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Effect of Early Mobilization and Proprioceptive Neuromuscular Facilitation in Acute Intracerebral Hemorrhage: A Case Study

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Abstract

Background: Intracerebral hemorrhage (ICH) is a severe subtype of stroke associated with high mortality and disability. Early physiotherapy intervention in the acute phase is essential to minimize secondary complications and support neurological recovery.

Objective: To evaluate the clinical outcomes of early mobilization combined with Proprioceptive Neuromuscular Facilitation (PNF) in a patient with acute ICH.

Methods: A case study was conducted on a 40-year-old male patient diagnosed with ICH and treated in the High Care Unit. The intervention was administered over three consecutive sessions and included passive range of motion exercises, early mobilization (bed mobility and sitting preparation), and PNF diagonal movement patterns. Outcome measures included Glasgow Coma Scale (GCS), Manual Muscle Testing (MMT), and Barthel Index.

Results: The GCS score improved from 13 to 15. Muscle strength increased from grade 0 to grade 3 in elbow flexors and up to grade 2 in distal joints. The Barthel Index improved from 20 (total dependence) to 55 (severe dependence), indicating progressive functional recovery.

Conclusion: The combination of early mobilization and PNF may contribute to early motor recovery and functional improvement in acute ICH patients. However, findings from this single case should be interpreted cautiously and cannot be generalized.

Keywords

Intracerebral Hemorrhage; Stroke; Early Ambulation; Proprioceptive Neuromuscular Facilitation; Activities of Daily Living; Case Reports

Introduction

Stroke remains one of the leading causes of mortality and long-term disability worldwide, ranking among the top contributors to the global burden of disease.[1] Intracerebral hemorrhage (ICH), defined as non-traumatic bleeding within the brain parenchyma, is a particularly severe subtype of stroke due to its high mortality rate and poor functional prognosis.[2] Compared with ischemic stroke, ICH occurs less frequently but contributes disproportionately to stroke-related death and disability.[3]

Globally, ICH accounts for approximately 28.8% of all stroke cases, with an estimated incidence of 40.8 cases per 100,000 population annually.[3] Epidemiological patterns also differ between regions, with a higher proportion of hemorrhagic stroke reported in Asian populations compared with Western countries.[4] In Indonesia, the prevalence of stroke has increased significantly over recent decades, reflecting the growing burden of cerebrovascular disease and associated risk factors such as hypertension.[5]

From a pathophysiological perspective, ICH is primarily caused by rupture of cerebral blood vessels, often associated with chronic or uncontrolled hypertension.[6] This event leads to hematoma formation, resulting in direct mechanical damage to brain tissue (primary injury) and increased intracranial pressure.[6] Secondary injury mechanisms, including neuroinflammation, oxidative stress, perihematomal edema, and iron-mediated toxicity, further exacerbate neuronal damage and contribute to neurological deterioration.[7] These processes may result in impaired consciousness, motor deficits, and reduced functional independence, particularly in the acute phase of the condition.

Patients with ICH admitted to intensive or high-care settings are at substantial risk of secondary complications due to prolonged immobilization, including muscle atrophy, joint contractures, deep vein thrombosis, and pulmonary complications.[8] Therefore, early and appropriate physiotherapy intervention is essential to prevent these complications and support recovery. Current clinical guidelines from the American Heart Association/American Stroke Association emphasize the importance of initiating rehabilitation interventions once the patient is hemodynamically stable and neurologically appropriate for activity.[2]

Early mobilization has been widely recognized as a key component of stroke rehabilitation in the acute phase. It aims to reduce complications associated with bed rest, improve circulation, and facilitate functional recovery.[9] In addition, Proprioceptive Neuromuscular Facilitation (PNF) is a therapeutic approach that enhances neuromuscular control through diagonal and spiral movement patterns designed to stimulate proprioceptive input and improve motor coordination.[10] The integration of PNF in early rehabilitation may provide more specific facilitation of motor recovery, particularly in patients with severe neurological deficits.

