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Physical Therapy Rehabilitation In A Patient With Guillain-Barre Syndrome With Acute Respiratory Failure: A Case Report

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Physical Therapy Rehabilitation In A Patient With Guillain-Barre Syndrome With Acute Respiratory Failure: A Case Report

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This Scholarly Project, submitted by Daniel P. Torok 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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PERMISSION

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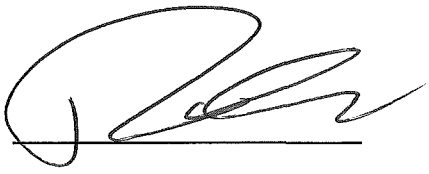
Signature 

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ABSTRACT

Background and Purpose. Guillain-Barre Syndrome (GBS) is a lower motor neuron autoimmune disorder that primarily affects the myelin sheaths of the peripheral nervous system (PNS). GBS results in generalized weakness and sensory deficits of the extremities and trunk; in severe cases it may impact cranial nerves, respiratory musculature, and the autonomic nervous system (ANS). The purpose of this case study is to describe the physical therapy interventions used for a patient diagnosed with GBS and the results from those interventions.

Case Description. This case study describes the 9-week acute care Physical Therapy management of a 51-year-old transgender female diagnosed with GBS presenting with symmetrical acute flaccid paralysis, paresthesia, and neuropathic pain of the extremities and trunk. She also presented with autonomic dysfunction resulting in dyspnea, dysphagia, and dysarthria.

Intervention. The physical therapy treatment of this patient involved range of motion, stretching, strengthening, aerobic endurance, neuromuscular re-education, balance and coordination, gait and assistive device training, and skin/joint protection.

Outcomes. Following physical therapy rehabilitation, the patient demonstrated improvements with range of motion (ROM), strength, fine and gross motor coordination, balance, ambulation, transfers, endurance, and functional skills; along with reduced neuropathic pain, paresthesia, and disability.

Discussion. This case illustrates the inpatient physical therapy interventions for a patient diagnosed with GBS based on the patient's presentation and response to interventions. The rationale for treatment was based on the GBS/AIDP Foundation International guidelines. A multidisciplinary approach which included physical therapy interventions was found to be very effective in regaining most of the patient's previous function. More research is needed to assess effectiveness of specific physical therapy interventions in treating this patient population.

CHAPTER I

BACKGROUND AND PURPOSE

Guillain-Barre Syndrome (GBS) is reported to be the most common cause of acute flaccid paralysis around the world. In the Western World, GBS has an average annual incidence of 1-2 per 100,000 people[1,2]. Men are 1.5 times more likely to be diagnosed with GBS compared to women. As you age, prevalence also increases with men under 30 years of age having a diagnosis rate of 1 out of 100,000 while men over 75 years of age is roughly 4 out of 100,000[1].

GBS is an autoimmune disorder that involves an immune response targeting the myelin sheaths of the nerve roots and peripheral nerves of the extremities resulting in myelopathy and neuropraxia[1,3]. Although the direct cause of GBS is unknown, it is often diagnosed following certain events, such as viral infections of the respiratory and gastrointestinal tracts. GBS has also been diagnosed in those who had surgeries or immunization days or weeks prior to onset in rare instances[4]. Initial onset of GBS typically consists of bilateral numbness, muscle weakness, and limb pain that begins in the distal lower extremities. Symptoms will occur in both the upper and lower extremities and will progress proximally over a relatively short amount of time[1,3]. In some cases, GBS may also result in demyelination of nervous tissue outside of the peripheral nervous system (PNS) resulting in autonomic nervous system complications in roughly two-thirds of this patient population[5]. Autonomic involvement may result in complications with fluctuating blood

pressure, arrhythmias, gastrointestinal dysregulation, and/or vasomotor dysfunction[5]. Cranial nerve (CN) involvement occurs in 45-75% of patients with the facial nerve (CN VII) being the most commonly affected, resulting in deficits with facial expression and taste[6]. According to a study from Lawn et. al.[7], roughly one-quarter of GBS patients develop weakness of the inspiratory and expiratory muscles with 17-30% requiring mechanical ventilation. Roughly 10-20% of patients develop respiratory failure with a mortality rate of 2-5%[3]. A study conducted by the University Medical Center in Rotterdam determined a mortality rate of 2.8% in GBS patients within a 6-month period after discharge[8]. They also determined that risk factors included increased age, severity of weakness, use of mechanical ventilation, delayed onset of weakness, time to peak disability, increased rate of symptom progression, and prior diarrhea[8,9].

Progression of symptoms can vary widely, moving distal to proximal anywhere from 12 hours up to four weeks from initial onset where symptoms reach maximum severity[1,10,11]. At that time, the progression of symptoms ceases and reaches a plateau phase at which point the symptoms remain unchanged for 1-2 weeks in most cases but can range anywhere from 2 days up to 6-months in more severe cases[3,10]. Following the acute stage is a period of gradual recovery that ranges from months to years depending on the severity of the GBS diagnosis, administration of treatment, and rehabilitation. GBS can lead to permanent disability, however, prognosis is typically good with 70% of GBS patients regaining complete pre-morbidity functional status[12,13,14,15]. Roughly one-third of patients develop mild GBS which is classified by maintaining the ability to ambulate while

severe GBS is classified as losing the ability to ambulate due to the neurological symptoms[16].

Diagnosis requires sound clinical judgment utilizing imaging and laboratory testing to rule out other similarly presenting pathologies such as acute and sub-acute polyneuropathies, botulism and porphyria, basilar artery thrombosis, myelitis, spinal compression, AIDS infection, and others[3,10]. Diagnosis of GBS requires lumbar puncture to analyze cerebral spinal fluid (CSF) protein and white blood cell (WBC) count. Typically, in the acute phase of GBS, findings from CSF and WBC analysis would result in an albuminocytolgical dissociation, which demonstrates an elevation in CSF protein (>0.55 g/L) without an elevation in white blood cells[17]. Another diagnostic test that can be used to support GBS diagnosis would be decreased peripheral nerve conduction velocities with nerve conduction studies (NCS). NCS are not always conclusive in GBS patients as a study by Luigetti et. al.[18] discovered that 37% of patients who had NCS performed in the first four days of disease onset had normal NCS findings[18]. NCS was found to have increased reliability with increased time following disease onset and increased severity of symptoms.

