

Progressive Physiotherapy for Respiratory Function and Early Mobilization in ICU Pneumonia: A Case Report

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Abstract

Background: Pneumonia in critically ill patients admitted to the intensive care unit (ICU) is commonly associated with impaired ventilation, secretion retention, and an increased risk of respiratory complications. Respiratory physiotherapy has been widely applied as a supportive intervention to enhance airway clearance and optimize ventilation.

Objective: This study aimed to evaluate respiratory outcomes and early mobilization in a patient with pneumonia receiving progressive physiotherapy from the ICU to the inpatient ward.

Methods: A single-patient case report was conducted in a 19-year-old male diagnosed with corrected metabolic acidosis, acute kidney injury, and pneumonia. The patient received six physiotherapy sessions, including three sessions in the ICU and three sessions in the inpatient ward. Interventions consisted of chest physiotherapy, thoracic mobilization, effective coughing exercises, passive to active-assisted range of motion (PROM–AAROM), infrared therapy, and positioning education. Outcome measures included vital signs, Modified Borg Scale (mBorg), thoracic expansion, capillary refill time, and ICU Mobility Scale (IMS).

Results: Respiratory rate decreased from 45 to 18 breaths per minute, accompanied by a reduction in dyspnea (mBorg score from 5 to 2). Thoracic expansion improved from 1 cm to 3 cm, while functional mobility increased (IMS score from 0 to 1). Hemodynamic parameters remained stable throughout the intervention period.

Conclusion: Progressive physiotherapy was associated with improvements in respiratory function and early mobilization in a patient with pneumonia and may be considered a supportive component in multidisciplinary management.

Keywords

pneumonia; intensive care units; respiratory therapy; physical therapy modalities

Introduction

Pneumonia is an acute infection of the lower respiratory tract involving the alveoli and pulmonary interstitial tissue. The inflammatory process leads to the accumulation of exudate within the alveolar spaces, thereby impairing gas exchange and resulting in ventilation–perfusion mismatch and hypoxemia.¹ Globally, pneumonia remains a major cause of morbidity and mortality, contributing substantially to the burden of respiratory diseases across all age groups.²

In patients with severe pneumonia requiring admission to the intensive care unit (ICU), the clinical condition is often exacerbated by decreased levels of consciousness, impaired cough reflex, and secretion retention, all of which contribute to compromised ventilation and increased risk of respiratory complications.³ In addition, prolonged immobilization during ICU stay accelerates functional decline, leading to reduced muscle strength, decreased functional capacity, and a higher risk of intensive care unit-acquired weakness.³

A decreased level of consciousness further compromises airway protection mechanisms, including cough reflex and swallowing coordination. This impairment increases the likelihood of aspiration and sputum retention, ultimately reducing the effectiveness of airway clearance mechanisms. As a consequence, ventilation–perfusion mismatch may worsen, respiratory workload increases, and respiratory insufficiency may develop or deteriorate.³ These pathophysiological changes highlight the importance of comprehensive management strategies beyond pharmacological treatment alone.

The management of pneumonia requires a multidisciplinary approach that integrates pharmacological therapy, medical support, and non-pharmacological interventions aimed at optimizing respiratory function and maintaining airway patency. In this context, respiratory physiotherapy including airway clearance techniques, chest physiotherapy, and thoracic expansion exercises has been widely implemented to improve alveolar ventilation, facilitate secretion mobilization, and enhance oxygenation.^{4,5} Furthermore, early mobilization has been shown to play a critical role in preserving functional capacity, preventing deconditioning, and supporting overall recovery in critically ill patients.^{4,5}

Despite the recognized supportive role of respiratory physiotherapy, current evidence regarding its effectiveness in patients with pneumonia, particularly in critical care settings, remains inconclusive. A recent Cochrane systematic review reported that the overall certainty of evidence for chest physiotherapy in adult pneumonia is low to very low, especially for major clinical outcomes such as mortality and length of hospital stay.⁶ However, some interventions have demonstrated potential benefits in improving specific clinical parameters, such as dyspnea, secretion clearance, and functional status, although further high-quality studies are required.⁶

Moreover, most existing studies evaluate isolated interventions or short-term outcomes, with limited evidence examining the role of progressive and continuous physiotherapy interventions spanning the transition from ICU care to inpatient rehabilitation. This transition phase is clinically important, as patients often experience rapid physiological and functional changes that require tailored and progressive rehabilitation strategies. Therefore, this case report aimed to evaluate the clinical outcomes of progressive

physiotherapy as a supportive intervention on respiratory function and early functional mobility in a patient with pneumonia undergoing critical care and subsequent inpatient management.

