The Effect of Coordinated Locomotor Training in Pontine Haemorrhagic Stroke – A Case Report

Dr. Priyanka Nahak[1], Nchumbeni M[2], Suchithra D.M[3]

[1]*Assistant Professor, Alva's College Of Physiotherapy & Research Centre, Moodabidri, Karnataka, Rajiv Gandhi University Of Health Sciences (RGUHS), Bengaluru, India*

[2,3]*Post Graduate Student MPT Neurology, Alva's College Of Physiotherapy & Research Centre, Moodabidri, Karnataka, Rajiv Gandhi University Of Health Sciences (RGUHS), Bengaluru, India*

***Abstract*- Pontine haemorrhagic stroke, a rare but severe form of stroke, poses significant challenges in rehabilitation due to its impact on critical neural pathways. Patients often suffer from impaired motor function, balance, and coordination, which necessitates a comprehensive and tailored rehabilitation approach. This case report explores the effect of coordinated locomotor training on the recovery of a patient who suffered from a pontine haemorrhagic stroke.**

A 52-year-old male presented with sudden onset of dizziness, dysarthria, and hemiparesis, and was subsequently diagnosed with a pontine haemorrhagic stroke. Initial assessments revealed significant deficits in motor function, gait, and balance. The patient underwent a structured and individualized coordinated locomotor training program aimed at improving gait, balance, and functional mobility.

The coordinated locomotor training was administered over a [duration] period, comprising [frequency] sessions per week. The program included a combination of treadmill training, overground walking exercises, balance training, and the use of assistive devices. Progress was monitored through regular assessments using standardized motor function scales and gait analysis.

Post-intervention assessments indicated significant improvements in the patient's gait speed, balance, coordination, voluntary control. The patient demonstrated enhanced coordination and a marked reduction in gait abnormalities. No adverse events were reported during the course of the intervention.

This case report suggests that coordinated locomotor training may be an effective rehabilitation strategy for patients recovering from pontine haemorrhagic stroke. The observed improvements in motor function and gait highlight the potential benefits of this approach in promoting neuroplasticity and functional recovery. Further studies with larger sample sizes are recommended to validate these findings and explore the underlying mechanisms

INTRODUCTION

Stroke is defined as an accident to the brain with rapidly developing clinical signs of focal or global disturbance to cerebral function, with symptoms lasting 24 hrs or longer or leading to dead, with no apparent cause other than of vascular origin and includes cerebral infarction, intracerebral haemorrhage and subarachnoid[1]. Stroke is a major cause of death and disability worldwide. According to the World Health Organization (WHO), around 15 million people suffer from stroke each year, with approximately 5 million dying and another 5 million being permanently disabled[2]. Studies suggest that the prevalence of stroke in India varies widely across different regions and populations[3]. Common risk factors contributing to the high prevalence of stroke in India include hypertension, diabetes mellitus, tobacco use, smoking, unhealthy diet, physical inactivity, and air pollution[4]. These factors are compounded by an increasing aging population and urbanization. Hypertension is highly prevalent among stroke patients[4]. Studies indicate that approximately 70% of stroke cases are associated with hypertension[5].

Traditionally stroke is classified into two broad categories of stroke syndrome (I) haemorrhagic and (II) ischemic stroke[6]. Ischemic stroke, occurs when a blood clot blocks or narrows an artery in the brain, Haemorrhagic stroke, is when a weakened blood vessel ruptures and bleeds inside the brain[2]. Haemorrhagic stroke are of two types: subarachnoid haemorrhage which compromise around 5% of all

strokes and intracerebral haemorrhage which accounts for 10% of all strokes[6].

