International Journal of Science and Healthcare Research
[Indexed, Peer-Reviewed Journal]
Vol. 10; Issue: 1; January-March 2025
Website: ijshr.com
Case Report *ISSN: 2455-7587*

Physiotherapy Approach to Improve Neuroplasticity in Cryptococcal Meningitis in Post Renal Transplant Recipient: A Case Report

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DOI: https://doi.org/10.52403/ijshr.20250130

ABSTRACT

Background: Cryptococcal Meningitis is an opportunistic infection caused by Cryptococcus neoformans. It has been reported to be an important cause of morbidity and mortality in solid organ transplant recipients. Common manifestations of the disease are of pulmonary and central nervous systems (CNS).

Case description: We report a case of 21-year-old female, who is known case of cryptococcal meningitis post renal transplant. Clinically, she had symptoms of reduced muscle strength of bilateral lower limbs, paresis of left leg, impaired balance, generalised weakness, headache and blurred vision. On examination lower limb muscle strength, hand grip strength and balance were reduced. Functional independence score was 37 on FIM (Functional Independence Measure) scale, which suggests that patient is fairly dependent for daily activities. We programmed tailor-made rehabilitation to improve neuroplasticity and thus the functional independence.

Purpose: To study the effect of physiotherapy rehabilitation in a rare case of cryptococcal meningitis.

Methods: Physiotherapy was started in the ICU empirically to increase mobility and prevent secondary complications in the form of positioning, passive exercises and breathing exercises and continued in wards more aggressively with protocols to improve balance and muscular strength for 8 weeks.

Result: 8 weeks of physiotherapy rehabilitation showed significant improvement in muscle strength, balance, and functional independence. We saw significant improvement in hand grip strength, lower limb manual muscle testing, balance and FIM score (90).

Conclusion: Structured physiotherapy treatment along with medications can improve symptoms of cryptococcal meningitis in solid organ transplant patients.

Keywords: *Physiotherapy, Neuroplasticity, Cryptococcal meningitis, Solid organ transplant, Physiotherapy in Renal Transplant, Functional independence.*

INTRODUCTION

Meningitis is the inflammation of meninges, these are 3 membranes (the dura mater, arachnoid mater and pia mater) that line the vertebral canal and skull enclosing the brain and spinal cord. [1] the aetiology can be infectious and non – infectious processes such as autoimmune disorder, paraneoplastic syndrome/cancer, drug reactions. Infection can be caused by several species of bacteria, viruses, fungi and parasites.[1] Cryptococcus species are encapsulated yeasts responsible for broad range of infections. Two major species are Cryptococcus neoformans and Cryptococcus gattii. Meningoencephalitis due to cryptococcal infection is the most serious manifestation [2]. Post renal transplant patients are on immunosuppressants medications, which is an important risk factor for cryptococcosis. Overall incidence of cryptococcosis in solid organ transplant recipients ranges from 0.2%- 0.5%[3]. In majority of cases occurrence is due to inhalation of organism from environmental sources. Diagnosis is made with antigen testing from serum or cerebrospinal fluid (CSF) or culture or histopathology from infected tissues [3]. Symptoms with CNS cryptococcosis are headache, nausea, vomiting, fever, malaise, altered mental status, cranial nerve dysfunction, body pain and neck stiffness [3]. Meningitis irrespective of cause can result in vasculitis of cerebral vessels which can lead to thrombosis and ischemic stroke resulting into musculoskeletal weakness [4]. In presented case MRI report shows multiple ischemic infarcts, which are leading cause of paresis, vision loss, memory and learning difficulties and altered balance and co-ordination. Physiotherapy is well reported for discussed traits for improving symptoms by improving neuroplasticity. Plasticity is a vital aspect of rehabilitation for individuals recovering from bacterial meningitis. It refers to the brain's ability to reorganize and form new neural connections to compensate for damaged areas. In meningitis, inflammation can impair cognitive and motor functions, to reverse that making rehabilitation strategies that promote neuroplasticity essential. These strategies, such as task-targeted exercises, sensory stimulation, and cognitive tasks, encourage the brain to rewire itself, helping restore lost functions. Rehabilitation focuses on optimizing neural pathways to improve cognitive and motor skills. This process highlights the importance of personalized interventions tailored to the individual's specific needs for effective recovery [5].

