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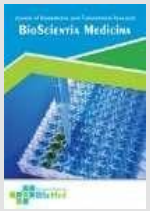

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Comprehensive Rehabilitation Improves Motor Function and Independence in a Patient with Left Hemiparesis Post-Ischemic Stroke: A Case Report

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A B S T R A C T

Background: Stroke remains a leading cause of disability worldwide, with ischemic stroke being the predominant type. Left-sided hemiparesis resulting from ischemic stroke significantly impairs motor function and activities of daily living, necessitating comprehensive rehabilitation interventions. This case report details the journey of a 72-year-old female patient who experienced left hemiparesis due to an ischemic stroke and underwent a comprehensive rehabilitation program. **Case presentation:** A 72-year-old female patient presented with sudden onset weakness in her upper and lower left limbs following an ischemic stroke. Initial assessments revealed significant impairments in motor function, balance, and self-care abilities, classifying her as having a moderate disability according to the Barthel Index. The rehabilitation program included passive and active range of motion exercises, functional mobilization techniques, resistance and balance training, infrared therapy, psychological support, and patient education. **Conclusion:** The comprehensive rehabilitation strategy implemented in this case resulted in significant improvements in the patient's motor function, balance, confidence, and independence in performing daily activities. This case underscores the crucial role of tailored and comprehensive rehabilitation programs in enhancing recovery and improving the quality of life for individuals following an ischemic stroke.

1. Introduction

Stroke is a devastating global health issue, recognized as a leading cause of long-term disability and mortality, and it places a substantial economic burden on healthcare systems worldwide. Ischemic stroke, the predominant type, accounts for approximately 87% of all stroke cases. It occurs when the blood supply to the brain is interrupted, leading to neurological deficits that can severely impact an individual's functional abilities. The impact of stroke is far-reaching, affecting not only the individuals who experience it but also their families and communities. The prevalence of stroke is a significant concern, with millions of new cases reported annually across the globe. This high incidence underscores the urgent need for effective prevention, treatment, and rehabilitation strategies to mitigate its impact on public health. In Indonesia, the prevalence of stroke has reached notable levels, further emphasizing the importance of implementing robust management and rehabilitation approaches to address this critical health challenge. Hemiparesis, characterized by weakness on one side of the body, is a common and debilitating consequence of stroke. This condition arises from damage to the contralateral hemisphere of the brain, disrupting the neural pathways responsible

for motor control. Left-sided hemiparesis, specifically resulting from damage to the right side of the brain, often affects motor control and can lead to significant difficulties with movement, balance, and coordination. The specific manifestations of hemiparesis can vary widely among individuals, depending on the location and extent of the brain injury. However, the overarching impact is a disruption in the ability to perform volitional movements, which can have profound implications for daily life.[1-3]

These motor impairments resulting from hemiparesis can significantly impact a patient's ability to perform activities of daily living (ADLs) and substantially reduce their overall independence and quality of life. ADLs encompass a wide range of self-care tasks, including bathing, dressing, feeding, and toileting. The inability to perform these tasks independently can lead to increased reliance on caregivers, diminished self-esteem, and a decreased sense of autonomy. Furthermore, the loss of mobility and independence can contribute to social isolation, psychological distress, and a higher risk of secondary health complications. Medical rehabilitation plays a pivotal role in the recovery process following a stroke. It represents a comprehensive and multidisciplinary approach aimed at minimizing the impact of disability, maximizing functional capabilities, promoting independence, and preventing secondary complications. The primary goal of stroke rehabilitation is to assist individuals in regaining lost skills and learning new strategies to compensate for residual deficits, ultimately enabling them to achieve their optimal level of function and participation in life. Comprehensive rehabilitation programs are essential for addressing the multifaceted challenges presented by stroke. These programs typically involve a combination of therapeutic exercises, functional training, assistive devices, and patient education, all carefully tailored to the individual's specific needs and deficits. The multidisciplinary team involved in stroke rehabilitation may include physicians, nurses, physical therapists, occupational therapists, speech-language pathologists, psychologists, social workers, and other healthcare professionals, all working collaboratively to provide holistic care.[4-6]