Pontine haemorrhage comprises approximately 10% of intracerebral haemorrhage with an estimated mortality rate ranging widely from 30% to 90%[7]. A study of patients with pontine haemorrhage indicated that PH due to the cavernous malformation had a more benign course and was associated with more favourable long outcome than PH due to hypertension[7]. There is an inherent presumption of poor outcome associated with pontine haemorrhage due to hypertension[8]. Symptoms like balance difficulty, dysphagia, dizziness, double vision, loss of coordination numbness slurred speech vertigo, hemiparesis and cognitive dysfunctions are seen in PH depending on the localization and size of haemorrhage[7].

CASE PRESENTATION

Patient Information

A 52-year-old male came to Alva's college of physiotherapy OPD with complaint of weakness in his left upper and lower limbs for the past five months, significantly impacting his ability to perform activities of daily living. He is an employee in the timber industry with his hand dominant as right. His medical history reveals hypertension which is managed with medication for the past three years. The patient's symptoms began suddenly on one night, when he experienced sweating, dizziness, and subsequently lost consciousness. Then he was taken immediately to a nearby hospital where he got admitted. NECT scan was done, which revealed an acute intraparenchymal haemorrhage involving pons with small intraventricular extension into fourth ventricle and mild perilesional edema with pre pontine cistern, and a chronic lacunar infarct of the right corona radiata. After regaining consciousness four days later, the patient suffered from temporary memory loss and was hospitalized for 17 days where physiotherapy treatment was continued. After discharged from hospital he started taking oil massage and ayurvedic treatments for 2 months before being advised to seek physiotherapy.

Clinical Examination and Findings

Before progressing for examination, a written consent form was taken from the patient. Observational analysis revealed that patient was mesomorphic with independent mode of ambulation. No swelling and tropical changes found in patient. Postural analysis of the patient revealed that there was slight head rotation towards right side, depressed left shoulder, retracted left side pelvis, left hip external rotation, with left knee hyperextension. Muscle tone of right side is normal whereas left side is described in table -1. ROM of left side is described in table.2. his gait pattern indicated genu recurvatum with a step length of 36cm and a stride length of 65cm, walking at a cadence of 60 steps per minute. His muscle tone showed slight hypertonia with a catch/release at the end range of motion, and muscle strength assessments indicated significant weakness, particularly in the left upper and lower limbs. Sensory examinations were within normal limits and cranial nerve assessment did not reveal any abnormalities.

Table.1 MUSCLE TONE

Muscles Tone	Left side
SHOULDER	
Flexors	1+
Extensors	1
Abductors	1+
Adductors	1
ELBOW	
Flexors	1+
Extensors	1+
Wrist	
Flexors	1+
Extensors	1+
Hip	
Flexors	1+
Extensors	1+
Abductors	1
Adductors	1
Knee	
Flexors	1
Extensors	1
Ankle	
Dorsi flexors	1+
Plantar flexors	1

Table.2 RANGE OF MOTION

JOINT ROM	Left side

Shoulder	
Flexors	0-85
Extensors	0- 30
Abductors	0-80
Adductors	80-0
Elbow	
Flexors	0-110
Extensors	110-0
Wrist	
Flexors	0-60
Extensors	0-50
Hip	
Flexors	0-90
Extensors	0-30
Abductors	0-45
Adductors	45-0
Knee	
Flexors	0-95
Extensors	95-0
Ankle	
Dorsi flexors	0-15
Plantar flexors	0-20

Table.3 MUSCLE STRENGTH

Voluntary control	Upper limb	Lower limb
Grade	2	3

INVESTIGATIONS	FINDINGS
MRI	• Late Sub acute intraparenchymal hemorrhage in the pons • Chronic lacunar infarcts in the bilateral lentiform nucleus • Multiple micro haemorrhages scattered in the bilateral cerebral and cerebellar hemispheres, bilateral basal ganglia and bilateral thalami
NCET	• Acute intraparenchymal hemorrhage involving the pons • Chronic lacunar infarct of left corona radiata

