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Physical Therapy Management of a Patient with Guillain-Barré Syndrome During Inpatient Rehabilitation Stay: A Case Report

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Abstract

Background: Guillain-Barré syndrome is a rare condition characterized by demyelination of the peripheral nervous system resulting from an erroneous attack by the immune system. Symptoms and complications develop rapidly and often result in significant functional impairments, which may persist beyond the acute phase of the condition. There is a currently a lack of evidence supporting the most effective early treatment interventions to facilitate a timelier return to function and decrease in long-term effects. **Purpose:** The purpose of this case report is to outline treatment interventions implemented within the inpatient rehabilitation setting to influence functional independence of a patient diagnosed with Guillain-Barré syndrome. **Case Description:** A 49-year-old male was admitted to an inpatient rehabilitation facility two weeks after being diagnosed with Guillain-Barré syndrome. He presented with decreased functional status, fatigue, lower extremity weakness, impaired fine motor skills, and difficulty walking. The patient's physical therapy goals were to increase strength, improve balance, and normalize walking so he could return to work. **Interventions:** Physical therapy interventions were focused on addressing functional mobility, cardiovascular endurance, gait training, balance, lower extremity strengthening, and patient/family education. **Outcome Measures:** The Functional Independence Measure was utilized to assess the patient's level of assistance required to perform activities of daily living**.** Manual muscle testing was performed to measure the patient's lower extremity strength improvement during physical therapy. **Discussion:** This case provides one example of notable improvements in strength, endurance, and functional abilities that occurred following four weeks of intensive inpatient rehab. Although the patient demonstrated progress and did not experience worsening symptoms during his inpatient stay, further research is needed to determine the most effective treatment interventions to facilitate return to function and diminution of associated sequelae.

Keywords: Physical therapy; rehabilitation; Guillain-Barré Syndrome; inpatient; interventions; neurology; functional independence measure

Introduction

Guillain-Barré syndrome (GBS) is a rare neurological disorder described by peripheral nervous system (PNS) demyelination as a result of an attack from the immune system.[1] Affecting approximately 1-2/100,000 adults annually, the incidence of GBS is slightly greater in males and has a slightly decreased occurrence in children.[1,2] Although the etiology remains unknown, no correlation has been found between risk for developing GBS and prior autoimmune disease or systemic illness. However, some studies suggest nearly 70% of individuals diagnosed with GBS report a recent respiratory or gastrointestinal infection preceding their neurological diagnosis.[2-4] Although several variations of the syndrome have been identified, including both axonal and demyelinating forms, acute demyelinating polyradiculoneuropathy (AIDP) is the most predominant in North America, accounting for approximately 90% of observed cases.[1]

Various hypotheses have been proposed to explain the pathogenesis of AIDP. One proposition suggests molecules on nerves resemble the structure of those found in certain microorganisms. When preceded by viral or bacterial infections, alteration of chemical structure may occur resulting in a phenomenon known as “molecular mimicry”. Thus, the immune system may mistakenly perceive these nerves as foreign or produce antibodies against myelin and attack via T lymphocytes and macrophages.[5] Another hypothesis suggests antigens located on the myelin sheath may produce antibodies that can induce complement activation and macrophage invasion of Schwann cells.[2,6] Despite the uncertainty of the pathogenic details, the common theme is an underlying autoimmune mechanism resulting in PNS demyelination.

The U.S National Institute of Neurological Disorders and Stroke (NINDS) developed initial diagnostic criteria for GBS in 1978. However, it was later modified in 1990 by Asbury and Cornblath and has since been the most widely used criteria for diagnosis of GBS in clinical practice.[7] The criteria identify clinical features required for the diagnosis as well as features strongly supportive of the diagnosis (Figure 1). The clinical presentation of GBS typically involves rapid, progressive muscle weakness (distal >proximal), tingling sensation the fingers and toes, difficulty walking, increased fatigue, and potentially pain. In addition, increased CSF protein without an elevation in white blood cells (WBC) has been shown to be strongly predictive of AIDP. Due to the rapidly progressive nature of GBS in its acute phase, affected individuals typically seek medical attention promptly. Physicians are then able to gather information from clinical features, nerve conduction studies, and a lumbar puncture to establish a diagnosis and implement an appropriate plan of care.

