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Physical Therapy Intervention in a Patient with West Nile Meningitis: A Case Approach

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PHYSICAL THERAPY INTERVENTION IN A PATIENT WITH WEST NILE MENINGITIS: A CASE APPROACH

by

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This Scholarly Project, submitted by Kelsie Gunnufson in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

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ABSTRACT

Background and Purpose. West Nile Virus (WNV) is a neurotropic virus capable of causing damage of varying severity.[1] WNV is commonly transmitted to humans from mosquitos and is most prevalent in the months of August and September due to the method of transmission.[1,2,3,4] The WNV can produce mild systemic symptoms classified as West Nile Fever (WNF). However, it can progress and infiltrate the nervous system, at which point the virus is categorized as neuroinvasive. One classification is West Nile Meningitis (WNM) that involves infection and inflammation of the meninges or coverings surrounding the brain and spinal cord. There is currently a limited amount of research related to the presentation and treatment of West Nile Meningitis. The purpose of this case study is to show the potential benefits of physical therapy intervention in order to increase the rate of functional recovery in patients with WNM.
Case Description. This case study describes the outpatient physical therapy interventions for an adult female recovering from West Nile Meningitis. The patient presented with poor dynamic balance, decreased coordination, decreased endurance, movement patterns similar to parkinsonism, rigid gait pattern, inability to dual-task, impulsivity and flat affect.
Intervention. The patient completed five weeks of outpatient physical therapy. Activities addressed her movement impairments and deconditioning. Exercises were related to strength, coordination, and functional balance with cognitive task integration.
Outcomes. The patient returned to work and independent living eight weeks after initial transmission. The patient showed clinically significant improvement on her MiniBESTest scores. She achieved near-baseline functional recovery in significantly less time than previous studies reported.
Discussion. Physical therapy intervention and an exercise program to address deconditioning and movement disorders in patients with West Nile Meningitis may significantly increase the rate of functional recovery. Although the primary pathology revolves around the central nervous system, it is important to remember the physical impairments associated with this condition. Physical therapy should be considered an integral part of treatment for cases of West Nile Meningitis.

CHAPTER I

BACKGROUND AND PURPOSE

West Nile Virus (WNV) is a neurotropic virus capable of causing damage of varying severity.[1] It is classified as a Flavivirus, that when introduced to its host, becomes a human, equine, or avian neuropathogen.[2] WNV is commonly transmitted to humans from mosquitos, but can also be transmitted from human to human through blood transfusions, organ transplants, exposure in a laboratory setting, and from mother to baby during pregnancy, delivery, or breastfeeding.[2,3,4] Because birds remain amplifying hosts, there is a maintained mosquito-bird-mosquito cycle preserving the virus.[2] WNV is most prevalent in the months of August and September due to the method of transmission.[1] However, it has been reported that this period of prevalence has been lengthened from December to April as the virus has moved further south in the United States.[3] The virus is indigenous to Africa, Asia, Europe and Australia. It was first introduced to the United States in 1999, when an epidemic of meningoencephalitis broke out in New York City, hospitalizing 59 people and killing 7.[2] During this epidemic, it was estimated that there were 3,500 to 13,000 cases of WNV.[5] The virus then began extending its range westward throughout the United States and into lower-central parts of Canada.[2] It is estimated that the prevalence of WNV has risen significantly since its introduction to the United States.[2,5] Between 1999 and 2005, 19,500 cases of WNV were reported to the Center for Disease Control and

Prevention (CDC), 8,300 of which were neuroinvasive.[6] According to the CDC, there were 1,662 cases of West Nile Virus disease reported in the United States in 2016.[4] WNV occurs more often in men than women (3:1) who report being active outdoors, which put them at risk for increased mosquito exposure.[1]

Following viral transmission, the incubation period spans 2 to 14 days with 2 to 6 days being most typical for WNV.[2,5] During this period, symptoms may begin to present and medical attention may be sought. The laboratory diagnosis for WNV is largely dependent on serology.[2] Specifically with West Nile Neuroinvasive Disease (WNND), the diagnosis depends on demonstration of WNV-specific IgM antibodies in the cerebrospinal fluid. Neuroimaging studies are normal for most people with WNND but some abnormalities may be observed in the basal ganglia, thalamus, cerebellum, and brainstem.[7] It is worth noting that retrospective studies have been unable to identify clinically distinguishable features of WNV from other viral neurological infections.[8] Patients are often monitored during their hospital stay to rule out treatable CNS infections or causes such as herpes virus infection, Guillain-Barrè syndrome, and/or bacterial meningoencephalitis.[2]

