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Impact of Non-Electrotherapeutic Stroke Rehabilitation in a Patient with Permanent Pacemaker - A Case Report

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ABSTRACT

Background: Stroke is a leading cause of long-term disability worldwide, with motor impairment being a major consequence. Electrotherapeutic modalities are often used in stroke rehabilitation to enhance motor recovery, reduce spasticity, and facilitate functional improvement. However, in patients with implanted cardiac devices such as pacemakers, electrotherapy poses potential risks due to electromagnetic interference. This case report highlights the effectiveness of a purely non-electrotherapeutic rehabilitation protocol in a stroke patient with a permanent pacemaker.

Case Presentation: A 68-year-old male with a history of hypertension and atrial fibrillation suffered a left middle cerebral artery (MCA) ischemic stroke resulting in right-sided hemiparesis. The patient also had a permanent pacemaker implanted two years prior. Given the contraindication of electrotherapy, a comprehensive rehabilitation plan without any electrotherapeutic interventions was implemented.

Intervention and Outcome: The rehabilitation protocol emphasized neurodevelopmental treatment (NDT), task-specific training, proprioceptive neuromuscular facilitation (PNF), and functional mobility exercises. Over an eight-week period, the patient demonstrated marked improvements in muscle tone, motor control, balance, and independence in activities of daily living (ADLs), as measured by the Fugl-Meyer Assessment and Barthel Index.

Conclusion: Non-electrotherapeutic rehabilitation can be an effective alternative in stroke patients contraindicated for electrotherapy due to pacemaker implantation. Tailored interventions focusing on neuroplasticity and functional re-training can result in meaningful clinical recovery.

Keywords: Stroke rehabilitation, pacemaker, non-electrotherapeutic, neuroplasticity, hemiparesis, physiotherapy

INTRODUCTION

Stroke is defined as an episode of neurological dysfunction caused either by focal cerebral, spinal, or retinal infarction, is a global health problem and fourth leading cause of disability worldwide.[1]Rehabilitation plays a vital role in facilitating recovery by promoting neuroplasticity, improving functional outcomes, and reducing long-term disability. A systematic review done by Debeuf et al concluded that electrotherapy in combination with physiotherapy has

positive effects on lower limb muscle strength and skeletal muscle characteristics in patients recovering from stroke.[2]

Interactions between cardiac rhythm devices (CRDs) and physical therapy procedures involving potential sources of electromagnetic interference (EMI) have been documented for several decades.[3-5] Currently, there are no established international policies governing the use of physiotherapy modalities in patients with Cardiac Rhythm Devices (CRDs), and consequently, no specific guidelines exist for local implementation. A review of existing literature and recommendations from CRD manufacturers indicates that modalities such as TENS, diathermy, and interferential electrical stimulation are generally discouraged in these patients. However, due to the lack of consensus, it may be feasible to administer these treatments safely under appropriate conditions, with careful monitoring of both the patient and the device. While further research is necessary, effective collaboration between physiotherapists and CRD clinic physicians can support the safe use of most physiotherapy modalities in this population.[6]

This case report presents the rehabilitation journey of a stroke patient with a permanent pacemaker, where a customized non-electrotherapeutic approach led to significant functional recovery.

MATERIALS & METHODS

A 68-year-old right-handed male presented to the rehabilitation department three weeks after experiencing an ischemic stroke. His medical history included poorly controlled hypertension and chronic atrial fibrillation, and he had undergone permanent pacemaker implantation two years earlier due to symptomatic bradycardia. The stroke affected the left middle cerebral artery territory, resulting in right-sided hemiparesis, facial asymmetry, and expressive aphasia. On neurological examination, motor power was graded as 2/5 in the right upper limb and 3/5 in the right lower limb according to the MRC scale. Muscle tone was graded as 1+ on the Modified Ashworth Scale in the right elbow and knee flexors, with brisk deep tendon reflexes on the right side. Sensory examination revealed decreased proprioception and light touch on the right. The patient demonstrated poor static and dynamic sitting balance and was non-ambulatory. Functional assessment using the Barthel Index yielded a score of 30/100, indicating severe dependence.

The diagnosis was ischemic stroke involving the left MCA territory with right hemiparesis. The patient had a dual-chamber permanent pacemaker implanted two years prior. MRI of the brain showed an infarct in the left frontal and parietal lobes. Functional assessments revealed a Fugl-Meyer Motor Assessment score of 29/100 and a Berg Balance Scale score of 8/56, while the Timed Up and Go test could not be performed due to the patient's non-ambulatory status.

The rehabilitation program was conducted over a duration of eight weeks, with five sessions per week, each lasting 45–60 minutes. The treatment plan excluded electrotherapeutic modalities and focused on non-electrotherapeutic interventions. Neurodevelopmental treatment techniques were used to facilitate midline orientation and trunk control in sitting, along with guided weight-bearing through the affected limbs and mirror therapy for upper limb activation. Task-oriented functional training included practice of bed mobility, sit-to-stand transitions, and step transfers, along with reaching activities in different planes and repetitive functional tasks such as grooming and feeding. Proprioceptive neuromuscular facilitation techniques were applied using diagonal movement patterns to promote coordinated limb movements, with emphasis on rhythmic initiation and hold-relax techniques to manage muscle tone.