The typical course of treatment involves close monitoring for fluctuating blood pressure (BP), oxygen saturation, cardiac arrythmias, respiratory function, and signs of hypoxia. Forced vital capacity (FVC) of less than 15mL/kg indicates respiratory failure which often requires intubation and admission into the intensive care unit (ICU)[19]. Immunotherapy such as intravenous immunoglobulins (IVIG), plasmapheresis, and immunosuppressive therapy are the most common treatment options for GBS and are indicated based on the severity of initial presentation and

electrophysiological prognostic factors[3,20]. Earlier administration of immunotherapy following disease onset has shown to lead to better functional outcomes and decreased demyelination of nerves[21]. Acute relapse of GBS following stabilization or improvement of symptoms occurs in less than 10% of severe GBS cases[22,23]. Some research has been done by using corticosteroids, however, results were not clinically significant in treatment of patients with GBS and is not widely used[24].

Rehabilitation for GBS patients admitted to the ICU requires a multidisciplinary approach of specialists to monitor respiratory and cardiac function, prevent secondary complication and disease progression, and initiate physical rehabilitation. Fatigue is reportedly the most disabling and challenging symptom to overcome during rehabilitation as it is a frequently occurring symptom in disorders that involve the PNS[25]. Specifically, in GBS, the level of fatigue severity tends to have a positive correlation with age and 60% of patients over 50-years-of-age report fatigue as their most limiting factor[26]. In many cases, increased fatigue can remain for years after full recovery of muscle strength and function[27]. During rehabilitation, physical therapy plays an important role in managing fatigue. It takes special care to improve activity tolerance, being careful not to overwork patients which can cause increased fatigue and possibly slowing progress. According to Garssen et. al.[27], implementation of patient specific rehabilitation programs managed by physical and occupational therapy resulted in a 20% improvement of self-reported fatigue symptoms, which remained at a 2-year follow up.

In the recovery stages of GBS, physical therapy interventions are often utilized to manage fatigue and pain, regain strength and neuromuscular control, and

address functional impairments associated with GBS. During the acute phase of GBS, physical therapy plays a role in monitoring for the following complications: deep vein thrombosis (DVT), dysautonomic disorders such as orthostatic hypotension due to immobilization, respiratory disturbances, respiratory muscle weakness, contractures, and sensory impairments[28,29]. To prevent joint contractures, prescription of orthotics, patient positioning, and gentle range of motion (ROM) is performed either passively or actively dependent on the ability of the patient. Orthotic devices may also be used to prevent the development of pressure sores from prolonged positioning. As the patient's symptoms stabilize and improve, physical therapy will work to facilitate weight-bearing through the lower extremities and improve upright tolerance in sitting and standing positions. Throughout the course of treatment, exercise prescription is focused on regaining muscular strength through resistive exercises and practice of functional activities. Early physical therapy interventions have been shown to improve mobility outcomes, decrease chronic fatigue symptoms, and improve mental function[30].

The purpose of this case study is to discuss and review the role of physical therapy as an intervention in the acute care setting of a patient with a diagnosis of GBS, who exhibited severe fatigue along with bilateral paralysis and paresthesia of the extremities and trunk due. This case report demonstrates that physical therapy twice per day can improve fatigue, strength, motor control, and function with 9-weeks of acute care rehabilitation.

CHAPTER II

CASE DESCRIPTION

Patient was a 51-year-old transgender female (biologically male but identifies as female) who was self-referred into the Emergency Department (ED) at the Veteran's Affairs Medical Center and eventually was diagnosed with GBS. The patient reported her initial symptoms occurred three days prior to visiting the ED and consisted of tingling, loss of sensation, and weakness of her toes and fingers. The patient had a past medical history of Type II diabetes mellitus that she assumed to be the source of her symptoms. However, she reported increasing fatigue and progressively worsening symptoms that continued to move proximally in her extremities. She sought medical attention three days following the initial symptoms when she was unable to drive or negotiate stairs to her 2nd floor apartment.

Three days after admission to the hospital following her ED visit, she was admitted to the ICU with complete loss of function and neuropathy of her extremities. A complete blood count (CBCs) and lumbar puncture was ordered and ruled out other pathologies and revealed elevated proteins in the CSF with normal white blood cell count. These results, along with peripheral NCS resulted in a formal diagnosis of GBS.

In the five days following her initial ED visit, her symptoms continued to worsen with complete flaccid paralysis and neuropathy of the extremities, trunk, and neck. Due to weakness of the neck and facial nerve involvement, the patient

became non-verbal and communicated using eye movements and weak facial and head movements. The patient also had autonomic nervous system involvement that led to loss of bowel and bladder control requiring catheterization. A nasogastric (NG) tube was inserted in the ICU due to increased risk of choking and aspiration from difficulty with swallowing. Increased respiratory weakness resulted in a respiratory insufficiency requiring a tracheostomy and mechanically controlled ventilation.

A referral for occupational and physical therapy services were placed after the patient reached the plateau phase of the disease progression, which was eight days after being admitted to the hospital from the ED. The patient's chief complaints were fatigue, difficulty with breathing, severely diminished motor control of extremities and trunk, loss of function, weakness, loss of sensation, and burning sensation of extremities. The patient had no functional control of extremities with trace muscle grades for all motions of bilateral upper and lower extremities. The patient reported relief of burning pain in extremities only with pharmaceutical pain medication. Patient's initial intake history revealed that she resided alone in a second-floor apartment with two flights of stairs with handrails on both sides to enter. Patient had two cats and had no immediate family in the area that could provide support. Patient reported that she had several close friends and a strong community support system that may provide assistance if needed. The patient was a retired military Veteran with access to VA health care benefits to manage costs of health care services. The patient reported working as a cross-country truck driver

that involved some heavy lifting and climbing, however, most time was spent in a seated position driving.

Examination, Evaluation and Diagnosis

Evaluation criteria was based on GBS/CIDP Foundation International guidelines for GBS/AIDP evaluation and treatment[31]. The patient was 5'6" and weighed 190lbs, which indicated a body mass index (BMI) of 30.7. A BMI of greater than 30 placed the patient in the obese category[32]. Upon initial evaluation in ICU, the patient was in Fowler's position with lower extremities slightly elevated. She had bilateral compression stockings, a catheter, a left arm IV, a nasogastric tube, and tracheostomy tube. She was non-verbal and could only communicate through facial expression and weak head gestures. With palpation, the patient was unable to detect light touch distal to her elbow and knee bilaterally. She was able to detect increased pressure of her extremities however tenderness and burning sensation was noted bilaterally at the gastrocnemius and plantar surface of both feet. Gross ROM was assessed in the Fowler's position for upper and lower extremities. Limited passive range of motion (PROM) and intense stretching sensation was experienced in bilateral hamstrings with straight leg raise (SLR) and gastrocnemius with dorsiflexion (see Table 1). All other upper and lower extremity motions were within normal limits and no pain was elicited during PROM.

