ACUTE CARE REHABILITATION FOR A PATIENT FOLLOWING TRAUMATIC SUBARACHNOID HEMORRHAGE

A Doctoral Project
A Comprehensive Case Analysis

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by

Nicole Palatinus

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Approved by:

______________________________________, Committee Chair
Edward Barakatt, PT, PhD

______________________________________, Second Reader
Toran MacLeod, PT, PhD

______________________________________, Third Reader
Bryan Coleman-Salgado, PT, DPT, MS, CWS

____
Date

Student: Nicole Palatinus

I certify that this student has met the requirements for format contained in the University format manual, and that this project is suitable for shelving in the Library and credit is to be awarded for the project.

________________________________, Department Chair ____________
Michael McKeough, PT, EdD Date

Department of Physical Therapy

Abstract

of

ACUTE CARE REHABILITATION FOR A PATIENT FOLLOWING TRAUMATIC SUBARACHNOID HEMORRHAGE

by

Nicole Palatinus

A 33-year-old male with a moderate to severe traumatic brain injury was seen for physical therapy treatment for three sessions over one week in the intensive care unit of an inpatient hospital. Treatment was provided by a student physical therapist under the supervision of a licensed physical therapist.

The patient's injury was caused by a collision with a motor vehicle while riding a bicycle without a helmet. The patient initially presented to the emergency department with a Glasgow Coma Scale score of 11. Computed tomography revealed skull fractures and supratentorial and infratentorial subarachnoid hemorrhages without midline shift.

The patient was seen for his initial physical therapy visit when he was able to participate meaningfully at four weeks following the injury. The patient was evaluated with the Rancho Los Amigos Level of Cognitive Functioning Scale, the Moss Attention Rating Scale, and the Activity Measure for Post-Acute Care "6-Clicks" Basic Mobility Short Form. Based on the findings of these measures, observation, and required assistance levels during transfers, a plan of care was established. Goals were for the patient to improve attention, arousal, cognition, bed mobility, transfers, balance,

ambulation, and overall functional mobility. The physical therapy treatment provided emphasized task-specific functional training and the principles of neuroplasticity.

The patient's attention, arousal, cognition, bed mobility, transfers, balance, and functional mobility improved over the duration of care. The patient was transferred to the service of another physical therapist for continued rehabilitation in the acute setting.

_______________________________________, Committee Chair
Edward Barakatt, PT, PhD

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Date

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Chapter 1

General Background

Traumatic brain injury (TBI) is an injury to the brain caused by a traumatic external force resulting in a change in brain function.[1] Traumatic brain injury is a major cause of long-term disability and death worldwide, and results in significant financial burden and negative consequence on quality of life.[2] In 2013, TBI accounted for approximately 2.8 million emergency department visits, hospitalizations, and deaths in the United States.[3] The total annual (direct and indirect) financial cost of TBI in 2010 was estimated to be $76.5 billion.[4] Additionally, 40% of individuals diagnosed with a moderate or severe TBI exhibit chronic impairments and disability.[5,6]

Brain injury resulting from trauma is categorized as either a primary or secondary injury. Primary injury is caused by direct damage to the brain tissue from contact with the bony skull, a penetrating object, or shearing of axons due to acceleration and deceleration of the brain inside the skull. Secondary injury (e.g. subarachnoid hemorrhage) is the result of the pathophysiological response to the initial (primary) injury. Damage to the brain may be isolated to discrete areas, as in the case of a penetrating object or contusion from blunt force. Damage may also be distributed throughout the brain, as in diffuse axonal injury or blast injury, which can lead to widespread edema and hemorrhage.[7]

Though there is no universal system for classification or diagnosis,[8] TBI is often designated by onset, or declination, of at least one of the following clinical signs immediately after injury: loss of or altered consciousness; seizure; focal neurological deficit; skull fracture; or an intracranial lesion.[9]

Severity of TBI is most often classified utilizing the Glasgow Coma Scale (GCS). Other characteristics used to designate TBI severity include duration of loss of or altered consciousness and duration of post-traumatic amnesia.[7]

Traumatic brain injury generally occurs in people in one of three age categories: over 75 years old (2,232 per 100,000 per year), 0-4 years old (1,592 per 100,000 per year), and 15-24 years old (1,081 per 100,000 per year). Males exhibit higher rates of TBI than females, and the prevailing mechanisms of injury are falls, being struck by an object, and motor vehicle accidents (MVA).[3] The prevalence of TBI-related disability was reported to be 1.1% of the United States population in 2005.[10]

