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Neuro-Physiotherapy Regimen to Enhance the Functional Performance of Meningitis with Ventriculitis and Hydrocephalus: Case Report

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Abstract

Prolonged immobility following acute meningitis often contributes to diminished strength, endurance, and balance as well as an increased risk of secondary problems such wounds, contractures, and respiratory infections. The purpose of this case report is to describe the progress from acute course toward a subacute and chronic phase of rehabilitation of a patient with a severe meningitis with ventriculitis and hydrocephalus plus emphasize the role of physical therapy in preparing the patient for the next level of care.

Keywords

Rehabilitation care; Physiatry; Physiotherapy; Rehabilitation; Meningitis

Intr

The public health concern of traumatic brain injuries is consequentialabout153 people in the U.S. die each day from brain injuries (BI) that include meningitis, costing a calculated $76.5 billion each year [1]. In 2013, these injuries lead to 2.5 million emergency department visits and 282,000 hospitalizations [1]. The Glasgow Coma scale (GCS) authorized classification of brain injury as mild, moderate, or severe and is need as soon as possible after the injury, and at variable times thereafter. Scores 3-8 are segregated as severe BI, 9-12 as moderate BI, and 13-15 as mild BI [2]. Severe BI demands aggressive management and often results in cognitive and physical manifestations that force long-term disability. It is calculated that 5 million people in the United States are affected by long-term disability after BI [3]. Severe injury provokes not only long-lasting neurological deficits (20% of adults) but it has been exposed that 20%-40% of patients end up dying as a consequence of brain injury or secondary complications [4]. Other studies declared mortality rates as high as 76% to 89% [4]. Due to neuronal damage, concomitant injuries such as orthopedic fractures, integumentary wounds, and/or vascular damage, as well as secondary disorders that develop after the accident, brain traumas cause a wide range of clinical demonstrations. It is important for clinicians to be ready for deficiencies in the areas of arousal, attention, cognition, joint integrity, motor function, endurance, and cardio-respiratory function [5].

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In this case report, early functional mobility training was proposed based on well-documented evidence to aid its validity in improving patient outcomes. Physical Therapists who are specialist in the critical care unit work as well as in neurorehabilitation to progress the quality of life, physical function, peripheral and respiratory muscle strength, escalating ventilator-free days, and reducing hospital and ICU stay [7]. Level 2 evidence, according to the Evidence-Based Review of Acquired Brain Injury project, supports the idea that early rehabilitation leads to better outcomes, including longer hospital stays and fewer comas, higher Functional Independence Measure (FIM) scores, extremely high cognitive levels at discharge, and a higher chance of being discharged home [8]. Interventions are designed to reduce muscle shortening, joint stiffness, and sensory deprivation while improving movement quality and promoting balance [9]. Functional training directly improves sit-to-stand, transfers, upper extremity usage, and gait, according to [10]. Animal models demonstrate that an enhanced environment (other people's presence) and early training (having the flexibility to move about) enhance functional recovery. Training in motor abilities will increase brain plasticity or adaptive mechanisms akin to reestablishment, which may aid in function reconstruction or memory [11]. Following a brain injury, the victim's sensorimotor actions construct this neural remodeling by suggesting that physiotherapeutic interventions stimulate the brain's neuroplastic potential [12].

Early sitting instead of supine transition is encouraged in acute hospitalization, and this leads to gains in functional residual capacity as well as more consistent breathing and perfusion. Additionally, gravity helps

the lungs' mucus to mobilize [13]. Significant improvements in arousal and/or awareness were observed when standing brain-injured individuals who were either vegetative or partially conscious changed their position. It has also been demonstrated that changing positions every two hours can help rule out hypovolemia, modify the length of resting muscles, load vertebrae, redistribute skin pressure, support the respiratory system, lessen the risk of osteoporosis, enhance circulation, and support renal function [14]. Despite an imperfect level of consciousness, the inception of physical therapy as soon as medically appropriate may drive to enhanced outcomes. Edlow et al. found that Magnetic Resonance Imaging (MRI) and Electroencephalogram (EEG) can identify covert consciousness and cortical feedback in patients who lack behavioral evidence of consciousness, giving evidence that patients may recover consciousness before behavioral hints are present. Lack of a reliable clinical tool to identify consciousness delays and limits approaches to rehabilitative care [15]. In this case, the early inception of physical therapy despite impaired cognition was important to maximize the patients' rehabilitation potential.

