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Balance And Functional Skill Training For A Patient With Cognitive Dysfunction And Impaired Safety Awareness: A Case Report

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

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Abstract:

Background and Purpose:

With advances in medicine, there are increasing numbers of people living after stroke. One of the major factors that can limit improvement in ability to complete functional tasks is cognitive dysfunction. Cognitive rehabilitation in conjunction with large amounts of repetition during physical therapy can result in lasting neuronal changes and help improve the safety of patients.

The purpose of this case study is to describe the decision making process for physical therapy examination and intervention for a patient who had a stroke with accompanying cognitive dysfunction and decreased safety awareness.

Case Description:

The patient was a male over age 85 who had a stroke. A computed tomography scan showed a small infarction involving the left parietal region that confirmed the stroke. Further examination confirmed impairments with cognition, strength, endurance, and balance, which affected his ability to safely perform functional tasks.

Outcomes:

The patient received treatment over the span of approximately five weeks. The patient improved in his ability to safely perform functional transfers, static and dynamic balance, and improved in cognitive function.

Discussion:

The patient's improvement from the initial evaluation to discharge was sufficient enough to permit him to return to his prior living situation. This case demonstrates that a program based on balance, strength, and endurance with cognitive training may help. Future case reports should further investigate the influence of cognitive training with other forms of therapy.

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Background and Purpose:

As with any other organ in the body, the brain relies on a steady supply of oxygen in order to perform. This is supplied through a network of blood vessels that can be occluded or ruptured under particular conditions. Either event will deprive brain cells of oxygen. This lack of oxygen over an extended period of time will cause brain cells to die, possibly taking with them the ability to move, speak, feel, think, or even recognize people[1]. With advances in medicine, there are increasing numbers of people living who have had a stroke. According to the American Heart Association[2] an estimated 6.8 million Americans over the age of 20 have had a stroke. Each year approximately 800,000 Americans have a stroke, 87% of which are ischemic in nature. There is an average of 1 stroke every 40 seconds in the United States.

With so many people affected by stroke one of the major factors that can limit improvement is cognitive dysfunction. Wolf and Rognastad[3] showed that executive dysfunction is present in 30-60% of mild stroke cases. Cognitive dysfunction after stroke can have a significant impact in everyday life. Foster et al[4] reported that patients had a 9 times increased of developing dementia immediately following a stroke. They found that patients with post stroke dementia have a decreased ability to perform executive functions, such as using their working memory, planning, and problem solving. A systematic review of the effects of cognitive rehabilitation for after stroke and other non-progressive brain injuries reported that there was some evidence that cognitive rehabilitation could help, but, made the recommendation for further studies be carries out[5]. Cognitive Rehabilitation interventions can include planning and organizational skills development, training in conscious problem solving techniques that are intended to become more automatic with practice, and use of pre and post scoring to develop awareness of task performance[5].

In addition to cognitive dysfunction, patients who have had stroke often have safety deficits that may impede the rehabilitation process. A person who lacks of awareness of neurologic impairments may choose activities that are beyond their abilities, and may require close supervision[6]. A second study was conducted in which they found that 40 percent of patients upon admission 25 percent of patients upon discharge lacked a sense of their own limitations[7].

Cognitive impairments can complicate the rehabilitation process for many patients with motor limitations. A patient with a decreased ability to reason has a more difficult time relearning skills and gaining independence. It has been noted by Rose[8] that to gain greater independence the patient needs increased amounts of physical activity. With repetition, lasting neuronal changes can be achieved.

The purpose of this case study is to describe the decision making process for physical therapy examination, intervention, and outcomes for a patient who had a stroke with accompanying cognitive dysfunction and decreased safety awareness.

Case Description:

History: The patient was an older male over age 85, who had been living with his wife in an assisted living facility. His seven living children were very supportive during his stay at the facility. He was a former civil engineer who helped design many structures in Las Vegas, Nevada. His son reported that his father had previously had a very sharp mind until he had a stroke at the end of May 2014. The cognitive decline experienced by the patient was concerning to the family.