Gross lower extremity strength was tested in the Fowler's position for the following motions: hip flexion, abduction/adduction, internal/external rotation, knee flexion/extension, ankle plantarflexion/dorsiflexion, and great toe flexion/extension. All motions tested 1/5 bilaterally and were pain free. Skin

Table 1. Initial Lower Extremity PROM Limitations (in Degrees)

	R	L
Hip Flexion (Knee bent)	120°	120°
Hip Flexion (Knee straight)	46°	48°
Dorsiflexion (knee bent)	6°	7°

inspection for pressure sores and skin integrity was unremarkable on the heels, sacrum, hips, and shoulders. Homan's sign (Sensitivity 54%, Specificity 89%) was completed and patient tested negative bilaterally for signs of DVT[33]. Plantar reflex (Sensitivity 51%, Specificity 99%) was completed and patient tested negative bilaterally for a Babinski sign indicating no upper motor neuron dysfunction[34]. Deep tendon reflexes were graded 0 (areflexia) bilaterally via the Achilles reflex indicating lower motor neuron involvement of the PNS.

Initial evaluation data indicated this patient had significant motor weakness of the extremities, trunk, facial, and respiratory musculature. The patient had increased neuromuscular control with the muscles of the trunk and proximal extremities compared to her distal extremities. Based on the plantar reflex testing and Achilles reflex testing, the PNS was likely involved with no evidence to suggest a central nervous system (CNS) insult. The patient also had deficits with proprioception and sensation to light touch that was more prominent distally. Due to these deficits, the patient was at a high risk for developing contractures, pressure sores, and a DVT. The patient was also completely dependent with all activities of daily living (ADL)/instrumental ADL (IADL) and self-care due to weakness and was

at a high fall risk. The patient required total assistance of two for bed mobility and ceiling lift for transfers. The self-care, transfer, and locomotion portion of the Functional Independence Measure (FIM) was completed and patient scored 1 in all tested areas (see Appendix A). The FIM is an objective measuring tool to assess patient's level of disability and response to treatment. Goals for this patient included increasing strength of trunk and extremities, improving endurance, avoiding formation of contractures, improving sensation and proprioception of extremities, decreasing pain, improving balance and coordination, and improving mobility, gait, and overall function. Completion of these goals would help the patient return to her prior level of function allowing her to complete ADL/IADLs, ambulate, discharge to home, and return to work activities.

Prognosis and Plan of Care

Mortality rates for GBS patients who have ICU management is roughly 2-12% and is roughly 5% in tertiary care centers with medical professionals who have previous experiences treating GBS[35]. The most common cause of GBS-related death is tied to complications from ventilation such as pneumonia, sepsis, acute respiratory distress syndrome, and autonomic dysfunction[36]. The primary goal for this patient while in the ICU was to restore optimal respiratory function as it is one of the biggest predictors for long term disability and mortality in this population. Other factors that have found to be associated with adverse patient outcomes include older age (>57 years old), poor upper extremity strength, acute hospital stay >11 days, an ICU admission, use of mechanical ventilation, and rapidly progressing onset of muscle weakness[37,38].

Most GBS patients will return to their prior level of function, however, 7-15% of GBS patients suffer with chronic neurological sequelae such as, foot drop, intrinsic hand and foot muscle wasting, sensory ataxia, dysesthesia, pain, increased fatigue, and overall functional impairments[39,40]. The risk of reoccurrence is rare and only occurs in 2-5% of patients[22,23].

Given this information, the patient had a fair prognosis based on the relatively low rate of mortality and reoccurrence within this population. Unfortunately, this patient was positive for all of the factors associated with adverse outcomes listed above. The patient was fortunately treated at a facility with a significant history of treating GBS. Primary goals for this patient for rehabilitation were focused on early bed mobility, transfers, and ambulation. Independent ambulation occurs in 20% of GBS patients after 4 weeks and is a predictor for reaching full prior level of function at 1 year while only 40% reach their prior level of function if they are ambulating with an assistive device at 4 weeks.

Throughout the plan of care, the patient was reassessed utilizing the FIM, MMT, and ROM. The patient's progress was also recorded and progressed based on her response to treatment with an emphasis placed on reducing fatigue, improving activity tolerance, strengthening, maintaining ROM, and functional mobility (ambulation, stair ambulation, bed mobility, and transfers).

CHAPTER III

INTERVENTION

Patient was seen twice each day for 30-minute sessions in the morning and the afternoon while in the ICU. She received the same frequency of physical therapy and occupational therapy throughout her course of treatment in the acute care setting. Physical therapy was primarily involved with regaining function of the lower extremities and trunk, improving activity tolerance, and improving functional mobility. Occupational therapy was primarily involved with regaining function of the upper extremities including self-care, adaptive device training, and fine motor skill reacquisition throughout the course of rehabilitation. This case study will focus on the trunk and lower extremities, gait, and mobility interventions.

Since the patient was intubated, verbal communication from the patient was impossible and use of facial and eye expressions was the main determinant for communication. Facial expressions were subtle and inconsistent initially due to CN VII involvement, therefore, close observation from the therapist was essential to assess the patient's response to interventions. During the 1st week of intervention, the patient received lower extremity PROM to end range for all motions of the hips, knees, and ankles to prevent the development of contractures and maintain flexibility due to the acute flaccid paralysis. The patient was encouraged to assist with motion through verbal cues from the therapist. Each lower extremity motion was completed through full range for 20 cycles with 3 second tempo in each

direction. The patient performed bed mobility training, rolling from supine to sidelying with maximum assist +2. She was cued to assist with positioning and rolling. While in sidelying, hip extension PROM exercises were performed. Passive sustained stretches for the hamstrings and heelcords were held for 90 seconds for 2 sets during the treatment session to prevent the development of contractures (see Appendix B for specific week 1 interventions). The patient was fitted with Multi Podus boots to reduce the risk of developing plantar flexion contractures, hip external rotation, and heel ulcers (see Figure 1.).

https://cdn3.volusion.com/vvhfx.vmyur/v/vspfiles/photos/6147ML-2T.jpg

Figure 1. Multi Podus Boot

During the 2nd week (see Appendix B for specific week 2 interventions), the patient completed transfers from supine to sitting at the edge of her hospital bed with maximum assist +3. She was encouraged to assist with the transfer through verbal cues to encourage neuromuscular facilitation. While sitting upright, she was cued to maintain sitting balance to enable core stabilization. In this position, lower extremity ROM exercises and stretching were also performed. She was unable to

maintain sitting balance with feet on the ground and required therapist assistance to stay upright. During each therapy session, the patient's level of strength was assessed through the amount of assistance needed with ROM activities. By the end of the second week, the patient was able to provide gradually increasing levels of effort but still required moderate assistance throughout the entire ROM with all hip and knee motions. She was still unable to move her limbs against gravity and quickly fatigued after 8-10 repetitions with therapist assistance. Bed mobility exercises continued during the second week with increased participation from the patient.