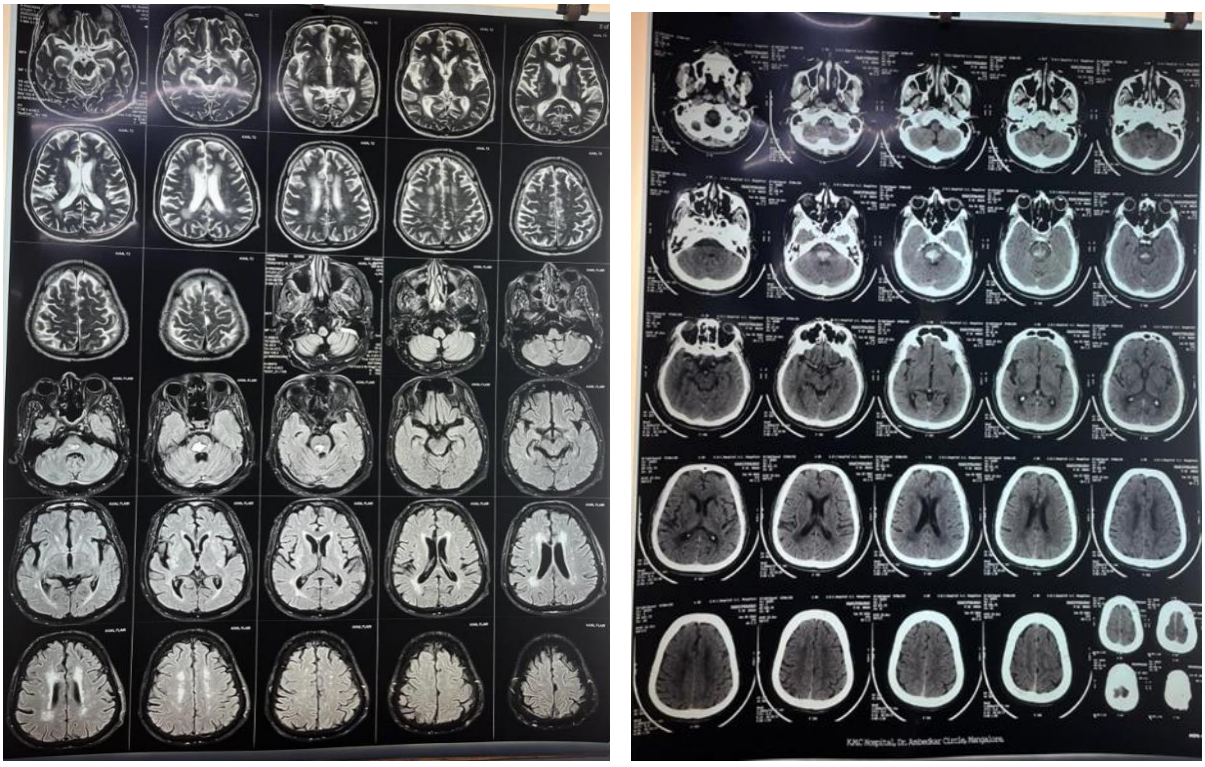


Fig 1- MRI Findings

Body structure and function	Activity Limitation	Participation Restriction
• Left corona radiata • Pons • Lentiform nucleus • Decreased strength of upper and lower limb. • Balance	• Difficulty in self-care activities like dressing, bathing	• Social gathering

Short Term Goals	Long Term Goals
• Patient and Family Education • To Maintain ROM of all the joints • To Normalize Tone • To Increase Strength of Upper limb, Lower limb and Core • To Maintain the muscle property • To reduce risk of secondary impairment	• To maintain ROM and improve strength • To improve static and dynamic balance • To correct gait pattern • To reduce risk of fall • To improve Quality of life

Diagnosis

The patient was diagnosed with a left hemiparetic stroke based on clinical findings and imaging studies, including MRI and NECT scans, which showed late subacute intraparenchymal haemorrhage in the pons, chronic lacunar infarcts in bilateral lentiform nuclei, and multiple microhaemorrhages. These findings corroborated the patient's symptoms and functional impairments.

