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Effect of Combined Breathing Control, Pain Management, and Strengthening Exercises in Tuberculous Meningitis: A Case Report

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Abstract

Background: Tuberculous meningitis (TBM) is a severe form of extrapulmonary tuberculosis that often leads to long-term neurological and functional impairments. Physiotherapy plays a crucial role in optimizing respiratory function and improving functional capacity in patients with TBM sequelae.

Objective: This case report aimed to evaluate the potential effectiveness of combined breathing control, pain management exercise, and strengthening exercise in improving respiratory and functional outcomes in a patient with TBM.

Methods: A case report was conducted on a 22-year-old female patient undergoing physiotherapy in a medical rehabilitation setting. The intervention consisted of breathing control (pursed-lip breathing and deep breathing), pain management exercise (relaxation positioning, gentle stretching, and postural correction), and strengthening exercises (bridging, straight leg raise, and isometric quadriceps). The program was administered over three sessions. Outcomes included dyspnea (Modified Medical Research Council scale), pain (Numeric Rating Scale), thoracic expansion, respiratory rate, and muscle strength (Manual Muscle Testing).

Results: After three sessions, dyspnea decreased from mMRC grade 3 to 2, pain reduced from 5/10 to 3/10 (40% reduction), respiratory rate improved from 27 to 22 breaths/min, and muscle strength increased from 3/5 to 4/5. Thoracic expansion improved across all measurement points. No adverse events were reported.

Conclusion: This case suggests that a combination of breathing control, pain management, and strengthening exercises may be beneficial in improving respiratory function and functional capacity in patients with TBM. Further studies with larger samples are required.

Keywords
Tuberculous Meningitis; Physiotherapy; Breathing Exercises; Rehabilitation; Muscle Strength

Introduction

Tuberculosis (TB) remains a major global health challenge, particularly in developing countries. According to the World Health Organization, TB is among the leading causes of death worldwide, with a substantial burden in Southeast Asia, including Indonesia, which ranks among the highest in global incidence.[1] While pulmonary TB is the most common presentation, extrapulmonary tuberculosis contributes significantly to morbidity, with tuberculous meningitis (TBM) representing the most severe and life-threatening form.[2]

TBM is characterized by infection of the meninges by *Mycobacterium tuberculosis*, leading to inflammation of the central nervous system and subsequent neurological impairment.[3] Despite advances in anti-tuberculosis therapy, TBM continues to be associated with high mortality and long-term disability. Survivors frequently experience residual complications such as motor deficits, impaired coordination, cognitive dysfunction, and reduced functional independence, which significantly compromise quality of life.[2,3]

In addition to neurological impairment, patients with TBM often present with secondary complications affecting respiratory and musculoskeletal systems. Impaired respiratory mechanics, reduced thoracic expansion, and abnormal breathing patterns may occur due to prolonged immobilization, postural dysfunction, or associated pulmonary involvement.[4] Furthermore, musculoskeletal pain and muscle weakness, particularly in the lower extremities, are common consequences of central nervous system damage and prolonged inactivity, leading to further functional limitations.[5]

Rehabilitation plays a crucial role in addressing these multidimensional impairments. Physiotherapy interventions, including breathing control, pain management exercise, and strengthening exercise, have been widely used to improve respiratory efficiency, reduce pain, and enhance functional mobility.[4,6] Breathing control techniques such as pursed-lip breathing and deep breathing exercise are known to improve ventilation, reduce dyspnea, and optimize gas exchange.[6] Pain management strategies, including relaxation positioning, gentle stretching, and postural correction, help reduce musculoskeletal discomfort and improve biomechanical efficiency. Meanwhile, strengthening exercises contribute to improved muscle performance and functional independence, partly through mechanisms associated with neuroplasticity and motor relearning.[7,8]

However, despite the theoretical and clinical relevance of these interventions, current evidence on rehabilitation in TBM remains limited. Most available studies focus on pulmonary tuberculosis or general neurological rehabilitation, with very few reports specifically addressing TBM patients.[4,8] Moreover, there is a lack of case-based evidence examining the combined effect of respiratory and motor physiotherapy interventions in this population. This represents an important gap in the literature, particularly considering the complex and multifactorial impairments observed in TBM patients.