Methods

This study employed a single-patient case report design developed in accordance with the CARE (CAse REport) guidelines to ensure completeness, transparency, and clinical relevance in reporting. The case was conducted at Udayana University Hospital, Indonesia, between February 2 and February 9, 2026, involving a 19-year-old male patient diagnosed with corrected metabolic acidosis, acute kidney injury (AKI), and pneumonia.

Ethical approval was not required, as this report describes routine clinical physiotherapy management without experimental intervention. All procedures adhered to the ethical principles outlined in the Declaration of Helsinki. Written informed consent for publication was obtained from the patient's family prior to the initiation of physiotherapy. Patient confidentiality was maintained through full anonymization of all identifiable data.

The patient was initially admitted to the emergency department on January 26, 2026, presenting with decreased consciousness. According to the accompanying history, the patient experienced malaise earlier that day but remained communicative. Following initial management, the patient was transferred to the intensive care unit (ICU) with diagnoses of corrected metabolic acidosis, acute kidney injury, corrected hyperkalemia, decreased consciousness, and diabetic ketoacidosis. Radiological examination confirmed the presence of pneumonia, while additional imaging suggested metabolic encephalopathy with cerebral edema. Clinical severity was assessed using the CURB(S)-65 scoring system, which includes confusion, blood urea level, respiratory rate, blood pressure, age, and oxygen saturation. The patient scored 3, indicating high risk, although oxygen saturation remained within normal limits (SpO₂ 97%).

The clinical course of the patient is summarized as follows: initial admission to the emergency department (January 26, 2026), ICU hospitalization (January 27 to February 4, 2026), initiation of physiotherapy in the ICU (February 2–4, 2026), transfer to the inpatient ward (February 5, 2026), and continuation of physiotherapy sessions in the inpatient setting (February 5, 6, and 9, 2026). This timeline provides a structured overview of disease progression and intervention phases, which can be converted into a visual flowchart if required.

Baseline clinical assessment was performed prior to the first physiotherapy session to establish reference values for subsequent evaluation. The assessment included vital signs (blood pressure, heart rate, respiratory rate, temperature, and oxygen saturation), level of consciousness using the Glasgow Coma Scale (GCS), and physical examination findings through inspection, palpation, percussion, and auscultation. Additional outcome measures included dyspnea, thoracic expansion, capillary refill time (CRT), and functional mobility.

Dyspnea was assessed using the Modified Borg Scale (mBorg), a 0–10 numerical scale with established reliability in patients with acute respiratory conditions (intraclass correlation coefficient [ICC] 0.81–0.97). Thoracic expansion was measured using a measuring tape at three anatomical landmarks (axillary level, fourth intercostal space, and xiphoid process) during maximal inspiration and expiration. This method has demonstrated high intra-rater reliability (ICC >0.90) and acceptable inter-rater reliability (ICC >0.78). Functional mobility was evaluated using the ICU Mobility Scale (IMS), which has excellent inter-rater reliability ($\kappa = 0.99$) in critically ill populations. However, not all measurements could be performed during the early ICU phase due to medical equipment constraints and the patient's clinical instability. Available data were nevertheless used as baseline references for monitoring progress.

Physiotherapy intervention was initiated on February 2, 2026, during ICU admission and continued across six sessions, consisting of three sessions in the ICU and three sessions in the inpatient ward. All interventions were delivered by a team of four physiotherapists under the supervision of two senior physiotherapists. The intervention program was individualized based on the patient's clinical condition and tolerance, with progressive adjustments across sessions.

The physiotherapy program included chest physiotherapy techniques such as percussion and vibration to facilitate secretion mobilization; thoracic mobilization exercises to improve chest wall expansion and ventilation; passive range of motion (PROM) exercises to prevent joint stiffness and ICU-acquired weakness; positioning strategies to optimize ventilation–perfusion matching and prevent complications associated with prolonged immobilization; and effective coughing techniques (including huffing and double cough) to enhance sputum clearance. From the fifth session onward, the intervention was progressed to include active-assisted range of motion (AAROM) combined with breathing control exercises to improve functional capacity and promote early mobilization.