Before the stroke he had been independent with functional activities. He had been somewhat active in the months leading up to the stroke, including completing rounds of golf at a local golf club. He reportedly did not smoke or drink alcohol. His previous medical history

included hypertension, coronary artery disease, atrial-fibulations, type 2 diabetes, gout, benign prostate hypertrophy, and insomnia. His past surgical history included a coronary artery bypass graft and pacemaker placement.

A computed tomography (CT) scan showed a small core infarction involving the left parietal region with associated small amount of penumbra, most likely sequelae of small vessel ischemia.

His medications included Metformin, Pantoprazole, Cyanocobalamin, Plavix, Onandseteon Hydrochloride, and Acetaminophen.

The patient's chief complaint was difficulty completing former activities because of a difficulty with memory, vocabulary, and weakness as a result of a stroke. He reported a decline in his right upper and lower extremity use that had an effect on his ability to complete functional tasks and participate in previous activities. In addition, safety became a concern when he reported that he did not need to use an assistive device with gait activities.

The patient's goals for physical therapy were to be able to return to and be safe at his previous assisted living facility in functional mobility and activities of daily living.

Systems Review:

The musculoskeletal system review revealed that the upper and lower extremity active range of motion was all within functional limits. Right lower extremity strength was impaired and the left unimpaired. The neuromuscular review revealed impairments with balance and gait. The integumentary review did not reveal any impairments. The cardiopulmonary review revealed a resting heart rate of 65 beats per minute, 155/50 blood pressure, 92% oxygen saturation on room air, and a respiratory rate of 18.

Clinical Impression #1:

The patient's primary problem was that he had difficulty performing functional tasks such as bed mobility, transfers, and gait activities due to balance problems. He had fair static standing balance and his gait abnormalities included; forward lean, decreased step length, decreased toe clearance, decreased heel strike, and shuffling. His impairments were exacerbated by impaired cognitive function and decreased safety awareness. In particular, he seemed to have difficulty expressing himself and remembering instructions when fatigued.

Based on the information from the history, the systems review, and the CT scan, the patient had a stroke in the left hemisphere of his brain. He may have damaged part of the speech centers of his brain that limited his ability to fluently communicate. He may also have had some delayed cognitive processing that made it difficult for him to safely make decisions.

Further examination was to include an array of tests and measures meant to quantify his impairments and delineate his fall risk. Included were light tough, sharp/dull discrimination, the Mini-BesTest, Tinetti Performance Oriented Mobility Assessment, Timed Up and Go (TUG), Two Minute Walk Test (2MWT), Global Deterioration Scale, Standardized Mini-Mental State Examination, and a functional mobility assessment.

The patient was a good candidate for this case report because his case helps to highlight the decision making process for a patient who had a stroke with associated cognitive dysfunction and decreased safety awareness.

Examination:

Included in the examination were tests and measures to examine the extent of impairments caused by the stroke. Included tests were in sensation, balance, gait, strength, endurance, cognitive, and functional tests. Results from the examination can be seen in Table 1.

Each of the tests and measures were chosen for their reliability and usefulness as outcome tools. There were not any studies identified in the literature search on strength and sensation testing regarding reliability and validity.

The Mini-BESTest[9] is an outcome tool that combines several well-known balance tests. It was used to track patient progression in balance from the start of care to discharge. It has been found to be valid and reliable [9,10].

The Tinneti POMA[11] is another balance test that was chosen to confirm balance impairments. It has been found to have excellent reliability and validity[12,13,14].

The Timed Up and Go[15] was used as a convenient tool to address balance progress over time. The test includes standing up, walking 10 meters and returning to the chair. The TUG has excellent reliability and validity[16,17].

The 2 Minute Walk Test[18] was chosen to evaluate the patient's endurance and gait speed. It was a useful outcome tool over the weeks. The 2MWT has excellent reliability and validity[18,19].

The Global Deterioration Scale[20] was used to measure cognitive function. It has been shown to have good to excellent reliability and good validity[21].

The Standardized Mini-Mental State Examination[22] was chosen as a way to quantify the patient's executive functioning including problem solving. It is a paper and pencil test that has been shown to have excellent inter-rater and intra-rater reliability and a high discriminant validity in the diagnosis of dementia[22,23].