Balance and core stability training involved exercises such as ball sitting, dynamic reaching, and supported standing,

progressing to unsupported standing and balance board activities. Gait training was initiated using parallel bars with an ankle-foot orthosis, along with verbal and tactile cues to improve step symmetry and cadence. Occupational therapy focused on retraining activities of daily living, including dressing, grooming, and toileting, and incorporated fine motor tasks using therapy putty and peg activities. Speech therapy addressed expressive aphasia through naming, repetition, and writing exercises. Psychosocial support and family education were provided, including counseling on realistic goal setting and home safety.

Electrotherapy modalities such as NMES, FES, TENS, and ultrasound in the chest or shoulder region were avoided due to the risk of electromagnetic interference with the pacemaker. Cardiology clearance was obtained prior to initiating rehabilitation, and the patient's vital signs and heart rhythm were closely monitored throughout the therapy sessions.

Statistical Analysis

Descriptive statistical analysis revealed substantial improvements across all outcome measures following 8 weeks of non-electrotherapeutic rehabilitation. The Fugl-Meyer Assessment improved from 29 to 69 (137.9% increase), while the Barthel Index increased from 30 to 80 (166.7% improvement), indicating enhanced functional independence. Balance scores on the Berg Balance Scale improved from 8 to 38 (375% increase), reflecting a significant reduction in fall risk. Muscle strength improved by 1.5–2 grades on the MRC scale, and spasticity reduced from Modified Ashworth Scale grade 1+ to 0–1. Timed Up and Go improved from non-testable to 38 seconds, demonstrating regained ambulatory ability. These findings indicate clinically meaningful recovery despite the absence of electrotherapeutic modalities.

RESULT

Following 8 weeks of structured non-electrotherapeutic rehabilitation, the patient demonstrated substantial improvements across motor, functional, and balance domains, as illustrated in Figures 1–3.

The **Fugl-Meyer Assessment (Figure 1)** showed a marked improvement from a baseline score of 29/100 to 69/100 post-intervention, indicating a **40-point increase (137.9%)** in motor recovery. This change reflects significant restoration of voluntary motor control in both upper and lower extremities.

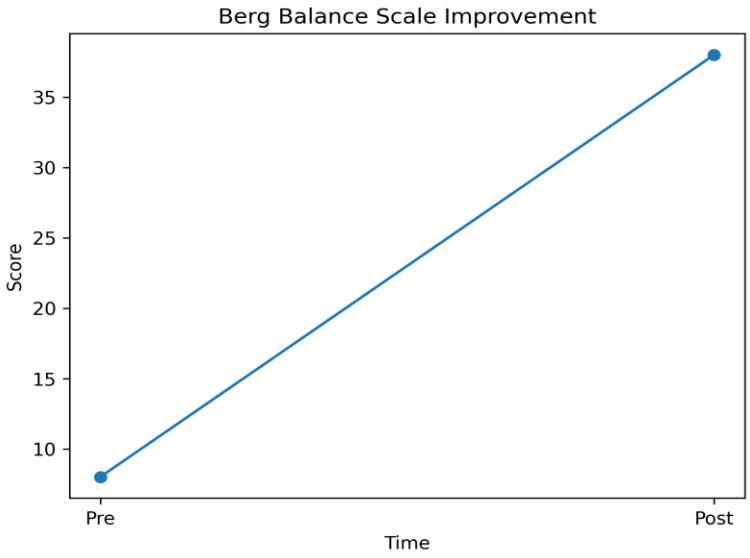
Functional independence, assessed using the **Barthel Index (Figure 2)**, improved from 30/100 at baseline to 80/100 after the intervention period, representing a **50-point gain (166.7%)**. This transition signifies a shift from severe dependency to moderate independence in activities of daily living.

Balance performance, measured using the **Berg Balance Scale (Figure 3)**, increased from 8/56 to 38/56, demonstrating a **30-point improvement (375%)**. This substantial gain indicates enhanced postural control and a clinically meaningful reduction in fall risk.

Additionally, the patient progressed from being non-ambulatory at baseline to achieving assisted ambulation (15–20 meters with a quad cane) by the end of the intervention. The **Timed Up and Go (TUG) test**, which was initially not feasible, was recorded at 38 seconds post-rehabilitation, reflecting regained functional mobility.

Muscle strength improved from **2/5 to 4/5 in the upper limb** and **3/5 to 4+/5 in the lower limb** (Medical Research Council grading), while muscle tone normalized from **Modified Ashworth Scale grade 1+ to 0–1**, indicating reduced spasticity.

