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The patient signed an informed consent allowing use of medical information for this report and received information on the institution's policies regarding the Health Insurance Portability and Accountability Act.

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## Abstract

Stroke is the primary cause of disability and care dependency in adults in the United States. Research has found that the risk of mortality post stroke can be greatly reduced through stroke rehabilitation. The purpose of this case report is to provide a framework of physical therapy rehabilitation that facilitated functional mobility and gait in a patient who experienced a stroke. The patient was a 50-year old male who was admitted to an inpatient rehabilitation hospital for physical therapy following a left middle cerebral artery ischemic stroke four days prior. The patient received three weeks of physical therapy after displaying right hemiparesis, apraxia and aphasia, abnormal tone, and impaired strength, balance, and mobility. Procedural interventions incorporated task-specific training including transfers and bed mobility, therapeutic activities, neuromuscular re-education,
therapeutic exercise, wheelchair management, balance training, and gait training with varying levels of assistance including: harness system, robot-assisted, and over-ground. Progression was documented through Functional Independence Measure and improvements were noted in strength, balance, functional mobility and gait. Gains in these areas may be consistent with daily physical therapy with progressing interventions. Further research should investigate the benefits of specific interventions and the intensity for this population.


## Background and Purpose

A cerebrovascular accident (CVA), also known as a stroke, occurs when blood is unable to flow to the brain. An ischemic stroke arises when blood flow is impeded due to a blocked artery whereas a ruptured blood vessel results in a hemorrhagic stroke.[4] Stroke is currently the fifth leading cause of death and the primary cause of disability and care dependency in adults in

the United States.[1] Although many factors increase the risk of stroke,[5] there are two primary factors that determine the prognosis after a stroke has occurred. Both patient age and stroke severity, size and location, have been found to be strong predictors in prognosis.[2]

Rehabilitation following a stroke also contributes to prognosis and can improve outcomes. Research has found that the risk of mortality post stroke can be reduced through stroke rehabilitation initiated during the first three months following a stroke.[3] In addition, increased frequency of rehabilitation can also lead to even greater gains.[6] This increased frequency is commonly seen in acute rehabilitation hospitals where a patient receives three hours of therapy a day between physical, occupational, and potentially speech therapy. In this setting physical therapy utilizes various techniques such as motor learning and exercises that generally focus on increasing mobility, coordination and balance, and motor function.[7] Although general principles may be found, there is limited research on specific treatment parameters employed when returning mobility and gait to patients who have experienced a stroke. Thus, the purpose of this case report is to provide physical therapy management strategies used during an inpatient rehabilitation stay for a patient who experienced an ischemic stroke.

## CASE DESCRIPTION

### Patient History and Systems Review

The patient was a 50 year-old Caucasian male taken to the emergency room seven hours post symptoms where he was diagnosed with a left middle cerebral artery (MCA) ischemic stroke. The patient was not a candidate for tissue plasminogen activator (tPA) due to symptom onset presenting greater than 4.5 hour prior to admission. The patient displayed right hemiparesis, aphasia, apraxia, and impaired coordination, sensation, and cognition in the

emergency room. He has a medical history of dyslipidemia, cigarette use for the past 25 years, occasional marijuana use, and a history of alcohol use but has abstained in the past three years.

Prior to his stroke, the patient worked full time doing masonry and flooring work. He was completely independent with activities of daily living (ADL) and instrumental activities of daily living (IADL). He lived with his wife in a multi-level home with 5 stairs and bilateral rails to enter and 16 stairs with a rail on the left to access the second floor. The primary bedroom and bathroom were on the second floor. A first floor bedroom set-up was available and the family planned to purchase a commode to accommodate the lack of a first floor bathroom.

The patient was admitted to an acute rehabilitation hospital 4 days after a left MCA stroke. Medications taken at this time included: aspirin and atorvastatin. Upon further examination, the patient showed significantly impaired left upper and lower extremity strength, tone, sensation, motor control, and coordination. He required supervision for bed mobility, moderate assistance for sit-to/from-stand, and maximum assistance for transfers, static standing, and to negotiate 2 stairs. His goals were to return to walking and home as quickly as possible and to become independent with ADLs. A systems review can be found in Table 1.

The patient signed an informed consent allowing the use of medical information, in adherence to the HIPPA policy.

**Clinical Impression 1**

Following the history and systems review, the patient displayed right hemiparesis, apraxia and aphasia, impaired strength, abnormal tone, and impaired cognition secondary to a left MCA stroke. The patient's medical status and current condition supported the initial diagnosis of a stroke and no differential diagnoses were needed. Further tests/measures include

the Functional Independence Measures (FIM), motor coordination testing, sensation testing, and gait analysis. The patient was also receiving speech therapy to address his cognitive and speech deficits and occupational therapy for upper extremity and ADL impairments. This patient was a good candidate for a case report due to his impaired function, age, and his potential participation in gait training interventions.