The WNV can produce mild systemic symptoms classified as West Nile Fever (WNF), in which case it does not affect the nervous system. However, it can progress and infiltrate the nervous system, at which point the virus is categorized as neuroinvasive. West Nile Neuroinvasive Disease (WNND) can be classified into three subsequent diagnoses. These are listed in order of increasing severity: Meningitis, Encephalitis, and Poliomyelitis.[2,8,9] West Nile

Meningitis (WNM) involves infection and inflammation of the meninges which are coverings surrounding the brain and spinal cord. This diagnosis is associated with the best chance for functional recovery and has the lowest rate of mortality of the neuroinvasisve forms. Once the infection progresses further to West Nile Encephalitis (WNE), the brain becomes swollen, symptoms intensify and prognosis worsens. The most severe form is West Nile Poliomyelitis (WNP) or Flaccid Paralysis which results from viral infection and destruction of the lower motor neurons or anterior horn cells of the spinal cord. Flaccidity is not limited to the limbs but also can occur in the facial muscles as well as the respiratory muscles, explaining why this form of WNND has the highest mortality and worst prognosis.[2] For clarity, see Table 1 for listing of West Nile abbreviations.

Table 1. West Nile Abbreviations

Term	Abbreviation
West Nile Virus	WNV
West Nile Fever	WNF
West Nile Neuroinvasive Disease	WNND
West Nile Meningitis	WNM
West Nile Encephalitis	WNE
West Nile Poliomyelitis	WNP

The majority (80%) of people infected with WNV are asymptomatic.[2,4,5,8] Common symptoms of non-neuroinvasive WNV or WNF, can include fever, myalgia, malaise, headache, gastrointestinal distress, rash, and anorexia.[1,2,5] The

acute illness with no neurological involvement usually lasts less than a week but may involve prolonged fatigue.[2] However, 1% of infected persons can develop more serious symptoms with greater anatomical damage as the virus becomes neuroinvasive.[4,8] Symptoms indicative of neurological involvement often occur several days after the systemic symptoms and include headache, altered level of consciousness, focal weakness, and paralysis.[1] In a prospective case series by Sejvar et al.,[8] it was reported that patients with acute WNND illness may present with movement disorders such as tremors, myoclonus, and parkinsonism. These movement disorders often go undiagnosed. Another descriptive case series of 228 patients by Bode et al.,[6] added respiratory failure, limb weakness, and cardiac arrhythmia to the list of associated signs and symptoms. Additionally, other rare neurological manifestation of WNV can include myelitis, optic neuritis, rhombencephalitis, and polyradiculitis.[2] It is unclear if the difference in symptom severity is due to the strength of the host's immune system or severity of neurovirulence among different strains of WNV.[1]

West Nile Meningitis (WNM) accounts for approximately 40% of the WNND cases.[2,9] One study by Sejvar et. al.[8] defined WNM as cases fitting two criteria. The first criterion includes clinical signs of meningeal inflammation, including nuchal rigidity, Kernig or Brudzinski sign, or photophobia or phonophobia. The second criterion includes additional evidence of acute infection, including one or more of the following: fever (>38°C) or hypothermia (<35°C), cerebrospinal fluid pleocytosis (≥5 leukocytes/mm3), peripheral

leukocyte count >10 000/mm3, and/or neuroimaging findings consistent with acute meningeal inflammation.

Patients with WNM are often hospitalized for supportive care for pain control, hydration, nutrition, etc. and have complaints of fatigue, weakness, and memory and concentration decline.[9] However, most patients are discharged to independent living after a relatively short hospital stay of one to two weeks.[8,9] One descriptive study of hospitalized patients with WNV and WNNV reported that 76% of patients hospitalized for WNM or WNF were discharged home without the need for increased care.[4] Recovery may take several weeks to months and some neurological deficits may be permanent, particularly in cases with flaccid limb paralysis.[4] In patients with WNM, 95% made a full recovery, with normal functional recovery at eight months.[1] Another case series involving five patients with WNM reported 100% returned to work and normal to near-normal functioning by eight months.[8] 10% of patients with West Nile Neuroinvasive disease will die as a result, although death is uncommon for West Nile Meningitis specifically.[4,6] Increased mortality has been linked to patient characteristics such as old age (>75 years old), history of diabetes mellitus, level of immunosuppression, disease severity related to level of consciousness, neuroimaging abnormalities, and development of limb weakness.[1] Bode et al. [6] also sites old age, history of diabetes mellitus, history of stroke, alcohol abuse, and decreased system immunity related to increased risk of the virus becoming neuroinvasive.