During the 3rd week (see Appendix B for specific week 3 interventions), the patient continued to perform transfers from supine to sit with therapist assistance with verbal cues. She was able to maintain sitting balance without upper extremity support with her feet planted on the floor for 20 seconds before losing her balance. Lower extremity AAROM against gravity was performed in sitting with demonstrating improved lower extremity strength. She had jerking concentric movements with poor eccentric control against gravity. She was able to complete two sit-to-stand transfers with maximum assistance of 2 with use of a standard walker with upper extremity support. She was able to maintain a standing position with maximum assistance of 2 with encouragement for two 30-second trials before lower extremity fatigue set in. She required maximum assistance of 2 to block knees from flexing and to prevent hip flexion. By the end of the 3rd week, she had 3/5 strength with all hip motions and 2+/5 strength with knee flexion and extension bilaterally. She continued to have difficulty with fatigue, coordination, and

proprioception of her lower extremities demonstrated by decreased strength and control of movements. At this time, the patient was able to communicate verbally as her ventilator was discontinued and replaced with supplemental oxygen. FIM scores were reassessed at this time (see Appendix A).

After 4 weeks (see Appendix B for specific week 4 interventions), the patient was discharged from the ICU and admitted into the acute care wing where she received physical therapy twice daily in the physical therapy department. She continued the same physical therapy scheduling with two 30-minute sessions for transfers, gait, and functional training completed in the morning and strengthening and endurance in the afternoon to avoid fatigue. With the use of bed rails and trapeze bar, the patient performed log rolling and supine to sit transfers with moderate assistance by the physical therapist and use of her upper extremities. Due to her grip strength deficits, she required the use of Dycem pads and therapist assisted hand holds to allow her to use her upper extremities for assistance. Balance training in sitting was performed and the patient was able to maintain sitting balance with feet on the floor with small perturbations for 30-second trials. She continued to receive sustained passive stretches to her lower extremities in sitting to maintain ROM and prevent the development of contractures since she continued to spend most of her day in supine. A sit to stand lift (see Figure 2.) was utilized during a cotreatment session with occupational therapy to encourage concurrent use of upper and lower extremities and encourage sustained weight bearing through the lower extremities. The patient was able to tolerate 3 sit to stand

transfers with the sit to stand lift and maintain two 30 second stands and a 60 second stand before lower extremity muscle fatigue set in. Strengthening

https://content.directsupplycdn.com/7D61B4B6626EC1E7F4085CA03C6FDDC304AF8F92395462A0CB6707A064907C1C?h=500&w=500

Figure 2. Sit to Stand Lift

activities for the lower extremities included ankle pumps against resistance, heel slides, long arc quads, glute sets, straight leg raises, and sit to stands. Strengthening exercises were able to be performed actively against gravity at this time without therapist assistance, however, she was unable to manage full active range of motion (AROM) independently. Verbal and tactile cues were provided to encourage controlled concentric and eccentric motions. Strengthening activities were progressed by decreasing rest time between sets when the patient tolerated and by increasing the number of repetitions initially.

At the beginning of the 5th week (see Appendix B for specific week 5 interventions), supplemental oxygen was discontinued as respiratory function improved. She was able to progress to larger, less predictable perturbations without loss of balance while sitting on a high low table with feet planted on the ground. She

Appendix A.

Functional Independence Measure (FIM) scores

FIM scores throughout treatment

	Initial	Week 3	Week 6	Discharge
Self-Care				
A. Eating	1	2	5	6
B. Grooming	1	2	4	7
C. Bathing	1	2	3	6
D. Dressing-Upper	1	2	4	6
E. Dressing-Lower	1	2	4	6
F. Toileting	1	3	3	7
Transfers				
G. Bed, Chair, Wheelchair	1	3	4	6
H. Toilet	1	3	4	6
I. Tub, Shower	1	2	3	6
Locomotion				
J. Walk/Wheelchair	1	1	4	6
K. Stairs	1	1	1	6
Motor Subtotal Score	12	23	39	68

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	☐ W Walk C Wheelchair B Both	☐ W Walk C Wheelchair B Both	☐ W Walk C Wheelchair B Both
M. Stairs	☐	☐	☐
Motor Subtotal Score	☐	☐	☐

maintained sitting balance without feet on the floor and progressed to maintaining sitting balance on an Airex balance foam pad. Sit to stand transfer training progressed significantly as she was able to transfer from wheelchair to standing in parallel bars using her upper extremities. At the beginning of week 5, she required moderate assistance of one and by the end of the week progressed to contact guard assist with transfers. Standing balance required the use of her upper extremities and minimal assistance for 30-60 seconds due to lower extremity fatigue. The patient was also able to manage her first steps during the 5th week by ambulating 15 feet in the parallel bars with minimum assistance of one. Strength and endurance were progressed by increasing the number of repetitions before increasing resistance. She was also encouraged to focus on slow and controlled eccentric movements to improve coordination.

During the 6th week (see Appendix B for specific week 6 interventions), the patient was discharged from acute care and admitted to the transitional care unit (TCU) where she continued to receive inpatient physical therapy twice daily. The patient quickly improved her standing balance without upper extremity assistance in the parallel bars with contact guard assist provided. Dynamic balance training was completed with contact guard assist for timed trials from 30-60 seconds and included narrowing base of support, tandem standing, Airex foam pad balance, reaching outside her base of support, and light perturbations. She also made significant progress with ambulation within the parallel bars using upper extremity support. She was able to ambulate 30-feet at a time for 3 sets and progressed to 6 sets with contact guard of 1. She demonstrated the ability to pivot 180° within the

parallel bars to change direction. She continued to have difficulty with eccentric control of lower extremities and dragging her feet that was corrected with verbal cues. By the end of the 6th week, she demonstrated the ability to ambulate without upper extremity support for 15 feet and minimal assist of 1. She required seated rest breaks of 2-3 minutes between trials due to lower extremity muscular fatigue. Bed mobility exercises continued with transfers from supine to sidelying, supine to sitting, supine to prone, and prone to quadruped with no contact assistance but continued to require verbal cues for lower extremities due to impaired proprioception. Lower extremity strengthening exercises continued with emphasis on slow, controlled concentric and eccentric movements. Patient was instructed to not watch legs during exercise to improve proprioception and coordination. She was able to perform exercises while maintaining conversation demonstrating improved ability with performing dual tasks. Patient FIM score was reassessed at this time (See Appendix A).

