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## Physical Therapy Management of a Patient Diagnosed with Transverse Myelitis: A Case Report

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### Abstract

**Background:** Transverse myelitis is a rare neurological disorder affecting the spinal cord and most commonly resulting in lower extremity functional deficits. Symptoms and complications can arise quickly leading to loss of ambulation, but the effects vary in each case. While medical treatment options and diagnostic approaches are discussed in the literature, research on physical therapy interventions are relatively rare. Thus, the purpose of this case report is to provide an example for acute rehabilitative care that may help document treatment options for this condition. **Case Description:** Patient A was admitted to inpatient rehabilitation after being diagnosed with transverse myelitis. She presented with a severely decreased functional status, requiring a wheelchair just days after being independent and a caretaker for her husband. **Interventions:** Physical therapy focused on improving functional movements such as walking, transferring to and from bed, and ambulating stairs. By discharge, the patient had improved in multiple facets of functional capacity and was prepared for continued therapy at a skilled nursing facility. **Outcomes at Discharge:** At discharge, Patient A had met nearly all of her goals but still needed further assistance that she would not get at home with her husband. She was discharged to a skilled nursing facility in her home town where she could continue to progress her functional abilities. **Discussion:** While some therapeutic approaches to transverse myelitis involve breaking down functional movements and relearning them as components, this patient demonstrated progress while focusing on whole functional movements such as gait, balance, transfers, and general lower extremity strengthening.

**Keywords:** Transverse myelitis; neurology; physical therapy; rehabilitation

**Background:**

Transverse myelitis is a neurological condition that creates bilateral lesions of the spinal cord (West, 2013). With this condition, inflammation builds up around a single or multiple segment of the spinal cord resulting in serious functional deficits (West, 2013). Most commonly it effects three to four segments and impacts both sides of the spinal cord (Young, 2016). This impairs communication between the spinal cord and nerve cells (West, 2013). The condition arises after the inflammatory process has ended, but the infectious agent still remains in the nervous system (Bhat, 2013). Causes of transverse myelitis can include demyelinating diseases; systemic inflammatory autoimmune disorders; neurosarcoidosis; viral, bacterial, infections, or parasitic infections; paraneoplastic syndromes; atopic myelitis; drugs/toxins; or can be considered idiopathic (Shin, 2013). Transverse myelitis incidence rates are reported at 1.34-4.6 per million per year (Bhat, 2010). Adults are significantly more affected than children, but males and females are equally impacted. The condition can be idiopathic, but up to 50% of cases are preceded by an infection (Bhat, 2010). Causes of transverse myelitis can include demyelinating diseases, systemic inflammatory autoimmune disorders, neurosarcoidosis, viral infections, bacterial infections, fungal infections, parasitic infections, paraneoplastic syndromes, atopic myelitis, drugs/toxins, or can be considered idiopathic (Shin, 2013). Transverse myelitis is referred to by multiple names in the literature including myelitis, acute transverse myelitis, partial myelitis, or partial transverse myelitis. For the purpose of this case study, the term transverse myelitis will be used consistently.

Transverse myelitis can affect motor, sensory, and/or autonomic dysfunction. The extent to what effects and their magnitude depend on the severity of the condition (Bhat, 2010). Symptoms can initiate and worsen over days or weeks before stabilizing. Typical symptoms include bowel/bladder dysfunction, dermatomal pattern sensory loss, and/or weakness most commonly influencing lower extremity flexors and upper extremity extensors depending on the level of the lesion (West, 2013). In addition, back pain at the impacted spinal level(s) can occur (West, 2013).

Transverse myelitis has been linked to both multiple sclerosis and neuromyelitis optica as initial symptoms leading to these conditions. Multiple sclerosis is an autoimmune disease where demyelination of the white matter of the spinal cord leads to degeneration of the central nervous system (Liu, 2018). Neuromyelitis optica is a non-progressive disorder that effects both the optic nerve and spinal cord leading to visual impairments (Awad, 2011).