Clinicians can easily audit patients' functional status with a readily available tool when outcome measures, like the FIM scale, are widely used. It depends on the accurate assessment and evaluation of the degree of help necessary to finish a mobility activity, which is something that trained nurses and physical therapists, as well as the patient's family members, are qualified to perform. In order to prepare the patient for the next level of care and to prevent secondary complications that could result in immobility, this case report aims to describe the subacute rehabilitation course of a patient with a severe BI infection who has more weakness in his left side than his right. It also highlights the importance of physical therapy interventions, particularly functional mobility training. By preparing the patient for the next stage of care and averting issues linked to immobility, functional mobility training helps patients stay mobile.

This patient's case was chosen because of the unusual difficulties faced by those with serious brain infections and its associated comorbidities, such as cognitive impairments and processing difficulties, as well as the lack of comparable examples in the literature. In addition, the cultural context here highlights social issues that should be taken into account when managing a patient care plan.

Case History

The patient was a 15-year-old male who had a complain of ear pain and sore throat. He presented to a local clinic in Saudi Arabia diagnosed with otitis media which he was started on antibiotics. He was only taken it for two days then he felt better so he stopped it altogether. Four days later he developed fever reaching to 40 degrees along with severe headache and multiple episodes of vomiting. As per his family he became confused and hallucinated about where he was but did not seek any medical advice at the time. By 3ed of October 2022 admitted to an advanced hospital where he had a prolonged hospitalization complicated by bilateral arm tonic posturing with facial deviation and frothy salivation, he was brought by ambulance car.

Examination

The neurosurgery doctors mandated that the patient be kept in contact isolation owing to an infection,

wear a right arm sling, and undergo right "Ankle-Foot Orthosis." Patient issues included his inability to walk, his need for assistance getting in and out of bed, his need for two assists when standing, and his inability to climb stairs. The right side's passive range of motion was restricted by dystonia in both the upper and lower limbs, but the therapist was unable to evaluate the right side's active range of motion or do Manual Muscle Testing (MMT). On the "Modified Ashworth Scale" (MAS), spasticity was observed in the right hip adductors, knee flexors, and plantar flexors in lower limbs 3/4. While there is considerable spasticity 4/4 on MAS in the upper limbs in the shoulder adductors, elbow flexors, and wrist flexors. The patient had sessions with a psychologist who explained that the patient could have input and output in verbal cue affected and manipulate, which is treated by psychosis medications. MMT was performed on the left side, which revealed a powerful left side with no weakness found. Therefore, what the physical therapist could not assess was patient impairment cognition and behaviour, which tends to be mild to moderate aggressive. Mobility out of bed was addressed for high-risk falls.

Plan of Care

The treatment plan consisted of functional training, gait training, monitored mobility, verticalization in tilting table, proprioceptive neuromuscular facilitation, weight shifting, and therapeutic exercise with physical therapy treatment sessions occurring daily. The period of the inpatient intensive rehabilitation program took 16 weeks.

Short term goals	Long term goals
Transfer skills = minimal assistance	transfer skills=complete independent
standing =supervision	mobility skills=hemi-walker, right dynamic AFO
sit > stand =Minimal assistance	assistive devices= hemi-walker, right dynamic AFO, Right arm sling, Right wrist support
Bed to chair = minimal assistance	ambulation =reach 400ft no supervision with walking aid

Table 1: Short-term and Long-term goals.

Interventions

Therapy sessions were two sessions daily 11 am, 13 pm 5 days per week for 8 weeks in NRU. It was vital to make thorough observations of the patient during each session. Due to the patient's difficulty explaining his ability to reveal pain vital signs were monitored during treatment as possible indications of pain. Functional Independence Measure "FIM" was the main tool for outcome measurement for impairment and physical disability. Observation of posture was a responsibility of the therapist, as an indication of pain, autonomic function, or neurological syndromes. Other symptoms noted combined episodes of tachycardia, hypertension, diaphoresis, and dystonia, all of which are expected with sympathetic hyperactivity [5,16].