Features required for diagnosis of BBS*
- Progressive weakness in legs and arms (sometimes initially only in legs)
- Areflexia (or decreased tendon reflexes) in weak limbs

Acute inflammatory demyelinating polyneuropathy (AIDP)

Additional symptoms
- Progressive phase lasts days to 4 weeks
- Relative symmetry of symptoms
- Mild sensory symptoms or sings
- Cranial nerve involvement, especially bilateral weakness of facial muscles
- Autonomic dysfunction
- Pain (often)

Nerve conduction study findings
- Features of demyelination (only assessable if distal CMAP amplitude is >10% LLN)
- Prolonged distal motor latency
- Decreased motor nerve conduction velocity
- Increased F-wave latency, conduction blocks and temporal dispersion

Acute motor axonal neuropathy (AMAN)

Additional symptoms
- Progressive phase lasts days to 4 weeks
- Relative symmetry of symptoms
- No sensory symptoms or sings
- Cranial nerve involvement (rarely)
- Autonomic dysfunction
- Pain (sometimes)

Figure 1: Diagnostic criteria for Guillain-Barré Syndrome, adapted from Asbury and Cornblath, 1990.

With no known cure currently, GBS presents an ongoing challenge for medical professionals to manage affected individuals' symptoms and facilitate their return to prior level of function. However, intravenous immunoglobulin (IVIG) and plasma exchange are early treatment interventions that have been proven to be effective methods of hindering the progression of nerve damage.[8] Multidisciplinary supportive care involving physical therapy, occupational therapy, speech-language pathology, and nursing services are highly beneficial to avoid or treat complications related to weakness, immobility, pain, and respiratory insufficiency, among other mechanisms GBS can have a devastating impact on. While classified as a monophasic disorder, GBS symptoms typically progress in the acute phase until reaching a maximum severity within two to four weeks.[9] Although the clinical course and outcomes of GBS are highly variable and specific to each individual, the majority of patients (85%) experience a nearly full recovery within 6 months to 2 years after onset of symptoms.[10] However, approximately 20% of adults affected by GBS remain unable to walk unaided 6 months after onset of symptoms.[8] In addition, it is not uncommon for adult patients with GBS to experience residual deficits that impair their daily activities and quality of life. Reduced muscle strength, sensory signs, persistent fatigue, and chronic pain are among the most commonly identified residual deficits that persist beyond neurological recovery.[11]

Despite the obscurity surrounding the etiology of GBS and absence of a known cure, it is apparent an effort needs to be made to intervene at an early stage to minimize the complications of a prolonged recovery. There is a gap in the literature concerning the effects of physical therapy interventions received by individuals with GBS, particularly for those in the sub-acute phase of the syndrome, and influence of skilled rehabilitation on functional independence. While the majority of individuals diagnosed with GBS experience a nearly full recovery within one year of diagnosis, there is a currently a lack of evidence supporting the most effective early treatment interventions to facilitate a timelier return to function. Thus, the purpose of this case report is to outline the treatment interventions implemented within the inpatient rehabilitation setting to influence functional independence of a patient diagnosed with GBS.

Case Description

Medical History/Clinical Presentation

A 49-year-old male presented to an inpatient rehabilitation facility with a medical history of Type II diabetes mellitus, chronic obesity, diverticulitis, hypertension, and obstructive sleep apnea. The patient was able to provide the following timeline of events leading up to his admission. Approximately two weeks prior, he reported to the emergency department with complaints of fatigue, difficulty walking, and lower extremity weakness that had rapidly progressed throughout the day. He was believed to be experiencing neuropathy related to his diabetes and was discharged home. A few days later, he fell in the shower, couldn't feed himself, demonstrated unsteady gait, and required assistance to use his cell phone. He was then admitted to a VA medical center where a nerve conduction study depicted AIDP variant. In addition, a lumbar puncture demonstrated elevated protein in his CSF with no increase in WBC count. Interestingly, an H. pylori antibody test was found to be positive as well. Given the acquired test results and clinical presentation, he was diagnosed with GBS. The patient was immediately started on a five-day course of IVIG and orders were placed to receive physical

therapy during his acute care stay. At the conclusion of his medical treatments, he was referred to an inpatient rehabilitation facility to participate in the extensive rehabilitation program.

