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Physiotherapy for Dyspnea and Thoracic Expansion in Pleural Effusion: A Case Report

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Abstract

Background: Pleural effusion involves abnormal fluid accumulation in the pleural cavity, which impairs lung expansion, reduces ventilation efficiency, and increases dyspnea, ultimately limiting functional capacity.

Objective: This case report aimed to evaluate the clinical effects of physiotherapy interventions on dyspnea severity and thoracic expansion in a patient with pleural effusion secondary to pneumonia.

Methods: A 77-year-old male diagnosed with left-sided pleural effusion due to pneumonia received a structured physiotherapy program consisting of deep breathing exercise, thoracic expansion exercise, and functional training. The intervention was administered three times per week for six sessions. Outcomes were assessed using the Borg Scale for dyspnea, modified Medical Research Council (mMRC) for functional capacity, thoracic expansion measurements, peak expiratory flow rate (PEFR), and incentive spirometry.

Results: Following six sessions, dyspnea severity decreased from Borg score 5 to 2 (60% reduction), while functional capacity improved from mMRC grade 2 to 1. Thoracic expansion increased from 2 cm to 3 cm (50% improvement). PEFR improved from 180 L/min to 250–260 L/min (approximately 44% increase), and inspiratory capacity increased from 275 mL to 1250 mL (approximately 354% increase). No adverse events were observed during the intervention period.

Conclusion: Physiotherapy interventions, including breathing and thoracic expansion exercises, may improve respiratory function, reduce dyspnea, and enhance functional capacity in patients with pleural effusion. However, findings from this single case should be interpreted with caution and cannot be generalized.

Keywords
Pleural Effusion; Dyspnea; Breathing Exercises; Thoracic Expansion; Pulmonary Rehabilitation

Introduction

Pleural effusion is a clinical condition characterized by abnormal accumulation of fluid within the pleural space, which disrupts normal respiratory mechanics and impairs pulmonary ventilation.[1,2] Under physiological conditions, a small amount of pleural fluid facilitates smooth movement between the visceral and parietal pleura; however, excessive accumulation reflects an underlying pathological process.[3] Pleural effusion is not a primary disease but rather a manifestation of various conditions, including infection, malignancy, cardiovascular disorders, and systemic inflammatory diseases.[4] Among these etiologies, pneumonia remains a major contributor, particularly in the form of parapneumonic effusion, which arises secondary to inflammatory responses in the pleural space.[5]

Pleural effusion associated with pneumonia significantly alters respiratory physiology. The accumulation of fluid within the pleural cavity compresses lung tissue, reduces lung compliance, and limits thoracic expansion, resulting in a restrictive ventilatory pattern.[6] Consequently, patients often experience progressive dyspnea, decreased oxygenation, and reduced functional capacity.[6] In more severe cases, parapneumonic effusion may progress to empyema, a condition associated with increased morbidity, prolonged hospitalization, and higher mortality rates.[7] Epidemiological evidence indicates that pleural effusion frequently complicates pneumonia and is associated with worse clinical outcomes compared with pneumonia without effusion.[8]

From a rehabilitation perspective, patients with pleural effusion commonly present with impaired breathing patterns, decreased chest wall mobility, and increased reliance on accessory respiratory muscles.[9] These alterations contribute to inefficient ventilation and increased work of breathing, further exacerbating dyspnea and limiting activity tolerance. In addition, prolonged inactivity during hospitalization may lead to physical deconditioning, thereby worsening functional decline.[10] Therefore, early and targeted physiotherapy interventions are essential to optimize respiratory function, improve thoracic mobility, and enhance overall functional capacity.[11]

Breathing exercises, particularly deep breathing exercise, have been shown to improve alveolar ventilation, promote lung re-expansion, and enhance gas exchange efficiency.[12] This intervention facilitates maximal inspiratory effort and supports alveolar recruitment, which is crucial in conditions involving reduced lung expansion. In parallel, thoracic expansion exercise aims to increase chest wall mobility and improve coordination between respiratory muscles, thereby enhancing overall ventilation mechanics.[12,13] When combined with early mobilization and functional training, these interventions may contribute to improved exercise tolerance and prevention of secondary complications such as atelectasis.[12,13]