A study by Samaan et al. [10] looked at the neuropsychological impairments related to West Nile. They found that cognitive impairments were comparable regardless of whether the patient was diagnosed with West Nile Fever or West Nile Neuroinvasive Disease and that these impairments were more prevalent with increasing illness duration. Slightly more concerning was their finding that neuropsychological impairments were observed more frequently at two to four years post-infection when compared to earlier stages of illness.

There is currently no cure or vaccine for WNV so prevention is the treatment focus with emphasis on use of insect-repellent and other protective measures against mosquito transmission.[2,4] Research and development for vaccines or therapeutics are currently underway. Although there are WNV vaccines for veterinary use, similar vaccines for humans have failed to be successful.[11]

An observational study by Hoffman and Paschal[12] demonstrated improved functional outcomes in patients with WNV following rehabilitation. They completed a retrospective chart review for 48 patients with WNV admitted to a rehabilitation facility in the Midwest. During their inpatient rehabilitation, they found significant effects for total and motor FIM scores and a moderate effect on cognitive FIM scores. They go on to say that most patients required additional physical therapy following discharge from inpatient rehabilitation. This study makes the case that rehabilitation services can improve multiple aspects of recovery from WNV.

Although there is no research specifically related to which physical therapy interventions are best for people with West Nile Neuroinvasive Disease, there is a significant amount of research related to physical therapy interventions for people with other neurological impairments, including Parkinson's disease.

A systematic review by Fritz et al.[13] investigated the effectiveness of motor-cognitive dual task training for people with neurological disorders. The review of 14 studies compared motor-cognitive dual task training with usual care for mobility and cognition. They found that dual-task training improved single-task gait velocity and stride length in Parkinson's disease (PD) and Alzheimer's disease (AD), dual-task gait velocity and stride length in PD, AD and brain injury, and may improve balance and cognition in PD and AD.

Another investigation into physical therapy treatment interventions for Parkinson's disease was a randomized controlled trial carried out by Hirsch et al.[14] The study compared two exercise training programs for people with PD. One group was a combined exercise group using both balance training and high intensity resistance training and the other group only used balance training. The study found that although balance and strength improved in both groups, there was a significantly larger improvement for the combined group. This study demonstrates the need for both balance and strength training to improve the functional mobility for patients with PD.

The purpose of this case study is to describe the physical therapy interventions used in the treatment of a patient with West Nile Meningitis and discuss the outcomes achieved following intervention.

CHAPTER II

CASE DESCRIPTION

This case study describes the clinical presentation, therapeutic intervention, and recovery of an adult women who contracted West Nile Meningitis. This case will focus on her recovery throughout her time in outpatient physical therapy, beginning approximately three weeks after transmission and through an additional five weeks of outpatient physical therapy intervention.

The patient was a 50-year-old female who contracted WNV from a mosquito bite in August 2016. The patient lives in a small, rural town in northern Minnesota. The patient recalled malaise and fatigue for one to two weeks prior to her admission to the hospital, at which point the fatigue, weakness, and body aches were debilitating necessitating a hospital admission. She was transferred to a larger hospital that was better equipped to diagnose her condition and manage her symptoms. There, she received care for one week. Treatment focused on symptom management for what was diagnosed to be West Nile Meningitis. After one week, she was then transferred back to the smaller hospital closer to her home for an additional week of treatment and monitoring. The patient was then discharged from the hospital to spend her days at her elderly mother's house and nights at home with her family (husband and two teenage daughters). Both living situations offered the patient the assistance she required. Although she was discharged from the hospital, her doctor requested she have

supervision from her mother or husband until she was deemed safe with independent living. Included with the patient's hospital discharge were orders for outpatient physical therapy to "evaluate and treat" with a diagnosis of West Nile Virus/Meningitis and Weakness.

At the initial outpatient physical therapy evaluation, which was approximately four weeks after the onset of WNF and two weeks since her diagnosis of WNM, the patient complained of malaise, weakness and fatigue, and balance and incoordination problems. The patient reported she had Type II Diabetes Mellitus but all other past medical history was unremarkable. She did not recall any previous neurological or neuromuscular problems. The patient's cognition was noticeably impaired with slowed responses therefore the patient's reported history was cross-checked with previous medical reports and subsequently confirmed. The patient was independent in all activities of daily living (ADL's) prior to symptom onset. At the time of her physical therapy evaluation, the patient reported she could still complete all ADL's independently, taking frequent rests due to fatigue and dizziness, but for safety purposes she was advised not to cook or to be left alone. The patient was physically fit, stated she had exercised regularly, and led an active lifestyle. This was evidenced by her mesomorphic body type and observable muscle definition. The patient was employed as a lead bank teller at a local bank. At work, she would stand or sit on a bar stool for eight hours a day and handle light-weight objects. She would interact with customers, compute simple mathematical problems, and supervise the other bank tellers. The patient had not been to work since her hospitalization

and was advised not to return until she was cleared by a primary care provider (PCP). Additionally, she was instructed not to drive or operate other large equipment until cleared by her PCP. The patient expressed no complaints or concerns related to other systems beyond those of neuromuscular origin that were discussed above.

