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Impact of physiotherapy rehabilitation in functional recovery of the patient following hemiplegic stroke: A case report

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ABSTRACT

A stroke is commonly defined as a neurological dysfunction due to abrupt vascular damage to the central nervous system (CNS). Ischemic stroke develops because of a thrombotic or embolic episode that lowers blood flow to the brain. To avoid harming the brain and worsening the outcome, intervene as soon as possible. The main aim of this case study is to explain the rehabilitation process following the episode of a stroke in order to gain early recovery and functional independence for the patient. Here a 75-year-old man complained of weakness in his right upper and lower extremities, as well as a deviation of his mouth angle and slurred speech since 8 days. He was diagnosed with right hemiplegic stroke after further investigations including Computed Tomography (CT scan) and Magnetic Resonance Imaging (MRI) and was managed conservatively. He was then referred to the neuro-physiotherapy department for further management. He was started with physiotherapy rehabilitation which was planned for 12 weeks which aimed for functional recovery of the patient following stroke and to gain functional independence. During this rehabilitation program patient gained affected upper limb control, upper and lower limb strength, basic functional mobility, improvement in gait, dynamic and static standing balance following episode of stroke.

Keywords: Physiotherapy rehabilitation, stroke rehabilitation, pnf approach, ischemic stroke, stroke

1. INTRODUCTION

A stroke is commonly defined as a neurological dysfunction caused by abrupt vascular damage to the CNS (French et al., 2016). A thrombotic or embolic event that reduces blood flow to the brain induces an ischemic stroke. A thrombotic event occurs when the blood supply to the brain is reduced due to vascular dysfunction, which is commonly caused by atherosclerosis, arterial dissection, fibromuscular dysplasia, or an inflammatory illness. When debris

from another region of the body obstructs blood flow via the affected artery, an embolic event result (Hui et al., 2023). Stroke is the world's second-greatest cause of mortality and the third-largest cause of disability. 68 percent of all strokes worldwide are ischemic, whereas 32 percent are hemorrhagic (Chugh, 2019).

In India, the yearly incidence of stroke was predicted to be between 105 and 152/100,000 individuals (Jones et al., 2022). Hemorrhagic and ischemic strokes are the two most basic types of strokes. About 80% of strokes are ischemic, but the relative frequency of hemorrhagic versus ischemic stroke varies depending on the community (Boehme et al., 2017). When blood vessels burst inside the brain or near its surface, it causes either intraparenchymal or subarachnoid strokes. The following categories-etiologic subtypes have been used to further categorize ischemic strokes: Cardioembolic, atherosclerosis, lacunar, other specific causes (dissections, vasculitis, particular hereditary illnesses, etc.), and strokes with no known etiology (Boehme et al., 2017).

Although there are similarities and differences between the risk factors for ischemic and hemorrhagic stroke, there are also distinctions among the etiologic types of ischemic stroke. High blood pressure greatly increases the chance of bleeding in the brain, but it can also lead to plaque build-up that blocks blood flow and causes ischemic stroke (Boehme et al., 2017). The clinical manifestation of a stroke is characterized by the area of the brain affected by obstruction of the arteries. Stroke clinical signs include sudden paralysis or numbness of especially of one side of face, arm and leg. Sudden confusion and difficulty speaking or comprehending speech, sudden visual disturbances in one or both eyes, troublesome walking, dizziness, loss of coordination or balance, sudden acute headache with no known reason (Chugh, 2019).

Early physiotherapy rehabilitation after stroke has significant effect in improving functional outcomes of the patients. During rehabilitation, task-oriented training can help to enhance functional mobility in a natural setting. The goal of task-oriented training is to improve the control strategy by resolving problems using a variety of approaches. Stroke patients perform a variety of movements during task-oriented training and learn to eliminate inappropriate movements, enhancing their capacity to adapt. It has been observed that task-oriented training can help stroke patients improve their balance, mobility, and task performance abilities (Timmermans et al., 2014).

2. CASE PRESENTATION

A 75-year-old male working as a farmer presented at a hospital with complaints of weakness in the right upper and lower limb since 8 days which was sudden in onset and gradually progressive. He also complained of deviation of the angle of the mouth to the right side along with the slurring of speech for 8 days. Then investigations such as CT and MRI of the brain were performed which were suggestive of ischemic changes to the left side of the brain with acute infarct in left corona radiata, lentiform nucleus and posterior limb of internal capsule, Intraparenchymal hemorrhage in the left thalamus, head of a caudate nucleus and lentiform nucleus which resulted in the right-sided hemiplegic stroke, this was suggested in the CT scan and MRI findings (Figure 1). He had a history of diabetes mellitus and hypertension since the last 15 years and no history of head trauma. He was then managed conservatively with medications and was referred to the Physiotherapy Department for further treatment.