Weeks 1-2

The first weeks of physical therapy treatment sessions at the inpatient rehabilitation program focused on the prevention of neurological and integumentary complications. Treatment consisted of positioning with pillows and other devices to offload bony prominences including the calcaneus, greater trochanter, ischial tuberosity, sacrum, occiput, and olecranon, along with turning every 2 hours. Passive range of motion was performed for family education so during the day and night can allow a spontaneous and free motor activity to shoulder, elbow, and wrist on the right side. Resting night splint and the blue boot was used to prevent plantarflexion contractures plus an air mattress was used to decrease the risk of pressure sores. The second major intervention included positional changes to improve tolerance to upright sitting. Bed mobility out of bed and in bed. Later supine to sit transfers training started, along with sitting balance were repeated and point out clearly. Tactile and verbal cues were employed to educate the patient on proper upright sitting technique. The supine to sitting transfer was performed with minimal assistance during the first three weeks. The patient's tolerance to sitting at the edge of the bed was monitored closely with vital signs, verbal indicators of pain, and amount of assistance provided. He progressed from an initial 10 minutes of sitting tolerance to 15 minutes after two weeks. The level of assistance provided improved from minimal assistance to moderate assistance for sitting balance. After the patient demonstrated tolerance to upright sitting with stable vital signs, the Nursing staff was advised to do minimal assistance so the patient can progress and tolerate further in "chair position" three times/day.

Week 3-5

The next phase of treatment in the inpatient intensive rehabilitation program started and focused on the facilitation of standing tolerance and gait. The patient reached sit to stand transfer training with maximal assistance of two persons which improved to moderate assistance of two persons. The therapists assisted by closing the patients' knees and providing a forward weight shift and trunk lift while giving tactile cues for extension through the thoracic and lumbar spine. The patient was found to demonstrate failed weight shifting, impaired force production direction, impaired control of descent, insufficient active weight-bearing in bilateral lower extremities, and shifted center of mass posteriorly resisting correction. The sitting balance was also improved with the patient tolerating and requiring minimal assistance to maintain balance. Dynamic sitting balance improved to requiring supervision intermittently due to the patient's impaired midline awareness.

Week 6-7

The patient starts to take his first steps during this last phase after the physical therapist provided the right dynamic AFO and right arm sling. The administration of Botox injection by physiatry was done for flexors synergies and adductors at upper limbs plus Baclofen 20 mg later add a dantrolene 25 mg for general right-side spasticity Firstly, he needed minimal assistance of two persons for large weight shifts and forward progression of swing leg later on assistance was not needed only supervision and verbal cues. The therapists used their leg and foot to advance the swing limb forward while also facilitating a weight shift towards the stance limb and closing the knee of the stance limb finally patient re-learn and get familiar with the new type of gait. The patient also re-learns tactile cueing at one shoulder to facilitate

trunk extension. Finally, was able to tolerate 12 meters of this gait before he started to become fatigued and could not hold any of his body weight.

By the 6th week, the psychologist stopped medication a sudden improved in-patient cognition and behavior happened when the patient mouthed respectfully and agreement with well information coming from him about pain and abilities as human being that sound like a miracle for the entire team and patient's family. He completed sit to stand transfers with close supervision. He increased his gait distance to 50 meters using Hemi-walker with supervision and assistance for weight shifts. His gait distance was limited by fatigue. During the 7th week, the patient achieved a gait distance of 150 meters but continued to require to use hemi-walker but not further assistance at weight-bearing. By the end of the 7th week, he was able to complete 160 meters using Hemi-walker with minimal assistance.