Traumatic brain injury may affect several body systems and can result in a varied collection of impairments and functional limitations depending on the injury mechanism, location in the brain, and magnitude. Consequences of a TBI may include deficits in the motor and sensory systems, issues with cognition and communication, impairment of life-critical mechanisms such as swallowing, and changes in behavior. Several factors are associated with poorer prognosis in individuals with TBI. These include: increased age, male gender, GCS score less than 8, diminished pupillary reactivity, injury resulting from a MVA, increased intracranial pressure, increased coma duration, and presence of basal skull fracture or subarachnoid hemorrhage.[11,12] Patients with subarachnoid hemorrhage have considerably worse outcomes than those without subarachnoid hemorrhage.[13]

Characteristics of the injury and individual influence the natural process of recovery and total time for recovery following a TBI. Restoration of function is proportional to injury severity and patients with more severe injury exhibit more gradual improvements.[14]

Chapter 2

Case Background Data

Examination – History

The patient was a 33-year-old male who was admitted to the intensive care unit (ICU) after being struck by a motor vehicle while riding a bicycle without a helmet. The patient experienced a loss of consciousness of unspecified duration following the accident, was noted to be obtunded and minimally responsive to pain, and had an initial GCS score of 11. The patient had several facial lacerations, hemotympanum on the left side, and a substantial amount of blood in the upper airways. The patient was emergently intubated due to acute respiratory failure.

Computed tomography (CT) revealed that the patient experienced traumatic supratentorial and infratentorial subarachnoid hemorrhages, a 14 millimeter right temporal lobe intra-axial hemorrhage, and multiple basilar skull fractures extending into the margins of the carotid arteries. The patient was also diagnosed with a closed, nondisplaced left mid-fibular fracture and dorsal dislocations of the second through fifth carpometacarpal joints of the left hand. The carpometacarpal joints were initially treated with a closed reduction and left wrist splinting and later treated with open reduction and internal fixation. The left fibula fracture was treated with use of controlled ankle motion (CAM) boot during weight bearing activities.

This patient was first evaluated by physical therapy at four weeks following the accident, while still in the ICU. The patient had been extubated and remained on weight bearing restrictions: non-weight bearing in the left hand and wrist; and weight bearing as tolerated in the left lower extremity in a CAM boot. He presented to physical therapy with severely impaired cognition and functional mobility. The patient required total assist from two people for bed mobility and maximal assist from two people when moving from sitting to standing and short distance ambulation of 6 feet without assistive device with CAM boot. The patient required a third person providing lower extremity facilitation during backward steps to return to bed. The patient was non-verbal and presented at Level IV with signs of emerging Level V on the Rancho Los Amigos Levels of Cognitive Functioning Scale (LOCF).

The patient was unable to communicate and his family was not available to provide medical or social details. Goals were formulated to improve functional mobility sufficiently to facilitate discharge to an inpatient rehabilitation setting.

Examination - Systems Review

The patient's cardiovascular/pulmonary system was impaired: resting heart rate was 108 beats per minute, respiratory rate was 18, blood pressure was 111/55 millimeters of mercury. The patient exhibited decreased endurance based on observation during bed mobility, sit to stand, and ambulation tasks. The integumentary system was impaired based on observation. The patient had several areas of ecchymosis and multiple lacerations; dressings were clean, dry, and intact. Impairments of the musculoskeletal system were evidenced by observation; the patient demonstrated decreased range of motion and strength. The neuromuscular system was impaired based on observation: the patient exhibited impaired arousal, impaired attention, impaired cognition, impaired balance, limited ambulation, and difficulty with fine and gross motor skills. The patient exhibited an impaired affect, was unable to communicate verbally, and was unable to follow commands.

Examination - Medications

Table 1 - Medications[15]

