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Neurodevelopmental Treatment (NDT) Approach for Improving Balance in the Hemiplegic Stroke Patient: A Comprehensive Case Study

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ABSTRACT:
Background: Stroke is the second leading cause of death and a significant contributor to disability worldwide. The prevalence of stroke is highest in developing countries, with ischemic stroke being the most common type. Considerable progress has been made in our understanding of the pathophysiology of stroke and the underlying mechanisms leading to ischemic insult. Stroke therapy primarily focuses on restoring blood flow to the brain and treating stroke-induced neurological damage. Pre-clinical and clinical care improvements will likely underpin successful stroke treatment, recovery, rehabilitation and prevention. The Bobath approach, also known as neurodevelopmental treatment (NDT), is a widely used concept in the rehabilitation of stroke patients with hemiparesis in many countries. This technique has been operated for years worldwide; however, strong evidence of its usefulness remains absent.
Methodology: In this case study, by applying the Bobath approach, the researcher saw a significant change in his patient regarding movement, posture, balance, and coordination.
Results: After seven (07) days of therapeutic intervention, the goal was achieved as reasonable postural control in sitting and standing, which was not during the assessment day. Now, the patient has been walking with minimum support and less compensatory movement present on the opposite side, but during the assessment, he required maximum support and could not walk. He needs more therapeutic intervention for independent walking. He also had limited movement in his Right upper limb.
Conclusion & Recommendation: Neurodevelopmental Treatment (NDT) is a practical treatment approach for stroke rehabilitation, especially for improving movement, posture, balance and coordination. For this case, the Physiotherapist must be more involved in his gait reeducation and upper Limb complications to achieve optimal levels of functional and ADLs status like grasping objects with his hand, carrying objects while maintaining proper alignment, etc.

Introduction

Stroke is a neurological disorder characterized by blockage of blood vessels. Clots form in the brain and interrupt blood flow, clogging arteries and causing blood vessels to break, leading to bleeding. Rupture of the arteries leading to the brain during stroke results in the sudden death of brain cells owing to a lack of oxygen. Stroke can also lead to depression and dementia [1].

Stroke is the second leading cause of death globally. It affects roughly 13.7 million people and kills around 5.5 million annually. Approximately 87% of strokes are ischemic infarctions, a prevalence which increased substantially between 1990 and 2016, attributed to decreased mortality and improved clinical interventions. Primary (first-time) haemorrhages comprise the majority of strokes, with secondary (second-time), haemorrhages constituting an estimated 10–25% [2]. The incidence of stroke doubled in low- and middle-income countries over 1990–2016 but declined by 42% in high-income countries over the same period. According to the Global Burden of Disease Study (GBD), although the prevalence of stroke has decreased, the age of those affected, their sex and their geographic location mean that the socio-economic burden of stroke has increased over time [3].

The incidence of stroke increases with age, doubling after the age of 55 years. However, in an alarming trend, strokes in people aged 20–54 years rose from 12.9% to 18.6% of all cases globally between 1990 and 2016. Nevertheless, age-standardized attributable death rates decreased by 36.2% over the same period [3–5]. The highest reported stroke incidence is in China, where it affects an estimated 331–378 individuals per 100,000 life years. The second-highest rate is in Eastern Europe (181–218 per 100,000 life years) and the lowest in Latin America (85–100 per 100,000 life years) [3].

Neurodevelopmental therapy (NDT), commonly referred to as the Bobath technique, is a widely accepted concept in many countries for the rehabilitation of hemiparesis stroke victims. This method has been utilized for many years worldwide, yet there is still a lack of conclusive proof supporting its value [6,7]. Bobath approach works on the different types of movement dysfunctions and is based on the active involvement of the patients so that they can develop motor control. Manual handling is holding the patient at specific proprioceptive points, for example, joint compression and distraction, so that patients can respond actively to perform functions. Manual handling can be of different types and is slowly removed to make the patient independent in motor activities. This type of therapy incorporates improved functional control and independence [8]. NDT/Bobath concept has been recognized as a treatment for stroke patients with impaired balance and movement dysfunction, and this study helped to find out its efficacy is required to account for its extensive use by physiotherapists.

Case Description

Mr. X, a 65-year-old right-handed gentleman, work as a farmer. There was a history of Cardio Vascular Accident on 30th May 2020 in the evening with right-sided hemiplegia. Before his incidence, He had been suffering from hypertension for the last 6 months. The patient lives in an urban area with his family in a muddy house, but due to a stroke, he was not able to do his daily activities independently, like transferring from bed to sit or bed to chair. He cannot move his right upper limb and lower limb independently. His clinical finding was poor postural control in seating and standing as he shifted his body toward the Left and more weight bearing on the left side. He took conservative management from a Neurologist and was referred to the Centre for the Rehabilitation of the Paralysed (CRP) for better rehabilitation management.