Despite the recognized role of physiotherapy in respiratory rehabilitation, the current literature remains limited regarding detailed case-based evidence specifically addressing physiotherapy management in pleural effusion secondary to pneumonia. Most available studies focus on general respiratory conditions or broader pulmonary rehabilitation programs, with limited emphasis on individualized physiotherapy approaches in this specific population.[14] This gap highlights the need for clinically detailed reports that describe assessment, intervention, and patient outcomes in real-world settings.

Furthermore, reporting individual cases provides valuable insights into clinical reasoning, intervention strategies, and patient responses, which may not be fully captured in large-scale studies. Such evidence is particularly relevant for guiding physiotherapy practice in complex respiratory conditions where variability in presentation and response to treatment is high.[15] Therefore, this case report aims to evaluate the effects of a structured physiotherapy program, including deep breathing exercise and thoracic expansion exercise, on dyspnea severity, thoracic expansion, and functional capacity in a patient with pleural effusion secondary to pneumonia.

Methods

This study employed a case report design following the CARE (CAse REport) guidelines to ensure completeness and transparency in reporting clinical information and intervention processes.[16] The report describes the clinical presentation, physiotherapy management, and outcomes of a patient with pleural effusion secondary to pneumonia who underwent a structured rehabilitation program.

The subject was a 77-year-old male diagnosed with left-sided pleural effusion due to pneumonia, admitted to Dungus General Hospital. The patient presented with progressive dyspnea and left-sided chest pain for approximately three weeks prior to hospitalization. He had a history of smoking but had ceased smoking five years earlier; however, he remained exposed to passive smoke at home. On admission, the patient was conscious, cooperative, and demonstrated good motivation to participate in rehabilitation. Written informed consent was obtained from the patient for participation and publication of this case report.

Clinical assessment was conducted comprehensively, including vital signs, respiratory examination, and functional evaluation. Baseline vital signs were within acceptable ranges, although respiratory rate was elevated (23 breaths/min), indicating respiratory distress. Physical examination revealed asymmetrical thoracic expansion with reduced movement on the left side, use of chest-dominant breathing, and a rapid, shallow breathing pattern. Percussion indicated dullness at the left sixth intercostal space, and auscultation revealed crackles, suggesting impaired ventilation.

Outcome measures were selected based on their clinical relevance and established validity. Dyspnea severity was assessed using the Borg Scale, a widely used tool with good reliability for evaluating perceived breathlessness during activity.[17] Functional capacity was measured using the modified Medical Research Council (mMRC) scale, which is validated for grading activity limitation due to dyspnea.[18] Thoracic expansion was measured using a tape measure at three anatomical levels (axillary, fourth intercostal space, and xiphoid process), a method commonly applied in respiratory physiotherapy assessment.[19] Pulmonary function was further evaluated using peak expiratory flow rate (PEFR) measured by a peak flow meter and inspiratory capacity measured using incentive spirometry (Voldyne), both of which are standard tools in respiratory rehabilitation.[15] The observed reduction in Borg Scale score by three points exceeds the minimal clinically important difference (MCID) commonly reported for dyspnea scales, indicating that the improvement is not only statistically observable but also clinically meaningful.

Additional diagnostic investigations included chest radiography and laboratory examination. Chest X-ray confirmed left-sided pleural effusion extending to the eighth intercostal space. Laboratory findings were generally within normal limits, except for elevated liver enzymes (SGOT/SGPT), which required cautious monitoring during exercise prescription. In addition to the confirmed diagnosis of pleural effusion secondary to pneumonia, differential diagnoses such as congestive heart failure-related pleural effusion and malignancy-associated pleural effusion were considered. However, these were deemed less likely based on clinical presentation, radiographic findings, and laboratory results, which were more consistent with an infectious etiology. It should be noted that diagnostic assessment in this case was limited by the absence of advanced imaging or pleural fluid analysis, which may introduce potential diagnostic bias. However, the diagnosis was supported by clinical and radiographic findings consistent with pneumonia-related pleural effusion.