Studies have shown that plasma exchange has shown positive results in treating transverse myelitis (Greenberg, 2007). Level of disability plays a role however (Greenberg, 2007). Those who have American Spinal Injury Classification (ASIA) A level of dysfunction have shown positive results when treated via plasma exchange in combination with steroids. Those who are not ASIA A level did not show the same positive benefits (Greenberg, 2007). High dose steroids are considered best for initial treatment of transverse myelitis and other central nervous system inflammatory-demyelinating diseases. Plasma exchange is more effective for patients who are suffering from more severe attacks and did not respond well to the steroid treatments (Aungsumart, 2017). During plasma exchange the plasma is extracted from the blood and replaced with plasma from a donor. Plasma exchange allows for the inflammatory cytokines and pathogenic antibodies to be removed from a patient's blood circulation (Aungsumart, 2017). Patient A in this case study was not treated through a plasma exchange but was continued on a steroid treatment during her time in inpatient rehabilitation as directed by her medical doctor.

Due to the rarity of transverse myelitis, research on the condition is limited. Most of the research available is directed toward the diagnostic and medical treatment facets of the disease. Unfortunately, evidence on optimal physical therapy for transverse myelitis is even more limited. If addressed, it often only amounts to a vague comment revealing that the patient

received some type of rehabilitation or physical therapy care. Often no details are included in reports beyond how often the patient received care from a physical therapist, if that was even reported. Calis et. al. (2011) focused on starting acute inpatient therapy early in order to prevent contractures and address daily functions. However, their treatment approaches are not well documented. Early initiation of physical therapy treatment has led to a decreased in the Modified Ashworth Scale scores and improvements in functional scores such as the Functional Independence Measurement, Barthel, and Functional Ambulatory Scale in the thirteen patients in this study (Calis, 2011). No control was used for comparison and no follow up was performed to determine the residual effects of this approach.

Han-Hung, et. al. (2018) reported in a case study their approach to physical therapy treatment for a patient suffering from transverse myelitis while in a hospital setting. The stay was short, only five days, but the group focused on breaking down functional movements into strengthening exercises before progressing to walking, sit to stand transfers, etc. Their criteria determining when to graduate from strengthening to functional movements was not disclosed (Han-Hung, 2018). During the five-day stay, walking was the only functional movement reported, and not until day five (Han-Hung, 2018). This case report provides an example of patient that tolerated early functional exercises with good progress observed, to address the lack of research pertaining to transverse myelitis and physical therapy.

### **Case Description:**

Patient A, a 74-year-old white female, was admitted to a regional medical center five days after her initial symptoms of transverse myelitis appeared. Her symptoms began as numbness of the right thigh and five days later it had spread to the left leg as well. This made navigating stairs difficult and reduced her ability to get around her home. She was not experiencing any effects in her upper extremities, but she did have difficulty urinating and stooling.

During the two days prior to admission on the inpatient rehabilitation floor, a neurological workup, including magnetic resonance imaging (MRI) of the cervical spine, thoracic spine, and brain regions were conducted. All returned normal. A cerebral spinal fluid study showed oligoclonal bands that support the diagnosis of transverse myelitis. She was diagnosed with radio-negative transverse myelitis with impaired mobility, inability to perform ADLs and transfers, poor endurance, and increased pain. She was initially treated with steroids (Solumedrol and a prednisone taper).

Patient A's surgical history included dilation and curettage of the uterus. Her family medical history involved both cancer and heart disease. She reported that she has never been a smoker and that she occasionally has a few glasses of wine per week, but not every week.

Patient A came to the hospital with her husband who suffers from memory issues and typically is cared for by Patient A. They live together in a split-level home where her bedroom and bathroom are on the second floor. She has additional steps to enter the home. She was previously not limited functionally in her home or the community.

Patient A was transferred to the inpatient rehabilitation floor two days after being admitted to the hospital. She was scheduled for two weeks of three hours /day of therapy (combination of physical, occupational, and speech, if needed) for five out of seven days per week. Her functional and medical status had not changed since her initial admission to the hospital. She noted feeling weak in both legs, but the right was worse than the left. She denied any shortness of breath or low back pain. She had been having difficulty sensing when to use the bathroom but was able to void successfully at times. She presented with proper orientation to person, place, time, and situation.

**Initial Evaluation**

The range of motion of Patient A's lower extremities were within functional limits. However, she had difficulty sensing where her feet were when walking. Her manual muscle testing results are provided in Table 1. She had impaired coordination when testing rhythmic ankle pumps and sliding the heel down the opposite shin. When testing sensory impairment, Patient A was able to tell where the therapist touched her, "but it did not feel right." She reacted to tickling on the right lower extremity, but not the left. Her great toe proprioception was normal.