CASE REPORT

A 21-year-old female had undergone orthotropic cadaveric renal transplant on 26th June 2023 & was re-admitted to institute of kidney disease and research center on 1st January 2024, as her creatinine level was increased to 2.4mg/dl. Renal biopsy showed acute thrombotic microangiopathy. Medications were started accordingly with daily follow-ups in wards. After two months, convulsion was seen in form of clenching of teeth (3-4 episodes), and she was then shifted to ICU. Following that, symptoms of headache, blurring of vision and irritability started, patient was also having altered mental status. Repetitive MRI brain showed meningeal enhancement with lesions of ischemic infarcts and CSF investigation done for Cryptococci antigen which came positive on 22nd March 2024, after which antifungal medications- Amphotericin B started. On physiotherapy examination in the ICU, patient had generalized muscular weakness, decreased tone of lower limb muscles (grade-1+), absent deep tendon reflexes of lower limbs and decreased lower limb muscle strength. According to oxford grading of manual muscle testing hip flexors and extensors of bilateral lower limb were grade 1 (visible and palpable contraction), hip abductors, adductors and knee flexors and extensors were grade 2 (full range of motion in gravity eliminated plane) and grade 1 in right and left lower limb respectively. Hand grip strength was 7.3 kg of dominant hand. Balance was checked with berg balance scale, which showed high fall risk with the obtained score of 10. FIM scale showed total assistance requirement in self-care, mobility,

transfer and locomotion components with the obtained score 37 out of 126. Ophthalmologist confirmed that the vision deficit was due to meningeal inflammation and not due to cranial nerve lesions, however cranial examination showed negative results, for treatment purpose that was not taken into consideration.

Table 1: Summary of Neurological Assessment

Superficial sensation	**Intact**	**Level of consciousness**	**GCS-15**
Deep sensation	Intact	Cognition	Mini-mental state examination (MMSE): 27 (normal score: 25-30)
Cortical sensation	Intact	Perception	Body scheme/Agnosia/Apraxia – NAD
Tone	Hypotonia (1+ grade)	Optic nerve	Patient is not able to read Snellen's chart due to absent vison in left eye and blurred vision in right eye.
Deep tendon reflexes	Not elicited (0-grade)	Oculomotor nerve	Pupil accommodation with light (normal response)
Babinski sign	Absent	Vestibulocochlear nerve	Balance is affected

Table 2: Summary of MMT Assessment

Upper limb	Right	Left
Shoulder flexors- extensors	3	3
Shoulder adductors- abductors	3	3
Elbow flexors -extensors	4	4
Wrist flexors- extensors	4	4

Core muscles	Grade
Rectus abdominis (curl up) & Transverse abdominals	3

Lower limb	Right	Left
Hip flexors	1	1
Hip extensors	1	1
Hip abductors	2	1
Hip adductors	2	1
knee flexors -extensors	2	1
Dorsiflexors	3	3
Planter flexors (modified position)	4	4

INTERVENTIONS

Physiotherapy was designed according to patients' tolerance level. With increased grade of Manual Muscle Testing, active movements and functional training was incorporated. For first two weeks, exercises were given in wider base of support with maximum support of therapist and caregiver. From third week, patient was encouraged to fulfil given activities and exercises with minimal / no assistance.

Table 3: Summary of Intervention

	GOALS	**INTERVENTION**
Week 1 (patient was in ICU- in altered sensorium and not following commands)	Prevention of bedsore and pulmonary complications Maintenance of musculoskeletal integrity	*-Positioning* *-Rolling in bed* *-Nebulization were given as per need with chest physiotherapy (PT) sessions* *-Passive limb PT for B/L upper limbs*

		and lower limbs
Week 2 (in the ICU- vision was lost in left eye and blurred in right eye- patient started co-operating better)	Prevention of further complications	*- Incentive spirometer cc/second)* *-Early mobilization*
	Enhancement of active movements by providing sensory and tactile stimulation	*- Sensory stimulation for lower limbs (taught to relatives for 2 hourly repetition)* *- Joint approximation* *- Supported long sitting in bed*
	To progression of musculoskeletal integrity	*- Assisted range of motion exercises for bilateral upper limb* *- Passive range of motion exercises for bilateral lower limb*
Week 3-5 (shifted to wards)	Enhancement of active movements Improving balance	*-Active limb PT for B/L upper limb* *-Active assisted limb PT for B/L lower limb* *-Unsupported sitting* *-Reach outs (patient is asked to reach out for therapist hands by following sound of claps as cue)* *- Vestibular balance conditioning exercises (supine- sitting- standing cervical movements)*
Week 6 – 8	Further improvement in balance and functional independence Transfer and walking	*-Active LPT for B/L upper limb and limb (gravity eliminated plane)* *-Core strengthening by abdominal muscles activation* *-Isometric exercise for quadriceps and gluteus muscles* *-Bridging (partial)* *-Unsupported standing* *-Weight shifting and pertubations* *-Standing reach outs* *-Walking with support*

Figure: 1(Assisted Hip Flexion)

Figure: 2(Reach outs in Unsupported sitting)

Figure: 3 (Standing with support and Gait training)

Figure: 4 (Incentive Spirometry)

Figure: 5 (High-sitting Knee Extension)

RESULT

After 8 weeks of rehabilitation, there was notable improvement in muscle strength balance and functional independence. Oxford grading of manual muscle testing for hip flexors - extensors- abductors & adductors of left lower limb were only grade 1 (visible/ palpable contraction of muscle), which increased to grade 3 (full range of motion against gravity).