This case is important because it highlights the application of an integrated physiotherapy approach targeting both respiratory and motor dysfunctions in a patient with TBM sequelae, an area that remains underreported in current literature.
Therefore, this case report aims to evaluate the clinical outcomes of combined breathing control, pain management exercise, and strengthening exercise in improving respiratory function and functional capacity in a patient with tuberculous meningitis.

Methods

This study was conducted as a case report in accordance with the CARE (CAse REport) guidelines. A 22-year-old female patient with a history of tuberculous meningitis (TBM) diagnosed two years prior was referred to the medical rehabilitation unit of a pulmonary hospital for physiotherapy management. The patient was a university student whose daily and academic activities had been significantly limited due to progressive weakness in the lower extremities and reduced functional capacity. No identifiable personal data were disclosed, and the case was reported in an anonymized form.

At initial assessment, the patient was conscious, cooperative, and hemodynamically stable, with blood pressure of 120/80 mmHg, heart rate of 87 beats/min, respiratory rate of 27 breaths/min, and body temperature of 36.2°C. Postural assessment revealed lumbar lordosis with impaired gait characterized by dragging of the lower limbs, requiring assistance during ambulation. The patient demonstrated shallow and rapid breathing patterns with reduced thoracic expansion.

Palpation findings indicated tenderness in the lower back region extending to the gluteal area, accompanied by muscle spasm in the paravertebral muscles, including the erector spinae, multifidus, and quadratus lumborum. Pain intensity was reported as 5/10 during movement and 4/10 on palpation in the lower back, as well as 5/10 chest pain during respiration. Dyspnea was graded as 3 on the Modified Medical Research Council (mMRC) scale. Muscle strength in the lower extremities was graded 3/5 using Manual Muscle Testing (MMT). The clinical timeline of the intervention and patient outcomes is presented in Table 1.

Table 1. Timeline of Physiotherapy Intervention and Clinical Outcomes

Day		Intervention	Outcome
Day (T1)	1	Initial assessment; breathing control; pain management; strengthening exercises initiated	Dyspnea mMRC 3; respiratory rate 27 breaths/min; pain 5/10; muscle strength 3/5
Day (T2)	2	Continued intervention with monitoring and adjustment based on tolerance	Respiratory rate decreased to 25 breaths/min; pain began to decrease
Day (T3)	3	Continued intervention and final evaluation	Dyspnea improved to mMRC 2; respiratory rate 22 breaths/min; pain reduced to 3/10; muscle strength improved to 4/5

Based on clinical findings, the physiotherapy diagnosis included impaired ventilation pattern, reduced thoracic mobility, musculoskeletal pain, decreased lower limb muscle strength, and functional mobility limitation. Differential diagnoses such as peripheral neuropathy and primary musculoskeletal disorders were considered; however, the overall presentation was consistent with neurological sequelae of TBM. The prognosis was considered fair due to the chronic nature of the condition with potential for functional improvement.

The intervention program consisted of a combination of breathing control, pain management exercises, and strengthening exercises. Breathing control techniques included pursed-lip breathing and deep breathing exercises aimed at improving ventilatory efficiency and reducing dyspnea. Pain management interventions included relaxation positioning, gentle stretching, and postural correction to reduce musculoskeletal discomfort and improve biomechanical alignment. Strengthening exercises targeting the lower extremities included bridging, straight leg raise, and isometric quadriceps exercises.

Exercise prescription followed the FITT principle. Breathing exercises were performed once daily at low intensity for approximately 6 minutes. Pain management exercises were conducted once daily within a pain-free range for 10–15 minutes. Strengthening exercises were performed two to three times per week with an intensity of 8–10 repetitions per set, 2–3 sets per exercise, for a duration of 15–20 minutes. Exercise progression was adjusted based on patient tolerance, with progression from active-assisted to active movements. No modification of the intervention protocol was required due to adverse effects.

Outcome evaluation was conducted at three time points (T1, T2, and T3). Primary outcomes included dyspnea (mMRC), pain intensity (Numeric Rating Scale), and respiratory rate. Secondary outcomes included thoracic expansion and muscle strength (Manual Muscle Testing). Improvements were observed across all measured parameters following the intervention. No adverse events or complications were reported, indicating that the intervention was safe and well tolerated.