Clinical Impression #2:

The patient had been in relatively good health up until the stroke and was actively engaged in activities such as golf. Post stroke, his chief complaint was difficulty with memory,

cognition, and weakness of his right side. A confirming CT scan showed a small stroke in the left parietal region of his brain. This could explain the reason that he had a difficult time coming up with words and difficulty with problem solving through tasks. The right side weakness probably contributed to his impaired balance in standing and walking. The patient had difficulty with functional tasks, which seemed to be exacerbated by a decreased problem solving ability. The outcome assessments that were used showed that the patient had impaired balance, decreased endurance, and impaired cognition. In addition, the functional assessment revealed that the patient had difficulty walking, getting into and out of bed, and getting up and down from sitting.

Due to his diagnosis and presentation at examination the patient should be classified in Practice Pattern 5D: Impaired Motor Function and Sensory Integrity Associated With Non-progressive Disorders of the Central Nervous System- Acquired in Adolescence or Adulthood.

He had a good prognosis for improvement with physical therapy. His main obstacle was cognitive dysfunction, decreased safety awareness, and endurance. His right side was weak, but still had use of his right side. He had potential for improvement because he was willing and able to participate in the rehabilitation program. As he completed many repetitions of functional tasks, he was able to make neuroplastic changes as described by Rose[8].

The patient's plan of care included coordination and communication with the staff at the rehabilitation facility and neurologist as needed. The patient was to be instructed about stroke etiology, specifically ischemia on the left side of the brain, and instructed on the importance of using the nursing staff when getting up. Procedural interventions were based on balance, strength, and endurance. Balance activities included balancing on an airex pad, side-stepping, and hitting a balloon back and forth. Strength activities included bed mobility, transfer training,

and rhythmic stabilizations using an exercise ball. Endurance activities included walking on a treadmill, overland gait training, and riding on a recumbent bike.

Short and Long-Term goals were set and can be seen in Table 2.

Interventions:

The patient was scheduled to be seen by physical therapy twice per day, on weekdays, and once per day on the weekends. Because the patient's tests and measures revealed decreased balance, strength, endurance, and impaired cognition, interventions were chosen in each of the first three areas with a focus on problem solving. Each day's treatment consisted of approximately thirty three percent endurance training, strength training, and balance training. Therapeutic exercises that were task oriented were chosen to maximize patient outcomes in balance and safety during transfers. See Table 3.

Stairs were specifically chosen for both strength and balance training because of Lee and Seo's[24] study. Cognitive training was included and based on a Cochrane Systematic Review[5] that supported the use of cognitive training with patients who have had a stroke.

A focus on transfers was emphasized from the very beginning and was progressed slowly throughout the episode of care due to safety concerns and cognitive deficits. Other strength interventions included walking up and down the stairs and rhythmic stabilizations with an exercise ball. These interventions were progressed as the patient gained expressed less physical exertion at an easier level.

Balance activities were chosen that were meant to challenge static and dynamic balance. It was hoped that over time neuroplastic changes in his brain would improve motor memory, which would help with balance. Some of the balance activities were inspired from the Mini-BesTest[9], such as balancing on a wedge. Training up and down the stairs began at the beginning

of the episode of care, but was stopped after two weeks due to patient preference. The remaining activities are described in Table 3. Initially he needed external support during these activities, but that was decreased over time. The decision to progress the patient was based on observation of a decrease in sway and loss of balance during static standing and walking activities.

Strength activities were chosen based on clinical experience and because they were task oriented. He, for example, did a lot of sit to stand training to build lower extremity strength and improve his ability to safely come to a standing position. The rhythmic stabilizations with the exercise ball were meant to increase his core strength that would help with control of the lower extremities.

Endurance training was composed of exercise on a recumbent bike, walking on a treadmill, and overland gait training (Table 3). He was progressed by increasing work time and decreasing rest periods. Endurance activities were chosen based on clinical experience and patient preference. Gait training, specifically, was important because of the many repetitions needed to make changes in neuroplasticity and motor memory[8].

The patient was educated about strokes on the left side of the brain and prognosis. He was instructed in the proper use of a front wheeled walker. Daily instruction on safety and proper mechanics during transfers were given because of his decreased cognition. Over time less instructions were given as he became more independent.