Diagnosis

(a) Functional Movement Analysis

i) A stability task - (Sitting and Standing)

Patient can sit independently with more slouch posture, asymmetrical shoulder and right shoulder more depressed than the Left side, less weight bearing of Right pelvic and right foot, less contact with the ground with trunk compensation. He can stand with moderate external support on his Left Hand and pelvis—more compensatory movement than sitting (Figure 01).

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Figure 01: Initial Sitting Position

ii) **A mobility task** - (transfers wheelchair to bed, Bed to Wheelchair; sit to stand- stand to sit): He can transfer from the wheelchair by using his Left U/L and moderate external support. The same compensatory movement occurs due to sitting and standing.

iii) **A manipulation component** - (Reaching and grasping in a sitting position): When he does selective movement, his compensation is less than mobility and stability tasks.

iv) **Sensorimotor performance -** His vision and vestibular sensation seem to be expected, but his tactile skin sense got reduced, absent 2-point discriminations; after Joint proprioception, his gravireceptors go downward, forward, on his right side due to weakness. Extensor thrust is present in sitting and standing due to excessive trunk activity. The ability to move the right shoulder is reduced due to soft tissue stiffness, possibly due to associated reactions in the U/L, trunk, and pelvis. Sit-to-stand and active standing abilities are dependent on poor core muscle activity, asymmetrical weight bearing on foot, and less efficiency of both affected and non-affected lower limbs.

(b) Postural control:

i) **Sitting:** The patient's base of support is asymmetrical. His foot is loosely touching with the ground, his Right foot is externally rotated, and more weight is borne on the lateral side and his foot arch is increased. Both Knees are flexed, and the right side is more externally rotated. The hip is flexed, and the right hip is externally rotated. The pelvis was mildly posterior tilted and right-side oblique. Lumbar lordosis decreased, thoracic spine curvature was more kyphotic, and the right side was more flexed. The upper trunk was slouched posture. The right shoulder level is lower than the Left shoulder, and the inferior angle of the Right scapula goes more laterally and downward with the slightly protruded neck.

ii) **Standing:** The patient cannot stand independently. During his independent standing, he falls down due to poor core muscle, weakness of the Right lower limb, loose contract with the right foot, and inability to maintain his centre of mass in a fixed position. While standing with external moderate, his centre of mass shifted backwards and towards his left shoulder and hip area. The associated reaction increased both feet, increased inversion of the right ankle, and less foot contact at the medial side and left knee. Poor activity core muscle and right side more downward than the Left side. The trunk seems slough and has a kyphotic posture. The right shoulder seems forward and depressed, the Right scapula is winging, the medial border is upward and more laterally from the spine, and the Right UL is internally rotated. Neck is flexed in position and shoulder to right side shoulder and it seems forward and depressed (Figure 02).

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Figure 02: Initial Standing Position

iii) **Sit to Standing:** Lack of good foot contact on the ground makes him unstable; lack of core activity gives him less pelvic and trunk control and increased associated reaction on the right side. Lack of concentric control of hip and pelvic muscles makes his COM go Left downward. Loss of dorsi flexion on Right L/L, less selective hip and knee flexion. Extensor thrust makes more compensation in the upper trunk and right U/L.

(c) Skilled Facilitation:

i) Manual: Correction of sitting posture, more active sitting posture, pelvic lateral shifting, and linear extension at the lower part of multifidus and upper part of multifidus at the trunk. Scapular setting and soft tissue mobilization of the forearm, wrist, hand, and finger make the afferent system active and reduce compensatory activity. Correction of standing posture, relieving gastrocnemius and soleus, along with foot preparation, sit-standing exercise, and controlled and facilitated core muscles in standing all make him more active in standing.

ii) Verbal: Full cognitive awareness and verbal communication ability make manual activity easy and efficient.

iii) Environment: Both feet make contact on the surface; the hand was supported by the bed, either a table or a 3rd person at the front, which makes him reduce the compensation of the scapula, upper trunk, and pelvis seem more efficient sitting.

Treatments

Table 01: Bobath treatment approach to improve balance by Physiotherapist

SL	Treatment	Clinical Reasoning
1.	Foot preparation	Improving afferent information will increase the **patient's** body schema**, leading to more accurate feed-forward commands for movement and improved single-leg** stance [9]. Foot preparationin both feet **relaxes his intrinsic muscle, reduces Lt LL hyperactivity, and increases** Rt foot muscular activity. **It** giveshim sensory **and proprioceptive information, helps him grasp the ground better, and improves** confidence.
2.	Lateral Pelvic Shifting	Try to facilitate **the Right side because the** Right side is weak. Improved selective movement of **the pelvis (AP and PA) increases weight transfer and hip extension during gait, leading to improved knee and foot control and an** increase inheel strike. Improved symmetry of pelvic movements leads to better weight shift towards **the** hemi leg during gait. This will **increase** stance time on the hemi side, leading to improved gait symmetry.
3.	Linier extension (Figure 03)	Releasing tight multifidus **aligns between the transverse process of the spine that restricts full extension of lumber and** thoracic along with trunk mobilization. **It is all about fascinating, more active sitting and**