Similarly knee flexors and extensors of left limb were also grade 1, improved to grade 3. Balance was just score 10 on berg balance scale (high fall risk), improved to score 39 (medium fall risk). Hand grip strength was reduced to 7.3 kg, which reached to 15kg. FIM score was 37/126 at first, increased to score 90/126 (higher the score, higher independence).

Table 2: Summary of Recovery

	1st - 2nd week	*3rd- 4th week*	*5th – 6th week*	*7th- 8th weeks*
Limb movements	UL- assisted LL- passive	UL- active LL- active assisted	UL- active LL- active in gravity eliminated plane	UL- with minimum free weights LL- active against gravity
Bed mobility	Maximum assistance	Moderate assistance	Minimal assistance	Independent
Supine- sit	Completely dependent	Moderate assistance	Minimal assistance	Minimal assistance
Sit- stand	Did not attempt	Attempted with 2-person support	Able to stand up with 1-person support	Able to stand up with 1- person support
Gait	Did not attempt	Did not attempt	Standing with support and spot marching	Walking with walker support

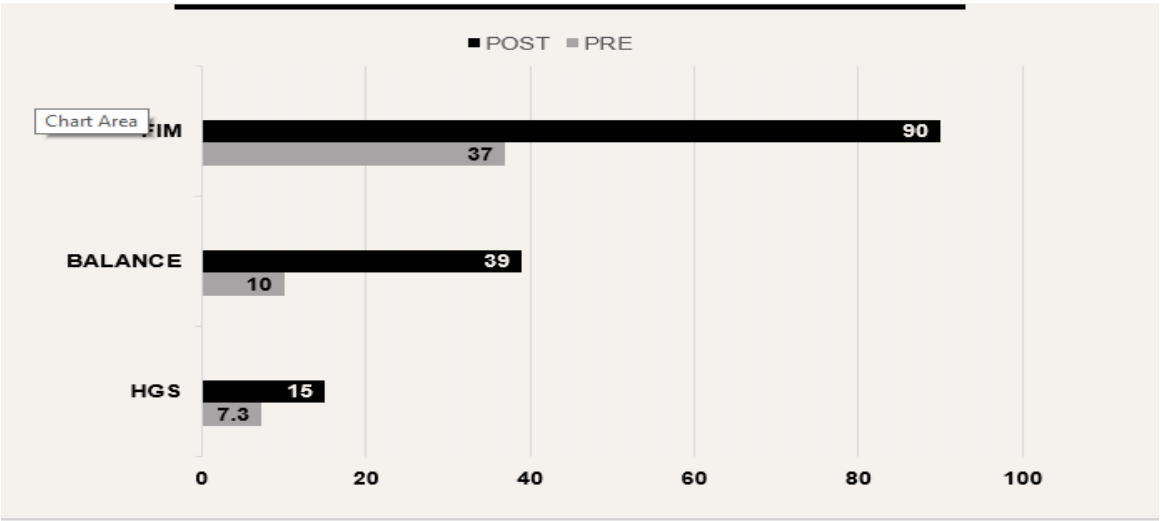

Figure:7- Graph illustrating pre and post physiotherapy evaluation of FIM, Balance & HGS

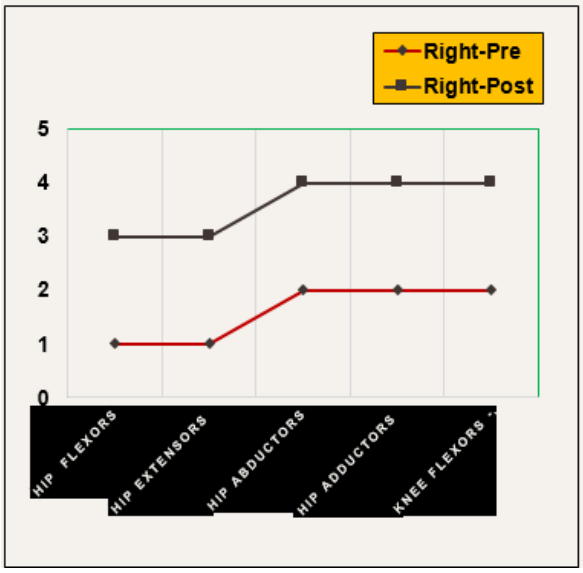

Figure:7- Graph illustrating pre and post physiotherapy MMT evaluation of right lower limb