The physiotherapy intervention consisted of a structured program combining breathing exercises and functional training. The core components included deep breathing exercise, thoracic expansion exercise, pursed-lip breathing, early mobilization, and gait training. The program was administered three times per week for two weeks (total six sessions), with each session lasting approximately 30 minutes. Exercise dosage followed the FITT (frequency, intensity, time, and type) principle and was adjusted according to patient tolerance.

Deep breathing exercise was performed by instructing the patient to inhale slowly through the nose, hold the breath for 3–5 seconds, and exhale gradually through the mouth. Thoracic expansion exercise incorporated coordinated deep inspiration with active upper limb movement to facilitate chest wall mobility. Pursed-lip breathing was used to improve expiratory control and reduce air trapping. Functional training included bed mobility, sitting balance, transfer training, and low-intensity gait training to improve endurance and prevent deconditioning.

Adherence to the intervention was monitored during each supervised session, and the patient demonstrated good compliance without any reported adverse events. No modifications to the intervention protocol were required during the treatment period, as the patient tolerated the program well. To enhance clarity regarding the sequence of intervention and assessment, the timeline of the physiotherapy program is presented in Table 1.

Table 1. Timeline of Intervention and Outcome Evaluation

Phase	Session	Description
Baseline	Session 1	Initial assessment (Borg Scale, mMRC, thoracic expansion, PEFR, incentive spirometry)
Intervention	Sessions 2–3	Ongoing physiotherapy intervention with interim outcome evaluation
Follow-up	Sessions 4–6	Continued intervention and final outcome evaluation

The intervention timeline demonstrates a structured progression consisting of baseline assessment, interim monitoring, and final evaluation. Initial measurements were obtained prior to the commencement of physiotherapy to establish baseline clinical status. Subsequent sessions incorporated both intervention delivery and periodic reassessment to monitor patient response. Final evaluation was conducted after completion of six sessions to determine overall changes in respiratory function and functional capacity. The clinical course of the case can be summarized as follows: initial presentation with dyspnea and reduced thoracic expansion, followed by diagnostic confirmation of pleural effusion due to pneumonia, implementation of a structured physiotherapy program, and progressive improvement in respiratory and functional outcomes over six sessions.

All data were analyzed descriptively, as appropriate for a case report design. Changes in outcomes were reported as absolute values and percentage improvements to enhance clinical interpretability. No inferential statistical analysis was performed.Ethical approval was not required for this case report according to local regulations. Written informed consent was obtained from the patient for publication of this report.

Results

Outcomes are presented across three domains: subjective (dyspnea), functional (mMRC), and objective (thoracic expansion and pulmonary function). The results are presented in alignment with the study objectives, focusing on changes in dyspnea severity, functional capacity, thoracic expansion, and pulmonary function following the physiotherapy intervention. Outcomes are reported descriptively across baseline and follow-up assessments. To provide a clear overview of clinical changes, a summary of key outcomes before and after the intervention is presented in Table 2.

Table 2. Summary of Clinical Outcomes Before and After Intervention

Outcome Measure	Baseline	Final Evaluation	Absolute Change	Percentage Change
Borg Scale	5	2	-3	-60%
mMRC	2	1	-1	-50%
Thoracic Expansion (cm)	2	3	+1	+50%
PEFR (L/min)	180	250–260	+70–80	+39–44%
Inspiratory Capacity (mL)	275	1250	+975	+354%

As shown in Table 1, all measured parameters demonstrated improvement following six physiotherapy sessions. Dyspnea severity, assessed using the Borg Scale, decreased from a score of 5 at baseline to 2 at the final evaluation. Functional capacity, measured using the mMRC scale, improved from grade 2 to grade 1. Thoracic expansion measurements demonstrated consistent improvement across all anatomical landmarks (axillary, fourth intercostal space, and xiphoid level), with an increase from 2 cm at baseline to 3 cm at follow-up.