**Examination – Tests and Measures**

A physical therapy (PT) examination was conducted one day following admission to an acute rehabilitation hospital. The examination consisted of the measures listed in Table 2. A sensory neuromotor test described by Gutman and Schonfeld[8] provided results for proprioception, light touch, and deep pressure and localization. The methods used for light touch and deep pressure and localization have been found to be reliable and valid through a peer-reviewed journal article by Felix and Wilderstrom-Noga.[9] Magee[10] describes the heel-to-knee test that was used to test the patient's coordination and although studies have yet to provide substantial reliability and validity for the heel-to-knee coordination test and the proprioception testing, these two techniques have been used in various settings throughout the country to provide insight into patients' sensation and coordination impairments. A study by Cournan[11] describes the methods of the FIM and also provides evidence of the many studies that have supported the validity and reliability of the FIM as a functional assessment tool.

**Clinical Impression 2**

The patient exhibited signs and symptoms consistent with a stroke such as right hemiparesia, impaired cognition and sensation, aphasia, and impaired balance and mobility. The

patient continues to be an appropriate candidate for this case study due to his current impairments and his motivation to improve is health with improved diet and smoking cessation and to return to more independent levels of functioning.

Given the patient's medical diagnosis and associated impairments, the primary diagnoses from the *Guide to Physical Therapy Practice*[12] would be "Pattern 5D: Impaired Motor Function and Sensory Integrity Associated with Nonprogressive Disorders of the Central Nervous System-Acquired in Adolescence or Adulthood". This category was supported by his extensive musculoskeletal, neuromuscular, and sensory impairments.

Patient age and stroke severity are the two greatest predictors of prognosis according to Edwardson and Dromerick.[2] Outcomes are more favorable in younger patients with smaller strokes. Although this patient was 50 years old, the initial delay in care may have contributed to the increased size of the stroke and, therefore, significant impairments. Overall, his young age, motivation, supportive family, and prior level of functioning support the chances of success with continued therapy.

In addition to PT, the patient was referred to occupational therapy (OT) and speech therapy with a speech language pathologist (SLP). Weekly meetings for coordination and communication of care occurred with all team members. It was determined that the patient would receive a total of three hours of care with one hour each for PT, OT, and SLP five days a week for three weeks. These treatments addressed the patient's current impairments, management of risk factors, medical condition, safety concerns, activity limitations, and interventions, The PT short term and long term goals for the patient are listed below:

*Short Term Goals (1 week):*

1. Move from sit to supine with the head of bed flat at the level of supervision (SPV).

2. Move from sit to stand with min (A).
3. Perform a stand-pivot with min (A).
4. Ambulate over level surfaces with min (A) over 75 feet (ft.).
5. Negotiate 5 steps with a rail on the left with min(A).
6. Ambulate with a manual wheelchair over 250 ft. with mod (I).
7.

*Long Term Goals (3 weeks):*

1. Ambulate 150 ft. with SPV and a large base quad cane (LBQC) to access home environment.
2. Ascend/descend 16 steps with a rail on the left and min(A) to access bedroom on second floor.

**Intervention**

***Coordination, Communication, and Documentation***

Weekly meetings for coordination and communication of care occurred with PT, OT, SLP, case manager, medical doctor, psychiatrist, rehab certified RN, and occasionally a nutritionist. Communication was maintained with all team members through daily documentation and weekly meetings as discussed in the plan of care. Documentation included the patient's initial evaluation, daily interventions and treatment sessions, patient response, and any additional communication needs. In addition, the patient's preferred orthotic vendor was included in order to provide the patient with an ankle-foot orthosis (AFO).

***Patient and Family Training***

Family and patient education occurred as often as possible with each member of the team as necessary or when requested. Patient and family education initially focused on safety, awareness,

and techniques for managing impairments. As progress increased, education focused on balance, functional mobility, donning and doffing the AFO, ambulation with a LBQC, wheelchair mobility, and stair negotiation. The patient also attended educational group therapy regarding risk factors, prevention, social support, and coping mechanisms. Family training regarding safety and assistance during ADLs and functional mobility in the home environment occurred primarily in the last week of treatment prior to discharge.