During the 7th week (see Appendix B for specific week 7 interventions), she continued to perform and progress with standing dynamic balance activities. She continued to received contact guard for safety, however, she was able to stand with feet together on Airex foam balance pad, reach outside base of support, and increased intensity and variation in perturbations. She was also able to play catch with a foam ball while standing and using both hands to catch and toss the ball without loss of balance. She progressed to ambulation with a front-wheeled-walker (FWW) with contact guard but no assist for 300 feet at a time with lower extremity fatigue being the limiting factor. She required seated rest breaks of 2-4 minutes for

recovery and at those times she was given verbal cues to avoid watching her feet during ambulation to improve lower extremity proprioception and coordination. She also completed activities in quadruped consisting of crawling, transfers to kneeling, and reaching to improve balance, strength, and coordination. Lower extremity strengthening exercises progressed by increasing number of repetitions and implementation of yellow and red TheraBand. She demonstrated improved neuromuscular control as eccentric motions were performed in a smoother, more coordinated fashion with verbal cues. She demonstrated the ability to sit to stand without upper extremity support from a low chair. She progressed to performing squats to 90° knee flexion with upper extremity support in the parallel bars in a slow and controlled manner with standing rest breaks. She also performed step-ups and step-downs on a 6-inch step in the parallel bars with minimal upper extremity support for balance and to prepare her for stair ambulation. By week 7, she started endurance training on the NuStep bike for 5 minutes at level one at a slow pace with an emphasis to avoid fatigue.

During the 8th week (see Appendix B for specific week 8 interventions), the patient quickly progressed in all areas with treatment focused on addressing the functional demands of discharging her back to her home. Special emphasis was placed on improving the quality of her gait and endurance. She progressed to using a 4WW with a seat for ambulation. Frequency of verbal cues continued to decrease for dragging and watching feet during ambulation. At this time, she was able to ambulate with her 4WW without rest breaks while negotiating slight inclines and declines. She performed stair ambulation using a single handrail, contact guard, and

a step to gait pattern. She was able to ascend and descend a flight of stairs before requiring a seated rest break due to fatigue. Floor transfers were started to ensure the patient could get off the floor in the event of a fall. She required contact guard with no assistance and verbal cues to transfer from quadruped to standing utilizing a stable surface and upper extremity assistance. She continued to utilize the NuStep bike twice daily at an intensity of 3-5 for 10-minute intervals with an emphasis to avoid fatigue. Lower extremity strengthening exercises were discontinued at this time to focus on compound movements related to improving functional tasks. For example, she was instructed to pick small/light weight items off the floor using a stable surface and upper extremities for support to maintain balance.

On the 9th and final week of therapy (see Appendix B for specific week 9 interventions), the patient was discharged home with a referral for home health physical therapy. She was able to ambulate community distances (+200m) without fatigue or loss of balance. By the final week, she was ambulating with her 4WW to all meals and to the PT department without supervision. She was also able to ambulate without a walker by the final week for distances of +500 feet with contact guard no assistance, however, she did fatigue, and her balance declined as a result. She could ambulate step-over-step with use of a handrail, however, fatigue would set in after a single flight. Strength and coordination continued to progress as evidenced by her ability to transfer from quadruped to standing without the use of assistive devices or use of a stable surface. By week 9, her endurance improved, as she was able to ambulate +600 feet around the hospital without fatigue or lower extremity weakness. She continued to improve her activity tolerance with the NuStep bike by

increasing her intervals to 15 minutes on level 5 with emphasis on avoiding fatigue. By her final week, the patient's strength continued to improve with all lower extremity motions improving to 5/5 aside from plantar flexion which was at 4/5. Her lower extremity flexibility also improved to within normal limits by the final week. The final FIM score was taken at this time (see Appendix A). The patient was discharged from physical therapy after meeting all goals. She received a referral for home health physical therapy to continue to improve endurance, gait, balance, strength, and overall function.

CHAPTER IV

OUTCOMES

The overall outcome for this patient was excellent considering the level of disability and function during the initial physical therapy evaluation. Outcomes for this patient were based on objective measurements including lower extremity strength, lower extremity ROM, and FIM scores. Her progress was also based on her ability to perform functional skills, for example, ambulation, transfers, bed mobility, and the number of rests breaks needed.

At discharge she no longer required the use of compression stockings on her lower extremities, catheterization, nasogastric tube, or tracheostomy tube. She had also regained function of her facial musculature and ability to communicate verbally by the 3rd week. Bilateral ankle, knee, and hip ROM was assessed throughout the plan of care using a goniometer. During the initial evaluation, she had limitations in PROM with hip flexion (with full knee extension) and dorsiflexion bilaterally. Initial measurements of hip flexion were 46° for the right hip and 48° for the left hip. At discharge, hip flexion was measured at 69° for the right hip and 72° for the left hip. Initial measurements of ankle dorsiflexion were 6° for the right ankle and 7° for the left ankle. At discharge, ankle dorsiflexion was 11° for the right ankle and 10° for the left ankle. Gross lower extremity strength, using manual muscle testing throughout the plan of care, demonstrated significant improvement in all areas. The following areas were tested every three weeks: hip flexion, abduction/adduction,

internal/external rotation, knee flexion/extension, ankle plantar/dorsiflexion, and great toe flexion/extension. At the initial evaluation, all motions tested 1/5 indicating palpable muscle twitch with contraction but no visible motion at the joint. At discharge, her plantarflexion tested 4/5 bilaterally indicating that she was able to complete 10-24 single leg heel raises through full ROM. Remaining bilateral lower extremity motions were graded 5/5 indicating patient's ability to hold the test position against gravity and with a maximal force from a physical therapist clinician. Deep tendon reflexes of the lower extremity were tested bilaterally using the Achilles Tendon reflex which primarily tests the S1 nerve root. At initial evaluation the patient tested 0 (areflexia) bilaterally indicating lower motor neuron involvement which was consistent with the patient's diagnosis. The Achilles Tendon reflex was tested again at discharge and was graded 1+ (diminished/low response) indicating improvement with the lower motor neuron involvement. The FIM, which has an excellent internal consistency (Conbach's alpha: 0.95 = FIM Motor, 0.95 = Total FIM), was also used as an objective test to assess the patient's functional performance throughout the plan of care[42]. FIM scores increased in all assessed areas throughout the plan of care and be viewed in Appendix A. The patient progressed significantly with all functions of bed mobility, transfers, and ambulation. Initially, the patient was completely dependent with bed mobility requiring maximum assist of two. Throughout the course of treatment, she made consistent progress with supine to sit, log rolling, and moving up/down the bed as strength and neuromuscular control improved. At discharge she required no assistance or supervision for any bed mobility. Significant improvement was made

with her ability to transfer as initially she required maximum assistance of two and use of a ceiling lift for bed and chair transfers and toileting. At discharge, the patient was capable of safe sit to/from stand transfers without assistance or supervision. Ambulation was not possible during the initial evaluation with patient making significant improvements by discharge. Ambulation was measured in feet ambulated and assistive device needed. Initially, the patient was only able to ambulate 15 feet within the parallel bars with minimum assistance of one at week 5. As she regained strength, neuromuscular control, and endurance, she progressed with the assistive device needed, gait quality, and ambulation distance. At discharge, she was able to ambulate without an assistive device for 500+ feet with contact guard assist for safety but required a 4WW to ambulate community distances (+200m) without supervision or rest. Gait quality also improved; initially she demonstrated an antalgic gait with poor eccentric knee extension control and foot drag and required cues to not to watch her feet. At discharge, she increased her gait speed and quality with increased eccentric knee extension and no foot dragging, decreasing her risk of falls. Verbal cues were also not needed at this time.