Pulmonary function outcomes showed progressive changes over the intervention period. To illustrate temporal trends, the progression of peak expiratory flow rate (PEFR) and inspiratory capacity is described below. At baseline (Session 1), PEFR was recorded at 180 L/min. During Session 2, pre-intervention values increased to 200 L/min, with post-intervention values reaching 260 L/min. In Session 3, pre-intervention values remained at 200 L/min, while post-intervention values reached 250 L/min. Similarly, inspiratory capacity measured using incentive spirometry showed a marked increase. At baseline, inspiratory capacity was 275 mL. By Session 2, values increased to 1250 mL and remained stable at this level during Session 3. To provide a clearer description of clinical progression during the intervention period, the changes observed across sessions are summarized in Table 3.

Table 3. Clinical Progression Across Intervention Sessions

Phase	Session	Description
Baseline	Session 1	Initial assessment of all outcome measures
Early Response	Session 2	Initial improvement observed in PEFR and inspiratory capacity
Progression	Session 3	Continued improvement with stabilization of inspiratory capacity
Maintenance	Sessions 4–6	Sustained clinical condition with no adverse events reported

The clinical progression demonstrates a gradual improvement following the initiation of physiotherapy intervention. Early changes were observed in pulmonary function parameters, particularly peak expiratory flow rate and inspiratory capacity, during the initial sessions. These improvements were subsequently maintained and stabilized in later sessions, with no adverse events reported throughout the intervention period.

No adverse events or complications were observed throughout the intervention period. The patient demonstrated good adherence to the physiotherapy program and was able to complete all prescribed sessions. Overall, the results indicate consistent improvement across subjective (dyspnea), functional (mMRC), and objective (thoracic expansion, PEFR, inspiratory capacity) outcome measures following the physiotherapy intervention.

Discussion

This case report demonstrates that a structured physiotherapy program incorporating deep breathing exercise, thoracic expansion exercise, and functional training was associated with improvements in dyspnea severity, thoracic expansion, and functional capacity in a patient with pleural effusion secondary to pneumonia. These findings are consistent with the established role of respiratory physiotherapy in optimizing ventilation and reducing respiratory symptoms in patients with pulmonary impairment.[9,11]

From a clinical reasoning perspective, the selection of physiotherapy interventions was based on the patient's primary impairments, including reduced thoracic expansion, ineffective breathing pattern, and decreased functional capacity. Deep breathing exercise was prioritized to enhance alveolar recruitment and inspiratory capacity, while thoracic expansion exercise was selected to address chest wall stiffness and asymmetry.[9,11,12] Functional training and early mobilization were incorporated to prevent deconditioning and improve overall activity tolerance. This individualized approach reflects a problem-oriented physiotherapy strategy tailored to the patient's clinical presentation.

The observed reduction in dyspnea, as indicated by the decrease in Borg Scale score from 5 to 2, may be explained by improved ventilatory efficiency and reduced work of breathing. Deep breathing exercises facilitate alveolar recruitment by promoting maximal inspiratory effort, thereby enhancing gas exchange and reducing the sensation of breathlessness.[9,11,12] In addition, thoracic expansion exercises contribute to improved chest wall mobility and synchronization of respiratory muscle activity, which further enhances ventilation distribution.[20] Compared with previous studies that reported similar improvements in dyspnea following breathing exercises, the magnitude of change in this case (60% reduction) appears clinically meaningful, although direct comparison is limited by differences in study design and patient characteristics.[12,17]

Improvements in functional capacity, reflected by the reduction in mMRC grade from 2 to 1, suggest enhanced tolerance to physical activity. This outcome is likely influenced not only by respiratory interventions but also by the inclusion of early mobilization and gait training.[9,12] In this case, the integration of functional training may have accelerated recovery by addressing both respiratory and systemic factors contributing to activity limitation.