The measurement instruments used in this study have established validity and reliability. The Modified Medical Research Council (mMRC) scale is a validated tool widely used to assess dyspnea severity in clinical populations. The Numeric Rating Scale (NRS) has demonstrated high reliability and responsiveness for pain assessment. Manual Muscle Testing (MMT) is also considered a reliable clinical tool for evaluating muscle strength, particularly in neurological and rehabilitation settings.

Written informed consent was obtained from the patient for publication of this case report and accompanying anonymized data. This study was conducted in accordance with the Declaration of Helsinki. Ethical approval was waived according to institutional policy, as this report involved a single case without experimental intervention and no identifiable patient information.

Results

Outcome evaluation was conducted at three time points: baseline (T1), mid-intervention (T2), and post-intervention (T3). The assessed parameters included dyspnea (mMRC), respiratory rate, thoracic expansion, pain intensity (Numeric Rating Scale), and muscle strength (Manual Muscle Testing). Overall, improvements were observed across all measured outcomes following the intervention. Detailed changes are presented in the tables 1-3.

Table 1. Changes in Clinical Outcomes Across Sessions

Outcome	T1 (Baseline)	T2	T3	Absolute Change	Relative Change
Dyspnea (mMRC)	3	3	2	↓1	33% improvement
Respiratory Rate (breaths/min)	27	25	22	↓5	18.5% improvement
Muscle Strength (MMT)	3/5	3/5	4/5	↑1 grade	—

Table 2. Thoracic Expansion Measurements (cm)

Measurement Site	T1	T2	T3	Expansion Change
Axilla	1.5 cm	0.5 cm	1.3 cm	Fluctuating improvement
ICS 4–5	1.2 cm	1.5 cm	1.5 cm	↑0.3 cm
Xiphoid Process	1.0 cm	1.0 cm	2.0 cm	↑1.0 cm

Table 3. Pain Intensity (Numeric Rating Scale)

Location	Type	T1	T2	T3	Absolute Change
Chest	Movement	5/10	4/10	3/10	↓2
Chest	Palpation	1/10	1/10	0/10	↓1
Lower Back	Movement	5/10	4/10	4/10	↓1
Lower Back	Palpation	4/10	3/10	2/10	↓2

To further illustrate the progression of clinical outcomes across the intervention period, graphical representations of key variables are presented in Figure 1–3. Figure 1 demonstrates the trend in dyspnea (mMRC), Figure 2 illustrates changes in respiratory rate, and Figure 3 presents the reduction in pain intensity (NRS) across the three assessment time points (T1–T3). These visualizations complement the numerical data presented in the tables and provide a clearer depiction of the observed clinical improvements.