Examination, Evaluation and Diagnosis

The examination was focused on the patient's complaints and the diagnosis given. The patient began the physical therapy examination with the mini-BESTest and required instruction through all parts. The mini-BESTest, a shortened version of the Balance Evaluation Systems Test (BESTest), assesses dynamic balance including anticipatory postural adjustments, reactive postural control, sensory orientation, and dynamic gait. The MiniBESTest is scored out of 28 points with a change of 4 points being minimally important. Research has found this test to be excellent overall with excellent test-retest reliability (ICC = 0.96), excellent interrater reliability (ICC = 0.98), excellent concurrent validity of Mini-BESTest with Berg Balance Scale (r = 0.85), and no floor/celling affect.[15] A student physical therapist, under the supervision of an experienced and licensed physical therapist, administered the test in the standardized method using the instructions included with the test. Overall, the patient scored 21/28 with 28/28 representing perfect performance and no impairment. Broken down by sub-categories, the patient scored 5/6 in Anticipatory, 3/6 in Reactive Postural Control, 6/6 in Sensory Orientation, and 7/10 in Dynamic Gait.

The remainder of the exam was performed using standardized examination techniques.[16] The therapist tested lower extremity strength through resisted isometrics and concluded 5/5 strength bilaterally with no indication of fading. Upper extremity strength was not tested by physical therapy in the anticipation that it would be tested by occupational therapy in her upcoming appointment. Active range of motion (AROM) was grossly assessed for both upper and lower extremities and found to be within functional limits (WFL). The patient reported no complaints of numbness or tingling in any extremity and therefore sensation was not formally tested. Reflexes were also not tested.

Assessment continued through observation of movement and behavior during her initial PT treatment after the above assessment. During the exercise session that followed the evaluation, the patient completed one set of 10 repetitions of the following exercises: single leg step-ups on an eight-inch box with moderate single handrail support, single leg stance with three-way toe point with handrail support as needed, single leg stance with unilateral D2 U/E PNF pattern, mini-squats with moderate bilateral hand support, exercise ball seated marching with both hands on the ball, and 20 yards of forward tandem walking. During these activities, it was noted that the patient required near-constant handrail support and often lost her balance, taking multiple steps in any direction and swinging her arms to regain her balance. As the initial session progressed, the patient began to display signs of fatigue with slowed walking pace and declining balance. The patient walked with a rigid gait that lacked arm swing or trunk rotation and she had a fixed forward gaze. The patient displayed an

uncharacteristic flat affect during conversation and tasks. This, along with her movement patterns, fit the definition of parkinsonism based on the therapist observation and personal opinion, although this was not officially documented. By definition, parkinsonism is a neurologic syndrome usually resulting from deficiency of the neurotransmitter dopamine as the consequence of degenerative, vascular, or inflammatory changes in the basal ganglia resulting in rhythmic muscular tremors, rigidity of movement, festination, droopy posture, and masklike face.[17] She maintained a flat affect throughout the initial session and denied her fatigue and need for rest breaks. Although the patient was oriented to person, place, time, and situation, she was slow to process questions or commands and was unable to dual-task (i.e. "walk and talk").

Based on the patient's presentation in therapy, signs and symptoms were consistent with her medical diagnosis of West Nile Meningitis and Weakness. Using the previously mentioned justifications, specifically the patient's score on the MiniBESTest, the patient was also given the physical therapy diagnosis of Balance Difficulties. Due to the pathology and inflammatory response within the patient's central nervous system, it was expected that the majority of the patient's complaints had a neuromuscular origin, leading to balance difficulties and incoordination.

Prognosis and Plan of Care

The patient was scheduled to attend physical therapy two times per week for 35-45-minute sessions for five weeks. The plan for these sessions was to continue to work on static and dynamic balance as well as strength and

reconditioning. Specifics of each session would change based on how the patient was progressing, what her primary concerns were, and her goal status. She was given one short-term goal and one long-term goal. Her short-term goal was to be met in two weeks and required that the patient have improved balance to complete an exercise session without losing her balance or taking compensatory steps more than twice in a session to be safe at home independently. Her long-term goal was set for six weeks and required that the patient have increased strength and endurance to complete a full therapy session without notable fatigue and/or requiring no rest break during the session in order to return to work.