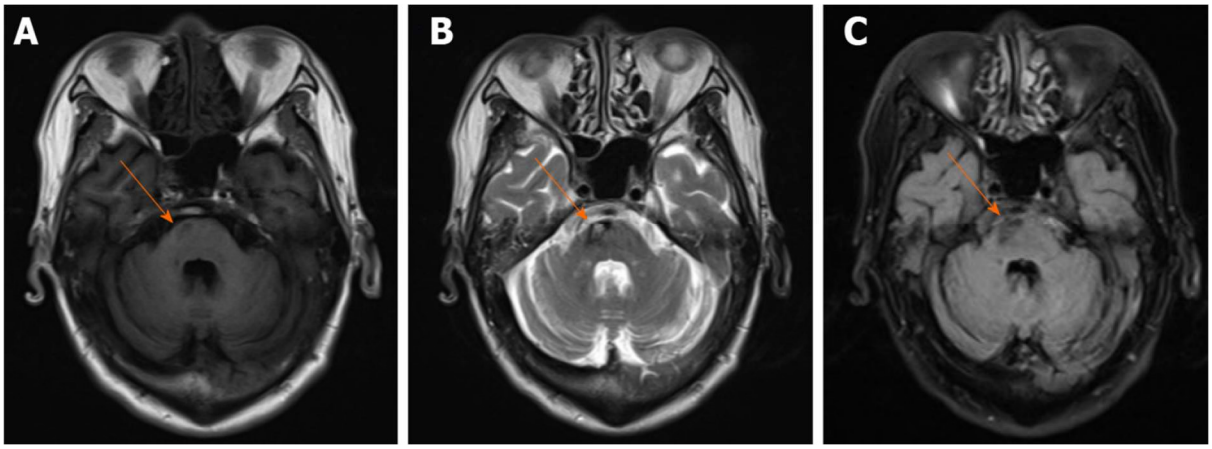

Figure 1 (A, B and C) Brain Magnetic resonance angiography revealed arteriosclerosis in bilateral siphon arteries

3. CLINICAL FINDINGS

The patient was explained about physical examination and intervention. He was conscious and oriented to time, place, and person. General examination findings were as a heart rate of 78 bpm, blood pressure of 146/88 mmHg, and a respiratory rate of 11 breaths

per minute. Musculoskeletal system examination findings revealed weakness in the right upper and lower limb. On neuromuscular system examination, he presented with an asymmetric gait pattern, impaired balance, and motor control. After examining the tone, he was in grade 1 on the modified Ashworth scale.

Manual Muscle Testing (MMT) was performed to evaluate the strength of the right upper and lower extremity and it was found to be reduced (shoulder flexion and abduction, elbow flexion-extension, wrist flexion-extension and similarly hip flexion-abduction, knee flexion-extension, and ankle dorsiflexion was in grade 3/5 of MMT). Range of motion (ROM) of the right upper and lower limb was also found to be reduced. Sensations were tasted over the right upper and lower limb and he had impaired light touch sensation. Communication was impaired as the patient has mild oropharyngeal dysphasia, requiring extra time to verbalize his thoughts.

Fugl-Meyer assessment (FMA) scale score-0/66, Trunk impairment scale - 0/23, DGI- 17/24, Coordination Tests: Non-equilibrium tests- Activity impossible, Equilibrium Tests- Grade 1 (activity impossible). The patient had an episode of stroke on the date 15th of May 2022, following which he visited the hospital on the 18th of May 2022 and after coming to the hospital underwent the investigation and imaging on the 20th of May 2022 after which he undergone the medical treatment and started with the physiotherapy rehabilitation on 3rd of June 2022. The timeline of incidents is mentioned in (Table 1).