Early mobilization and rehabilitation have been proven to be highly beneficial in improving physical function and facilitating brain recovery after stroke. Initiating rehabilitation interventions as early as medically stable in the acute phase of stroke can help to minimize complications, promote neuroplasticity, and optimize functional outcomes. The intensity and duration of rehabilitation should be individualized based on the patient's needs, tolerance, and progress. Rehabilitation interventions following stroke focus on a variety of critical aspects, including improving motor function, balance, gait, and upper limb dexterity. Motor function rehabilitation aims to restore strength, coordination, and control of affected limbs through targeted exercises and activities. Balance training is crucial for enhancing stability and preventing falls, which are a significant risk for individuals with hemiparesis. Gait training focuses on improving walking ability, addressing issues such as reduced speed, asymmetry, and compensatory gait patterns. Upper limb rehabilitation addresses specific deficits in hand and arm function, which are essential for many ADLs. Psychological support and education are also integral components of comprehensive stroke rehabilitation, playing a vital role in addressing emotional distress and enhancing therapy adherence. Stroke can have significant psychological consequences, including depression, anxiety, and frustration. Providing psychological support, counseling, and education can help patients and their families cope with these challenges, improve their emotional well-being, and promote active participation in the rehabilitation process. Patient education is essential for empowering individuals to understand their condition, manage their symptoms, and make informed decisions about their care.[7-10] This case report aims to describe in detail the comprehensive rehabilitation program and its outcomes in a 72-year-old female patient who experienced left hemiparesis secondary to an ischemic stroke.

2. Case Presentation

The patient, at the time of initial presentation, was a 72-year-old female. Her primary complaint, the symptom that prompted her medical consultation, was the sudden onset of weakness affecting her left upper and lower limbs. This abrupt compromise of motor function represented a significant change in her physical status and prompted clinical investigation to determine the underlying etiology and guide appropriate management. Delving into the specifics of the symptom onset, it was reported that the patient had experienced an initial phase characterized by tingling and numbness localized to her left hand and foot. This prodromal sensory disturbance subsequently progressed to overt weakness in the affected extremities. Notably, the evolution of these symptoms occurred in a relatively short time frame. The sequence of events began after the patient's afternoon prayer, and the presentation to medical services occurred the following day. The temporal proximity between the initial sensory symptoms, their progression to weakness, and the seeking of medical attention is clinically significant, suggesting an acute process that warranted immediate evaluation. A comprehensive review of the patient's past medical history revealed a six-month history of uncontrolled hypertension. This pre-existing condition is a critical factor in the context of the patient's presenting symptoms, as hypertension is a well-established risk factor for cerebrovascular events. It is important to emphasize that, beyond hypertension, the patient's medical history was notable for the absence of several other conditions. Specifically, there was no history of diabetes mellitus, kidney disease, heart disease, hyperuricemia, or hypercholesterolemia. The absence of these conditions helps to narrow the differential diagnosis and focuses attention on potential etiologies related to the patient's uncontrolled hypertension. The lack of a history of diabetes, kidney disease, and heart disease is pertinent as these conditions can independently contribute to vascular pathologies and neurological deficits. Similarly, the absence of hyperuricemia and hypercholesterolemia reduces the likelihood of gout-related complications or hyperlipidemia-associated vascular disease playing a primary role in the patient's presentation. The patient's social history provides important context regarding her living situation and prior occupation. She was reported to be married with two children. At the time of presentation, she was residing with her youngest child, her son-in-law, and her grandchildren. This multi-generational household environment may have implications for the patient's support system and potential for assistance during her recovery and rehabilitation. Prior to her current status, the patient had been employed as a farmer. However, at the time of presentation, she was unemployed. Her prior occupation as a farmer suggests a history of physical activity and potentially demanding work, which could be relevant to her functional baseline and rehabilitation goals. Her current unemployment status might also have implications for her social and economic circumstances. Upon arrival at the medical facility, a series of vital signs were recorded. The patient's blood pressure was measured at 150/74 mmHg. This blood pressure reading, while the diastolic pressure is within a commonly accepted range, the systolic pressure is elevated and confirms the patient's history of uncontrolled hypertension. It is important to note that while a single reading provides a snapshot, it must be interpreted within the context of her history of hypertension. The patient's temperature was 36.7°C, which is within the normal range for body temperature. Her pulse rate was recorded at 73 beats per minute, which also falls within the normal range for heart rate. The patient's oxygen saturation was 98%, indicating adequate oxygenation of the blood. The respiratory rate was 18 breaths per minute, which is within the normal range for respiration. These vital signs, taken collectively, provide an initial physiological assessment of the patient. The elevated systolic blood pressure, however, stands out and is consistent with her known history of hypertension, reinforcing its potential role in her presenting condition. A thorough neurological examination was conducted. The patient was

