sources of bias should be considered. Observer bias may have occurred during clinical assessment, particularly in subjective measures such as dyspnea scoring. Measurement bias may also be present due to variability in peak expiratory flow performance and thoracic expansion measurements. Efforts were made to minimize these biases by using standardized procedures and consistent measurement techniques across sessions.

However, several limitations must be acknowledged. As a single-case report, the level of evidence is inherently low, and the findings cannot be generalized to broader populations. Individual variability, including prior health status and responsiveness to treatment, may influence outcomes. Additionally, the absence of long-term follow-up limits the ability to assess sustained effects of the intervention. Potential sources of bias, such as observer bias and measurement variability, were also not fully controlled.

Despite these limitations, this report provides clinically relevant insights into the application of combined physiotherapy interventions in pneumonia. It contributes to the limited body of case-based evidence by illustrating how multiple modalities can be integrated effectively in practice. Future research should focus on controlled studies with larger sample sizes to evaluate the comparative effectiveness of combined versus single physiotherapy interventions, as well as long-term outcomes.

## Conclusion

This case report demonstrates that a structured combination of physiotherapy interventions, including Active Cycle of Breathing Technique (ACBT), postural drainage, myofascial release, and infrared therapy, was associated with clinically meaningful improvements in airway clearance and respiratory function in a patient with pneumonia. The intervention contributed to a reduction in dyspnea, increased thoracic expansion, improved peak expiratory flow, and normalization of clinical respiratory findings, indicating enhanced ventilatory efficiency and secretion clearance.

However, as this study is based on a single-case design, the level of evidence is inherently limited. The findings should therefore be interpreted with caution and should not be generalized to broader patient populations without further supporting evidence. From a clinical perspective, the integration of multiple physiotherapy modalities may offer a practical and effective approach to managing airway clearance impairment in patients with pneumonia, particularly when tailored to individual patient needs. Future studies with larger sample sizes, controlled designs, and longer follow-up periods are required to confirm these findings and to establish stronger evidence for clinical practice.

These findings may be particularly relevant for physiotherapy practice in hospital settings, where early implementation of combined airway clearance strategies can support respiratory recovery in pneumonia patients.

## Author Contribution

Farah Hasna Maulida: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft.

Prayitno: Supervision, Validation, Methodology, Writing – review and editing.

Isnaini Herawati: Investigation, Resources, Data curation.

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## Conflict of Interest Statement

The authors declare no conflict of interest.

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## Ethics Statement

Ethical approval was not required for this case report in accordance with institutional and local regulations. Written informed consent was obtained from the patient for participation and publication of clinical data.

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