***Procedural Interventions***

The patient was scheduled for one hour sessions of PT at least five days a week. He received PT, OT, and SLP treatment for a total of 3 hours per day for 21 days. Procedural interventions for PT focused on task-specific training including transfers and bed mobility, therapeutic activities, neuromuscular re-education, therapeutic exercise, wheelchair management, balance training, and gait training with varying levels of assistance including: harness system, robot-assisted, and over-ground. The specific interventions and the corresponding parameters can be found in Table 3 and Table 4. Interventions initially focused on early mobility and early stimulation and use of hemiparetic side as research[1] has shown this increases level of consciousness, independence, and functional reorganization. Literature[1] has also supported the use of range of motion, functional mobility training (bed mobility, sitting, transfers, locomotion), and ADL training in the rehabilitation process. Many of these interventions chosen were determined by the clinical instructor but have also been supported through research[1] and clinical practice. The interventions began at baseline ability and were progressed as the patient was able to increase strength, coordination, balance, and tolerance. Cognitive components factored in to day-to-day interventions as motivation, extent of the aphasia, and frustration varied. The patient

consistently displayed compliance by attending scheduled appointments and performing home program.

**Outcome**

The patient progressed from an overall FIM level of maximum assist to a level of minimum assist/supervision level for functional mobility and gait. He gradually met all of his short term goals over the course of treatment. He was able to meet his long term goal for stairs but required occasional Min(A) for walking. Overall, the patient demonstrated significant improvement regarding functional mobility and gait. He was able to roll right, left, and to supine with mod(I) by occasionally using railings or surroundings. He completed supine to and from sitting at a mod(I) level. The patient demonstrated safe transitions from sitting to and from standing at a SPV level. He was able to ambulate 150 feet with SPV-min(A) using a LBQC. The patient was also able to negotiate 18 steps with min(A) by discharge. He also displayed mod(I) when utilizing his wheelchair for 250 feet, locking and unlocking the brakes, and adjusting footrests. In addition, he was able to don and doff his AFO independently which was worn any time the patient would be weight bearing.

In general, the patient also displayed improvements with strength, coordination, activity tolerance, cognition, and endurance. Although he showed vast improvements, the patient and his wife agreed that he should be discharged home at a wheelchair level. This decision would allow for increased independence for the patient and a decreased fall risk. Lastly, the family and therapist discussed and agreed that the patient should continue therapy at an outpatient setting to continue progress and improve mobility and balance.

**Discussion**

The patient progressed well through three weeks of inpatient rehabilitation. He was able

to improve both this functional mobility and gait throughout the course of treatment. Factors that may have positively influenced outcomes include gradual progression of interventions, consistency, high patient motivation, transfer and gait training interventions, and family support. In addition, the services provided by OT and SLP must also be considered when assessing the patient's progress.

It would be beneficial to have further research supporting specific interventions for patients that have experienced a stroke. Although research has shown that various factors such as age may affect recovery,[15] there is a lack of literature regarding interventions. Many interventions utilized in this case have some evidence to support them, such as the technique of paretic lower extremity loading,[16] but the data is limited and specific guidelines are lacking in many of these studies. Even with interventions that have shown positive outcomes, such as BWSTT,[17] further research is required to determine effective parameters for the variable population of patients with strokes.

In conclusion, individuals who have experienced a stroke face many variables that will affect recovery. Decreased age can benefit a patient while increased risk factors and severity of stroke can certainly hinder recovery. The use of research supported and patient specific interventions may assist in restoring gait and functional mobility in patients. Further research should investigate the comparison of BWSTT to other gait intervention and specific parameters for interventions.

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346 **TABLES and FIGURES**

347 Table 1. Systems Review

| Systems Review | |
|---|---|
| **Cardiovascular/Pulmonary** | Unimpaired; vitals: HR: 62 bpm, BP: 120/79 mmHg at rest |
| **Musculoskeletal** | Right lower extremity (LE): active ROM and strength impaired grossly due to hemiparesis, passive ROM WFL<br>Right LE strength:<br>-Hip flexion, adduction, and abduction: 2-/5<br>-Knee extension: 3-/5<br>-Knee flexion and ankle plantarflexion: 1/5<br>-Ankle dorsiflexion: 0/5<br><br>Left lower extremity: within functional limits (WFL) range of motion (ROM) and strength<br>Left LE strength: 5/5 |
| **Neuromuscular** | tone: right LE hypotonia, left LE: unimpaired |
| **Integumentary** | bilateral lower extremities unimpaired |
| **Communication** | impaired: aphasia and apraxia |
| **Affect, Cognition, Language, Learning Style** | comprehension, memory, and problem solving: minimum assist; social interaction: modified independence; expression: maximum assistance<br>learning style: verbal description and demonstration |