**Table 1.** Physical therapy manual muscle testing results at initial evaluation.

	Right lower extremity	Left lower extremity
Hip flexion	2+/5	3+/5
Hip extension	Mod resistance	Mod resistance
Hip abduction	2/5 at least	2/5 at least
Hip adduction	2/5 at least	2/5 at least
Knee flexion	Mod resistance	Mod resistance
Knee extension	4/5	4/5
Ankle plantarflexion	Max resistance	Max resistance
Ankle dorsiflexion	4/5	4/5
Ankle eversion	4/5	4/5
Ankle inversion	4/5	4/5

Patient A's bed mobility required up to moderate assistance of one. Generally speaking, she needed moderate assistance at the lower extremities and minimum assistance at the trunk. She was able to sit at the edge of bed while taking perturbations but needed assistance to get shoulders stacked above hips to improve positioning for balance. She needed moderate assist of two to get out of a chair to a front-wheeled walker and to return to a seated position. She especially needed help getting her hips to the back of the chair due to her lack of sensation of her legs. Patient A was unsteady without using the walker for standing support and leaned heavily on her arms to support her body weight. She required max assistance of one with another at the wheelchair for safety when transferring to and from the car. She was unable to navigate stairs or curbs at the time of initial evaluation. When walking with the walker Patient A needed moderate assistance of two and took too large of steps if she did not look down at her feet. She was able to walk 10 feet on her first attempt and built up to 35 feet on the first day. She had a tendency to adduct her legs and even cross them if she was not careful while walking. She had obvious right knee hyperextension. She was able to walk backwards with moderate assistance of two but could not properly place her feet consistently. She was given a wheelchair for mobility purposes, but had difficulty navigating turns at initial evaluation.

Patient A had previously worked at a CPA office, but had retired and started volunteering at a local hospital's gift shop. The entrance to her home had 5 steps with a single railing on the right side for support. In addition to her husband, her son (currently unemployed) was present for the evaluation. It was determined through evaluation and subsequent treatment sessions that neither of them would be willing/capable despite Patient A's wishes to go home with her son. In addition to the stresses from the medical condition Patient A's grandson was to be married outdoors at a state park two weeks later and she wished to attend.

**Interventions:**

Patient A was seen twice per day (morning and afternoon) Monday through Friday by a physical therapist or physical therapist assistant for two weeks. She was seen on Saturdays if

time during the week was missed due to medical complications or other appointments. She also had scheduled visits with occupational therapists, psychologists, and recreational therapists.

After the initial evaluation the physical therapy team focused on developing a home exercise program for strengthening and range of motion that Patient A could complete in her room once per day away from therapy. This would allow for her therapists to focus on functional hands-on work during therapy sessions. These exercises started simple and were similar to what might be given for a total knee replacement with some adjustments. The exercises included heel slides, supine hip abduction, hip adduction, ankle pumps, glute sets, quadriceps sets, and short arc quad exercises. She needed assistance with the supine hip exercises due to the lack of space in her hospital bed. To resolve this her son or husband assisted outside of therapy.

### Strengthening Tasks

Each day one of two lower extremity strengthening tasks were performed during therapy in addition to the home exercises prescribed. Either Patient A spent time working on the NuStep recumbent stepper machine to help coordinate her step pattern and increase leg strength and endurance, or she would perform sets on the leg press shuttle. Patient A enjoyed both of these activities and described them as something she could feel working her muscles “properly”. She progressed in both exercises building up to 12 minutes on the NuStep. Initially, she needed constant tactile cuing to prevent her hips from rolling in while sitting on the machine. With strengthening from her home exercise program, further strengthening through other activities and repetitions on the NuStep, she was able to maintain a proper lower extremity position by the start of her second week of therapy. On the leg press shuttle the patient is supine with her lower extremities started in a 90/90 position with her feet positioned shoulder width apart on a platform. She would then press her legs into full extension against resistance. She started with 48 pounds and progressed to 96 pounds bilaterally. When performed unilaterally she progressed from 24 pounds to 60 pounds on her left and 52 on her right. She had similar difficulty with her hip internally rotating during the exercises. Unlike the NuStep, her extension was not controlled by the machine and she would hyperextend her right knee if not supported by the therapist. During the early stages of performing this exercise she needed constant cuing to slow down and focus on controlling her knee and hip movements. She needed a therapist’s support under the knee to prevent hyperextension throughout her inpatient rehabilitation but was able to gain control of her hip internal rotation by early in week three.