Infrared therapy was applied as an adjunct modality for superficial muscle relaxation and local circulation enhancement, with a duration of 10–15 minutes per session at a distance of 40–60 cm. Its use was supportive rather than primary, considering the limited evidence in critically ill populations. All interventions were performed within patient tolerance, with continuous monitoring of vital signs to ensure safety and clinical stability.

Outcome evaluation was conducted after each physiotherapy session. Vital signs were recorded immediately post-intervention, followed by a rest period before additional physical assessments were performed. Thoracic expansion measurements were initiated on the fourth day when the patient's condition allowed for more accurate assessment. Changes in dyspnea, respiratory parameters, thoracic mobility, and functional status were documented across all six sessions.

Data analysis was performed descriptively by comparing baseline and post-intervention values across sessions. Trends in clinical parameters, including respiratory rate, dyspnea score, thoracic expansion, and functional mobility, were analyzed to evaluate the patient's response to progressive physiotherapy. Given the single-case design, no inferential statistical analysis was conducted.

Results

The results of this case report are presented to illustrate changes in respiratory function and early functional mobility following progressive physiotherapy from the ICU to the inpatient setting. Outcome evaluation was conducted after each intervention session, with particular emphasis on respiratory parameters, perceived dyspnea, thoracic expansion, and functional mobility. To provide a comprehensive overview of the patient's clinical progression, vital signs and key clinical parameters were recorded across all six physiotherapy sessions. The summarized results are presented in Table 1.

Table 1. Changes in Vital Signs and Clinical Parameters Across Physiotherapy Sessions

Parameter	T1	T2	T3	T4	T5	T6
Blood Pressure (mmHg)	127/99	136/88	130/84	138/89	130/70	113/74
Heart Rate (beats/min)	86	78	78	88	72	89
Respiratory Rate (breaths/min)	28	26	20	18	18	18
Temperature (°C)	36.5	36.5	36.5	36.0	36.0	36.0
Oxygen Saturation (%)	97	97	98	98	100	100
Level of Consciousness (GCS)	E4V1M5	E4V1M5	E4V1M5	E4V1M6	E4V1M6	E4V1M6

As shown in Table 1, the patient demonstrated a progressive improvement in respiratory rate, which decreased from 28 breaths per minute at the first session (post-intervention) to 18 breaths per minute by the fourth session and remained stable thereafter. Oxygen saturation showed a gradual increase, reaching 100% from the fifth session onward, while hemodynamic parameters remained within stable ranges throughout the intervention period. Improvement in the level of consciousness was also observed, particularly from the fourth session, indicated by an increase in the motor response component of the GCS. In addition to physiological parameters, changes in perceived dyspnea, thoracic expansion, and functional mobility were evaluated to assess the functional impact of the intervention. These outcomes are summarized in Table 2.