Demographics and Initial Evaluation

The patient reported his premorbid level of function was independent. A husband and father of three children, he makes a living as a deputy sheriff and enjoys hunting and fishing in his free time. He reported residing in a single-level home and has five stairs to enter with bilateral handrails. The patient's functional physical therapy goals were to "increase strength, improve balance, and walk so he could return to work". Home with assistance as needed was the anticipated discharge plan.

At the initial evaluation, the patient presented without any complaints of pain. His primary complaints were related to weakness in his legs, decreased ability to walk, and loss of his fine motor skills. Sensation and proprioception were grossly intact in bilateral lower extremities. A cognitive screen determined orientation x4 and the patient was able to follow 3-step commands. His lower extremity range of motion measured within functional limits bilaterally. However, he presented with greatly impaired bilateral lower extremity strength, as measured by manual muscle testing (MMT). His lower extremity weakness was found to be rather symmetrical with minimal distinction noted between proximal and distal musculature at the time. The patient demonstrated good static and dynamic balance in a seated position but poor balance when standing. A mild forward head, rounded shoulders posture was observed by the therapist, regardless of position.

The patient presented with significant impairments related to function, as indicated by the Functional Independence Measure (FIM), which was an instrument utilized to assess the level of assistance required to perform various functional activities (Figure 2). The motor dimensions assessed during his inpatient rehabilitation stay included bed to chair transfer, wheelchair propulsion, ambulation, and stairs. The patient performed a bed <> manual wheelchair transfer requiring contact guard assistance (CGA) for supine <> sitting transition and moderate assistance (mod A) from the therapist for the stand pivot transfer (SPT) (FIM bed/chair/wheelchair transfer score: 3). The patient propelled a manual wheelchair a distance of 70 feet utilizing bilateral upper extremities and close stand by assistance (SBA) over smooth, level surfaces demonstrating right and left turns (FIM wheelchair distance scale: 2; FIM wheelchair score: 3). He completed a sit to stand transfer utilizing bilateral wheelchair armrests w/mod A from therapist. The patient ambulated a distance of 83 feet using a heavy-duty rolling walker (HDRW) and requiring mod A x 2, with the second person needed for a close wheelchair follow to ensure safety (FIM walk distance scale: 2; FIM walk score: 1). He demonstrated heavy reliance on upper extremity support during ambulation and exhibited increased knee flexion in stance, forward flexed posture, and decreased step length bilaterally. The patient negotiated four stairs requiring bilateral handrails and mod A x 2 for safety purposes (FIM stairs score: 1). A reciprocal stepping pattern was demonstrated during ascent while a step-to pattern was selected during descent. In addition, quality indicators used to quantify health care outcomes related to patient progress and expected standard of care were used to measure bed mobility and vehicle transfer performance. The patient demonstrated all bed mobility requiring touching assistance and a wheelchair <> vehicle SPT was executed with mod A from therapist during his initial evaluation.

Bed/Chair/Wheelchair Transfer (Includes how patient does sit to supine and supine to sit)	
Transferred independently, ambulatory or wheelchair without other device or help	7
Needed sliding board, walker, rails, chair arms, extra time, or raised own HOB (no helper)	6
Supervision/Set – up/Cues	5
Needed help with foot/arm rests or staff locks brakes	5
Needed steadying or help with 1 limb or min A pt 75+	4
Needed boost or help with 2 limbs or mod A pt did 50-74%	3
Max assist (needed much lifting) pt did 25-49%	2
Total assist/Hoyer lift/2 staff members/Pt did less than 25% of effort	1
Activity did not occur this shift	0