Due to the relative rarity of this disease and variation in presentation, it was difficult to predict the speed of recovery. However, research has been able to link diabetes to increased disease severity,[1,6] putting this patient at a slight disadvantage. Although, it was promising that the patient was previously physically fit, had maintained her strength, was not experiencing limb paralysis, and was highly motivated. Two studies have reported that near-normal functional recovery from WNM, including return to work, is expected in eight months or less.[1,8]

CHAPTER III

INTERVENTION

The patient was seen two times per week for 35-45-minute sessions for five weeks. The focus of treatment was centered on strengthening and neuromuscular re-education to improve physical conditioning and balance. The exercises were progressed or modified as needed based on the therapist's assessment and the patient's subjective report. A complete listing of all interventions performed is included in Table 2 at the end of this chapter. Adaptation and explanation of how to do each exercise in a home environment were provided for the patient. Her spouse was included in the patient education for the initial three weeks of treatment, at which point her cognition had improved and she became more independent in therapy. It is worth noting that despite multiple reminders and continued emphasis on the importance of a home exercise program, the patient continually admitted non-compliance.

Week One

Exercises included single leg step-ups, single leg stance with upper and lower extremity movement, mini-squats, mini-squat on foam, tandem walking, seated marching on exercise ball, catch and overhead lift of weighted ball, as well as X-rider for conditioning.

The patient presented with slow and hesitant movement initiation and rigid gait. She spoke with a flat affect and was unable to hold a conversation for more

than a minute. She required maximal hand support for all exercises, often losing her balance. She struggled to comprehend and execute multi-step exercises, requiring frequent cueing. As the session progressed, signs of fatigue such as decreases in balance and increased confusion became evident, indicating deconditioning.

Week Two

Exercises included all exercises from week one with increased resistance/distance and less support/stability provided. Added exercises included bicep curl to overhead press with free-weights while seated on an exercise ball, and an obstacle course involving sit to/from stand, stepping over a box, and standing toe taps on a short cone.

At this point, the patient began showing signs of increased confidence in movement initiation and rhythm for multi-step exercises, yet she still moved slowly. This was especially evident with the single leg step-ups as she was more confident with her foot placement and less hesitant to begin the motion of each step yet still looked down at her feet for visual re-assurance. She was able to decrease the amount of hand support needed for balance activities by the end of the second week, typically self-selecting a minimal one or two hand support with a handrail in comparison to the moderate assistance she required before. During gait activities, the patient appeared less rigid and return of normal arm swing was observed. Mild improvement had been made in her affect as she was now producing three to four word responses and made a joke. It was noted that her performance declined in open environments. Due to space requirements, the

treatments took place in a large gym and not an individual treatment room. However, the patient and therapists were the only ones in the gym, simulating a closed environment, apart from when other therapists or patients would use the space, creating a true open environment.

Week Three

Exercises included most of the previous exercises, with some removed, some progressed (via increased resistance or decreased support), and additional exercises added in. The complete list for week three was single leg step-ups, forward lunges on a Bosu ball, single leg stance, mini squat on foam, seated marching on an exercise ball, bicep curl to overhead press with free-weights seated on an exercise ball, catch and overhead lift of weighted ball standing on foam, tandem walking, obstacle course involving sit to/from stand, stepping over a box, and toe taps on a short cone, and X-rider for re-conditioning.

During this week, the patient continued to improve her confidence with movement initiation, execution, and balance with increased speed and rhythm of her exercises. She was able to look forward as opposed to looking at her feet when doing the exercises. During multistep exercises, she made less errors and was quicker to correct and restart than the previous weeks when she would hesitate and stutter her steps. Her movements appeared more natural and fluid and less calculated. The patient still required minimal handrail assist and would take one to two compensatory steps when she would lose her balance. She began attempting more exercises without holding onto a handrail, showing improved confidence in her balance. She appeared to have increased

endurance, showing less signs of fatigue during the sessions. She continued to improve in her affect and could carry out short conversations, providing two to three replies, although she was still unable to talk and do her exercises simultaneously. However, at this time she was able to count her repetitions without assistance or decreased performance. The patient had returned to driving against the recommendation of physical therapy, occupational therapy, and her primary care provider due to her increased impulsivity and poor decision-making ability. At this point, the patient's main complaint was her dynamic balance, specifically when she would get up from sitting and walk around her house. She stated that she felt as though she might lose her balance or trip.

Week Four

Exercises included all exercises from week three, with increased resistance and/or cognitive dual-tasking during execution of exercise, and the addition of standing on foam with her eyes closed, standing on foam with her eyes open and manual perturbations provided by therapist, retro walking, and standing elliptical.