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Table 2. Initial Examination

| **Tests & Measures** | **Initial Examination Results** | |
|---|---|---|
| FIM* | Bed mobility: SPV<br>Sit-to/from-stand: Mod (A)<br>Transfers: Max (A)<br>Static Standing: Max (A)<br>Stair negotiation: 2 stairs Max (A) | |
| | **Left** | **Right** |
| Proprioception | Unimpaired | Impaired |
| Light Touch | Unimpaired | Absent |
| Deep Pressure & Localization | Unimpaired | Absent |
| Coordination (heel to shin) | Unimpaired | Maximally Impaired |
| Gait Analysis | -Late stance: decreased hip extension<br>-Swing phase: decreased step length<br>-Overall decreased cadence | -Late stance: decreased hip extension, push off, weight bearing, weight shift, narrow base of support (<2 inches)<br>-Swing phase: decreased knee flexion, step length, and foot clearance<br>-Overall decreased cadence |

*FIM scores, refer to appendices: modified independence (Mod(I)) supervision (SPV), minimum assistance (Min (A)), moderate assistance (Mod (A)), maximum assistance (Max (A)).

371 Table 3. Interventions
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| | Description* | Frequency | Purpose |
|---|---|---|---|
| Therapeutic Activity: Bed Mobility | Roll to left, right, and supine. Supine to/from sit. | As needed | To increase independence in self-care, increase body awareness, and process sequencing. |
| Therapeutic Activity: Transfer Training | Squat pivot and stand pivot from bed to/from wheelchair and to/from mat. Sit to/from stand from variety of surfaces. | At least twice per session | To increase independence, process sequencing, increase use of right UE and LE. |
| Balance Activities | Static: seated at edge of bed with use of UE, then progressed to unsupported. Standing with assist progressed to standing unsupported.<br><br>Dynamic Standing: Lateral weight shift, perturbations at hips and shoulders (lateral, anterior, and posterior), ball toss, and toe taps on 1-inch block. | 3-4 times per week | To increase use of right UE and LE, improve posture, improve and then challenge base of support, improve gait with weight shifting and perturbations in static standing, and improve safety |
| Therapeutic Exercises: LE strengthening | Seated: ankle dorsiflexion/ plantarflexion, hip flexion (marching), glute sets, knee extension, hip abduction/ adduction, hamstring curls<br><br>Standing: mini squats, hip abduction/adduction, hamstring curls, marching, hip flexion | 3 times per week.<br><br>Initial:10 repetitions x 3 sets | Strengthening and stability. Improve activation of targeted muscles, especially when used with Bioness L300**) |
| /Body-weight supported treadmill training (BWSTT): Robot-Assisted Gait | Patient utilized (BWSTT) system either with Robot-Assisted Gait or with a | Once a week for the first 3 weeks | Research supports BWSTT as a tool to return gait to non-ambulatory patients by assisting with the reorganization of neural |

| | | | |
|---|---|---|---|
| Training or Harness System | harness system to decrease body weight support. See table below | | circuitry[13] |
| Neuromuscular Activities/Left LE weight bearing | Quadruped, high kneel, weight shift to right, standing on block with 1 foot, Bioness L300 in conjunction with gait and strengthening | 3-4 times per week, Bioness L300 incorporated 5 times | Increase right LE weight bearing to increase proprioception/sensation |
| Gait Training: with Bioness L300, dorsiflexion wrap, or AFO | Started supported at rail on left, progressed to LBQC. Initial distance 35 ft., progressed to 150 ft. Visual aid utilized in beginning to assist with midline posture. | At least 2 trials per treatment session for 21 days | To increase functional independence, improve weight bearing, and facilitate sequencing.<br><br>According to research[14], providing a visual aid can assist patients to determine a midline posture after a stroke. |
| Stair Training | Initially negotiated 2 steps, progressed to 12 steps. | Once per week | To allow the patient to access his home environment |

* Progress measured by level of assist, level of cueing required, number of trials, distance, safety during task, and time.

**Bioness L300 Foot Drop System, 19 Ha'Haroshet St., PO Box 2500, Industrial Zone, Ra'Anana 43654, Israel

Table 4. Body Weight Support Treadmill Training with Robot-Assisted or Harness System

| **Parameter** | **Session Number*** | | |
|---|---|---|---|
| | **1-** Robot-Assisted | **2-** Harness system | **3-** Harness system |
| Minutes | 15 | 9 | 15 |
| Speed (mph) | .9-1 | .30-.65 | .35-.80 |
| Distance (ft) | 1413 | 466 | 916 |
| % Body Weight Supported | 0 | 9-12 | 6-8 |

* Parameters adjusted based on patient feedback

## APPENDICES

FIM Levels:

7: Complete Independence (Timely, safely)

6: Modified Independence (Device)

5: Supervision (Patient completes 100%)

4: Minimum Assistance (Patient completes 75% or more)

3: Moderate Assistance (Patient completes 50%-74% or more)

2: Maximal Assistance (Patient completes 25%-49% or more)

1: Total Assistance (Patient completes less than 25%)

0: Activity does not occur