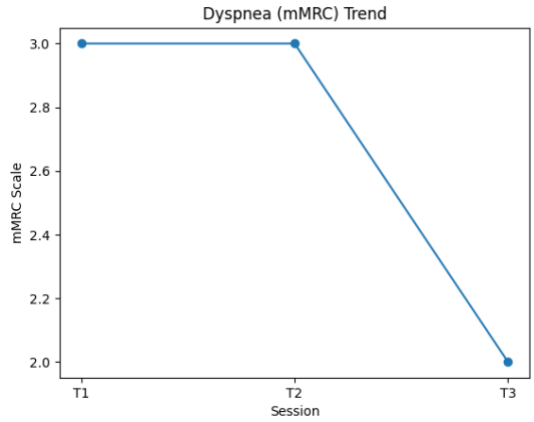

Figure 1. Trend of Dyspnea (mMRC) Across Sessions

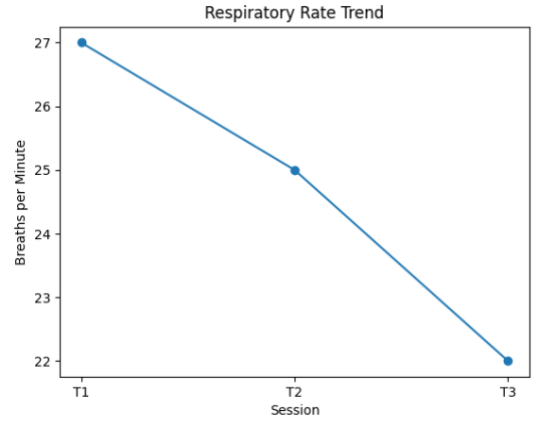

Figure 2. Trend of Respiratory Rate Across Sessions

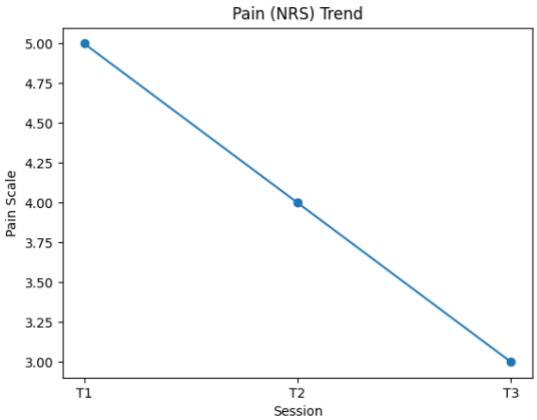

Figure 3. Trend of Pain (NRS) Across Sessions

Dyspnea improved from mMRC grade 3 at baseline to grade 2 at T3. Respiratory rate decreased progressively from 27 breaths/min at baseline to 22 breaths/min at the final evaluation. Muscle strength increased from grade 3/5 to 4/5. Thoracic expansion demonstrated measurable improvement at all anatomical landmarks, with the most notable increase observed at the xiphoid level (increase of 1.0 cm). Pain intensity decreased across all measured domains, particularly in chest movement pain and lower back palpation pain. No adverse events or complications were reported during the intervention period.

Discussion

This case report demonstrates that a combination of breathing control, pain management exercise, and strengthening exercise may contribute to improvements in respiratory function and functional capacity in a patient with tuberculous meningitis (TBM). The observed reductions in dyspnea, respiratory rate, and pain, along with improvements in thoracic expansion and muscle strength, indicate a positive clinical response following a short-term physiotherapy intervention.

The improvement in dyspnea and respiratory rate observed in this case is likely associated with enhanced ventilatory efficiency resulting from breathing control techniques. Pursed-lip breathing and deep breathing exercises are known to reduce airway collapse, prolong expiration, and improve alveolar ventilation, thereby decreasing the sensation of breathlessness.[5,9] These findings are consistent with previous studies in pulmonary conditions, which have demonstrated that controlled breathing techniques can significantly improve respiratory parameters and reduce dyspnea.[6,10] However, evidence specifically focusing on TBM remains limited, highlighting the relevance of this case.

Pain reduction in both the chest and lower back regions may be attributed to the combined effects of relaxation positioning, gentle stretching, and postural correction. These interventions likely reduced muscle tension, improved spinal alignment, and enhanced overall biomechanical efficiency.[7] Improved posture may also have contributed indirectly to better respiratory mechanics by optimizing thoracic expansion and diaphragmatic function. This interaction between musculoskeletal and respiratory systems underscores the importance of a multidimensional rehabilitation approach in TBM patients.[11]

The observed increase in muscle strength, particularly in the lower extremities, may be explained by neuromuscular adaptation and early neuroplastic changes induced by strengthening exercises. Repetitive, task-oriented movements such as bridging and straight leg raise are known to stimulate motor unit recruitment and facilitate neural reorganization.[8] In patients with central nervous system involvement, such as TBM, rehabilitation interventions may promote functional recovery by enhancing synaptic plasticity and improving motor control. Although the molecular mechanisms of neuroplasticity are complex, their clinical manifestation can be observed through gradual improvements in muscle strength and functional mobility.[4]

Importantly, this case highlights the potential synergistic effect of combining respiratory and motor interventions. Rather than addressing impairments in isolation, the integrated approach used in this case targeted multiple domains simultaneously, including ventilation, musculoskeletal function, and mobility. This may explain the consistent improvements observed across different outcome measures within a relatively short intervention period.[12]

When interpreting these findings, it is essential to consider the hierarchy of evidence. As a single case report, this study provides a low level of evidence compared to randomized controlled trials or systematic reviews. Therefore, the results cannot be generalized to broader populations. However, case reports play an important role in generating clinical hypotheses and providing preliminary evidence, particularly in areas where higher-level evidence is scarce, such as rehabilitation in TBM.

This case also demonstrates several clinically relevant implications. First, the combination of breathing control, pain management, and strengthening exercises appears to be feasible and safe in a clinical rehabilitation setting, as no adverse events were reported. Second, early and targeted physiotherapy interventions may help prevent further functional decline and support recovery in TBM patients. Third, integrating respiratory and motor rehabilitation strategies may provide more comprehensive benefits compared to isolated interventions.