described as being conscious and oriented, indicating that she was aware of herself, her surroundings, and the current situation. There were no cranial nerve deficits detected during the examination. The absence of cranial nerve deficits suggests that the neurological insult was likely focused on specific motor pathways rather than broadly affecting brainstem function or specific cranial nerve nuclei. However, the neurological examination did reveal a decrease in sensation to light touch and pinprick on the left side of the body when compared to the right side. This finding of unilateral sensory impairment is a critical localizing sign, suggesting a lesion in the contralateral hemisphere of the brain or in the sensory pathways that serve the left side of the body. The diminished sensation to both light touch and pinprick indicates involvement of both the discriminative touch and pain pathways. The musculoskeletal examination focused on assessing the range of motion and muscle strength in both the upper and lower limbs. The examination of the right upper limb revealed a normal range of motion and normal muscle strength. This finding establishes a baseline for comparison and indicates that the patient's right side was not directly affected by the acute neurological event. In stark contrast, the left upper limb exhibited limitations in passive range of motion at the shoulder, elbow, wrist, and fingers. This restriction in passive movement suggests the possibility of increased muscle tone, joint stiffness, or other mechanical limitations in the affected limb. Furthermore, the left upper limb demonstrated significantly reduced muscle strength, graded as 1/5 on the Medical Research Council (MRC) scale, in all muscle groups. The MRC scale is a standardized tool for assessing muscle strength, with 1/5 indicating only a flicker of movement. This severe weakness in the left upper limb represents a profound motor deficit. The right lower limb, similar to the right upper limb, demonstrated a normal range of motion and normal muscle strength. This further emphasizes the unilateral nature of the patient's motor impairment. The left lower limb, however, presented with limitations in the range of motion in the hip, knee, ankle, and toes. This restriction mirrors the findings in the left upper limb and indicates a more generalized compromise of movement on the left side of the body. Additionally, the left lower limb exhibited reduced muscle strength, graded as 3/5 on the MRC scale, in the hip flexors and extensors, knee flexors and extensors, and ankle dorsiflexors and plantarflexors. A grade of 3/5 on the MRC scale indicates that the muscle can move the joint against gravity but not against resistance. While not as severe as the weakness in the left upper limb, this reduced strength in the left lower limb still represents a significant motor impairment. The findings of the musculoskeletal examination, taken together, strongly suggest a left-sided hemiparesis, characterized by both limitations in range of motion and significant muscle weakness, with the upper limb more severely affected than the lower limb. An assessment of the patient's functional status was conducted using the Barthel Index. The Barthel Index is a widely used and validated tool for measuring a person's independence in activities of daily living. The patient's score on the Barthel Index was 45 out of a possible 100. This score indicates moderate disability. The assessment revealed that the patient required assistance with bathing, dressing, and grooming. These are fundamental self-care activities, and the need for assistance highlights the significant impact of the patient's condition on her daily life. The patient demonstrated limited independence in feeding and bowel/bladder control. While not requiring complete assistance, the limitation in these areas indicates some degree of functional impairment and a need for support. The Barthel Index score, combined with the specific areas of dependency, provides a comprehensive picture of the patient's functional limitations at the time of presentation. Diagnostic findings played a crucial role in confirming the clinical suspicion and identifying the underlying pathology. The Siriraj Stroke Score was calculated to be -7.6. The Siriraj Stroke Score is a clinical tool used to differentiate between ischemic and hemorrhagic stroke in resource-limited settings. A negative score, as in this case, indicates a high probability of ischemic

stroke. This clinical assessment was further supported by a Brain CT scan, which confirmed the presence of a right-sided ischemic stroke. Computed tomography (CT) of the brain is a neuroimaging technique that allows for the visualization of brain tissue and the identification of structural abnormalities. The confirmation of a right-sided ischemic stroke aligns with the patient's left-sided hemiparesis, as the right side of the brain controls motor function on the left side of the body. Complete blood tests were performed, and the results were within normal limits. These tests are important for ruling out other potential causes of the patient's symptoms and for assessing her overall health status. An electrocardiogram (ECG) was also conducted, and it showed no acute abnormalities. The ECG helps to assess the electrical activity of the heart and to identify any cardiac conditions that might have contributed to or resulted from the patient's presentation. Based on the totality of the clinical presentation, the neurological examination findings, and the diagnostic investigations, the final diagnosis was left hemiparesis secondary to a right-sided ischemic stroke. This diagnosis accurately reflects the patient's primary motor deficit, its location, and its underlying cause. The constellation of symptoms, including the sudden onset of left-sided weakness, the presence of risk factors such as uncontrolled hypertension, the findings of the neurological and musculoskeletal examinations, and the confirmation of a right-sided ischemic stroke on the CT scan, all converge to support this diagnosis (Table 1).