The patient had notable improvements in cognitive function at this point in recovery. She was now able to maintain conversation while doing her exercises, as well as moderate level mathematical computations, with only mild decrease in performance. Also, her balance and balance recovery strategies were normalizing and nearing her baseline, allowing her to be progressed to unstable surfaces without support, such as standing on a foam pad with her eyes closed or standing on a foam pad and receiving manual perturbations from the therapist.

She required fingertip touch on a handrail only when she felt she was losing her balance. The number and frequency of compensatory steps had significantly decreased, especially with tandem walking, one of her biggest struggles. She was significantly less affected by open environments than previously. She also improved with impulsivity and safety recognition. This was demonstrated when she moved away from a piece of equipment which gave her more space to do her exercises. If she were to lose her balance and fall toward it, there was a potential of injuring herself. This environmental safety awareness had not been evident until this point in therapy.

Week Five/Discharge

Exercises consisted of all exercises performed the previous week. The patient's ability to perform her exercise program was assessed prior to her discharge to assure she could independently complete her home exercise program.

The patient was near baseline for strength, endurance and balance at the time of discharge. She returned to her prior level of function and returned to an exercise regimen at a local gym. Both the therapist and the patient were in agreement that the patient would be able to continue her rehabilitation independently and she was discharged from physical therapy. At her final session, the patient completed the Mini-BEST test, performed with the same equipment, environment, and evaluator as her initial assessment. Her results are discussed in the next chapter.

Patient education was also provided to both the patient and her spouse throughout her time in physical therapy. Education provided to the patient covered the following topics: disease acquisition and progression, prognosis for functional recovery, importance of energy conservation and rest for recovery, safety awareness, dangers of returning to activity too soon, and reasoning behind her driving restriction related to delayed reaction time, decreased neuromotor coordination, and impulsivity.

Overall, the patient was able to make many functional and cognitive gains during the course of the five-week physical therapy intervention period. Due to the lack of a standardized treatment approach or protocol for the underlying impairments from WNM, the physical therapy interventions were chosen at the therapist discretion. Intervention focused on functionality to address the patient's primary impairments based on patient complaints and the findings of the MiniBESTest. According to the research stated previously in this case study, the patient's functional and neuromotor recovery was accomplished ahead of the eight months to one-year average reported for WNM.

Table 2. Physical Therapy Interventions

Exercise	Week 1 Session 1	Week 1 Session 2	Week 2 Session 3	Week 2 Session 4	Week 3 Session 5	Week 4 Session 6	Week 4 Session 7	Week 5 Session 8
Step-ups	10 reps/leg	15 reps/leg	15 reps/leg	15 reps/leg	15 reps/leg	15 reps/leg	15 reps/leg	15 reps/leg
Single leg standing with 3-way toe point	10 reps/leg	15 reps/leg	15 reps/leg	15 reps/leg				
Single leg stance	(10 reps/leg with D2 UE pattern)	10 sec hold 5 reps	10 sec hold 5 reps	10 sec hold 5 reps	10 sec hold 5 reps	10 sec hold 3 reps	10 sec hold 3 reps	10 sec hold 2 reps
Mini-squat on foam	10 reps (10 reps without foam)	15 reps 2 set	15 reps 2 sets	15 reps 2 sets	15 reps 2 sets	15 reps 2 sets	15 reps 2 sets	15 reps 2 sets
Seated marching on exercise ball		15 reps	15 reps	15 reps	15 reps 2 sets	15 reps 2 sets	15 reps 2 sets	15 reps 2 sets
Bicep curl to Arnold press with free weights, seated on exercise ball			15 reps 3# bilaterally (B)	15 reps 4# (B)	15 reps 4# (B)	15 reps 5# (B)	15 reps 6# (B)	15 reps 6# (B)
Catching a ball, raising overhead, and throwing back		10 reps 1# ball	15 reps 1# ball Standing on foam	15 reps 2 sets 4# ball Standing on foam	15 reps 4# ball Standing on foam	15 reps 7# ball Standing on foam	15 reps 11# ball Standing on foam	15 reps 11# ball Standing on foam
Obstacle courses			Sit to/from stand (x3), reciprocal toe touches on short cone (x6), step over 4-inch box (x6), walking 4 yards down/back	Sit to/from stand (x3), reciprocal toe touches on short cone (x8), step over 4-inch box (x8), walking 4 yards down/back	Sit to/from stand (x3), reciprocal toe touches on short cone (x8), step over 4-inch box (x8), walking 4 yards down/back	Sit to/from stand (x3), reciprocal toe touches on short cone (x8), step over 4-inch box (x8), walking 4 yards down/back	Sit to/from stand (x3), reciprocal toe touches on short cone (x8), step over 4-inch box (x8), walking 4 yards down/back	
Forward and lateral lunge on BOSU ball					15 reps/leg each direction	10 rep/leg each direction	15 reps/leg each direction	
Static standing on foam, eyes closed						20 sec hold 3 reps	20 sec hold 2 reps feet together	20 sec hold 2 reps feet together
Static standing on foam, therapist generated perturbations						1.5 mins	1 min feet shoulder width apart 30 sec feet together	1 min feet shoulder width apart 30 sec feet together
Tandem walking	30 yards	35 yards	40 yards	40 yards	45 yards	45 yards	55 yards	55 yards