Overall, the graphical trends demonstrate consistent and clinically meaningful improvements across all outcome measures, supporting the effectiveness of a non-electrotherapeutic rehabilitation approach in this patient.


Berg Balance Scale Improvement
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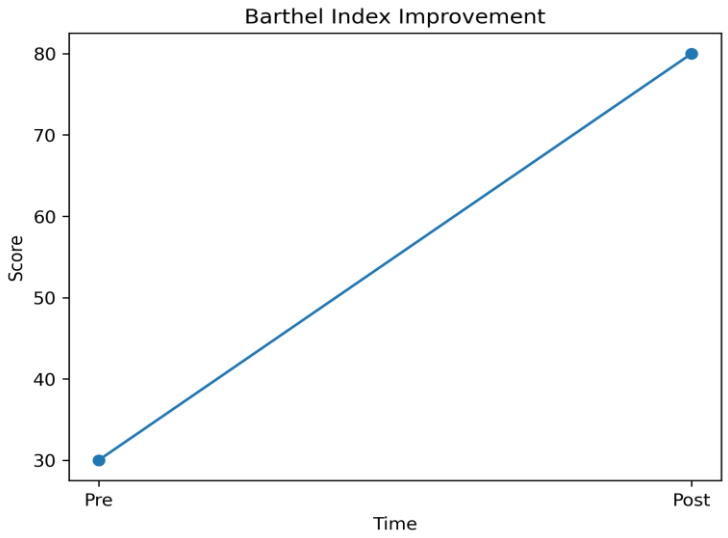
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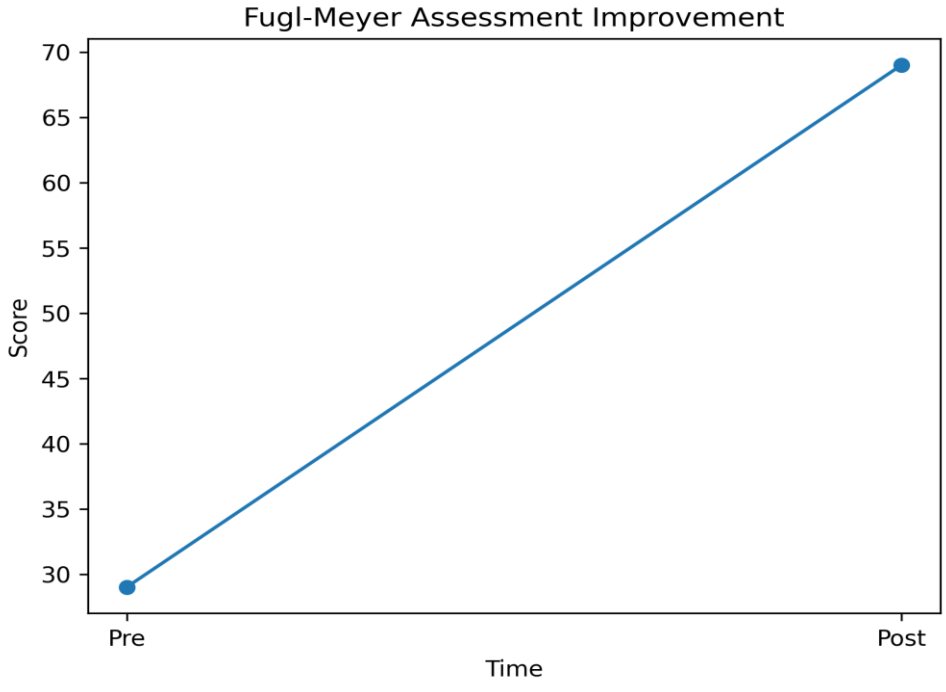
Fugl-Meyer Assessment Improvement
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DISCUSSION

Electrotherapy is widely used in stroke rehabilitation, especially for neuromuscular re-education. However, its use in patients with cardiac pacemakers is controversial. While modern pacemakers have better shielding, the risk of inappropriate sensing remains, especially with high-frequency or poorly placed electrodes.[4]

This case underscores the potential of non-electrotherapeutic methods to achieve significant neurological and functional recovery. Neurodevelopmental and task-oriented strategies encourage motor relearning through cortical reorganization and use-dependent plasticity.[5] PNF and balance training further enhanced coordination and proprioceptive feedback.

Although electrotherapy may offer benefits, this case illustrates that when it is contraindicated, conventional methods can still be effective. The progress in this patient supports existing literature on neuroplasticity and the role of intensive, meaningful, and repetitive task training.

Limitations

Being a single case, the findings cannot be generalized. Long-term follow-up and comparison with patients receiving electrotherapy would help validate these outcomes.

CONCLUSION

This case demonstrates that non-electrotherapeutic rehabilitation approaches can yield substantial improvements in motor function and independence in stroke patients with a permanent pacemaker. Tailored, patient-centered therapy focusing on neurodevelopmental and task-based methods should be considered a safe and effective alternative when electrotherapy is contraindicated.

Declaration by Authors

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