Table 2. Changes in Dyspnea, Thoracic Expansion, and Functional Mobility

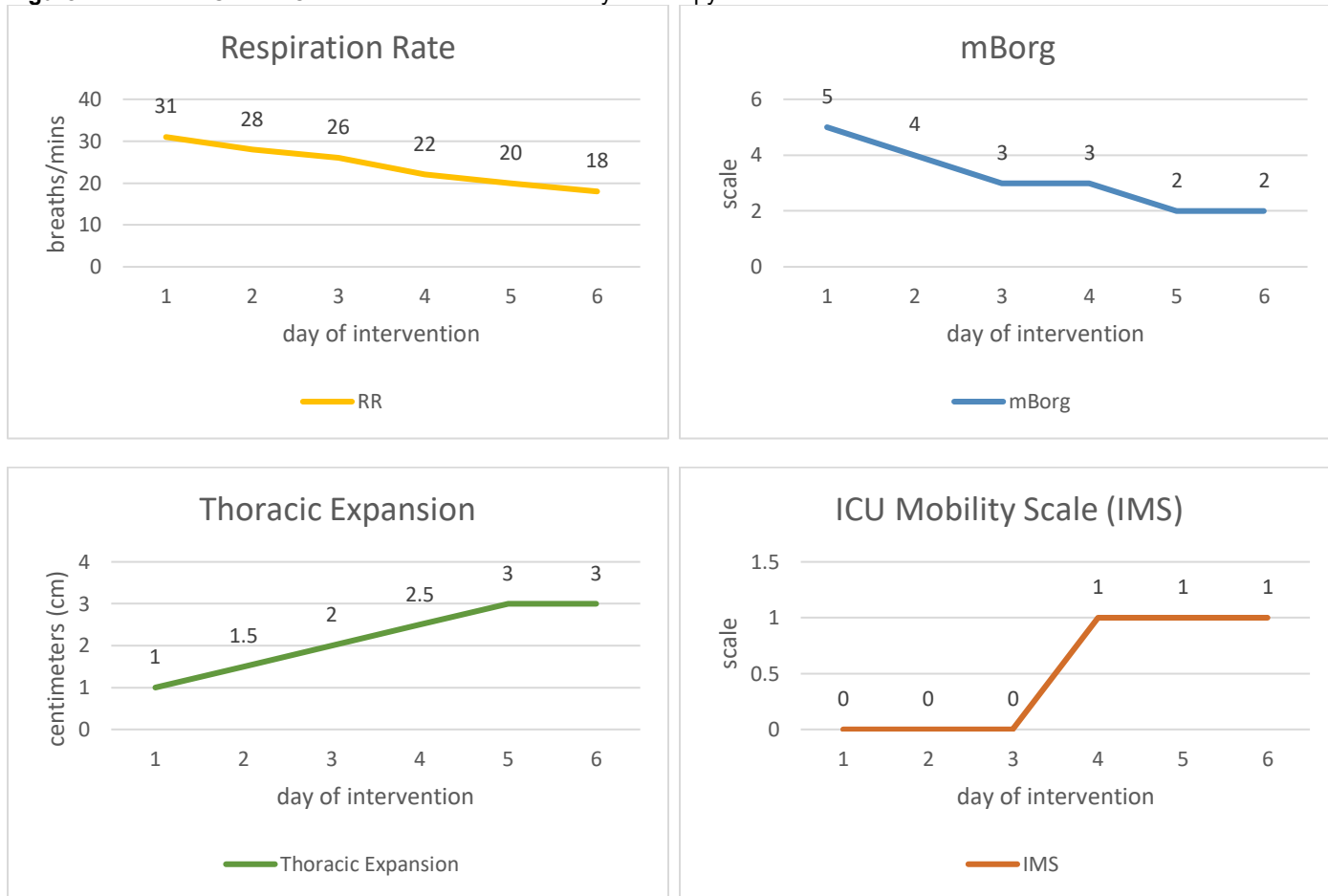
Parameter	T1	T2	T3	T4	T5	T6
mBorg Dyspnea Score	5	4	3	2	2	2
Thoracic Expansion – Axilla (cm)	NT	NT	NT	1.0	2.0	2.8
Thoracic Expansion – ICS 4 (cm)	NT	NT	NT	1.2	2.0	3.0
Thoracic Expansion – Xiphoid (cm)	NT	NT	NT	1.0	2.0	3.0
ICU Mobility Scale (IMS)	0	0	0	0	1	1

As presented in Table 2, perceived dyspnea decreased consistently across sessions, with the mBorg score declining from 5 at baseline to 2 by the fourth session and remaining stable thereafter. Thoracic expansion measurements, which were initiated during the inpatient phase due to earlier clinical limitations, showed progressive improvement across all anatomical landmarks, with the most notable increase observed at the xiphoid level (from 1 cm to 3 cm).

To complement the tabulated findings and provide a clearer visualization of the patient’s clinical progression, the trends in key outcome measures across physiotherapy sessions are illustrated in Figure 2. This figure presents the trajectory of respiratory rate, perceived dyspnea (mBorg), thoracic expansion, and functional mobility (ICU Mobility Scale) over time, allowing for a more intuitive interpretation of changes across intervention sessions.

Figure 2 demonstrates a consistent downward trend in respiratory rate and dyspnea scores, alongside a gradual increase in thoracic expansion and functional mobility. The graphical representation highlights the temporal pattern of improvement, particularly the stabilization of respiratory parameters from the fourth session onward and the delayed but observable initiation of functional mobility in the later sessions.

Figure 2. Trends in Clinical Outcome Measures Across Physiotherapy Sessions



Functional mobility, as assessed by the ICU Mobility Scale (IMS), remained at level 0 during the ICU phase, indicating complete dependence. A transition to level 1 was observed in the fifth session and maintained in the final session, reflecting the patient's ability to initiate minimal movement in bed.