Exercise	**Week 1** Session 1	Week 1 Session 2	**Week 2** Session 3	Week 2 Session 4	**Week 3** Session 5	**Week 4** Session 6	Week 4 Session 7	**Week 5** Session 8
Retro walking							25 yards	
X-rider	8 mins Resistance level 1	10 mins Resistance level 1	10 mins Resistance level 2	10 mins Resistance level 3	10 mins Resistance level 4	5 mins Resistance level 4	6 mins Resistance level 5	
Elliptical						5 mins Resistance level 3	7 mins Resistance level 4	
MiniBESTest	Completed (21/28)							Completed (26/28)

CHAPTER IV

OUTCOMES

After five weeks of outpatient physical therapy intervention the patient was discharged from PT. At her final session, the patient completed the MiniBESTest. She performed the test with the same equipment, environment, and evaluator as her initial assessment. Overall, the patient scored 26/28. She improved by 5 points, exceeding the 4 points designated as the minimal important change.[15] Broken down by sub-categories, the patient scored 5/6 in Anticipatory, 5/6 in Reactive Postural Control (improved 2 points), 6/6 in Sensory Orientation, and 10/10 in Dynamic Gait (improved 3 points). Since the patient displayed no deficits in L/E strength or U/E and L/E AROM at the initial evaluation and there was no reason to believe these would decline, they were not retested at discharge. The patient met both of her goals in a timely manner and demonstrated improved balance and endurance for return to independent living and work.

The patient had inquired about when PT could be discontinued at the last three sessions, as this is when she became more independent with her home program. Her home exercise program closely mirrored the activities done in therapy and she had also returned to the gym and her usual exercise routine (at a decreased intensity per physical therapy's request). It was evident that her balance, endurance, and affect had improved as well as her improved score on the MiniBESTest and improved cognition. These all played a key role in the PT's

decision to discharge the patient. She was instructed to continue with her home exercise program for six months and then continue with physical activity as she previously had done. She was encouraged to return to PT if she felt she was declining or not continually improving. At discharge, the PT and patient agreed with the discharge plan. The patient was overall satisfied with her time in physical therapy and the improvements she had made.

CHAPTER V

DISCUSSION

In this case of West Nile Meningitis, the patient was able to make significant improvements in balance and physical conditioning in only five weeks at an outpatient physical therapy setting. This was possibly due to the patient's relatively young age, as neurological complication of WNV often occur in older populations. Another reason for the patient's quick recovery may have been her physical fitness prior to contracting the disease.

At the conclusion of the intervention period, the patient had not reached her baseline for physical or cognitive functioning, according to the patient's self-report of symptoms and recovery progress. She made substantial improvements in both categories as she was able to return to independent living and was deemed capable of completing the remainder of her therapy at home independently. It is a common occurrence in the field of physical therapy that a patient be discharged from therapy with a home exercise program to complete independently to further improve from their current state. This is often done to keep costs for the patient low and as a convenience to the patient's schedule.

The primary care provider and the physical therapist were in agreement that the patient could return to independent living at the third week of the physical therapy intervention period. The primary care provider had different concerns regarding return to work. Both medical professionals were in agreement that the

patient was capable of carrying out the physical tasks related to her job. However, the primary care provider was concerned that physiological recovery related to the central nervous system was not stable enough to take on the stress of returning to full work days. A consensus was made by her medical team that the patient may return to work for three half-days of work on Mondays, Wednesdays, and Fridays. Following this, the plan was to re-evaluate and determine if the patient could increase her time at work.

A limitation of this study was lack of long-term follow-up. The patient was no longer under the physical therapist's care after partial return to work and the results are unknown. Following discharge, the patient was advised to return to physical therapy, should she have any questions or recurring issues. It is worth noting that the patient was not seen in PT after her discharge, as she was instructed.