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		standing.
4.	Stand To Sit & Sit to Stand (Figure 04)	**Properly** controlled **sit-to-stand and stand-to-sit** practice **gives him good motor control of concentric and eccentric muscles**.
5.	Stop Standing	**Gradually create weight-bearing lower limb posture** with posterior pelvic tilt**, selective building up, and** knee extension. Strengthens right lower limb extensors. Coordination and control between concentric and eccentric activity. Facilitation of right proximal hamstring and TA activity to stabilize pelvis with CHOR improving afferent information to the CNS**,** limiting the activation of compensatory strategies elicited by **more significant** degrees of postural sway [10].
6.	Scapular Setting	**Gradually e**stablish active stable scapula. For **the** creation of glenohumeral joint external rotation and UL extension without compensation of scapula. Creation of length in pectoralis major and latissimus dorsi, activation of triceps for selective elbow extension.

Figure 03: Activation of leg and foot in supine

Figure 04: Linear Extension of lumber Spine

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Figure 05: Sit to stand and stand to sit

Outcome Measurement

Table 02: Outcome measurement after completing rehabilitation (Berg Balance Scale)

SL. No.	Item Description	InitialSore	Discharge Score
1	Sitting to standing	1	3
2	Standing unsupported	2	4
3	Sitting unsupported feet on the floor	3	4
4	Standing to sit	2	3
5	Transfers	1	4
6	Standing unsupported with eyes closed	1	2
7	Standing unsupported with feet together	0	2
8	Reaching forward with outstretched arms	1	3
9	Pick up objects from the floor	2	2
10	Turning to look behind/over left and right shoulders	1	2
11	Turn 360 degrees	0	1
12	Count the number of times step touch measured stool	1	2
13	Standing unsupported, one foot in front	1	3
14	Standing on one leg	0	1
	Total score	16	36

The maximum score would be =56.
Interpretation: (0-20) = Wheelchair-bound; (21-40) = walking with assistance, 41-56) = Independent. After the treatment session, the patient's BBS score was 36. According to the scale, a patient needs walking with assistance.

Discussion

It has become increasingly apparent that the integrity of the somatosensory system is critical for motor recovery following stroke [11]. Postural control is a sophisticated motor ability contingent on the interplay of many sensorimotor processes with environmental and functional settings [12].

Light touch can potentially improve long-term function by facilitating proper postural musculature recruitment needed to maintain a voluntary upright stance. In calm standing, light touch lowers postural sway: sensory augmentation can be pretty successful, entirely suppressing the enhanced sway associated with the left leg, for example (over-activity). The relationship of the head to the trunk is another crucial aspect of balance management. Neck postural muscles give proprioceptive feedback, transforming muscular lengthening and shortening into muscle tone. Integrating feedback concerning head and body orientations aids in postural control regulation. Patients with reduced somatosensorial may rely more heavily on visual and vestibular input. Rehabilitation's function in facilitating motor recovery is produced by promoting brain plasticity [13]. The idea of plasticity as a form of behavioural adaptation (learning) is linked to a change in synapse function [14]. The structure and function of intact brain areas are reshaped during recovery after cortical injury, determined by the individual's sensorimotor experiences in the weeks to months following injury. The severity of the stroke is critical: early intervention appears to aid brain plasticity [15]. For proper posture regulation, information from primarily three sensory modalities must be integrated: somatosensory (70%) afferents, vestibular (20%) afferents, and visual (10%) afferents [16].

The central nervous system integrates this sensory feedback and subsequently generates a corrective, stabilizing torque by selectively activating tonic muscles [17]. A common problem that may develop is acquired sensory loss due to a lack of appropriate use of somatosensory information. Excessive reliance on visual input may be a learned compensatory response that occurs over time. Maintaining standing balance involves a mixture of reactive (feedback) and predictive (feedforward) control processes associated with anticipatory postural adjustments. Setting these adjustments may involve an internal forward model that predicts the consequences of movement.

Conclusion

This case study showed that the neurodevelopmental treatment (NDT) significantly improves movement, posture, balance and coordination of stroke patients with hemiplegia by seven sessions once daily for 45 minutes each. In quantitative evaluation, the researcher got a Berg Balance score of 16 before and 36 after treatment. However, the patient still needs more sessions further to achieve the goal of walking independently.

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Conflict of Interest

The authors have declared that he has no conflicts of interest with anyone.

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