Table 1 Timeline

Date of CVA	15/5/22
Date of visiting hospital	18/5/22
Date of Investigations and imaging	20/5/22
Physiotherapy rehabilitation started on	3/6/22

Diagnostic Assessment

MRI Brain: Acute infarct in left corona radiata, lentiform nucleus and posterior limb of internal capsule, Intraparenchymal hemorrhage in left thalamus, head of caudate nucleus and lentiform nucleus, Age related atrophy with small vessel ischemic disease. Color Doppler Study of bilateral Internal Carotid Artery: RIGHT: Shows calcified plaque on posterior wall, thickness of 3mm at bifurcation of artery, causing narrowing approximately 40% and LEFT: Shows calcemic plaque, calcified at bifurcation causing thickness of 1.8mm, without significant narrowing.

Therapeutic Intervention

Patient was started with planned physiotherapy rehabilitation after 2 weeks of his episode of stroke. The patient underwent an intensive rehabilitation program for 1.5 hours per day 6 days per week, over a period of 12 weeks, which focused on improving basic functional mobility, trunk control, gait, dynamic and static standing balance, and in affected side strength and range of motion which will help patient return to functional activities and to perform activities of daily living independently. Patient was initially started with right upper and lower limb passive range of motion exercises in a pain-free range with 1 set of 10 repetitions. Positioning in the bed and bed mobility activities were taught to the patient.

Proper positioning in bed helps in preventing development of contractures during spastic stage. Bed mobility activities included rolling to both sides using the sound limb. Patient was also taught pelvic bridging to improve trunk control, to relieve pressure on buttocks, initial bed mobility and to help initiate supine to sit transfers. He was also started with mirror therapy, electrical stimulation, and facilitatory techniques. In mirror therapy, patient was taught to place his sound limb outside the mirror box and affected arm inside the box and to do hand therapy exercises with his non affected hand, with focusing his vision on the reflection in the mirror.

Electrical stimulation to the major muscles like deltoid, biceps and wrist flexor-extensors and in lower limb hamstring, quadriceps and calf muscles were started within the ranges of 15-25 mA and 25-35 Hz which was given for 20 minutes in each session. Facilitatory techniques were given like quick icing, tapping and joint compression over the muscle belly. Patient was taught supine to sit leading from both the sides with more emphasis on raising with more involved side leading with assistance given initially during transfer. After that treatment was focused to improve the sitting balance of the patient.

Initially patient was started with low frequency with shifts, symmetrical weight bearing on both hips as well as activities that promotes more use of affected side were encouraged and weight bearing on more affected hip during sitting. Perturbations in sitting position and sitting on Swiss ball was started to improve static sitting balance and after it was progressed to improve dynamic balance by giving activities such as reach outs in different directions in sitting position. After this focus was to improve

right upper extremity function. Passive to Active assisted movements of right upper extremity were started. Interventions at the shoulder girdle included Active ROM exercises such as shoulder flexion, extension, internal rotation, and external rotation.

The Active Assisted ROM exercises were performed using a cane and progressing to a weighted bar and included shoulder flexion and external rotation. These exercises were performed at 2 sets of 5-8 repetitions; they were progressed to 3-4 sets of 8-12 reps. Initially PNF began at the shoulder girdle to assist with scapular elevation, protraction, retraction, upward rotation and downward rotation. PNF was applied to the Left wrist and hand in order to train hand opening and closing. Proprioceptive neuromuscular facilitation (PNF) started at 2 sets of 5 reps and progressed up to 10 reps.

Resistive exercises included the use of resistive thera band. The patient's exercises were geared toward improving left upper extremity strength. D1 and D2 PNF patterns exercises were used to resistively train the patient as well as improve motor control and sequencing. These exercises were performed at 2 sets of 5-8 reps and progressed accordingly. The patient began with a low resistance red thera band and progressed up to higher resistance.

When the patient gained some active control of right upper extremity, Task-Oriented Approach was given to the patient to gain functional control of right upper extremity. At 3-4 days of the treatment more functional exercises were implemented and were geared toward multi-directional reaching and grasping. The patient reached above, below and across the body while reaching to grasp items of different shapes, sizes and diameters. These exercises began in sitting and progress to standing. This intervention was performed for 2-4 sets of 8-12 reps 2x/wk.

The lower extremity therapeutic exercises like stretching for hamstrings and heel cords were performed for approximately 20 minutes per session 5 times per week. Over-ground gait training was performed 5 days/week with least restrictive assistive device. The patient worked on distance and ambulation quality, he was progressed by using less supportive assistive devices, dual tasking, head turns, uneven surfaces and stepping over obstacles. Backward or side walking was performed in the parallel bars for 2-3 sets with bilateral rail hold 5 days/week, as this intervention was geared toward improving gait mechanics and symmetry.