To further contextualize these findings, the clinical trajectory of the patient from admission to completion of physiotherapy is summarized as follows: initial ICU admission with severe respiratory compromise and decreased consciousness; gradual stabilization of respiratory and hemodynamic parameters during early physiotherapy sessions; transition to the inpatient ward with improved clinical status; and subsequent enhancement of thoracic mobility and early functional activity during later sessions. This progression reflects a consistent pattern of clinical improvement aligned with the staged physiotherapy intervention.

Overall, the results demonstrate a coherent trend of improvement in respiratory function, reduction in dyspnea, enhancement of thoracic expansion, and initiation of early functional mobility, without evidence of hemodynamic instability throughout the intervention period.

Discussion

This case report demonstrates that progressive physiotherapy administered across the ICU and inpatient phases was associated with consistent improvements in respiratory function and early functional mobility in a patient with pneumonia. The observed clinical trajectory, characterized by reductions in respiratory rate and dyspnea alongside improvements in thoracic expansion and mobility, reflects a pattern of recovery that is physiologically plausible and aligned with the intended mechanisms of the applied interventions.

From a pathophysiological perspective, the initial presentation of tachypnea, ineffective cough, and abnormal breath sounds is consistent with the inflammatory processes underlying pneumonia, in which alveolar exudate accumulation disrupts gas exchange and leads to ventilation-perfusion mismatch.¹ The subsequent reduction in respiratory rate across sessions may be interpreted as an indirect indicator of improved ventilatory efficiency and decreased work of breathing.⁷ This improvement is likely attributable, at least in part, to enhanced airway clearance and more effective alveolar ventilation following the application of chest physiotherapy techniques.⁶ By facilitating the mobilization of secretions from peripheral to central airways, these techniques may reduce airway obstruction and improve ventilation distribution, thereby diminishing the physiological drive for compensatory tachypnea.⁸

The progressive reduction in perceived dyspnea, as measured by the Modified Borg Scale, further supports this interpretation. Dyspnea is a multidimensional symptom influenced by respiratory mechanics, gas exchange abnormalities, and neural perception of respiratory effort.¹ In the present case, the decrease in dyspnea scores suggests an improvement in the balance between ventilatory demand and capacity. Interventions such as breathing exercises and thoracic expansion techniques may contribute to this effect by optimizing lung inflation, improving respiratory muscle coordination, and enhancing overall ventilatory efficiency.⁶ These findings are consistent with previous reports indicating that respiratory physiotherapy can alleviate dyspnea and improve patient comfort in individuals with pneumonia and other acute respiratory conditions.⁹

Improvements in thoracic expansion observed during the later sessions provide additional evidence of enhanced chest wall mobility and ventilatory mechanics. In patients with pneumonia, reduced lung compliance and pain-related breathing restriction often limit chest wall excursion, particularly in the acute phase.¹⁰ The gradual increase in thoracic expansion in this case likely reflects both mechanical and functional recovery, supported by repeated thoracic mobilization and breathing control exercises. These interventions may facilitate re-expansion of previously under-ventilated alveolar regions, improve costovertebral joint mobility, and reduce stiffness associated with prolonged immobilization.⁶ Although the final thoracic expansion values did not reach those typically observed in healthy individuals, the magnitude of improvement remains clinically meaningful within the context of acute illness.¹¹

The initiation of early functional mobility, as indicated by changes in the ICU Mobility Scale (IMS), represents another important finding. While the increase from IMS level 0 to 1 may appear modest, it signifies a critical transition from complete immobility to the ability to initiate minimal movement.¹² This early phase of mobilization is particularly relevant in critically ill patients, as prolonged immobility is strongly associated with the development of ICU-acquired weakness and subsequent functional decline.¹³ The timing of this improvement, which coincided with stabilization of physiological parameters and recovery of consciousness, underscores the importance of integrating physiotherapy interventions with the patient's overall clinical status.¹⁴

The role of early mobilization in ICU settings has been well documented, particularly in its capacity to preserve muscle strength, enhance pulmonary function, and reduce complications associated with prolonged bed rest.¹⁵ In the present case, the progressive introduction of active-assisted exercises and breathing control during the later sessions likely contributed to both respiratory and functional improvements. This finding aligns with emerging evidence suggesting that combined respiratory and mobilization interventions may yield synergistic benefits in critically ill populations.⁴

However, the interpretation of these findings must be situated within the broader context of current evidence. A Cochrane systematic review reported that the overall certainty of evidence supporting chest physiotherapy in adult pneumonia remains low to very low, particularly for major outcomes such as mortality and length of hospital stay.⁶ This highlights an important distinction between physiological improvements observed at the individual level and the broader evidence base required to support generalized clinical recommendations.¹⁶ In this case, the observed improvements should therefore be interpreted as clinically relevant but not definitive evidence of efficacy.