Although both early mobilization and PNF have been individually studied in stroke rehabilitation, evidence regarding their combined application in acute ICH patients, especially in high-care unit (HCU) settings, remains limited. Existing studies predominantly focus on ischemic stroke or subacute phases, leaving a gap in understanding their effectiveness during the acute phase of hemorrhagic stroke in critical care environments.

Therefore, this case study aims to evaluate the clinical outcomes of combining early mobilization and Proprioceptive Neuromuscular Facilitation (PNF) in improving motor function and functional independence in a patient with acute intracerebral hemorrhage treated in a high-care unit setting.

Methods

This study was conducted as a case study following the CARE (CAse REport) guidelines to ensure comprehensive and transparent reporting of clinical presentation, intervention, and outcomes in a patient with intracerebral hemorrhage (ICH) managed in a high-care setting.

This case study was conducted as part of routine clinical practice and did not involve experimental intervention. Formal ethical approval was not required according to institutional policy for single-case reports. However, written informed consent was obtained from the patient's family for the use of anonymized clinical data for publication purposes. All procedures adhered to the principles of the Declaration of Helsinki.

A 40-year-old male patient was admitted to the emergency department with sudden onset of severe headache followed by decreased consciousness. The patient worked as a security officer and motorcycle driver. He had a history of uncontrolled hypertension, which is a major risk factor for intracerebral hemorrhage. At admission, the patient presented with blood pressure of 227/125 mmHg and decreased level of consciousness. He was subsequently admitted to the High Care Unit (HCU) for intensive monitoring and management. No detailed family history or additional comorbidities were documented in the medical record. Detailed information regarding the duration of hypertension, prior treatment adherence, and additional lifestyle-related risk factors was not available in the medical records, which limits further risk factor analysis.

Initial clinical examination revealed impaired consciousness with a Glasgow Coma Scale (GCS) score of 13 (E3V4M6). Neurological examination showed left-sided hemiplegia, indicating involvement of the right cerebral hemisphere. Pathological reflexes, including Babinski and Chaddock reflexes, were positive, suggesting upper motor neuron lesion.

Vital signs at admission indicated severe hypertension, while other physiological parameters such as heart rate, respiratory rate, oxygen saturation, and body temperature were within acceptable ranges for clinical monitoring.

During hospitalization, the patient also received standard medical management for intracerebral hemorrhage, including blood pressure control and neurological monitoring as part of routine care in the High Care Unit. The physiotherapy intervention in this study was implemented as a complementary approach alongside medical management.

The patient was diagnosed with intracerebral hemorrhage based on clinical findings and hospital medical records. The lesion was reported to involve the right temporal region, including the basal ganglia area (lentiform nucleus, external capsule, and insular cortex). However, detailed radiological findings such as computed tomography (CT) scan images and hematoma volume were not available for this report

The diagnosis of intracerebral hemorrhage (ICH) in this case was established based on clinical presentation and confirmed by hospital medical records. Given the acute onset of neurological deficits accompanied by severe hypertension, the diagnosis was considered consistent with hemorrhagic stroke. Differential diagnoses such as ischemic stroke or other causes of altered consciousness were not further explored in this report, as the diagnosis had been clinically established and managed according to standard hospital protocols. However, detailed radiological parameters such as hematoma volume, expansion, and neuroimaging progression were not available for analysis in this report, which limits the depth of diagnostic interpretation. The clinical progression and physiotherapy intervention timeline are summarized in Table 1.