Communication and coordination was performed with the nursing staff for needs including helping the patient get dressed and dispensing needed medication. The nursing staff were particularly helpful in managing an upper respiratory infection that was present for approximately four weeks. There was communication with the neurologist via notes regarding patient progress. There was communication with the dietary staff when it was learned that the

patient had difficulty digesting sausage. Last, there was communication and coordination with the social worker to work on discharge planning.

Outcomes:

The patient received treatment over the span of approximately five weeks. Over that time, he improved in his functional transfers, static and dynamic balance, and cognitive function. Standardized tests performed at the initial evaluation and at discharge were both carried out by the author (Table 1).

The patient's progression in functional transfers was limited by cognitive deficits and required many repetitions to perform an independent supine to sit transfer and safe sit to stand transfer. He eventually was independent in bed mobility, supine to and from sit, and sit to and from stand. His improved ability to independently perform functional transfers allowed him to qualify to return to his assisted living facility.

The patient demonstrated an improvement in balance with his scores on the Mini-BesTest, Tinetti POMA, and the TUG. A progression from weeks 1 through 5 can be seen in Figures 1, 2, and 3 on each of the respective tests. The final scores showed a decreased risk of falling compared to admission. His final outcome on these tests still put him at some risk for falling, but he still qualified to return to the assisted living facility.

The patient's scores on the Standardized Mini-Mental State Examination improved by four points to a final score of 17. A score of between 10 and 19 indicates a moderate amount of cognitive impairment[25].

Discussion:

The patient improved enough from the initial evaluation to discharge to allow him to qualify to return to his prior living situation at an assisted living facility with his wife. This is

significant because he had become accustomed to his surroundings at the assisted living facility, which included independent living. If he had not been independent with functional transfers and safe to ambulate on his own, he either would not have been allowed to return or he would have had an increase in the amount of assistance needed. The increased assistance would have resulted in increased costs for the patient.

There were some positive factors associated with the outcome of this case. One of these was his motivation to return home to be with his wife. His family was very supportive and anxious to see some normalcy return to their lives. The patient was compliant with all therapy with the exception of training on the stairs. A major positive factor was the patient's willingness to perform high amounts of repetition of performing functional activities such as transfers and gait training.

A factor that may have slowed down the patient's recovery was his impaired executive functioning in combination with decreased safety awareness. An upper respiratory tract infection also may have impaired the patient's ability to fully participate in therapy.

This case demonstrates that a patient with a left side stroke and associated impairments of weakness and impaired cognitive function can improve with physical therapy. A program based on balance, strength, and endurance with cognitive training may be helpful. An important concept is the idea that high amounts of repetition is a requisite in motor learning and can lead to neuroplastic changes[8]. Cognitive training may be helpful as it relates to the ability to independently complete functional tasks as problem solving skills are developed[5].

The decision making process during this case was influenced by research that emphasized cognitive training in conjunction with strategies to utilize possible neuroplastic changes. These are not the only theories available that affect new learning in patients who have had a stroke.

Future case reports or studies would do well to further investigate the influence of cognitive training with other forms of therapy, such as modified constraint induced movement therapy for a patient with upper extremity weakness and impaired cognitive function. Aloraini et al[26] described the qualifications and a protocol for constraint induced movement therapy, but the patient in their report had intact cognition. The continued publication of individual case reports on patients who have had stroke is an important way to describe the decision making process for the many different presentations seen in patients who have had a stroke.

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Table 1. Tests and Measures from Initial Examination and Discharge.

Test/Measure/Outcome Tool	Admission	Discharge	Comments
Light Touch	Intact bilaterally	NT	
Sharp/Dull Discrimination	Right extremity had mild deficit	NT	
Mini-BesTest	6/28	18/28	Scores <17 indicates at risk for falls.
Tinetti POMA	13/30	16/30	Scores<20 indicate greater fall risk
TUG	49 Seconds	16 Seconds	>30=High Fall Risk, 12-30=Moderate Fall Risk
Strength	R LE=4/5, L LE=5/5	R LE=5/5, L LE=5/5	4=Good, 5=Normal
2MWT-Gait Speed	.44 meters/second	.71 meters/second	>.8=Community Ambulator, .4 to .8= Limited Community Ambulator
2MWT-Distance	53 meters	85 meters	Normal = 150 meters
Functional Assessment	Roll R/L=CGA, supine<>sit=Min A, sit <> stand= CGA	Roll R/L=Independent, supine<>sit=Independent, sit<>stand=Independent	
Gait Assessment	Forward lean, dec step length, dec toe clearance, dec heel strike, shuffling	Improved step length, toe clearance, and heel strike.	
Global Deterioration Scale	3	NT	Mild Cognitive Impairment
Standardized Mini-Mental State Examination	13/30	17/30	Scores of 10-19= Moderate Cognitive Impairment