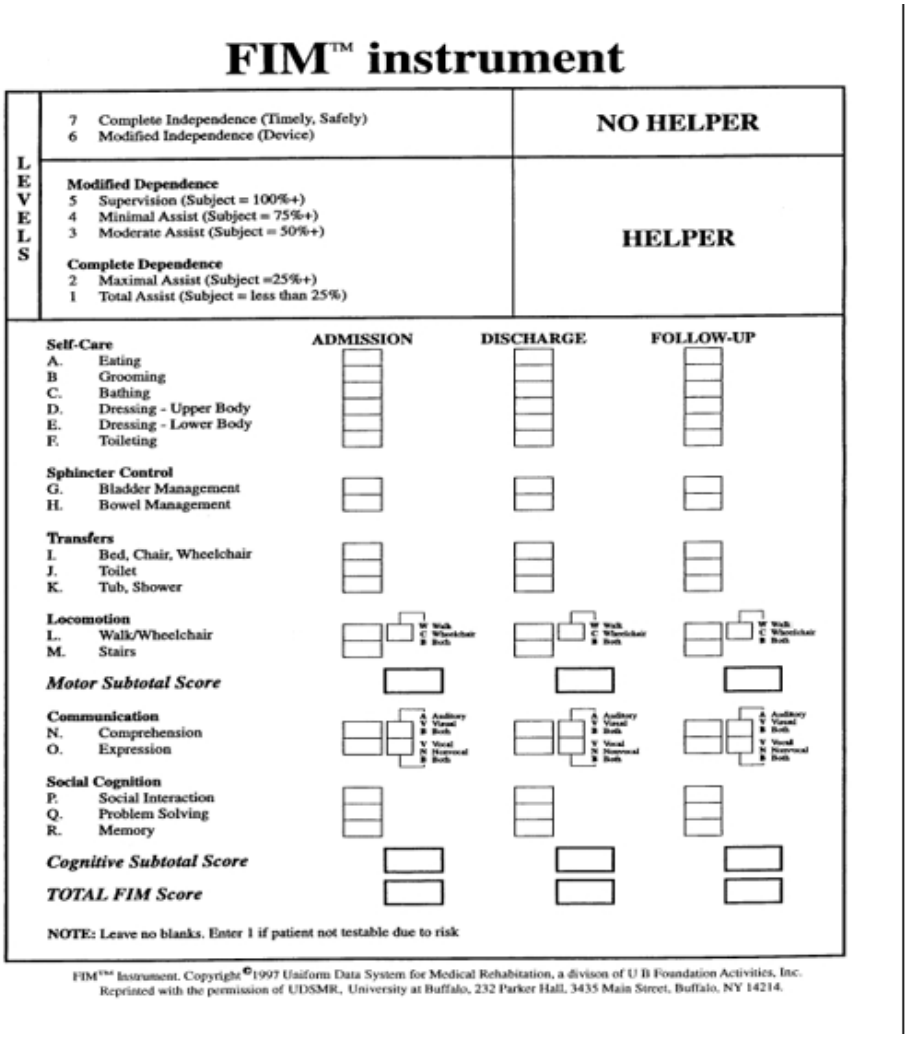
Week 8

This was the final week of the patient's inpatient hospitalization before being discharged to outpatient rehabilitation in the same hospital. He completed bed mobility and supine to sitting transfers without assistance complete independent also complete independent stood. He did progress gait distance. He was able to use a Hemi walker for ambulation this week and reach 160 meters. The patient demonstrated the ability to initiate stepping without any cues for the progression of the swing leg this week. (Table 2) below shows the patient's progress, requiring less assistance over time.

Period	Bed mobility	Supine->Sit	Sit->Stand	Gait
Week 1-2	minimal assistance	maximum assistance	Did not attempt	Did not attempt
Week 3-5	minimal assistance	moderate assistance	Max assistance	did not attempt
Week 6-7	complete independent	complete independent	complete independent	by hemi walker minimal assistance
Week 8	complete independent	complete independent	complete independent	by hemi walker minimal assistance

Table 2: Rrequired Assistance for mobility Tasks.

The patient initially scored the lowest possible at FIM 'Functional Independence Measure". At the first acute rehabilitation but he was progressed furthermore after each week. Table 1 & Table 2 explain the goals and progression that was made and done for the patient during his stay at the hospital. Appendix 1.