Stairs (One flight is 12 – 14 stairs)	
Goes up/down 12 – 14 steps without handrail or support	7
Goes up/down 12 – 14 steps with handrail, support, AFO, assistive device, or extra time, or safety concerns	6
Goes up/down 4 – 11 steps independently with or without assistive device	5
Goes up/down 12 – 14 steps with supervision, cues, coaxing	5
Goes up/down 12 – 14 steps with steadying, touching assisting or needs help with one limb	4
Goes up/down 12 – 14 steps performing 50-75% of the activity	3
Goes up/down 4 – 11 steps, assist of only 1 person; pt performing 25-49%	2
Cannot go up 4 – 6 steps, or needs 2 people, or is carried up the stairs; or refuses to attempt	1
Activity did not occur this shift	0

Wheelchair (Cannot be a 7) Score distance first and then level of assistance	
Propels wheelchair minimum 150 ft. independently	6
Propels wheelchair minimum 150 ft. with supervision/Set – up/Cues	5
Operates wheelchair minimum 50 ft. independently (This patient would be at "household mobility")	5
Propels wheelchair minimum 150 ft. with minimum help around corners, door frames, grades, patient provides 75+ %	4
Propels wheelchair minimum 150 ft. with moderate help to steer, patient provides 50-74% effort	3
Propels wheelchair 50-149 ft. with maximum help from staff to push and steer, patient provides 25-49% effort	2
Total assist – Patient provides less than 25% effort (Less than 50ft). Staff propelled Wheelchair	1
Activity did not occur this shift	0

Walk – Score this section for functional mobility; (ex: ambulated patient in hallway). Score distance first and then level of assist	
Walks minimum 150 ft. independently – w/out assistance device	7
Walks minimum 150 ft. with assistance device/ extra time	6
Walks minimum 150 ft. with supervision/Set-up/Cues	5
Walks minimum 50 ft. with or without device independently (This patient would be a "household ambulatory")	5
Walks minimum 150 ft. with steadying assistance	4
Walks minimum 150 ft. with mod assist or helping initiate steps	3
walks 50-149 ft. with max assist and initiating steps	2
Total assist to walk/2 staff members – Less than 50 ft.	1
Activity did not occur	0

Figure 2: A quick reference to FIM scoring.

Treatment Interventions

Individuals are required to receive a minimum of three hours of therapy a day to qualify for the inpatient rehabilitation setting. Due to the patient's lack of need for speech therapy, he received 90 minutes of both physical therapy and occupational therapy a day, 5-6 days a week, for a total of 18 treatment sessions. Skilled physical therapy interventions were implemented to address functional mobility, cardiovascular endurance, gait training, balance, lower extremity strengthening, and patient/family education. Patient education pertaining to intensity/frequency of therapy, fall prevention protocol, plan of care, and GBS prognosis played a critical role in his rehabilitation process. Initially, the patient desired to return to work as a deputy sheriff in six weeks' time, so it was important to engage in conversations early to provide education on setting realistic expectations without decreasing his morale. The patient exhibited deficits in strength, balance, and endurance activities requiring frequent rest breaks throughout his inpatient stay. A crucial component of the rehabilitation process was to teach energy conservation techniques and activity pacing to avoid overuse and fatigue, which is recognized as a red flag and may greatly prolong recovery in this patient population.[10]

Early physical therapy interventions concentrated on engaging in aerobic activity to improve lower extremity strength, tolerance to fatigue with prolonged exercise, and cardiovascular endurance. The patient participated in open environment gait training and stationary recumbent

cycling (SNS bike/NuStep) each session to promote these benefits. During ambulation trials, the patient was provided verbal cues to address gait mechanics such as intermittent knee buckling, stride length, reliance on upper extremity support, heel to toe transition, and weight shift. Progressive strengthening exercises were implemented throughout his rehabilitation program with modifications to frequency, load, intensity, and volume when appropriate. To improve lower extremity strength and neuromuscular control, the following exercises were introduced: standing heel raises, repeated sit to stands, seated marches, seated hip abduction, seated hip adduction, seated knee flexion, long arc quads, clamshells, side lying hip abduction, hook lying bridges, straight leg raises, and four-way ankle resistance exercises. Supine transversus abdominus marches, penguins, and crunches were also completed as core activation exercises to improve proximal stability for distal mobility. To maintain muscular flexibility, the patient received straight leg raise hamstring stretch, knee to opposite shoulder piriformis stretch, and standing gastrocnemius and soleus wedge stretch.