*R=Right, L=Left, Min A= Minimum Assistance, CGA= Contact Guard Assist, LE= Lower Extremity, Dec= Decreased, NT=Not Tested

Table 2: Short and Long Term Goals.

Short Term Goals	Long Term Goals
1. Patient will decrease TUG time to 30 seconds in order to be in the moderate fall risk category.	1. Patient will increase gait speed to greater than or equal to 0.8 meter/second without AD independently.
2. Patient will be Modified Independent in rolling right and left 100% of the time to be more independent in functional mobility.	2. Patient will be independent in supine to sit and sit to supine transfers 100% of the time to be more independent in functional mobility.
3. Patient will be independent in sit to stand and stand to sit transfers 100% of the time to be more independent in functional mobility.	3. Patient's score on the Tinetti will be above 18 in order to be in the moderate to low fall risk category.
	4. Patient will decrease TUG time to less than 10 seconds in the moderate to low fall risk category.

TUG= Timed Up and Go, AD= Assistive Device

Table 3: Therapeutic Exercises.

Balance	Strength	Endurance
Side Stepping	Stairs up/down	Recumbent bike
Step Over Dixie Cups	Squats down to chair	Gait training
Cone Placement High/Low	Supine to sit training	Ambulation on treadmill
Single Leg Stance	Sit to stand training	
Stairs Up/Down	Rhythmic Stabilizations with exercise ball	
Airex Pad looking up/down/side to side		
Ambulation looking up/down/side to side		
Hit a balloon		
Pass a basketball		
Stand on wedge		
Stand on wooden block		

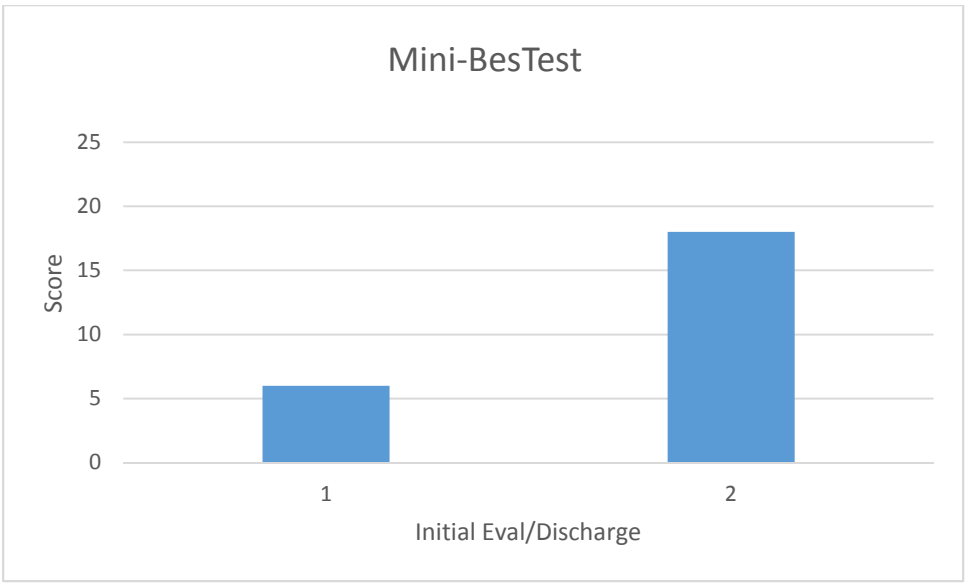

Figure 1: Mini Best Test. The patient improved by 18 points from the initial evaluation to discharge, five weeks later. Scores less than 17 indicate a greater risk for falls.