PHYSIOTHERAPY MANAGEMENT

The primary goal of physiotherapy for this patient was to enhance functional independence and improve the strength, coordination, and balance necessary for ADL. The physiotherapy management plan was comprehensive and targeted both short-term and long-term goals. Initially, the focus was on educating the patient and his family about the condition and the importance of adhering to the prescribed exercises. Energy conservation techniques were also discussed to help manage fatigue.

CONVENTIONAL TREATMENT

To reduce tone functional stretching training was given for both upper and lower extremity for 3 times a week over a period of 4 week, for improving strength exercises including straight leg raises (SLR) with weight cuffs, clamshell exercises with theraband exercise, 1.5 kg dumbbells for shoulder strengthening, and various lower limb strengthening activities using therabands.. To improve balance the following foam pad training was used.

Exercise	Description
Double-stance standing	Repeat twice with eyes open, twice with eyes closed with 30 sec hold
Single leg stance	Stand on one leg with the other placed midway up the calf and hold it for 20 sec with eyes open and with eyes closed
Free-leg swinging	Stand on left leg while moving the right leg slowly forward, side and back. Switch legs and repeat 3 times, then again with eyes closed Initially, participants may slide feet over the floor
Heel and toe raises	Rock slowly up onto toes and hold, then roll back onto heels and hold Repeat 3 times with eyes open, 3 times with eyes closed
Neck and trunk rotation	Stand while slowly rotating the neck and trunk Repeat 3 times with eyes open and 3 times with eyes closed
Touching the floor	Touch the floor while squatting down Repeat 5 times with eyes open and 5 times with eyes closed
Sideways walking	Walk sideways, bringing the trailing foot just up to the lead one Repeat 5 times with eyes open for approximately 7-m distance
Forward walking	Walk forward without looking at the ground Repeat 5 times with eyes open for approximately 7-m distance
Ball throwing	Ball throwing with eyes open for 10 times and eyes closed with 10 times


Fig 2- Heel raise on foam pad Fig 3- Single leg stance on foam pad

SPRINTER AND SKATER EXERCISE

Four weeks of sprinter and skater exercises has been given. The four basic postures used for CLT program are (supine, bridge, sitting, and standing) along with gait training. The total duration for training was 30 min per day, 5 days in a week for 4 weeks. 20 min of for the four postures (5 min each) and 10 min for gait training. The sprinter and skater patterns were performed for 2 min and 30 sec for each pattern in supine, bridge, sitting, and standing postures. The sprinter pattern was performed by imitating a runner's movement, including the flexion-adduction-external rotation pattern in the paralyzed upper limb and the extension-abduction-internal rotation pattern in the lower limb of the same side. For the opposite upper limb, the extension-abduction-internal rotation pattern was applied, and for the lower limb of the same side, the flexion-adduction-external rotation pattern was applied. The skater pattern was performed by imitating the skater's actions, including the flexion-abduction-external rotation pattern in the paralyzed upper limb and the extension-adduction-external rotation pattern in the lower limb of the same side. For the upper limb on the opposite side, the extension-adduction-internal rotation pattern was applied, while the flexion-abduction-internal rotation pattern was applied on the lower limb on the same side. If the patient was unable to raise the paralyzed upper or lower limb to execute the pattern properly in each posture, therapist's assistance was provided. For gait training marching, tandem walking, forward and backward walking, obstacle crossing, staircase climbing, and lateral step up/down exercises were given.