The Zero-G® gait trainer harness system was utilized to increase the patient's mobility while reducing the risk of injury. This technology provided the patient the opportunity to walk without the use of an assistive device and enabled the therapist to correct gait mechanics during body weight supported (BWS) ambulation. In addition, lower extremity strength and dynamic balance was further challenged during various activities in a safe, controlled environment. The fall setting was adjusted to velocity which required the patient to demonstrate controlled sit to stand maneuvers. Tandem walking, sidestepping, and backwards walking were multidirectional ambulation activities incorporated to improve dynamic balance. Obstacle courses including altered surfaces, turns, stairs, and cones were constructed to improve midline stability, tolerance to fatigue, and surface adaptability with various proprioceptive input (Figure 3).

Figure 3: Simulated obstacle course demonstrated utilizing Zero-G® gait trainer BWS harness system.

Finally, manually controlled perturbation response training was performed to facilitate the patient's transition back into the unpredictable environment outside of the inpatient rehabilitation facility. Percentage of BWS applied, complexity of the task, and exercise volume were variables able to be modified in accordance to the patient's response to the activity.

Outcomes

Functional performance progress was assessed throughout the patient's inpatient rehabilitation stay using the FIM. The FIM is a widely accepted functional assessment instrument used in the inpatient rehabilitation setting. The purpose of the FIM was to provide a system of measurement that could be utilized to assess a patient's level of assistance required to perform activities of daily living.[12] The instrument is an 18-item, clinician-reported scale consisting of 13 motor tasks and 5 cognitive tasks that assesses function in the following categories: self-care, continence, mobility, transfers, communication, and cognition. Tasks are graded on a 7-point ordinal scale ranging from total assistance/complete dependence complete independence with a higher score indicating less need for assistance. Physical therapy monitored improvement primarily in the mobility and transfers categories with bed to chair transfers, wheelchair propulsion, ambulation, and stairs being the motor dimensions of focus. The patient's progress was assessed at initial evaluation, discharge evaluation, and every Monday in-between to provide information in team conference meetings regarding patient outcomes and plan of care. Data was obtained from all five dates of assessment (Day 1, 2, 9, 15, and 18) to compile FIM progress over the course of the inpatient rehabilitation program (Figure 4).