### Gait Training

Our initial goals were driven by functionality, thus scheduled therapy visits focused on improving her ability to perform activities of daily living (ADLs). We felt it would be a disservice to only address strength in the early stages and move onto more functional goals during the latter part of her stay. During each of Patient A’s sessions she would walk as far as she could before taking a break at least once. Typically, she went for two to three walks as far as she could tolerate. Other shorter walks were performed between therapy activities. As noted in the initial evaluation, she relied heavily on her arms to support her weight and struggled to consistently take appropriate length steps in a straight pattern.

At day three gait training moved to the above-head harness system in an attempt to reduce Patient A’s reliance on her arms for support. This continued until day ten. At this time Patient A had reduced her reliance on her arms only minimally. It was determined that support from the physical therapy team would allow for a more realistic situation and provide at least equal benefits for the patient. During this time, we also worked on being able to turn when walking. Initially she needed moderate assistance of two to complete a 180-degree turn. Due to

her lack of proprioception she had difficulty placing her feet in the correct spot if she was not paying close attention. As she progressed with therapy, she was able to navigate turns with less assistance but still required moderate assist of one with another at standby for safety when turning at time of discharge.

Steps were also addressed later in Patient A's care. At her home entrance she only had one railing to work with but was unable to ambulate stairs without the use of both railings. Much like when she walked, she relied heavily on her arms to support her bodyweight. With cuing she was able to properly place each foot on each step. A therapist was always involved in his activity. With repetitions her step pattern and foot placement improved but her energy levels limited her.

### Transfers

Her sit to stand and bed to chair/chair to bed transfers were practiced and addressed from the start. As we practiced and gave cues about proper set up, leaning her upper body away from her destination, and proper use of her arms to supplement her leg strength, she was better able to assist the therapist and her caretakers. Patient A improved to the point where she could assist by adjusting her foot placement with her upper extremities when preparing for a bed to chair or chair to bed transfer. She was unable to complete this positioning using only her legs. She demonstrated improved leg strength throughout her day allowing her to help with the push. We initially started with a slideboard, but in the last week we were able to complete the transfer with two partial stand pivots. She was unable to improve enough to perform a slideboard transfer independently, so this became the most efficient option for her and her caregivers. We practiced full sit to stands from her wheelchair to her front wheeled walker as well as parallel bars. It was initially a struggle for Patient A, but with the improved leg strength she was able to better consistently get to a standing position. She did have "falls" back into the chair throughout her stay, but they were not common at the end and were typically a result her not getting a proper forward lean or being tired from previous activities. Her car transfers were addressed after she became familiar with her chair to bed transfers. Due to the tight space of a car transfer we continually used a slideboard for safety. Patient A was educated on proper placement of the wheelchair and understood how to use the car frame to her advantage. We started this task late in week two and midway through week three she was able to direct a caregiver without error.

### Balance

To address her balance deficits, we implemented a variety of balance exercises to keep the challenges new. Starting with firm surfaces we practiced simply standing with one hand off of the front wheeled walker and progressed to both hands being removed. As she progressed when added head turns and eyes closed. Firm surfaces were graduated to floor mats and Airex pads. Tasks such as marching in place, reach with upper extremities, tapping toes on cones, and catching a ball were implemented on the varying surfaces to challenge Patient A.