Table 1. Timeline of Clinical Course and Physiotherapy Intervention

Day/Session	Clinical Status	Intervention	Outcomes
Day 1 (HCU)	GCS 13, severe hypertension, hemiplegia	Passive ROM, positioning	Stable vital signs
Day 2 (HCU)	GCS 14, improved responsiveness	PNF initiation, bed mobility training	Early motor activation
Day 3 (HCU)	GCS 15, compos mentis	Sitting preparation, continued PNF	Improved motor control
Post-HCU	Stable condition	Functional mobilization (rolling, transfer)	Increased independence

Clinical outcomes were assessed using standardized and widely accepted instruments in neurological rehabilitation. The level of consciousness and overall neurological status were evaluated using the Glasgow Coma Scale (GCS), which provides an objective measure of patient responsiveness.[11] Muscle strength was assessed using Manual Muscle Testing (MMT), graded on a scale from 0 to 5, allowing systematic evaluation of motor function recovery.[12] Functional independence in activities of daily living (ADL) was measured using the Barthel Index, with total scores ranging from 0 to 100, where higher scores indicate greater independence.[13] These instruments have been extensively validated and are commonly employed in stroke rehabilitation to ensure reliable and clinically meaningful outcome assessment.

The selection of early mobilization and Proprioceptive Neuromuscular Facilitation (PNF) was based on current evidence supporting their role in enhancing motor recovery and preventing complications in acute stroke patients. Early mobilization has been shown to reduce the risk of complications associated with prolonged bed rest and improve functional outcomes, while PNF facilitates neuromuscular activation through proprioceptive stimulation and coordinated movement patterns.[26]

The physiotherapy program was designed according to the FITT principle (Frequency, Intensity, Time, and Type) and was carefully adapted to the patient's clinical condition during the acute phase. The intervention was administered over three consecutive sessions in the High Care Unit, ensuring consistency in the treatment duration and addressing previous discrepancies. The program was delivered once daily with low intensity, adjusted to the patient's tolerance and clinical stability, and each session lasted approximately 15 minutes. The type of intervention consisted of passive and facilitated movements aimed at promoting early neuromuscular activation while maintaining patient safety.

The intervention protocol comprised several components. Passive range of motion (ROM) exercises were applied to both upper and lower extremities to maintain joint mobility, prevent contracture formation, and stimulate neuromuscular responses. Proprioceptive Neuromuscular Facilitation (PNF) techniques were implemented using diagonal movement patterns, including D1 and D2 flexion and extension patterns for both upper and lower extremities, to enhance motor control and proprioceptive input. Each movement was performed in 5–10 repetitions per set, with continuous monitoring of the patient's physiological and neurological responses.

In addition, early mobilization was introduced progressively through functional activities, including proper positioning and postural alignment, bed mobility exercises such as rolling to both sides, and gradual preparation for sitting. This structured progression was intended to facilitate safe transition toward functional independence while minimizing the risk of complications associated with prolonged

Patient safety was continuously monitored throughout the intervention by assessing hemodynamic and clinical parameters, including blood pressure stability, oxygen saturation, and level of consciousness. In addition, signs of fatigue or intolerance during

the exercises were carefully observed. The intervention was adjusted or immediately discontinued if any abnormal responses or signs of clinical instability were detected, in order to ensure patient safety during the acute phase of rehabilitation.

Data were analyzed descriptively by comparing clinical outcomes across three consecutive sessions. Changes in GCS, MMT scores, and Barthel Index were interpreted based on clinical relevance rather than inferential statistics, consistent with the nature of a case study.

Results

Clinical outcomes were evaluated across three consecutive physiotherapy sessions during the acute phase of hospitalization in the High Care Unit. Parameters assessed included vital signs, level of consciousness (GCS), range of motion (ROM), muscle strength (MMT), and functional independence (Barthel Index). Changes in physiological parameters and neurological status across the three sessions are presented in Table 2.