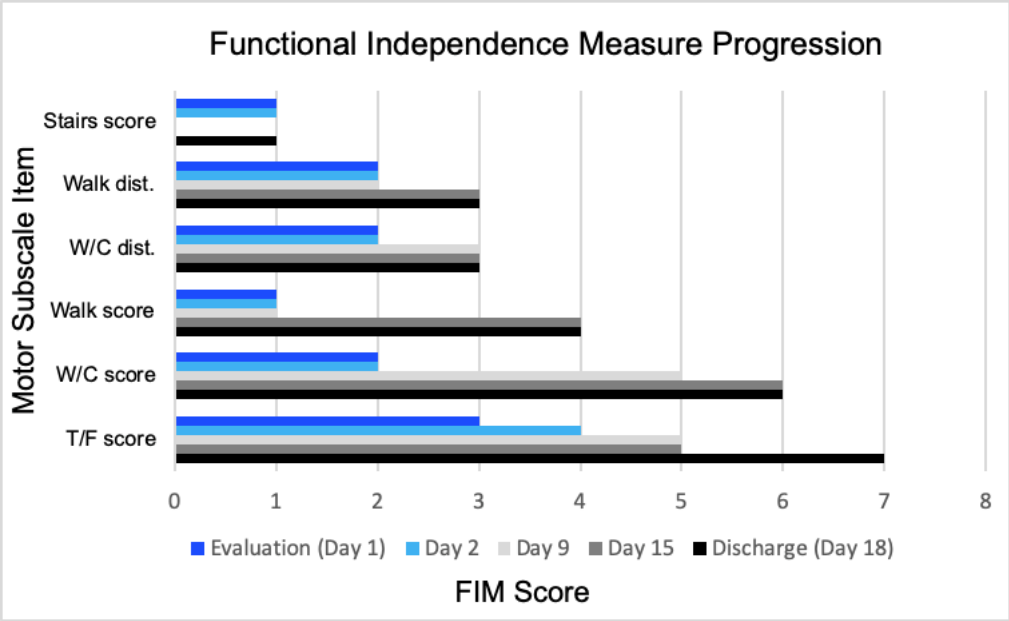

Figure 4: Functional performance progress assessed throughout inpatient rehabilitation program.

As depicted in Figure 4, the patient improved in nearly all FIM dimensions assessed from initial evaluation to discharge. Stair performance was improved to a reciprocal step-through pattern with decreased postural steadying required. The patient ambulated a distance of 320 feet using a four-wheeled walker with steadying assistance from the therapist at discharge which improved his FIM walk distance score to 3 and his FIM walk score to 4. Manual wheelchair locomotion was improved to a distance of 162 feet with modified independence due to increased time to complete task and increased fatigue noted, giving him a discharge FIM wheelchair distance score of 3 and FIM wheelchair score of 6. The patient demonstrated

independence with transferring to and from the bed/chair/wheelchair with no activity limitations at discharge giving him a FIM transfer score of 7. In addition, with regard to quality indicators, all bed mobility and vehicle transfers were demonstrated with independence at discharge thus permitting a safe transition to his home.

Assessment metrics of the FIM have been extensively measured in the inpatient rehabilitation setting in persons with strokes, traumatic brain injuries, spinal cord injuries, and numerous other neurological conditions.[13] The FIM exhibits an excellent internal consistency and test/retest reliability (ICC) for its motor domain (0.95).[12] In a study conducted to determine the minimal clinically important difference (MCID) of the FIM instrument, patients affected by stroke were found to have an MCID of 17 for the total motor FIM.[14] However, what constitutes an appropriate MDC and MCID using partially completed standard outcome measures is unclear. A patient can be considered as "improved" when one anchor-based value (patient scoring) has been reached, but the degree of impact is incalculable as only 3/13 motor tasks were assessed for the patient.

The patient's lower extremity strength was measured throughout his inpatient stay utilizing manual muscle testing (MMT). A re-assessment was performed by the same therapist at discharge to measure progress (Figure 5). Consistent with the patient's subjective complaints upon admission, gross lower extremity muscle weakness was identified rather symmetrically with the patient only able to hold most test positions against gravity. However, eighteen treatment sessions later, the patient was able to maintain the majority of the test positions against moderate to strong pressure given by the therapist. Although the patient's left lower extremity remained slightly weaker compared to the right, greater strength limitations were noted more distal bilaterally.

	Lower Extremity MMT Scores			
	Evaluation		Discharge	
	Left	Right	Left	Right
Hip flexion	3	3+	4	4+
Hip abduction	3-	3	4+	4+
Hip adduction	NT	NT	4+	4+
Hip IR	NT	NT	4	5
Hip ER	NT	NT	4	5
Knee flexion	3+	3+	4	4+
Knee extension	4	4	4	4+
Ankle dorsiflexion	3+	4	4-	4-

Table 1: Lower extremity strength comparison between initial evaluation and discharge as measured by MMT.

The primary focus of physical therapy in the inpatient rehabilitation setting is facilitating return to function. Although the FIM was utilized to measure progress with everyday functional tasks and MMT measured muscular strength changes, it would have been appropriate to administer an outcome assessment to measure the level of difficulty the patient perceived various activities to be. The patient made numerous complaints of fatigue and decreased endurance throughout his inpatient stay, and rest breaks and modifications to exercise interventions were implemented accordingly. Although these subjective reports decreased as the patient improved his strength and tolerance to fatigue, no standard outcome assessment was utilized to record his response to activity. The Borg Scale of Perceived Exertion is a patient-reported relative scale ranging from "no exertion" (6) to "maximal exertion" (20). The use of an

outcome assessment that measured the patient's rating of exertion during activity would have been appropriate to measure functional recovery, help the patient identify activity limitations, and support a safe discharge recommendation.