The patient, following the acute management of her ischemic stroke, was initiated into a comprehensive rehabilitation program designed to address the neurological deficits and functional impairments resulting from the event. This rehabilitation program was structured to provide a multidisciplinary and integrated approach to recovery, encompassing various therapeutic modalities and interventions tailored to the patient's specific needs and limitations. The core of the rehabilitation program consisted of therapeutic exercises, a fundamental component aimed at restoring and enhancing motor function. Within this category, several specific exercise modalities were employed. Passive Range of Motion exercises were initiated, involving therapist-assisted movement of the affected limbs through their full range of motion. This intervention was implemented with a frequency and duration of 10 to 15 repetitions, administered twice daily. The primary objective of these passive ranges of motion exercises was to maintain joint mobility and prevent the development of contractures. Contractures, characterized by the tightening or shortening of muscles or other tissues, can significantly impede movement and functional recovery. Therefore, the consistent application of a passive range of motion exercises was crucial in mitigating this risk and preserving the structural integrity of the joints. As the patient's strength began to improve, the rehabilitation program incorporated Active-Assisted Range of Motion exercises. These exercises involved the patient actively participating in the movement of their limbs, with the therapist providing assistance as needed. The progression from passive to active-assisted range of motion reflects a gradual increase in the patient's engagement and effort in the therapeutic process. The key objective of active-assisted range of motion exercises was to facilitate the regaining of movement in the major joints affected by the stroke. This stage of exercise represents a transition towards greater independence in movement, with the therapist's assistance being progressively reduced as the patient's motor control improves. Further progression in the therapeutic exercise regimen led to the implementation of Active Range of Motion exercises. These exercises involved independent movements performed by the patient to move the affected limbs. Active range of motion exercises were introduced once sufficient voluntary movement was present, signifying a level of motor control that allowed for independent effort. The primary objectives of active range of motion exercises were to continue improving the range of motion in the affected limbs and to enhance muscle strength. This stage of exercise emphasizes the patient's active participation and self-directed effort in the

rehabilitation process, promoting the restoration of functional movement and strength. Strengthening exercises were also incorporated into the therapeutic exercise component of the rehabilitation program. These exercises involved progressive resistance exercises utilizing resistance bands and light weights. The application of progressive resistance is a well-established method for increasing muscle strength, with the resistance being gradually increased as the patient's strength improves. Strengthening exercises were performed in sets of 10 to 12 repetitions, with three sets being administered during each session. The key objective of these strengthening exercises was to increase muscle strength in the affected limbs, thereby improving the patient's ability to perform functional movements and enhancing overall motor function. Functional mobilization techniques constituted another essential element of the therapeutic exercise component. These techniques were designed to improve functional movements, including rolling, sitting, transfers, and standing. Functional mobilization was integrated into the daily rehabilitation sessions, reflecting its importance in promoting independence in basic movements. The focus on functional movements underscores the goal of rehabilitation to enhance the patient's ability to perform everyday tasks and to regain independence in mobility. Balance training was also a key component of the therapeutic exercise regimen. These exercises focused on both static and dynamic balance, incorporating weight shifting and core stability exercises. Balance training was integrated into the daily sessions, highlighting its importance in improving stability and preventing falls. Stroke often affects balance and coordination, increasing the risk of falls and limiting functional independence. Therefore, the inclusion of balance training is crucial in addressing these deficits and promoting safe and effective movement. Gait training was implemented as the patient's standing ability improved. This aspect of the rehabilitation program involved practicing walking with the use of assistive devices, such as a walker or cane. Gait training aimed to achieve a correct gait pattern and to improve walking ability. Stroke can significantly affect gait, leading to abnormalities such as reduced speed, asymmetry, and decreased step length. Gait training focuses on addressing these issues and promoting a more efficient and functional walking pattern. The use of assistive devices provides support and stability during the process of regaining walking ability. In addition to therapeutic exercises, the rehabilitation program incorporated modalities, with infrared therapy being a key example. Infrared therapy involves the application of infrared light to the affected limbs. This modality was administered for 20 minutes per session, twice daily. The key objectives of infrared therapy were to reduce pain, improve circulation, and promote muscle relaxation. Infrared therapy is often used as an adjunct to therapeutic exercises, as its effects can help to enhance the benefits of exercise and improve the patient's comfort. Functional training formed another critical aspect of the rehabilitation program. Activities of Daily Living training, delivered through occupational therapy, focused on promoting independence in daily tasks, such as feeding, dressing, and other self-care activities. This training was integrated into the daily sessions, emphasizing its importance in improving independence in ADLs through the use of adaptive equipment and strategies. Occupational therapy plays a vital role in helping patients regain the skills necessary for performing everyday tasks and in adapting to the environment to facilitate independence. Support and education were also integral components of the comprehensive rehabilitation program. Psychological support was provided through regular sessions aimed at addressing emotional distress and anxiety. This support was integrated into the program, reflecting its importance in enhancing emotional well-being and coping mechanisms. Stroke can have significant psychological consequences, and providing support to address these issues is essential for overall recovery. Patient education was also provided, focusing on information regarding the patient's condition, therapy adherence, and self-management strategies. This