Verbal and tactile cues were given during the interventions to improve biomechanics, symmetry, and sequencing. Static balance was trained by having the patient stand with wide and narrow base of support as well as tandem stance with arms crossed for 30-40 seconds. This was done for 2 sets and progressed from a soft matt to a thick foam surface. To train dynamic balance exercises were aimed toward having the patient walk 10m cone obstacle courses. The 10 m courses contained different types of surfaces such as compliant, downward sloped, upward sloped or uneven surfaces. The courses also contained objects the patient needed to step over or around, these objects were of different shapes, sizes, and heights.

To progress these exercises the patient was asked to speed up, slow down, turn head (right, left, up or down) as well as repeat the alphabet or answer questions (dual tasking). This intervention was both to improve static and dynamic balance as well as the patient's confidence (Interventions given like lower limb stretching, PNF approach and sit to stand activity are in (Figure 2) and gait training and upper extremity exercises given are in (Figure 3)). During this rehabilitation program patient gained affected upper limb control, gained upper and lower limb strength, gained basic functional mobility, improved in gait, dynamic and static standing balance, and in affected side strength and range of motion. He decreased his dependency on assistive devices throughout the intervention.

Patient's pre and post outcome measures have been taken and are in (Table 2). Outcome measures used in this study are modified Ashworth scale which helped to measure the improvement in the tone and spasticity of the patient pre an post intervention, upper extremity Fugl-Meyer scale helped to evaluate and measure the recovery of the patient after stroke, trunk impairment scale evaluates the impairment of the trunk and its recovery after stroke and dynamic gait index helps to assess the gait, balance and fall risk of the patient after stroke.

Table 2 Outcome Measures

Outcome Measures	Pre-test score	Post-test score
Modified Ashworth Scale	¼	0/4
Upper Extremity Fugl-Meyer Assessment Scale	0/66	60/66
Trunk impairment scale	0/23	20/23
Dynamic Gait Index	17/24	23/24

Figure 2 Treatment given - PNF approach, lower limb stretching, sit to stand activities

Figure 3 Patient started with gait training and upper extremity exercises

4. DISCUSSION

In this case study patient presented with a complaint of right upper and lower limb weakness due to the episode of left hemiplegic stroke. He was managed conservatively with medications and was referred to physiotherapy for further treatment. After this he underwent physiotherapy rehabilitation for 12 weeks and during this rehabilitation program patient gained affected upper limb

control, gained upper and lower limb strength, gained basic functional mobility, and improved in gait, and dynamic and static standing balance. He decreased his dependency on assistive devices throughout the intervention. Early intervention will help prevent brain damage and adverse outcome.

The trunk exercises primarily focused on selective trunk movements may have contributed to the improvements in trunk control. These exercises also increased awareness of trunk position and anticipatory postural adjustments, which both contributed to the development of good trunk control and helped to strengthen the trunk muscles. In the study done by Karthikbabu et al., (2011), he investigated how trunk rehabilitation affected patients with chronic strokes in terms of trunk control, balance, and gait. The study revealed that gait metrics had a smaller effect size than the Trunk Impairment Scale (1.75) and Berg Balance Scale (1.65). (0.65) after trunk therapy, cadence and gait speed significantly improved.

According to the study, trunk workouts are crucial for stroke patients' rehabilitation (Karthikbabu et al., 2011). A study done by Patten et al., (2006) and Pollock et al., (2014) has proved that high resistance training and integrated functional task practice have improved upper extremity function in post-stroke patients. Thus, in this case, study, following rehabilitation after an episode of stroke helped the patient to gain functional independence as well as helped him to perform activities of daily living (ADLs) independently.

5. CONCLUSIONS

In this case study, physiotherapy that was given had a significant effect on improving upper extremity function and trunk control. During this rehabilitation program patient gained affected upper limb control, gained upper and lower limb strength, gained basic functional mobility, improved in gait, and dynamic and static standing balance. He decreased his dependency on assistive devices throughout the intervention. Early intervention helps prevent brain damage and adverse outcome. The trunk exercises primarily focused on selective trunk movements have contributed to the improvements in trunk control. These exercises also increased awareness of trunk position and anticipatory postural adjustments, which both contributed to the development of good trunk control and helped to strengthen the trunk muscles. Thus, this rehabilitation program helped patient in functional recovery following the stroke and to gain functional independence.

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Ethical approval

NA

Informed consent

Written & amp; Oral informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

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Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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