The patient tolerated all interventions well with minimal complaints of excessive fatigue that impeded the patient's rehabilitation. The patient continued to have neuropathic pain of the lower extremities that primarily affected the dorsum of the foot and anterior surface of lower leg; however, symptoms had greatly improved. The patient was extremely motivated throughout the plan of care and did not miss a physical therapy appointment at any time during her inpatient stay. Overall, the patient was extremely happy with the progress she made in all areas.

CHAPTER V

DISCUSSION

The patient significantly reduced her disability and improved function throughout her course of treatment as an inpatient. During the initial evaluation, the patient was completely dependent and required maximum assistance for nearly all motions and tasks. Although the patient was able to return home and demonstrated improvements with strength, balance, and functional mobility, she was still not at her prior level of function due to her limitations with mobility, fatigue, sensation impairments, and fine motor skills. For this reason, she would benefit from continued therapeutic interventions from occupational and physical therapy to address these limitations.

Throughout the course of treatment, special emphasis was placed on achieving functional mobility to promote independence as her goal was to return home and back to work. Each week, interventions were performed to get her prepared for standing and then progressed to walking. This was completed by strengthening muscles of the trunk and lower extremities through transfer exercises, quadruped activities, balance exercises, assistive device training, and gait training. According to Lubenova et. at.[43], physical therapy interventions should be formed and directed based on the current presentation of relative symptoms while addressing specific functional tasks. By utilizing this principle, the physical therapy interventions were successful in achieving that patient's goal of safe ambulation.

Bed mobility and functional transfers were another area that this patient made great improvements in. At the initial evaluation, she was completely dependent and required maximum assistance of two for any positional changes. Ceiling lifts were used multiple times daily for toileting, bathing, and transfers. At discharge, the patient was independent with all positional changes, including transferring off the floor in the event of a fall. According to Khan et. al.[44], assessments and intervention should not primarily focus on movement quality. A greater focus should be placed on promoting safe execution of skills to promote functional independence[44]. This patient responded well to a systematic approach of interventions, which included exercises that encouraged frequent positional changes and required the patient to solve problems promoting independence[45].

Lower extremity strengthening played a vital role in promoting independence for this patient. Lower extremity strength improved in all areas from 1/5 (trace) muscle grades during the initial evaluation to 4/5 – 5/5 (good-normal) at discharge. Isometric exercises were completed against gravity and increased in both intensity and repetitions. Sit to stand exercises progressed to upper extremity supported squats, which encouraged coordination between the lower extremity and trunk musculature to promote synergy between these muscle groups. Cues were required initially due to impairments with balance and proprioception. Cues included proper positioning to initiate the movement sequence and increasing movement speed. According to Davidson et. al.[46], purposeful training of sit to stand with emphasize on optimal positioning of the lower extremities and trunk improved coordination, consistency of movement, and reduced energy demands.

Patients who are diagnosed with GBS tend to have high rates of depression and anxiety throughout the entire rehabilitation process[47]. These same conditions are also 4 times more likely to occur in transgender individuals[48]. As a result, this patient was at a high risk of developing a depressive and/or anxiety disorder during the rehabilitation process. Effective communication with the patient and other healthcare providers (physician, psychiatry, social work, etc.) played a vital role in ensuring she had the support and resources needed throughout the rehabilitation process. Recreational therapy became an option for the patient when she became medically stable. A study by Gassaway et. al.[49], demonstrated decreased rates of depression (PHQ-9) in patients that had access to recreational therapies while in inpatient settings. As a result, she was able to participate in group social activities and community outings throughout the plan of care which may have contributed to her high levels of motivation during her rehabilitation.

Although the results of physical therapy interventions positively impacted the patient's functional progress throughout the plan of care, there were several limitations regarding objective measures and documentation that would benefit similar patients in the future. Utilizing more outcome measures when treating this patient could have greatly benefited this patient in both the acute care setting and for any post-discharge outpatient rehabilitation. One example of an outcome measure that would have benefited the patient is the Fatigue Severity Scale (FSS) as it is often used in patients with neuromuscular disorders. The FSS is an easy to implement questionnaire that collects the patient's subjective assessment of how fatigue impacts their daily functioning on a scale from 1 (no fatigue) through 7

(extreme fatigue)[50]. The FSS demonstrates good test-retest reliability (Cohen's kappa vale = 0.84) and internal consistency (Cronbach's alpha coefficient = 0.88)[51].

Two other objective measures that would be recommended to apply to future cases would be the 10-Meter Walk Test (10MW) and the Timed Up and Go Test (TUG). The 10MW test is a performance measure that can be utilized to assess speed and quality of gait, functional mobility, and vestibular function in patients who ambulate with or without assistive devices[52]. The 10MW has excellent neuromuscular test-retest reliability (ICC = 0.91) and is usually applied to monitor patient progress and compare with normative data[53]. The TUG is an objective measure to determine fall risk and track progress with balance, gait, sit-to-stand transfers, and functional mobility in the rehabilitation setting. The TUG has a high sensitivity and specificity of 0.87 for determining fall risk, however, it has its limitations with predicting fall risks in community environments[54,55].

Other areas of consideration and change for future patients would be increasing the frequency of co-treatments with occupational therapy as a method of conserving time and energy for the patient. Roughly 4 hours per day was spent completing therapeutic activities between the two disciplines. Co-treatments were initially performed in the ICU to maintain range of motion with upper and lower extremities and to provide assistance with bed mobility. Co-treatments were also performed during week 4 when utilizing the sit to stand lift. Use of neuromuscular electrical stimulation (NMES) may have been a beneficial modality to use during the initial acute phase of the diagnosis. A study by Harbo et. al.[56] demonstrated decreased muscle wasting on extremities that were treated with NMES during the

acute phase. Functional electrical stimulation (FES) could have also been implemented during the initial phases of gait training as a method of preventing foot drop during the swing phase of gait. Although these modalities were not used, our patient still had favorable outcomes from the implemented interventions.

Individually tailored physical therapy interventions are necessary for successful outcomes when treating patients with GBS. Interventions must be evaluated daily due to the frequently changing symptoms and condition of the patient. Physical therapists must be cognizant to evaluate the patient's immediate and daily responses to treatment to ensure proper prescription of exercise type and intensity. Intensity of exercises must be high enough to promote a physiological and therapeutic response while remaining below the threshold of irritation to prevent unwanted fatigue and nervous stress[57]. Although quality research on this topic is limited, this case study demonstrates that physical therapy interventions have a positive impact on regaining function and decreasing disability in GBS patients in the acute care setting.