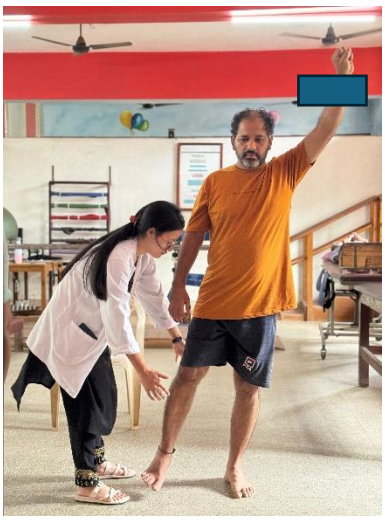


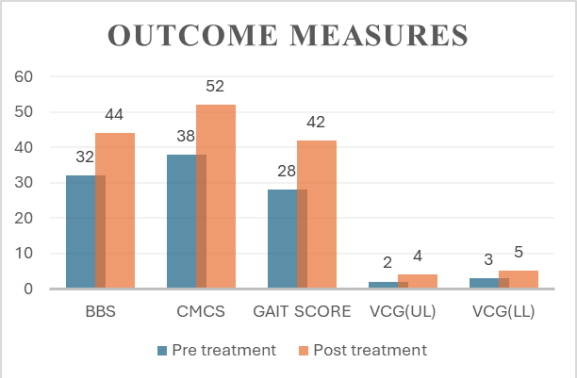
Fig 4- Left side skater technique Fig 5- Left side sprinter technique Fig 6- Left arm sprinter pattern

RESULTS

This study used both conventional and novel approach to treat a patient with pontine haemorrhage. After 4 weeks of training balance, coordination, gait function, voluntary control grading has been improved. Table 4 shows the pre and post training improvement.

Table.4 OUTCOME MEASURES

Outcome measures	Pre treatment	Post treatment
BBS	32	44
CMCS	38	52
GAIT SCORE	28	42
VCG(UL)	2	4
VCG(LL)	3	5



DISCUSSION

The results from this case study demonstrate the potential efficacy of coordinated locomotor training (CLT) in the rehabilitation of a patient with pontine hemorrhagic stroke, which resulted in significant improvements in motor function, balance, and gait. The patient showed marked progress in terms of gait speed, balance, and coordination, with no adverse events. These outcomes align with the growing body of research that highlights the effectiveness of CLT in neurorehabilitation.

Pontine hemorrhagic stroke is rare and particularly debilitating, leading to significant impairments in motor function, coordination, and balance. As this case study illustrates, the use of a structured and individualized rehabilitation approach that includes CLT can facilitate recovery by promoting neuroplasticity and improving functional mobility. Studies have shown that early and targeted interventions, such as those using CLT, are crucial for the recovery of motor functions in stroke patients.

Eun et al. (2023) showed that the combination of PNF (Proprioceptive Neuromuscular Facilitation) sprinter and skater patterns significantly improved both static and dynamic balance, as well as walking ability, in stroke patients. This is attributed to the improved coordination of limb and trunk movements, which is crucial for gait rehabilitation. Similar to the present case, this study demonstrated that by engaging both the upper and lower limbs in a coordinated manner, stroke patients can achieve significant gains in motor control and functional mobility [9].

Kim et al. (2006) focused on the role of resistive exercises in stroke rehabilitation. Their study highlighted how exercises that engage stronger muscles to support weaker ones (in close-chain states) can enhance overall muscle strength and function. This approach, which mirrors the coordinated activities used in CLT, was found to be effective in improving muscle coordination and strength in both the upper and lower limbs, similar to the improvements noted in the current case [10].

Previous research suggests that balance training performed using a foam rubber pad improves proprioception in the lower limbs and the sensitivity of the cutaneous receptors in the soles. These adaptations may explain why balance training performed using a foam rubber pad effectively improved balance [11].

The coordinated locomotor training program applied in this case led to substantial improvements in motor function, balance, and gait, reinforcing the potential benefits of such a rehabilitation strategy for pontine hemorrhagic stroke patients. These findings are consistent with recent studies that highlight the importance of early, targeted, and structured rehabilitation approaches in promoting functional recovery after stroke. The integration of both dynamic and static training methods, coupled with close monitoring of progress, appears to be critical for optimizing outcomes.

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