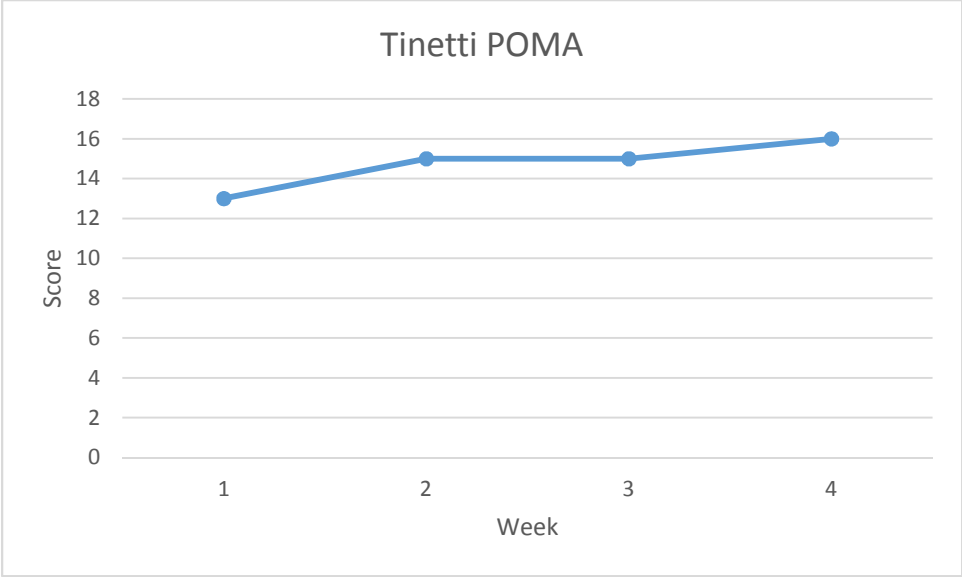

Figure 2: Tinetti POMA. The patient showed gradual improvement. The score at the initial evaluation was 13 and improved to 16 at time of discharge. Scores less than 20 indicate fall risk.

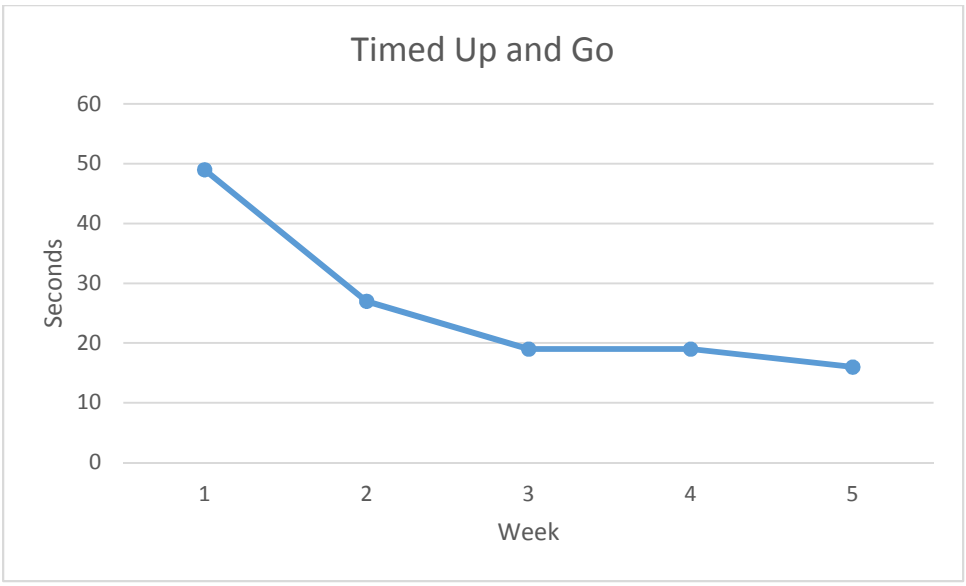

Figure 3: Timed Up and Go. The patient initially had a sharp decrease after the initial evaluation from 49 seconds to 27 seconds. His final time at discharge was 16 seconds. Times greater than 30 seconds indicate high fall risk and times between 12 and 30 indicate moderate fall risk.