Reflective Practice

Although the outcomes of this case were very good considering the state the patient was in during the initial evaluation, there are several areas that could be improved on and implemented to achieve the best outcome possible. During the initial evaluation, most questions were directed toward the primary care team due to the patient's inability to communicate verbally. More questions and specific evaluations regarding the patient's perception of pain is an area that could have required more attention. Although her pain was managed with pharmaceuticals, we

could have implemented more pain management interventions to reduce the risk of developing a pharmaceutical dependence. We could have implemented the Visual Analogue Scale for Pain (VAS Pain), Short Form-36 Bodily Pain Scale (SF36-BPS), or the Chronic Pain Grade Scale (CPGS). Using these tests and measures would have allowed us to document and observe her changes in perception of pain. Using this information, we could assess how effective pain management modalities were and also made referrals to pain specialists. There seems to be a lack of research on non-pharmaceutical pain management options for patients with GBS, therefore, more research should be geared towards identifying more treatment options.

Sensory impairments are also a key feature in those diagnosed with GBS. More questioning and attention toward the areas where sensation was impaired, and characteristics of those impairments should be prioritized in the future. Asking the patient about what areas are painful/aggravating and whether or not light touch/vibration/deep pressure is being noticed. We could record and monitor the progress of nerve reinnervation, monitor muscle soreness, and prevent any unwanted injuries knowing this information. Filament testing would have been a great tool to use for assessing sensation and should be implemented for future cases.

As mentioned earlier, implementing more objective tests and measures should be used for the following areas: fatigue, gait speed, gait quality, balance, quality of life, and function. Using these tests and measures would not only contribute to better outcomes while in the inpatient setting, they would establish a baseline for outpatient care after discharge and establish areas of need.

Unfortunately, documentation of objective information throughout the course of treatment was a major weakness in the case and will be improved for future cases.

Although respiratory therapy was heavily involved for this patient, physical therapy could have implemented more respiratory techniques to assist this patient due to the respiratory failure that occurred in the acute stages. Recording oxygen saturation with a pulse oximeter during exercise and recording the amount of supplemental O2 during treatment sessions would have been a valuable method of tracking oxygen demands of the body. Implementing co-treatments with respiratory therapy could have been useful for practicing postural drainage, breathing and coughing techniques, and resistive inspiratory exercises to prevent secondary respiratory complications and improve quality of breathing.

Psychological support is another area that I will highlight regarding this patient. Although she demonstrated a high level of motivation throughout the plan of care, she was at a high risk of developing depression and anxiety disorders due to her diagnosis, being transgender, and having a lack of family support. Although social work was involved throughout the entire case, counseling and psychiatry would have had a positive impact on the patient's overall wellbeing. The patient did have periods of fear, anxiety, guilt, and shame during her treatment and through my experience, physical therapy was an outlet for addressing her personal thoughts and feelings. In the future, allowing the patient to "vent" is an effective method of managing patients when they are struggling with their diagnosis. Asking the patient about positive things can help pull them out of their negative mindset and build a more positive, forward looking outlook. Referral to counseling or psychiatry would

have been the right option for this patient and will be utilized more readily in the future.

Overall, this patient's outcomes were favorable due in part to the frequency of physical therapy and occupational therapy interventions. Although this is ideal, it is not always realistic for many patients. Fortunately, this patient was a Veteran with VA medical benefits, therefore, she was able to receive treatment without direct costs. Early mobilization with encouraged assistance from the patient was essential with preventing secondary complications and regaining function. Another area of emphasis during her 9-weeks of therapy was avoiding excessive fatigue. Although we could regulate the amount of exercise during therapy, we could not always account for the energy expenditure from busy days where the patient attended many different appointments. Therefore, we had to regularly modify the plan of care to compensate for increased fatigue when present.

Personally, treating this patient gave me a diverse treatment experience that required me to adapt the plan of care daily due to the patient's quick return of function. For example, during the first few weeks she was non-verbal which required me to be creative with communication between the patient. Monitoring facial expressions, lip reading, and writing on a whiteboard became the main methods of communication. This was frustrating for the patient and myself at times since we would not be on the same page and required more time, but it did not affect the quality of the interventions. Overall, I was extremely excited to take part in helping this patient regain most of her function and set her up to succeed with continued outpatient physical therapy. It allowed me to utilize many different motor

learning interventions is a short period of time, which is perfect for a student completing a 9-week clinical experience. The lessons and experience from this patient helped me grow as a competent and effective clinician.

Appendix B.

Physical Therapy Interventions Weeks 1-9

Week 1 – Physical Therapy Interventions

Lower extremity PROM in Supine	• All motions of the hip, knee, and ankle • 20 repetitions at 3 second tempo • Verbal cues to assist
Hamstring and heelchord stretch	• Passive, low load stretch into dorsiflexion and hip flexion with knee in full extension • 90 second stretch, 2 sets each
Log rolling/bed mobility	• 1-3 repetitions each direction • Maximum assist +2 with verbal cues to assist with motion

Week 2 – Physical Therapy Interventions

Transfer supine to sitting	• Maximum assist +2 with verbal cues to assist with motion • Seated position, feet on floor with cues to maintain sitting balance
Lower extremity PROM in Seated	• All motions of the hip, knee, and ankle • 20 repetitions at 3 second tempo • Verbal cues to assist • Seated position with assistance to maintain balance
Hamstring and heelchord stretch	• Passive, low load stretch into dorsiflexion and hip flexion with knee in full extension • 90 second stretch, 2 sets each
Log rolling/bed mobility	• 1-3 repetitions each direction • Maximum assist +2 with verbal cues to assist with motion

Week 3 – Physical Therapy Interventions

Transfer supine to sitting	• Maximum assist +1 with verbal cues to assist with motion • Seated position, feet on floor with cues to maintain sitting balance 20 seconds, 3 sets
Lower extremity AAROM in Seated	• All motions of the hip, knee, and ankle • 20 repetitions at 3 second tempo • Verbal cues to assist • Seated position with assistance to maintain balance
Hamstring and heelchord stretch	• Passive, low load stretch into dorsiflexion and hip flexion with knee in full extension • 90 second stretch, 2 sets each
Log rolling/bed mobility	• 3-5 repetitions each direction • Maximum assist +1 with verbal cues to assist with motion