This case demonstrates the recovery of a patient with WNM eight weeks following suspected transmission. This is a shorter period of recovery than had previously been reported in other studies. In an article by Jeha and Sila,[1] it was reported that 95% of patients with WNM returned to full functional recovery by eight months. Another case study series reported 100% of patients with WNM returned to work and normal to near-normal functioning by eight months.[7] Neither of the studies mentioned the use of exercise, balance activities, or other physical therapy interventions so it is assumed that these were not utilized with those patients. Based on these studies, it is not surprising that this patient was able to achieve near full recovery. It is important to take note of the length of recovery

time needed. The patient in this study was able to return to near baseline levels in only two months, a quarter of the time that the other studies reported. This is even more surprising when considering the patient's past medical history of diabetes, which has been suggested to increase the disease severity and mortality of West Nile Neuroinvasive Disease.[1,6]

On an individual basis, many of the physical and neuromuscular side-effects of WNND are commonly treated and improved through physical therapy intervention. Some of these movement disorders include tremors, myoclonus, parkinsonism, and limb weakness; as well as more common side-effects secondary to illness such as fatigue and weakness.[6,8,9] It is logical to believe that physical therapy could yield the same recovery benefits for these symptoms for WNND regardless of origin.

It should be noted that this condition and the movement disorders and other physical impairments associated with it are of neurological origin. In this case, however, an orthopedic examination and intervention approach was utilized. Although not ideal, the approach did yield positive results. In reflection, the author believes that a neurological based approach may have been better suited for this pathology. If an orthopedic physical therapy approach can produce the functional improvements seen in this case it is possible that a neuromuscular physical therapy examination and intervention may magnify the results and should therefore be examined further.

There is currently no research available on the use of physical therapy with this patient population. This case study provides evidence of functional

recovery of WNM symptoms following physical therapy intervention indicating the need for physical therapy involvement once these patients are discharged from an acute care setting. It is the author's hope that this case study has demonstrated the need for further investigation into the usefulness of physical therapy intervention for patients with WNM.

Reflective Practice

Overall, I feel like this was a positive experience regarding the patient in this case study. However, in order to improve on clinical performance and personal growth, honest reflection is always necessary. Improvements or additional approaches or techniques could be discussed on any aspect of this case.

While taking the history, it would have been beneficial to know what specific treatments she was receiving in the hospital, as well as what the physical therapist found during examination or the chosen intervention. It also would have been good to have the patient fill out a functional assessment, not only to see how she personally rated herself but to use as an outcome measure.

During the examination, it would have been helpful to have more objective measures. For example, I would have liked to use a dynamometer to test strength of the lower extremities and grip strength. I also should have tested upper extremity strength myself instead of leaving it for occupational therapy to test. I also could have measured her endurance in a standardized measure such as a six-minute walk test or timed sit to stand. The examination could have included more neurological components (dermatomes, myotomes, two-point

discrimination, proprioception, etc.) but since the patient had no specific complaints, that specific testing was not completed.

I felt that my plan of care was well suited for my patient's needs. Although, I could have done more to encourage my patient to be compliant with her home exercise program or have involved her family more in the process of assuring she completed her exercises. Due to her non-compliance at home, it may have been beneficial to see the patient three times a week as opposed to two times a week.

It may have also been more efficient to try some neurological based interventions with the patient during her recovery such as resisted Proprioceptive Neuromuscular Facilitation (PNF) patterns or rhythmic stabilization.

Although research is limited on this topic, more could be done. It may be interesting to compare WNM to other insect transmitted diseases such as Lyme disease or the Zika virus. The case could also be improved if more information could be found about the interventions (physical or pharmaceutical) currently being used in patients with WNM, as well as their functional outcomes following these interventions. Currently, a lot of the research available focuses on transmission, epidemiology, and symptom pathology, with a focus on WNE, as opposed to WNM.

I do believe I was a positive advocate for my patient on the topic of referrals. I petitioned to the primary care provider to refer the patient to occupational therapy to assess her fine motor and cognitive skills. However, occupational therapy only completed an evaluation and no follow up

interventions. They determined that although deficient in these areas, the patient would recover these skills on her own. I also worked with the primary care provider to encourage the patient to undergo a safe driving evaluation but the patient refused. I could have worked harder to ensure follow through on both situations.

There was room for personal improvement from the standpoint of a physical therapist in this case. I believe that through reflection and continuous learning I will be better suited to treat a patient with this or similar diagnoses in the future.

At this time, the author would like to call upon other clinicians and researchers to become involved in finding new ways to help patients with WNV. There is reason to believe that through rehabilitation and physical therapy techniques the recovery time for patients with West Nile Meningitis can be significantly shortened. Exploration and research are the critical next steps to helping this patient population.

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