Discussion

Guillain-Barré Syndrome is a rapidly progressive autoimmune disorder involving demyelination of the peripheral nervous system. Due to damage of the myelin sheath, GBS is characterized by progressive muscle weakness, areflexia in affected limbs, pain, and occasionally autonomic dysfunction. As a result, consequences such as decreased endurance, impaired functional abilities, and prolonged weakness typically develop.

Early detection and medical intervention are important for this patient population to avoid more serious potential complications, such as respiratory paralysis. Fortunately, given the rapid onset of symptoms in its acute phase, the patient was able to quickly recognize harm and sought medical attention. Conversely, the severity of symptoms increases during the progressive phase of GBS which adds to the difficulty of providing physical therapy interventions in the inpatient rehabilitation setting. Without appropriate patient education of the typical prognosis, the recovery process may be disheartening for an individual with unrealistic expectations when in reality, maintenance of function during its progressive phase would be a favorable outcome. Thus, it is important to understand the individual's goals and expectations as success is more than objective scores on an outcome assessment.

Individuals affected by GBS may take as long as two years to fully recover.[15] Although the majority of GBS survivors regain the ability to walk independently, the impact of GBS on individuals' quality of life may persist beyond this time.[16] Strength impairments, decreased balance, and functional limitations are the main areas of focus for physical therapy interventions in the inpatient rehabilitation setting. However, researchers have determined these deficits only account for approximately 40-50% of the quality of life reduction expectations for individuals with AIDP.[17] Fatigue, chronic pain, and anxiety/depression were attributed to the remaining majority as potential long-term complications responsible for decreasing quality of life in individuals with immune-mediated neuropathies.[17] Since these symptoms are less tangible and more difficult to be objectively measured, they are often overlooked.

According to one study, nearly 90% of individuals affected by GBS made a full functional recovery within 5 years. However, 38% of those patients claimed their work situations had to be altered and 44% reported a change in their leisure or social activities as a result of GBS.[18] Another study examined factors impacting long-term health outcomes of GBS survivors diagnosed an average of six years prior. Despite demonstrating good functional recovery as indicated by the FIM motor dimensions, 16% of the patients reported a moderate to extreme impact on their ability to participate in family, work, and social activities and 22% reported similar levels of depression and anxiety.[19]

Outcome measurement is challenging in rehabilitation research. Although an instrument such as the FIM illustrates the level of assistance needed for functional tasks, it does not reflect how the individual adapts or copes with the challenges associated with a longer-term disabling condition. However, improved patient function reduces the associated burden of care and thus has important psychosocial and cost-benefits. Although it is important for physical therapists to understand the potential complications associated with long-term illnesses, rehabilitation in the

inpatient setting prioritizes treating limitations that will have the greatest direct impact on recovery and making appropriate discharge recommendations where the associated sequelae can be further addressed.

A good prognosis for recovery was determined for the patient due to independent prior level of function, positive response to treatment interventions, consistent family support, and an intent to continue the plan of care following discharge. The patient was contacted three months after discharge and has provided the following update on his recovery. He reports he is able to ambulate without the use of an assistive device up to a distance of half a mile; however, walking on uneven surfaces and decreased endurance persist as challenges at this time. He is now able to complete twelve stairs independently with the use of a handrail. The patient has not returned to work as a deputy sheriff for safety reasons as he continues to exhibit physical limitations of decreased fine motor skills and impaired balance. He has an upcoming interview with the Department of Corrections which would be more feasible while he continues to recover. Unfortunately, the patient and his wife decided to separate, and he has since moved back to his hometown to be closer to his family. Due to this, his plan of care was interrupted, and he only received two weeks of outpatient physical therapy.