education was ongoing throughout the program, highlighting its importance in increasing understanding and promoting active participation in the recovery process. Empowering patients with knowledge about their condition and how to manage it is a crucial aspect of effective rehabilitation. The parameters of the rehabilitation program included a program duration of four weeks. This period of time was designated for intensive rehabilitation, allowing for focused and consistent therapeutic intervention. The program was structured with sessions taking place six days a week, with two sessions per day. This frequency and duration of therapy sessions are indicative of an intensive rehabilitation approach, aimed at maximizing functional recovery within a defined timeframe. Each session had a length of 60 to 90 minutes. These sessions, occurring twice daily (morning and afternoon), provided focused and intensive therapy, allowing for the delivery of the various therapeutic exercises, modalities, and functional training components of the program. The structure of the program, with its defined duration, frequency, and session length, reflects a commitment to providing comprehensive and intensive rehabilitation to optimize the patient's recovery potential (Table 2).

The patient's progress throughout the comprehensive rehabilitation program was meticulously documented and assessed across several key domains, providing a detailed account of the intervention's effectiveness. These assessments focused on a range of motion, manual muscle testing, functional independence as measured by the Barthel Index and the Functional Independence Measure, balance, and gait. Range of Motion, a fundamental aspect of physical function, was evaluated at the initiation of the rehabilitation program, revealing limitations in the left upper and lower extremities. These limitations manifested as restrictions in the ability to move the joints through their normal physiological arcs. Following the four-week rehabilitation program, a notable increase in active range of motion was observed in the left upper and lower extremities. This improvement signifies a positive change in the patient's capacity for movement, with greater ease and extent of joint motion. The observed change from limited range of motion to a notable increase in active range of motion constitutes a significant improvement. This enhancement in range of motion is a crucial indicator of the program's success in restoring joint mobility and facilitating functional movement. Increased range of motion directly translates to an improved ability to perform daily activities that require limb movement, contributing to a greater level of independence. Manual Muscle Testing, a clinical method used to assess muscle strength, was also conducted at the beginning and conclusion of the rehabilitation program. Initially, the patient exhibited significant weakness in the left upper extremity, with a muscle strength grade of 1/5. This grade indicates that the muscle was only capable of a flicker of contraction, representing a severe degree of weakness. The left lower extremity demonstrated a muscle strength grade of 3/5, indicating that the muscle could move the joint against gravity but not against resistance. Following the four-week rehabilitation program, the manual muscle testing revealed substantial gains in muscle strength. The left upper extremity strength improved to an average of 3/5. This improvement from 1/5 to 3/5 represents a clinically meaningful increase in strength, allowing for more functional use of the arm. The left lower extremity strength improved to an average of 4/5. This improvement signifies that the muscle could move the joint against some resistance, indicating a greater capacity for weight-bearing and movement. The changes observed in muscle strength in both the upper and lower extremities represent a significant improvement in muscle strength. This enhancement in muscle strength is a critical factor in the patient's ability to perform functional tasks, such as reaching, grasping, and walking. The improved muscle strength directly contributes to enhanced motor control, coordination, and overall functional independence. The Barthel Index, a widely used measure of functional independence in activities of