FIM™ instrument

LEVELS		
	7 Complete Independence (Timely, Safely) 6 Modified Independence (Device)	NO HELPER
	Modified Dependence 5 Supervision (Subject = 100%+) 4 Minimal Assist (Subject = 75%+) 3 Moderate Assist (Subject = 50%+) **Complete Dependence** 2 Maximal Assist (Subject =25%+) 1 Total Assist (Subject = less than 25%)	HELPER

	ADMISSION	DISCHARGE	FOLLOW-UP
Self-Care			
A. Eating			
B Grooming			
C. Bathing			
D. Dressing - Upper Body			
E. Dressing - Lower Body			
F. Toileting			
Sphincter Control			
G. Bladder Management			
H. Bowel Management			
Transfers			
I. Bed, Chair, Wheelchair			
J. Toilet			
K. Tub, Shower			
Locomotion			
L. Walk/Wheelchair			
M. Stairs			
Motor Subtotal Score			
Communication			
N. Comprehension			
O. Expression			
Social Cognition			
P. Social Interaction			
Q. Problem Solving			
R. Memory			
Cognitive Subtotal Score			
TOTAL FIM Score			

NOTE: Leave no blanks. Enter 1 if patient not testable due to risk

Appendix: Functional Independence Measure (FIN).

Discussion

This patient case did not credit the effectiveness of physical therapy interventions alone; rather, an interdisciplinary team as a whole made such an effective treatment for patient and family awareness possible. The significant improvements in performance over night and the advanced time taken on assistance for mobility tasks made this patient case possible. Healthcare professionals have recognized the efficacy of physical therapy interventions in averting potentially fatal secondary consequences. Furthermore, the intervention's effects could not show appreciable increases in mobility; instead, they might act as brain priming for the long-term restoration of motor function. The main objective of neurological rehabilitation is to guide neuronal remodeling in a way that promotes function recovery. Clinicians should base treatment decisions on this core goal.

This case report expressed subacute physical therapy interventions in the treatment of an adult with a severe brain meningitis and secondary complication resulted in Right side stroke weakness. The outcomes brought out to demonstrate significant improvement in functional ability, however, the presence of

secondary complications correlated with immobility and the progression of mobility with decreasing levels of assistance demonstrate the effectiveness of the physical therapy interventions. At hospital discharge, the patient was ready to transition to outpatient rehabilitation, where he would receive more maintained and specific therapy interventions and make significant improvements in functional mobility. Physical therapy treatment of severe meningitis with stroke complications is supported by this patient case, which also contributes to the body of closed research evidence. This increases the importance of physical therapy for these patients in the acute rehabilitation care scenario. Even though physical therapy is widely used to treat meningitis patients, there is still no data to support its efficacy in improving patient outcomes in this specific demographic. Studies on neuro/trauma patients enrolled in a structured mobility program in the intensive care unit have shown markedly improved functional mobility results along with a reduction in length of stay and cost of treatment [8]. "Powerful evidence exists that intensive task-orientated rehabilitation programs lead to earlier and well-functional abilities," according to a 2008 systematic review of physiotherapy conducted following BI [9]. It is generally acknowledged among researchers that the most effective treatment approaches are multidisciplinary, goal-oriented, involve all members of the healthcare team early and frequently, and emphasize family commitment and education. Further studies are vital to uncover the efficaciousness of particular physical therapy therapies in promoting motor recovery and, eventually, functional recovery within the population of meningitis survivors.

Conclusion

This case report expressed subacute physical therapy interventions in the treatment of an adult with a severe meningitis and secondary complication resulted in Right side stroke weakness. The outcomes brought out to demonstrate significant improvement in functional ability, however, the presence of secondary complications correlated with immobility and the progression of mobility with decreasing levels of assistance demonstrate the effectiveness of the physical therapy interventions. Researchers do agree that the most practical treatment approach is one that is multidisciplinary and goal-oriented, with early and often involvement of all members of the healthcare team, along with family education and commitment. More research is highly needed to expose the effectiveness of specific physical therapy interventions to facilitate motor recovery and ultimately functional recovery in the meningitis survivor's community.

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