### Functional Electrical Stimulation Bike

On day 8 the patient was introduced to a functional exercise stimulation (FES) bike. The rationale was that electrical stimulation may facilitate the neuromuscular activation to further improve functional movement. For this setup Patient A, the electrical stimulation pads were placed over her anterior tibialis gastrocnemius, hamstrings, quadriceps, gluteus, and paraspinal muscles bilaterally. This allowed the FES machine to assist Patient A in riding a bike, where a track was presented on an iPad in front of her. Patient A was told to do as much of the movement as she could, and the FES would assist her as needed. The iPad screen provided feedback to the patient, including statistics showing how fast she was going, how far she had

gone, and if she was using one leg more than the other, her avatar would tip to that side and possibly fall over. FES bicycling was performed twice in week two and twice in week three. Ideally, the intensity of the electrical stimulation can be set on the first day with only minimal adjustments in subsequent sessions. However, Patient A had variable symptoms and was never able to consistently feel comfortable with the pre-set levels, requiring that we spent additional time adjusting levels during each session. This reduced the time that Patient A was able to get feedback from the machine. It was likely that the four sessions prior to discharge were not enough to have a lasting impact on Patient A.

### Depression Associated with Transverse Myelitis

During her stay as sessions progressed, it was evident that Patient A was not seeing the success that she had hoped for. She began to show increasing depressive symptoms during therapy sessions. She often talked about how well others were progressing compared to her despite the differences in their initial conditions and disease complications. It may have been further complicated by the fact that she was unable to achieve her goal of attending her grandson's wedding. Depression is not an uncommon syndrome associated with transverse myelitis. It is estimated that 17% of those suffering from transverse myelitis have resultant depressive symptoms (Liu, 2018). While her depression-like condition did not fully resolve by discharge, it improved some after she was able to use FaceTime to virtually attend and watch her grandson's wedding.

### **Outcomes at Discharge:**

Patient A was discharged from inpatient rehabilitation to a skilled therapy location after three weeks. During the physical therapy discharge evaluation, Patient A was able to perform all bed mobility with standby assistance only. Her sitting balance had improved to supervision while at edge of bed and she could transfer from that position to a chair using her front wheeled walker with minimum assistance of one. She and her son were independent as a unit when transferring from a wheelchair to a car using a wheelchair and front-wheeled walker. Her sit to stand transfers had improved to minimum assistance of one to light contact assistance depending on her energy levels and was able to balance with light contact assistance and use of a front-wheeled walker. With light contact assistance Patient A ambulated 90 feet during her last session. She continued to take small steps bilaterally to improve her gait rhythm. Adduction of her right leg persisted but had improved. She was able to ambulate curbs with her front wheeled walker and minimum assistance of one. She had more difficulty with steps as she was unable to use her walker but could complete four steps both ascending and descending without a break using bilateral railings and minimum assist from one. For safety reasons she used a step to pattern rather than a step through pattern. Her manual muscle testing was not completed for at the end of her period of care due to the focus on changes in her functional status. She was independent with her home exercise program and wheelchair use in the physical therapist's opinion. At the time of discharge, Patient A had met the majority of her physical therapy goals. She did not meet the goal of ambulating 150 feet on level surfaces with minimum assistance and least restrictive device. However, she did make improvements toward each goal during her time with the inpatient rehabilitation staff. With these improvements, it was determined she was appropriate for discharge to a skilled nursing facility.

At discharge she was still using a wheelchair as her primary mode of ambulation but was now independently using it. She continued to have some anxiety, and depression related to both her condition and poor sleep during her stay. She described her lower extremity sensation as, "improved, but still not right." However, since her initial evaluation, she had an increased area of sensation loss on the right lower extremity, as noted by her medical doctor.

**Discussion:**

The rehabilitation team chose to on interventions targeting improved functional mobility immediately. By giving Patient A a home exercise program, to work on her own, it allowed us to focus our treatment sessions on tasks that required our assistance and expertise. Breaking down movements may be helpful, but in the limited time we had with our patient we believed it would be more beneficial to help her in larger capacity movements. Given more time we may have chosen to approach recovery with a different plan. It would likely have been a disservice to Patient A to continue to wait and address functional mobility until later in her recovery. Patient A made progress in several areas, but continued to exhibit notable deficits in others. While we cannot know whether using a different approach would have resulted in similar, worse, or even better outcomes, this case highlights that the patient was able to tolerate treatments involving whole functional tasks. However, we augmented this approach with isolated exercises for strength and endurance to maximize the likelihood of success in the acute period.

There is ample opportunity for more research to be done with this patient population. If and when this further research occurs, varying physical therapy approaches, such as those mentioned in this report, should be compared to provide our patients with the best and most efficient care possible.

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