daily living, was employed to quantify the patient's ability to perform self-care tasks. At the outset of the rehabilitation program, the patient's Barthel Index score was 45. This score categorized the patient as having moderate disability, indicating a significant need for assistance with various activities of daily living. Following the four-week rehabilitation program, the patient's Barthel Index score increased to 85. This increase of 40 points on the Barthel Index reflects a substantial improvement in functional independence. The patient achieved independence in feeding, grooming, and bowel and bladder control. This signifies a major reduction in the need for assistance with these essential self-care activities. The patient required only minimal assistance needed for bathing and dressing. While not fully independent in these tasks, the reduction in the level of assistance required demonstrates significant progress. The improvement in the Barthel Index score from 45 to 85 represents a transition from moderate disability to mild disability. This improvement by 40 points is a key indicator of the rehabilitation program's success in enhancing the patient's ability to perform activities of daily living and increasing her overall level of independence. Balance, a crucial component of mobility and safety, was also assessed throughout the rehabilitation program. Initially, the patient presented with poor balance and was unable to stand independently. This represented a significant limitation in her ability to maintain an upright posture and increased her risk of falls. Following the four-week rehabilitation program, the patient demonstrated improved balance and was able to stand independently for longer periods. This improvement reflects a greater ability to maintain stability and control posture. The change from an inability to stand independently to the ability to stand independently for longer periods represents a significant improvement in balance. This enhanced stability and reduced risk of falls are critical outcomes of the rehabilitation program, contributing to increased safety and functional mobility. Improved balance allows for greater participation in activities of daily living and reduces the fear of falling, promoting a more active and independent lifestyle. Gait, or the pattern of walking, was evaluated to determine the impact of the rehabilitation program on the patient's ability to ambulate. At the beginning of the program, the patient exhibited circumduction and a reduced step length on the affected side. Circumduction is a compensatory gait pattern where the leg is swung out to the side during walking, often seen in individuals with weakness or limited hip and knee flexion. The reduced step length indicated a shorter distance covered with each step, contributing to a less efficient and potentially unstable gait. Following the four-week rehabilitation program, the patient demonstrated an improved gait pattern with reduced circumduction and an increased step length. This indicates a more normalized and efficient walking pattern, with less reliance on compensatory movements. The change from a gait characterized by circumduction and reduced step length to an improved gait pattern with reduced circumduction and increased step length represents a noticeable improvement. This increased walking efficiency and independence with the use of a cane are significant outcomes of the rehabilitation program. The improvement in gait allows for greater mobility and participation in community activities, enhancing the patient's quality of life. The use of a cane provides additional support and stability, further contributing to safe ambulation. The Functional Independence Measure (FIM) was utilized to provide a comprehensive assessment of the patient's overall functional independence. At the start of the rehabilitation program, the patient presented with lower scores in both the motor and cognitive domains of the FIM. These lower scores reflected a greater need for assistance with both physical tasks and cognitive functions. Following the four-week rehabilitation program, the patient demonstrated a substantial improvement in both the motor and cognitive domains of the FIM. This indicates a broad enhancement in the patient's ability to perform both physical and cognitive tasks independently. The substantial improvement observed in both motor and cognitive domains of the FIM represents a significant improvement in overall

functional independence. This enhanced independence in ADLs is a primary goal of rehabilitation and reflects the program's success in improving the patient's ability to participate in daily life with less reliance on assistance. The FIM provides a comprehensive measure of functional change and highlights the holistic benefits of the rehabilitation program (Table 3).

Table 1. Summary of patients' clinical findings.

Feature	Initial presentation
Patient demographics	72-year-old female
Chief complaint	Sudden onset weakness in left upper and lower limbs
Onset of symptoms	Tingling and numbness progressed to weakness in the left hand and foot after afternoon prayer, one day prior to the presentation.
Past medical history	Six-month history of uncontrolled hypertension. No history of diabetes mellitus, kidney disease, heart disease, hyperuricemia, or hypercholesterolemia.
Social history	Married, two children, lives with youngest child, son-in-law, and grandchildren. Previously worked as a farmer, currently unemployed.
Vital signs (on arrival)	Blood pressure: 150/74 mmHg, Temperature: 36.7°C, Pulse rate: 73 bpm, Oxygen saturation: 98%, Respiratory rate: 18 breaths/minute.
Neurological examination	Conscious and oriented, no cranial nerve deficits. Decreased sensation to light touch and pinprick on the left side of the body compared to the right side.
Musculoskeletal examination	**Right Upper Limb:** Normal range of motion and muscle strength. **Left Upper Limb:** Limited passive range of motion in shoulder, elbow, wrist, and fingers; significantly reduced muscle strength (1/5 MRC scale) in all muscle groups. **Right Lower Limb:** Normal range of motion and muscle strength. **Left Lower Limb:** Limitations in range of motion in hip, knee, ankle, and toes; reduced muscle strength (3/5 MRC scale) in hip flexors and extensors, knee flexors and extensors, and ankle dorsiflexors and plantarflexors.
Functional status	**Barthel Index:** 45/100, indicating moderate disability. Required assistance with bathing, dressing, grooming, limited independence in feeding, and bowel/bladder control.
Diagnostic findings	**Siriraj Stroke Score:** -7.6 (high probability of ischemic stroke). **Brain CT Scan:** Confirmed the presence of a right-sided ischemic stroke. **Complete Blood Tests:** Within normal limits. **Electrocardiogram (ECG):** No acute abnormalities.
Diagnosis	Left hemiparesis secondary to a right-sided ischemic stroke.