MEDICATION	DOSAGE	REASON	SIDE EFFECTS
acetaminophen, TYLENOL (analgesic)	500 mg tablet Q 6 hrs PRN	fever; mild pain	edema, difficulty breathing
acetaminophen / caffeine / butalbital, FIORICET (analgesic)	325/4050 mg tablet Q 6 hrs PRN	headache	drowsiness, lightheadedness, confusion, difficulty breathing
bacitracin-polymyxin b, POLYSPORIN (antibiotic)	500-10000 units TID applied topically	infection at abrasion sites	difficulty breathing
cefepime, MAXIPIME (antibiotic)	2 g Q 8 hrs in NS 100 mL IVPB	infection prophylaxis	headache, difficulty breathing, seizures, confusion
ceftriaxone, ROCEPHIN (antibiotic)	1 g Q 24 hrs in NS 100 mL IVPB	infection prophylaxis	pale skin, weakness, or shortness of breath when exercising
docusate sodium, COLACE (stool softener)	100 mg tablet BID	constipation	nausea, difficulty breathing, stomach pain
enoxaparin, LOVENOX (anticoagulant)	30 mg subcutaneous injection Q 12 hrs	DVT prophylaxis	fever, edema
fludrocortisone, FLORINEF (corticosteroid)	0.2 mg tablet BID	adrenocortical insufficiency	vomiting, headache, dizziness, restlessness, easy bruising
hydrocortisone, SOLUCORTEF (corticosteroid)	50 mg injection, variable frequency	corticosteroid insufficiency	headache, dizziness, emotional lability, weakness, joint pain
labetalol, NORMODYNE, TRANDATE (beta blocker)	10-20 mg injection Q 15 mins PRN (SBP greater than 155)	hypertension	dizziness, lightheadedness, malaise, headache
linezolid, ZYVOX (antibacterial)	600 mg tablet Q 12 hrs	infection prophylaxis	headache, nausea, vomiting, dizziness
ondansetron, ZOFRAN (serotonin 5-HT3 receptor antagonists)	4 mg IV Q 4 hrs PRN	nausea and vomiting	headache, constipation, weakness, malaise, chills, drowsiness
oxycodone, ROXICODONE (opiate analgesic)	5 mg tablet Q 3 hrs PRN	moderate pain	stomach pain, drowsiness, headache, mood changes
potassium chloride, KLOR-CON (electrolyte)	40 mEq with 4 oz water or juice, variable frequency	hypokalemia	confusion, listlessness, tingling sensation, weakness of legs
quetiapine, SEROQUEL (atypical antipsychotic)	50 mg tablet, variable frequency	secondary psychosis	dizziness, unsteadiness, pain, weakness, vomiting, headache, irritability
mg = milligrams; Q = every; hrs = hours; PRN = as needed; TID = three times a day; g = grams; NS = normal saline; mL = milliliters; IVPB = intravenous piggyback; BID = two times a day; DVT = deep vein thrombosis; mins = minutes; SBP = systolic blood pressure; IV = intravenous; mEq = milliequivalents; oz = ounces			

Chapter 3

Examination – Tests and Measures

The patient's deficits were categorized using the International Classifications of Functioning, Disability and Health (ICF) Model.[16] The GCS and CT were used to categorize TBI severity, to assess consciousness, and to identify potential impairments at the body structure and function level based on lesion location. The Moss Attention Rating Scale (MARS) and LOCF were used at the body structure and function level to measure attention and assess arousal and cognition. The Activity Measure for Post-Acute Care "6-Clicks" Basic Mobility Inpatient Short Form (AMPAC) was used to identify activity limitations and as a prognostic tool. Assessment of the level of assistance required for basic mobility tasks was also used to evaluate activity limitations. There was no available information regarding the patient's premorbid participation status. The patient's activity level function was used to assess level of assistance required for the patient to perform activities of daily living (ADLs).

The GCS was used to evaluate the patient's level of consciousness and TBI severity. The scale has three components: eye opening status, motor responses to speech or stimuli, and verbal responses to speech or stimuli. Eye opening is graded from 1 (no response) to 4 (spontaneous opening). Similarly, the motor and verbal response components both have a minimum score of 1; the motor response has a maximum score of 6 (obeys commands for movement) and the verbal response has a maximum score of 5 (oriented). The sum score of the components can be utilized to classify severity of the TBI. Scores of 8 or less indicate severe TBI, scores between 9 and 12 indicate moderate

TBI, and scores of 13-15 indicate mild TBI.[17] Grote et al established sensitivity and specificity values for diagnosing severe TBI for patients with multiple injuries with a GCS score of 8 or below.[18] The positive likelihood ratio (LR+) for a GCS score less than or equal to 8 was calculated to be 3.15. The negative likelihood ratio (LR-) was calculated as 0.53. Therefore, a score greater than 8 is indicative of a minimal shift in pre-test to post-test probability for diagnosis of a severe TBI.

In cases of secondary TBI progression, the initial GCS score can underestimate the injury severity.[11,18] Other factors used in determining TBI severity are duration of loss of or altered consciousness, duration of post-traumatic amnesia, and neuroimaging findings. Imaging is used in cases of moderate to severe TBI to clarify the type and location of the lesion(s), potential harmful sequelae, and necessary medical interventions. Information from the CT regarding the lesion location can be helpful in evaluating injury severity, focusing the objective exam, and anticipating potential deficits.