Table 2. Vital Signs and Glasgow Coma Scale Across Sessions

Parameter	Session 1	Session 2	Session 3
Blood Pressure (mmHg)	227/125	198/110	165/95
Heart Rate (beats/min)	99	94	88
Respiratory Rate (breaths/min)	19	20	18
Temperature (°C)	36.8	36.7	36.7
SpO_2 (%)	98	98	99
GCS (E,V,M)	E3V4M6 (13)	E4V4M6 (14)	E4V5M6 (15)
Level of Consciousness	Apathetic	Compos mentis	Compos mentis

The data demonstrate progressive stabilization of vital signs alongside improvement in level of consciousness over the three sessions. Assessment of joint mobility across all major joints indicated preserved movement capacity throughout the intervention period. The detailed ROM findings are summarized in Table 3.

Table 3. Range of Motion and End-Feel Assessment

Joint Region	Movement	End Feel	Pain	ROM
Shoulder	All directions	Firm	None	Full
Elbow	Flexion/Extension	Hard/Firm	None	Full
Wrist	All directions	Firm	None	Full
Hip	All directions	Firm	None	Full
Knee	Flexion/Extension	Soft/Hard	None	Full
Ankle	All directions	Firm	None	Full

All assessed joints demonstrated full range of motion without pain during the evaluation period. Changes in muscle strength across sessions are presented in Table 4.

Table 4. Muscle Strength Progression (MMT Scores)

Region	Movement	Session 1	Session 2	Session 3
Shoulder	All movements	0	0	1
Elbow	Flexion	0	1	3
Elbow	Extension	0	0	1
Wrist	Flexion/Extension	0	1	2
Hip	Flexion	0	0	2
Knee	Extension	0	0	1
Ankle	Dorsiflexion	0	1	2

The data indicate progressive increases in muscle strength across multiple joint regions over the intervention period. Functional independence was assessed using the Barthel Index, with results presented in Table 5.

Table 5. Barthel Index Scores Across Sessions

Session	Score	Category
Session 1	20	Total dependence
Session 2	35	Severe dependence
Session 3	55	Severe dependence

An increase in Barthel Index score was observed across sessions, indicating progressive improvement in functional independence. Overall, the patient demonstrated consistent improvements across neurological status, muscle strength, and functional independence over three consecutive physiotherapy sessions. No adverse events or complications were reported during the intervention period. No long-term follow-up data were available after the patient was transferred out of the High Care Unit, which limits the evaluation of sustained functional recovery.

Discussion

This case study describes the clinical course and outcomes of a patient with acute intracerebral hemorrhage (ICH) who received early physiotherapy intervention consisting of early mobilization and Proprioceptive Neuromuscular Facilitation (PNF). The findings demonstrate progressive improvement in level of consciousness, muscle strength, and functional independence over three consecutive sessions during the acute phase of care.

Improvement in neurological status, as indicated by the increase in Glasgow Coma Scale (GCS) score from 13 to 15, reflects recovery of consciousness and cognitive responsiveness. GCS is widely recognized as a reliable clinical tool for monitoring neurological status and predicting outcomes in patients with brain injury, including stroke.[1] The observed improvement is likely influenced by both medical stabilization and supportive rehabilitation, highlighting the importance of multidisciplinary management in acute ICH.[2]

The progressive increase in muscle strength, particularly from grade 0 to grade 3 in the elbow flexors and up to grade 2 in distal joints, suggests early activation of motor pathways. In patients with stroke, motor impairment is primarily associated with disruption of corticospinal tract function, leading to reduced motor unit recruitment and impaired voluntary contraction.[3] Recovery of motor function in the early phase is closely related to neuroplasticity, a process in which the central nervous system reorganizes and forms new neural connections in response to stimulation and activity.[4]

The application of PNF in this case may have contributed to facilitating neuromuscular activation through specific diagonal movement patterns that enhance proprioceptive input and motor coordination. Previous studies have shown that PNF can improve motor function and coordination in patients with neurological disorders, including stroke.[3] Additionally, passive range of motion and facilitated movements may help maintain joint integrity and prevent secondary complications such as contractures.[5]