Table 2. Comprehensive rehabilitation program following stroke.

Component	Description	Frequency & duration	Key objectives
Therapeutic exercises			
* Passive range of motion (PROM)	Therapist-assisted movement of affected limbs through the full range of motion.	10-15 repetitions, twice daily.	Maintain joint mobility and prevent contractures.
* Active-assisted range of motion (AAROM)	The patient participates in movement with the therapist's assistance.	As strength improves, progression from PROM.	Regain movement in major joints.
* Active range of motion (AROM)	Independent exercises to move affected limbs.	Once sufficient voluntary movement is present.	Improve range of motion and muscle strength.
* Strengthening exercises	Progressive resistance exercises using bands and light weights.	3 sets of 10-12 repetitions.	Increase muscle strength in affected limbs.
* Functional mobilization	Techniques to improve functional movements (rolling, sitting, transfers, standing).	Integrated into daily sessions.	Enhance independence in basic movements.
* Balance training	Exercises for static and dynamic balance, including weight shifting and core stability.	Integrated into daily sessions.	Improve stability and prevent falls.
* Gait training	Practicing walking with assistive devices (walker, cane).	As standing ability improves.	Achieve correct gait pattern and improve walking ability.
Modalities			
* Infrared therapy	Application of infrared light to affected limbs.	20 minutes per session, twice daily.	Reduce pain, improve circulation, promote muscle relaxation.
Functional training			
* Activities of daily living (ADL) training	Occupational therapy focusing on independence in daily tasks (feeding, dressing, etc.).	Integrated into daily sessions.	Improve independence in ADLs using adaptive equipment and strategies.
Support & education			
* Psychological support	Regular sessions to address emotional distress and anxiety.	Integrated into program.	Enhance emotional well-being and coping mechanisms.
* Patient education	Information on condition, therapy adherence, and self-management strategies.	Ongoing throughout program.	Increase understanding and promote active participation in recovery.
Program parameters			
* Program duration	4 Weeks	6 days a week, 2 sessions per day.	intensive rehabilitation period.
* Session length	60-90 minutes	Twice daily (morning and afternoon).	Focused and intensive therapy sessions.

Table 3. Progress and outcomes of the rehabilitation program.

Assessment area	Initial status	Final status (4 Weeks)	Improvement	Key findings
Range of motion (ROM)	Limited ROM in the left upper and lower extremities.	A notable increase in active ROM in the left upper and lower extremities.	Significant improvement.	Increased joint mobility and functional movement.
Manual muscle testing (MMT)	Left upper extremity: 1/5 strength. Left lower extremity: 3/5 strength.	Left upper extremity: Average 3/5 strength. Left lower extremity: Average 4/5 strength.	Significant improvement in muscle strength.	Enhanced ability to perform functional tasks.
Barthel index	45 (Moderate Disability)	85 (Mild Disability)	Improved by 40 points.	Achieved independence in feeding, grooming, and bowel/bladder control; minimal assistance needed for bathing and dressing.
Balance	Poor balance, unable to stand independently.	Improved balance, and ability to stand independently for longer periods.	Significant improvement.	Enhanced stability and reduced risk of falls.
Gait	Circumduction and reduced step length on the affected side.	Improved gait pattern with reduced circumduction and increased step length.	Noticeable improvement.	Increased walking efficiency and independence with a cane.
Functional independence measure (FIM)	Lower scores in motor and cognitive domains.	Substantial improvement in motor and cognitive domains.	Significant improvement.	Increased overall independence in ADLs.