Week 4 – Physical Therapy Interventions

Transfer supine to sitting	• Maximum assist +1 with verbal cues to assist with motion • Seated position, feet on floor with cues to maintain sitting balance 20 seconds, 3 sets
Lower extremity strengthening	• Ankle pumps (yellow TheraBand), heel slides, long arc quads, glute sets, and straight leg raises • 2 sets of 10 repetitions, rest breaks between as patient tolerated • Verbal and tactile cues for controlled concentric and eccentric motion
Sitting balance	• Sitting balance on edge of high low table, feet planted on floor, no back or upper extremity support • Small predictable, perturbations • 3 sets of 30 second trials, rest breaks between as patient tolerates
Hamstring and heelchord stretch	• Passive, low load stretch into dorsiflexion and hip flexion with knee in full extension • 90 second stretch, 2 sets each
Log rolling/supine to sit	• 3-5 repetitions each direction • Upper extremity assistance with bed rails and trapeze bar • Therapist assistance with hand hold
Sit to stand transfers	• Sit to stand lift • 3 sets of 30-60 standing with cues for upper extremity support and lower extremity muscle facilitation

Week 5 – Physical Therapy Interventions

Transfer supine to sitting	• Maximum assist +1 with verbal cues to assist with motion • Seated position, feet on floor with cues to maintain sitting balance 20 seconds, 3 sets
Lower extremity strengthening	• Ankle pumps (yellow TheraBand), heel slides, long arc quads, glute sets, and straight leg raises • 2 sets of 20 repetitions, rest breaks between as patient tolerated • Verbal and tactile cues for controlled concentric and eccentric motion
Sitting balance	• Sitting balance on edge of high low table, feet planted on floor, no back or upper extremity support • 3 sets of 30 second trials, rest breaks between as patient tolerates • Larger, unpredictable perturbations • Sitting balance with feet not planted on ground • Sitting balance while on Airex foam balance pad
Hamstring and heelchord stretch	• Passive, low load stretch into dorsiflexion and hip flexion with knee in full extension • 90 second stretch, 2 sets each
Log rolling/supine to sit	• 3-5 repetitions each direction • Upper extremity assistance with bed rails and trapeze bar • Therapist assistance with hand hold
Sit to stand transfers	• Sit to stand from wheelchair with upper extremity support in parallel bars • 5-10 sit to stands, rest breaks based on patient tolerance
Standing balance	• Standing balance in parallel bars with upper extremity support • 3-5 sets, 30-60 second as patient tolerates

Week 6 – Physical Therapy Interventions

Dynamic Balance	• Narrowing base of support • Tandem standing • Airex foam balance pad standing • Reaching outside base of support • Light perturbations • 30-60 second trials
Lower extremity strengthening	• Ankle pumps (yellow TheraBand), heel slides, long arc quads, glute sets, and straight leg raises • 2 sets of 20 repetitions, rest breaks between as patient tolerated • Verbal and tactile cues for controlled concentric and eccentric motion
Ambulation	• Parallel bars with upper extremity support 30-foot intervals, contact guard • Progression from 3 sets to 6 sets • Seated rest between trials • Verbal cues for foot dragging
Hamstring and heelchord stretch	• Passive, low load stretch into dorsiflexion and hip flexion with knee in full extension • 90 second stretch, 2 sets each
Bed mobility	• Supine to sidelying, supine to sit, supine to prone, and prone to quadruped • No contact assistance, verbal cues for positioning and engagement
Sit to stand transfers	• Sit to stand transfers from 18" chair between ambulation and balance activities • Upper extremity assistance and contact guard • Verbal cues to weight shift over lower extremities

Week 7 – Physical Therapy Interventions

Dynamic Balance	• Narrow base of support on airex foam balance pad • Catching/tossing foam ball • Moderate perturbations, increased variation • Reaching outside base of support • Contact guard for safety • 30-60 second trials
Lower extremity strengthening	• Ankle pumps, seated dorsiflexion, heel slides, long arc quads, glute sets, and straight leg raises • 2 sets of 20 repetitions, TheraBand resistance (Yellow/Red) rest breaks between as patient tolerated • Verbal cue to not watch limbs and for controlled concentric and eccentric motion
Ambulation	• FWW, contact guard no assist • 300-foot intervals, seated rest as needed • Verbal cues to avoid watching feet • Verbal cues for foot dragging
Hamstring and heelchord stretch	• Passive, low load stretch into dorsiflexion and hip flexion with knee in full extension • 90 second stretch, 2 sets each
Bed mobility	• Supine to sidelying, supine to sit, supine to prone, and prone to quadruped • No contact assistance, verbal cues for positioning and engagement
Squats	• Squats with upper extremity support in parallel bars • 3 sets of 10 repetitions with standing rest breaks
Step up/Step down	• 3 sets of 10 repetitions on 6-inch step • Parallel bars with upper extremity support, contact guard no assistance
NuStep Bike	• Upper and lower extremity endurance • 5 minutes, level one • Emphasized slow and consistent pace to avoid fatigue and gauge activity tolerance

Week 8 – Physical Therapy Interventions

Ambulation	• 4WW, supervision • 300-foot intervals without seated rest breaks • Ascend/descend slight inclines • Verbal cues to avoid watching feet • Verbal cues for foot dragging
Stair ambulation	• Single handrail • Step to gait • Contact guard, no assistance • Ascend/descend flight of stairs with seated rest break between trials
Floor transfers	• Supine to quadruped to seated in chair with use of chair for assistance • Supine to quadruped to standing with use of stable surface for assistance • Verbal cues for safety
NuStep Bike	• Upper and lower extremity endurance • 10 minutes intervals, 3-5 level intensity • Twice daily • Emphasized slow and consistent pace to avoid fatigue and gauge activity tolerance
Hamstring and heelchord stretch	• Passive, low load stretch into dorsiflexion and hip flexion with knee in full extension • 90 second stretch, 2 sets each
Functional Squats	• Squats to pick up small items off the floor • Use of single upper extremity on stable surface for support • Cones placed along parallel bars, walking to cone, squat to pick up and hand to therapist before moving onto next cone

Week 9 – Physical Therapy Interventions

Ambulation with assistive device	• 4WW, supervision while in therapy, no supervision between meals and within hospital hallways • 600+ feet without rest breaks or verbal cues for safety/gait quality
Ambulation without assistive device	• 500+ feet without assistive device • Contact guard, no assistance from therapist (safety) • Increased fatigue, required seated rest break
Stair ambulation	• Single handrail • Step overstep gait • Contact guard, no assistance • Ascend/descend flight of stairs with seated rest break between trials
Floor transfers	• Supine to quadruped to seated in chair without assistive device or upper extremity support • Supine to quadruped to standing with without assistive device or upper extremity support • No verbal cues for safety
NuStep Bike	• Upper and lower extremity endurance • 15 minutes intervals, 5 level intensity • Twice daily • Emphasized slow and consistent pace to avoid fatigue and gauge activity tolerance
Functional Squats	• Squats to pick up small items off the floor • Upper extremity support from 4WW • No upper extremity support, contact guard, no assistance • Cones scattered around floor requiring navigation to objects in space

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