Several limitations should be acknowledged. This report describes a single patient, which limits external validity and generalizability. The duration of the intervention was relatively short, and long-term outcomes were not assessed. Additionally, no control or comparison group was included, making it difficult to attribute improvements solely to the intervention. Some outcome measures were descriptive and did not include advanced statistical analysis or patient-reported outcome measures, which could provide a more comprehensive evaluation of treatment effects.

Despite these limitations, this case contributes to the limited body of evidence on physiotherapy management in TBM and suggests that a combined rehabilitation approach may be beneficial. Future studies with larger sample sizes, longer follow-up periods, and controlled designs are needed to confirm these findings and establish stronger evidence for clinical practice.

Conclusion

This case report suggests that a combination of breathing control, pain management exercise, and strengthening exercise may be beneficial in improving respiratory function, reducing pain, and enhancing functional capacity in patients with tuberculous meningitis. Improvements were observed in dyspnea, respiratory rate, thoracic expansion, and muscle strength following a short-term intervention.

However, given the nature of a single-case design, these findings should be interpreted with caution and cannot be generalized to a wider population. This report highlights the potential role of integrated physiotherapy interventions in addressing both respiratory and motor impairments in TBM patients. Further research with larger sample sizes, longer follow-up periods, and controlled study designs is required to confirm the effectiveness of these interventions and to establish evidence-based rehabilitation protocols.

Author Contribution

Dyah Retno Palupi: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing – Original Draft.
Isnaini Herawati: Supervision, Methodology, Validation, Writing – Review and Editing.
Ririt Eka Lestari: Investigation, Data Curation, Resources.

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Conflict of Interest Statement

The authors declare no conflict of interest.

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Ethics Statement

Written informed consent was obtained from the patient for publication of this case report and accompanying anonymized data. The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was not required for this case report based on institutional policy.

References

1. World Health Organization. Global tuberculosis report 2024. Geneva: WHO; 2024.
2. Arshad A, Dayal S, Gadhe R, Mawley A, Shin K, Tellez D. Analysis of tuberculosis meningitis pathogenesis, diagnosis, and treatment. J Clin Med. 2020;9(9):2962.
3. Susan D, Irfanuddin, Okparasta A. Factors influencing mortality in meningitis patients at Dr Moh Hoesin Hospital Palembang. Neurona. 2021;38(1):1–7.
4. Aherrao S, Harjpal P, Tikariha A. Extensive physiotherapy rehabilitation for pulmonary tuberculosis and tuberculous meningitis with ventriculoperitoneal shunting: a case report. Cureus. 2024;16(9):e70578.
5. Dhengare A, Pohekar S. Effectiveness of breathing exercises among patients with chronic obstructive pulmonary disease. J Pharm Res Int. 2021;33:354–61.
6. Suryarinilsih Y, Netti, Budi H. Deep breathing and coughing techniques for airway clearance in pulmonary tuberculosis patients. Int J Curr Sci Res Rev. 2023;6(4):2347–51.
7. Srinivas M, Patil NJ, Prabhakar K, Jagmohan SV. Effect of yoga on quality of life in patients with pulmonary tuberculosis: a randomized controlled trial. Int J Yoga. 2023;16(3):185–91.
8. Kripa S, Kaur H. Relationship between posture and lower back pain. New Horiz Med Med Res. 2022;3:144–9.
9. Tenriola A, Khumaerah A. Respiratory exercise therapy in tuberculosis patients: a systematic review. [journal not identified]. 2025;9(2):75–84.
10. Berampu S, Wibowo A, Jehaman I, Tantangan R, Siahaan T, Ginting RI. Pursed-lip breathing exercise to reduce breathlessness in COPD. In: Proceedings of the International Conference on Health Informatics; 2019. p. 196–202.
11. Lee YJ. Thoracic mobilization and respiratory muscle endurance training improve diaphragm thickness and respiratory function in patients with a history of COVID-19. Medicina (Kaunas). 2023;59(5):906.
12. Valiullina SA, Litus AYu, Feskov GP, Novoselova IN. Effectiveness of comprehensive postural and pulmonary rehabilitation in a child with cerebral palsy and comorbid pulmonary pathology: a case report. Phys Rehabil Med Med Rehabil. 2025;7:243–50.