It is also important to acknowledge that the improvements observed in this patient cannot be attributed solely to physiotherapy interventions.¹⁷ The patient received comprehensive medical management, including treatment for metabolic acidosis, acute kidney injury, and other systemic conditions, all of which likely contributed to overall recovery. The multifactorial nature of clinical improvement in critically ill patients necessitates cautious interpretation of causality, particularly in single-case designs.¹⁷

The inclusion of infrared therapy as an adjunct modality in this case warrants specific consideration. While infrared radiation is commonly used for its thermal and circulatory effects in musculoskeletal conditions, its role in respiratory rehabilitation, particularly in ICU populations, remains unclear.¹⁸ Given the limited evidence supporting its use in this context, it is unlikely that infrared therapy played a primary role in the observed improvements. Instead, it should be regarded as a supplementary intervention with non-specific effects.

This case report has several strengths, including the implementation of a progressive, phase-based physiotherapy program that spans the transition from ICU care to inpatient rehabilitation. The use of standardized outcome measures, such as the mBorg scale and IMS, enhances the reliability of the findings and facilitates comparison with existing literature. Additionally, the detailed documentation of clinical progression provides valuable insights into the practical application of physiotherapy in a critical care setting.

Nevertheless, several limitations must be acknowledged. As a single-case report, the findings are inherently limited in terms of generalizability. The absence of objective pulmonary function measurements, such as arterial blood gas analysis or spirometry,

restricts the ability to quantify physiological improvements more precisely. Furthermore, the inability to perform certain assessments during the early ICU phase resulted in incomplete baseline data for some outcomes. Future research should focus on larger, controlled studies to better elucidate the role of progressive physiotherapy in patients with pneumonia, particularly during the critical transition from ICU to inpatient care.

Conclusion

This case report demonstrated that progressive physiotherapy administered across the ICU and inpatient phases was associated with improvements in respiratory function and early functional mobility in a patient with pneumonia. The intervention was accompanied by reductions in respiratory rate and perceived dyspnea, increased thoracic expansion, and the initiation of minimal functional activity, while maintaining hemodynamic stability.

These findings support the role of progressive physiotherapy as a supportive component within multidisciplinary management, particularly in facilitating the transition from critical care to inpatient rehabilitation. Clinically, the implementation of structured and individualized physiotherapy programs may contribute to optimizing respiratory recovery and preventing complications related to immobilization in critically ill patients.

However, given the inherent limitations of a single-case design, these results should be interpreted with caution. Further research involving larger samples and controlled study designs is required to establish the effectiveness and generalizability of progressive physiotherapy interventions in patients with pneumonia.

Author Contribution

Tjokorda Istri Agung Rosanthi Pradnyani: Conceptualization, investigation, data curation, formal analysis, writing-original draft preparation.

Ni Ketut Cintya Dewi: Literature review, methodology, data interpretation, writing-review and editing.

Alfioni Angleque George Putri: Data collection, visualization, manuscript drafting, and validation.

Ni Ketut Evitri Widhiantari: Investigation, data management, and manuscript editing.

I Gede Eka Juli Prasana: Supervision, methodology, scientific review, and validation.

Ariezta Jeviana: Clinical supervision, patient management, and resources.

Dewa Ayu Kadek Ari Purnama Dewi: Clinical validation, manuscript review, and final approval of the manuscript.

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Conflict of Interest Statement

The authors declare no conflict of interest.

Funding Sources

This study received no external funding.

Ethics Statement

This case report was conducted in accordance with the Declaration of Helsinki. Ethical approval was not required as the study involved a retrospective description of routine clinical care without experimental intervention. Written informed consent for publication was obtained from the patient's legal guardian. All patient data were anonymized to ensure confidentiality.

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