The increase in thoracic expansion from 2 cm to 3 cm across all measurement points indicates improved chest wall compliance and respiratory mechanics. In pleural effusion, fluid accumulation restricts lung expansion and alters the biomechanics of the thoracic cage.[3,10] Thoracic expansion exercises likely mitigated these effects by enhancing rib cage mobility and facilitating re-expansion of compressed lung tissue. This finding aligns with previous reports demonstrating that targeted chest mobility exercises can significantly improve thoracic excursion in patients with respiratory disorders.[19]

Objective improvements in pulmonary function, as evidenced by increased peak expiratory flow rate (PEFR) and inspiratory capacity, further support the effectiveness of the intervention. The increase in PEFR suggests reduced airway resistance and

improved expiratory flow dynamics, while the substantial improvement in inspiratory capacity reflects enhanced lung expansion and alveolar ventilation.[5] [6,9,11,12]These changes are consistent with the physiological mechanisms underlying breathing exercises, which include increased tidal volume, improved diaphragmatic function, and more effective alveolar recruitment.[12] Notably, although the values did not reach normal reference ranges, the observed improvements indicate meaningful functional recovery within a relatively short intervention period.

A key strength of this report lies in its detailed clinical documentation, including comprehensive assessment and sequential outcome measurement. Unlike larger studies that often provide aggregated data, this case highlights individualized patient response and clinical reasoning in physiotherapy management. This is particularly important given the limited availability of detailed case-based evidence focusing specifically on pleural effusion secondary to pneumonia.[14] The present findings contribute to filling this gap by demonstrating the potential benefits of a structured, multi-component physiotherapy approach in this population.

From a clinical perspective, the results suggest that early implementation of respiratory physiotherapy, combined with functional training, may play a critical role in improving patient outcomes.[9,11] These interventions are relatively simple, cost-effective, and feasible to implement in various clinical settings, including general hospitals with limited resources. However, clinicians should consider patient-specific factors such as severity of effusion, comorbidities, and tolerance to exercise when designing rehabilitation programs.

Despite these positive findings, several limitations must be acknowledged. First, as a single case report, the results cannot be generalized to a broader population. Individual variability in disease severity, comorbid conditions, and response to intervention may influence outcomes. Second, the absence of a control condition limits the ability to attribute improvements solely to the physiotherapy intervention, as spontaneous recovery or medical treatment may also have contributed. Third, the short duration of follow-up does not allow assessment of long-term outcomes or sustainability of improvements.

Future research should focus on larger-scale studies, including randomized controlled trials, to evaluate the effectiveness of specific physiotherapy interventions in patients with pleural effusion. Additionally, further investigation into optimal exercise dosage, timing of intervention, and long-term functional outcomes would provide valuable guidance for clinical practice. Overall, this case report highlights the potential role of physiotherapy in improving respiratory and functional outcomes in patients with pleural effusion due to pneumonia, while also emphasizing the need for further high-quality evidence to support clinical decision-making.

Conclusion

This case report demonstrates that a structured physiotherapy program, including deep breathing exercise, thoracic expansion exercise, and functional training, was associated with reduced dyspnea, improved thoracic expansion, and enhanced functional capacity in a patient with pleural effusion secondary to pneumonia. These findings suggest that early and targeted physiotherapy may serve as a practical and supportive intervention in the clinical management of respiratory impairment due to pleural effusion. However, given the single-case design, these results should be interpreted cautiously and cannot be generalized. Future studies with larger samples and controlled designs are recommended to confirm the effectiveness, determine optimal intervention protocols, and evaluate long-term outcomes. Clinically, this case highlights the importance of early, structured physiotherapy intervention in improving respiratory outcomes in patients with pleural effusion.

Author Contribution

Fahra Fadhilla: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing original draft.
Isnaini Herawati: Conceptualization, Methodology, Supervision, Validation, Writing review and editing.
Mulatsih Nita Utami: Data curation, Investigation, Validation, Writing review and editing.

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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 according to local regulations. Written informed consent was obtained from the patient for publication of this report.

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