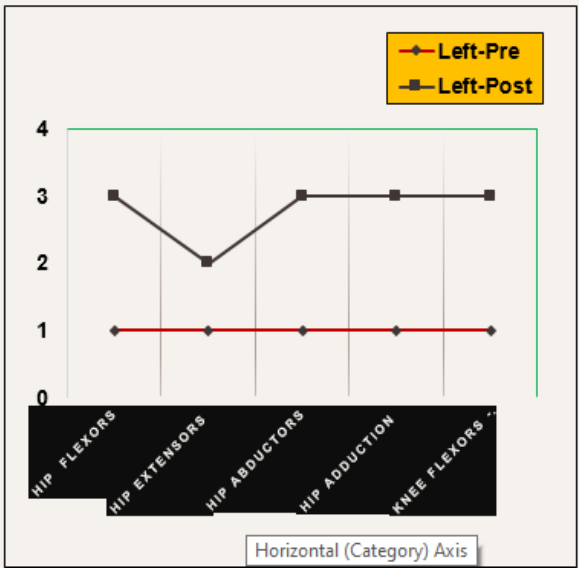

Figure:8- Graph illustrating pre and post physiotherapy MMT evaluation of left lower limb

DISCUSSION

In cases of solid organ transplantation, role of physiotherapy is well reported for, neuropathies, stroke and other CNS complications. However, in cryptococcal meningitis specifically post renal transplantation it is not very much elaborated. This case report may provide some data on scope of physiotherapy for cryptococcal meningitis. Cryptococcal meningitis associated vision deficit is reported in 30% of patients, also it requires longer hospital stay.[6] Both factors can contribute to patients' poor general condition and decreased physical activity, which leads to functional dependency and risk of developing secondary complications with regards to pulmonary and musculoskeletal systems.

Our patient had no vision in left eye and decreased vision in right eye, so we have incorporated exercises with audio-tactile commands which are specially designed for visually impaired people after reviewing systematic review done by Maristella Borges et al, who has developed audio tactile protocol for such patients so therapist can efficiently command exercise using audio

tactile stimulation.[7] Caregivers are also instructed to ensure proper positioning and to change a patient's position regularly, every two hours, to avoid complications. Physiotherapy rehabilitation, which includes strength and balance/co-ordination, is typically planned after four weeks and continues for about two months. These rehabilitation efforts, driven by the principle of neuroplasticity, aim to support gradual recovery and functional independence. Our patient presented with decreased muscular strength, poor balance, blurred vision and lack of motivation to return to independent activities of daily life. Rehabilitation protocol was based on improving these specific factors to provide maximum efficiency in active life ahead. We focused more over bedside exercises to prevent fall risk as patient's balance was highly affected as patient was visually impaired, that is why we incorporated vestibular balance conditioning by cervical movements in all three positions (supine- sit- stand). Once strength and trunk stability improved dynamic exercises as perturbations, reach outs and supported walking started according to principal of stability (sequencing of exercise done by increasing level of center of gravity and narrowing base of support with improvement in balance).

Theeb Naif S Alasalem et al, reported neuro physiotherapy regimen to enhance the functional performance in case with meningitis with hydrocephalus and concluded the secondary complications, correlated with immobility and the progression with decreasing level of assistance shown effectiveness of physical therapy [8].

Physical therapy along with medications can improve physical activity and independence, which ultimately brings confidence and develops a feeling of wellbeing. Reason of improvement by physiotherapy in neurological conditions is reported due to neuroplasticity. Jitesh Kumar et al has provided narrative review on innovative approaches and therapies to enhance neuroplasticity and promote recovery in patients with neurological disorder (2023) and concluded that neuroplasticity-based brain rehabilitation and individualized intervention gives tremendous results.[9]

Limitation

This is a single case study, which questions the generalizability of results obtained. Future studies should employ larger sample size to provide strong evidence in particular area of research. Additionally, patient was on antifungal medications, effect of medications with specific dosage on the course of rehabilitation was not taken into consideration, future studies can investigate the effect of specific drug and its indulgence with physical therapy.

CONCLUSION

Cryptococcal meningitis is primarily treated by medications. However, physiotherapy will improve functional independence by preventing secondary complications and improving symptoms such as pain, muscular weakness, impaired balance & coordination.

Declaration by Authors

Acknowledgement: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

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How to cite this article: Nikita R. Gelotar, Mansi Patel, Bharat Tiwari, Fagun Jain. Physiotherapy approach to improve neuroplasticity in cryptococcal meningitis in post renal transplant recipient: a case report. *International Journal of Science & Healthcare Research.* 2025; 10(1): 223-230. DOI: *10.52403/ijshr.20250130*

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