3. Discussion

This case report meticulously details the positive outcomes observed in a 72-year-old female patient who presented with left hemiparesis following an ischemic stroke and subsequently underwent a comprehensive rehabilitation program. The patient's initial condition was characterized by moderate disability, a classification grounded in the presence of significant motor and functional impairments that substantially limited her capacity to engage in activities of daily living. The tailored rehabilitation program, specifically designed to address her unique needs and challenges, incorporated a multifaceted approach. This comprehensive strategy encompassed therapeutic exercises aimed at restoring motor function, functional training focused on enhancing independence in daily tasks, the application of infrared therapy as an adjunct modality, the provision of psychological support to address emotional and psychological well-being, and patient education to

empower the individual to actively participate in her recovery journey. The implementation of this comprehensive rehabilitation program yielded marked improvements across a spectrum of functional domains, including motor function, balance, and the level of independence achieved in activities of daily living.[11-13]

The findings elucidated in this case are consistent with the well-established benefits of comprehensive rehabilitation in the context of post-stroke recovery. The existing body of evidence robustly supports the notion that early and intensive rehabilitation interventions are associated with improved neurological outcomes and enhanced functional independence. The emphasis on early intervention aligns with the concept of neuroplasticity, the brain's inherent ability to reorganize itself by forming new neural connections. Rehabilitation, particularly when initiated early, can harness these neuroplastic mechanisms to optimize functional recovery. The intensity of rehabilitation is also a critical factor, with a greater intensity of therapy often correlating with better outcomes, although the optimal intensity must be individualized to the patient's tolerance and needs. The improvement observed in muscle strength and coordination in this patient can likely be attributed to the combination of passive and active exercises, coupled with resistance and balance training. Passive exercises, by maintaining joint mobility and preventing contractures, lay the groundwork for subsequent active movement. Active exercises, in turn, promote muscle activation and strengthening. The incorporation of resistance training further challenges the muscles, leading to hypertrophy and increased force production. Balance training specifically targets postural control and stability, which are often compromised following stroke. The synergistic effect of these different exercise modalities likely contributed to the positive changes observed in the patient's motor function.[14-17]

Functional mobilization techniques played a crucial role in enhancing the patient's ability to perform daily tasks and transfers. These techniques, by focusing on the specific movements required for everyday activities, facilitate the translation of improved motor function into real-world functional gains. For instance, practicing sit-to-stand transfers, bed mobility, and other essential movements enables the patient to regain independence in these critical activities. The emphasis on functional training ensures that the rehabilitation program is not solely focused on impairment-level improvements but also on enhancing the patient's ability to participate in meaningful activities. Infrared therapy, utilized as an adjunct to the exercise program, may have contributed to pain reduction and muscle relaxation, thereby facilitating greater participation in the rehabilitation sessions. Pain is a common sequela of stroke and can significantly hinder participation in rehabilitation. Modalities such as infrared therapy, by addressing pain, can improve the patient's comfort and willingness to engage in therapy. Muscle relaxation is also beneficial, as it can reduce spasticity and improve range of motion. While the specific contribution of infrared therapy in this case cannot be isolated, its potential role in supporting the overall rehabilitation process is plausible.[18-20]

4. Conclusion

In conclusion, this case report highlights the effectiveness of a comprehensive rehabilitation program in improving motor function and independence in a patient with left hemiparesis following an ischemic stroke. The rehabilitation strategy, which included therapeutic exercises, functional training, infrared therapy, psychological support, and patient education, led to significant improvements in the patient's range of motion, muscle strength, balance, and ability to perform activities of daily living. These positive outcomes underscore the critical role of tailored and comprehensive rehabilitation programs in enhancing recovery and improving the quality of life for individuals following an ischemic stroke. The findings align with existing evidence supporting the benefits of early and intensive rehabilitation interventions in optimizing neurological

outcomes and promoting functional independence. The improvement in motor function can be attributed to the synergistic effects of various exercise modalities, including passive and active exercises, resistance training, and balance training. Functional mobilization techniques facilitated the translation of improved motor skills into real-world functional gains, while infrared therapy may have contributed to pain reduction and muscle relaxation, further supporting the rehabilitation process. This case emphasizes the importance of a multidisciplinary approach in stroke rehabilitation, addressing not only physical impairments but also psychological and educational needs. The positive results demonstrate the potential for significant functional recovery even in older adults with stroke, highlighting the need for continued investment in and access to comprehensive rehabilitation services. Further research, including larger studies and randomized controlled trials, is warranted to further validate these findings and to optimize rehabilitation strategies for stroke survivors.

5. References

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