Early mobilization also plays a critical role in the management of acute stroke patients. It has been associated with improved circulation, prevention of complications related to prolonged bed rest, and enhanced functional recovery.[6] In this case, gradual progression from passive positioning to bed mobility and sitting preparation was implemented in accordance with the patient's clinical stability. This approach aligns with current clinical guidelines recommending early but safe mobilization in stroke patients once hemodynamic parameters are stable.[2]

Functional improvement, as indicated by the increase in Barthel Index score from 20 to 55, reflects enhanced independence in activities of daily living. Although the patient remained within the category of severe dependence, the observed improvement suggests meaningful early functional gains. The Barthel Index is a widely used and validated tool for assessing functional outcomes in stroke rehabilitation.[7]

Although the minimal clinically important difference (MCID) for the Barthel Index in acute intracerebral hemorrhage patients is not consistently defined, the observed increase of 35 points in this case suggests a clinically meaningful improvement in functional independence.

Despite these positive findings, several limitations must be acknowledged. First, this study involves a single patient, which limits the generalizability of the results. Second, the improvement observed cannot be attributed solely to physiotherapy intervention, as concurrent medical treatment and natural recovery processes may have contributed significantly. Third, the absence of detailed radiological data and long-term follow-up limits the ability to fully evaluate the extent and sustainability of recovery. Potential sources of bias include the lack of a control condition, the short duration of observation, and the descriptive nature of the analysis. The absence of additional standardized neurological assessments, such as the National Institutes of Health Stroke Scale (NIHSS), limits the comprehensiveness of neurological evaluation in this case.

These factors should be considered when interpreting the findings. From a clinical perspective, this case highlights the feasibility and potential benefits of integrating early mobilization and PNF in the acute management of ICH patients in high-care settings. However, the implementation of such interventions must be carefully tailored to individual patient conditions, with close monitoring of hemodynamic and neurological status to ensure safety.

Future research should focus on larger sample sizes, controlled study designs, and longer follow-up periods to establish the effectiveness of combined early mobilization and PNF interventions. Randomized controlled trials are particularly needed to determine causal relationships and optimize rehabilitation protocols in acute ICH patients.

Conclusion

This case study demonstrates that early physiotherapy intervention, including passive range of motion, early mobilization, and Proprioceptive Neuromuscular Facilitation (PNF), was associated with improvements in neurological status, muscle strength, and functional independence in a patient with acute intracerebral hemorrhage. An increase in Glasgow Coma Scale score, progressive gains in Manual Muscle Testing grades, and improvement in Barthel Index score indicate early recovery in both motor and functional domains. These findings suggest that structured and closely monitored physiotherapy interventions can be feasibly implemented in high-care settings during the acute phase of stroke.

However, as this report is based on a single case, the findings are descriptive and exploratory in nature. The observed improvements cannot be attributed solely to the physiotherapy intervention, as concurrent medical management and natural recovery may have contributed to the outcomes. Therefore, the results should be interpreted with caution and cannot be generalized to broader patient populations.

From a clinical perspective, early mobilization combined with PNF may be considered as a supportive rehabilitation approach in acute ICH patients, provided that patient safety and hemodynamic stability are carefully monitored.

Future studies with larger sample sizes, controlled designs, and longer follow-up periods are required to establish the effectiveness and clinical significance of this combined intervention.

Author Contribution

Muhammad Daniel Mustofa: Conceptualization, data collection, data analysis, manuscript drafting.
Wahyu Tri Sudaryanto: Supervision, methodology validation, critical revision of the manuscript.
Yunita Nur Rochmah: Study design, data interpretation, manuscript review and editing.

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Conflict of Interest Statement

The authors declare no conflict of interest.

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Ethics Statement

This case study was conducted as part of routine clinical practice. Formal ethical approval was not required according to institutional policy for single-case reports. Written informed consent was obtained from the patient's family for the publication of anonymized clinical data.

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