While there remains limited evidence to direct the rehabilitation of GBS, this case provides one example of notable progress that occurred following four weeks of intensive inpatient rehab. Throughout his inpatient stay, the patient demonstrated improved strength, endurance, and functional abilities. Although we cannot differentiate between what might be natural progression and recovery, it does speak to the fact that the intensive therapy did not worsen his symptoms and the patient tolerated the 3 hours/day without difficulty. There remains a need for further research to determine the most effective treatment interventions to facilitate return to function and diminution of associated sequelae.

References

1. Arcila-Londono X, Lewis R. Guillain-Barré syndrome. *Semin Neurol.* 2012;32(3):179-186.
2. van den Berg B, Walgaard C, Drenthen J, Fokke C, et al. Guillain-Barré syndrome: pathogenesis, diagnosis, treatment and prognosis. *Nat Rev Neurol.* 2014;10(8):469-482.
3. Donofrio P. Guillain-Barré Syndrome. *Continuum* 2017;23(5):1295-1309.
4. Esposito S, Longo M. Guillain-Barré syndrome. *Autoimmun Rev.* 2017;16(1):96-101.
5. Guillain-Barré Syndrome Fact Sheet. National Institue of Neurological Disorders and Stroke. https://www.ninds.nih.gov/Disorders/Patient-Caregiver-Education/Fact-Sheets/Guillain-Barre-Syndrome-Fact-Sheet#3139_5. Published 2019. Updated August, 2019. Accessed.
6. Hafer-Macko C, Sheikh K, Li C, et al. Immune attack on the Schwann cell surface in acute inflammatory demyelinating polyneuropathy. *Ann Neurol.* 1996;39(5):625-635.
7. Asbury A, Cornblath D. Assessment of current diagnostic criteria for Guillain-Barré syndrome. *Ann Neurol.* 1990;27:S21-24.
8. van Doorn P, Ruts L, Jacobs B. Clinical features, pathogenesis, and treatment of Guillain-Barré syndrome. *Lancet Neurol.* 2008;7(10):939-950.
9. Bölükbaşi F, Ersen G, Gündüz A, et al. Guillain-Barré Syndrome and Its Variants: Clinical Course and Prognostic Factors. *Archives of Neuropsychiatry.* 2019;56(1):71-74.
10. O'Sullivan S, Siegelman R, Shaffer S, Sutlive T. *National Physical Therapy Examination Review and Study Guide.* 22 ed2019.

11. Bersano A, Carpo M, Allaria S, Franciotta D, Citterio A, Nobile-Orazio E. Long term disability and social status change after Guillain-Barré syndrome. *J Neurol.* 2006;253(2):214-218.
12. Functional Independence Measure. Shirley Ryan Ability Lab. https://www.sralab.org/rehabilitation-measures/fimr-instrument-fim-fimr-trademark-uniform-data-system-fro-medical. Updated October, 2015. Accessed.
13. Harvey L. *Management of Spinal Cord Injuries.* Churchill Livingstone; 2008.
14. Beninato M, Gill-Body K, Salles S, Stark P, Black-Schaffer R, Stein J. Determination of the minimal clinically important difference in the FIM instrument in patients with stroke. *Arch Phys Med Rehabil.* 2006;1(87):32-39.
15. Meythaler J. Rehabilitation of Guillain-Barré syndrome. *Arch Phys Med Rehabil.* 1997;78(8):872-879.
16. Forsberg A, Press R, Einarsson U, de Pedro-Cuesta J, Holmqvist L. Disability and health-related quality of life in Guillain-Barré syndrome during the first two years after onset: a prospective study. *Clin Rehabil.* 2005;19(8):900-909.
17. Merkies I, Kieseier B. Fatigue, Pain, Anxiety and Depression in Guillain-Barré Syndrome and Chronic Inflammatory Demyelinating Polyradiculoneuropathy. *Eur Neurol.* 2016;75:199-206.
18. Bernsen R, de Jager A, Schmitz P, van der Meché F. Long-term impact on work and private life after Guillain–Barré syndrome. *J Neurol Sci.* 2002;201(1-2):13-17.
19. Khan F, Pallant J, Ng L, Bhasker A. Factors associated with long-term functional outcomes and psychological sequelae in Guillain-Barre syndrome. *J Neurol.* 2010;257(12):2024-2031.