The MARS is an observational clinical assessment of attention for use with patients with moderate to severe TBI. Patients are rated by an observer on a 22-item scale.[19] Each item receives an ordinal score ranging from 1 or "definitely false" to 5 or "definitely true", a total MARS score can range from 22 to 110, and higher scores indicate higher levels of attentiveness.[20] Minimal detectable change (MDC) at the 95% confidence interval (MDC_{95}) was calculated to be 5.7 points.[19,20] This MDC_{95} indicates an increase of at least 5.7 points is required to demonstrate real change, and any change less than 5.7 points may be due to measurement error. Intra-rater reliability, test-retest reliability, and minimally clinically important difference (MCID) have not been established.

The LOCF is a standardized ordinal scale that describes the cognitive and behavioral capacity of a patient with a TBI. The scale includes ten stages that patients progress through as they demonstrate improved cognition, behavior, and independence. The stages range from Level I: No Response, Total Assistance to Level X: Purposeful, Appropriate, Modified Independent.[21] The LOCF provides clinicians with an overall assessment of recovery and can be used to guide treatment and discharge planning. The LOCF has been found to have good inter-rater (ρ=0.89) and test-retest (ρ=0.82) reliability[22] in patients with TBI.

The AMPAC is an activity level outcome measure that assesses basic mobility through the evaluation of six activities: turning over in bed; moving from supine to sitting on the edge of bed; sitting down on and standing up from a chair; moving to and from a bed to a chair; walking in a hospital room; and climbing three to five steps. Each item is scored on a scale of 1 (unable, total assistance required) to 4 (no difficulty, no assistance required) where the lowest raw sum score is 6, the highest is 24, and higher scores equate to higher levels of function. The MDC of the standardized score at the 90% confidence level (MDC_{90}) is 4.72 points.[23] The MCID has not been established.

The basic mobility AMPAC score can also be utilized as a prognostic tool for predicting discharge destination from acute care. A standardized cutoff score of 42.9 (as measured at the initial visit) has been shown to be useful in categorizing patients as being likely to discharge home with services or to an institution. For a patient scoring higher than the cutoff score, the positive predictive value to discharge home is 0.748. The negative predictive value for a patient to discharge to an institution is 0.801.[24] This negative predictive value indicates the probability of discharging to an institution for a patient with a score below the cutoff is 0.801.

Table 2 - Examination Data

BODY FUNCTION OR STRUCTURE		
Measurement Category	**Test Used**	**Findings**
Injury severity, assessment of localization of deficits	CT	Per chart review: Basilar skull fractures involving the sphenoid sinus, planum sphenoidale, and both mastoids and petrous pyramids. Fractures extend the margins of the carotid artery canals. Supratentorial and infratentorial subarachnoid hemorrhages. 14 mm right temporal lobe intra-axial hemorrhage. Normal size ventricles. No midline shift. Effaced basilar cisterns. Pneumocephalus.
Injury severity, consciousness	GCS	Per chart review: raw score at hospital admission: 11/15
Attention	MARS	Raw score: 40/110
Arousal, cognition	LOCF	Level IV, emerging Level V
FUNCTIONAL ACTIVITY		
Measurement Category	**Test Used**	**Findings**
Functional mobility	AMPAC	Raw score: 8/24 Standardized score: 28.58/61.14
Bed mobility	Assessment of assistance level, AMPAC item 3	Raw score: 1/4 Required total assist x2 to move supine to and from sitting on EOB
Transfers	Assessment of assistance level, AMPAC item 2	Raw score: 1/4 Required maximal assist x2 to move sitting on EOB to and from standing
Sitting balance	Assessment of assistance level	Trace+ sitting (static and dynamic) balance, poor weight shifting in sitting, required maximal assist to maintain balance though may have been capable if able to attend to task
Ambulation	Assessment of assistance level, AMPAC item 5	Raw score: 2/4 Required maximal assist x2 with stepping forward, maximal assist x3 with stepping backward
PARTICIPATION RESTRICTIONS		
Measurement Category	**Test Used**	**Findings**
Level of assistance required for ADLs	Assessment of activity level function	Patient required total assist x2 for bed mobility, maximal assist x3 for functional activities, and was unable to perform ADLs

CT = computed tomography; mm = millimeters GCS = Glasgow Coma Scale; MARS = Moss Attention Rating Scale; PT = physical therapy; LOCF = Rancho Los Amigos Levels of Cognitive Functioning Scale; AMPAC = Activity Measure for Post-Acute Care "6-Clicks" Basic Mobility Inpatient Short Form; EOB = edge of bed; ADLs = activities of daily living

Chapter 4

Evaluation

Evaluation Summary

The patient was a 33-year-old male that was treated in an ICU and first seen for physical therapy four weeks status post a moderate to severe TBI following a bicycle versus motor vehicle accident. Injuries resulted in intracranial and subarachnoid hemorrhages, multiple fractures of the skull and left extremities, and respiratory failure. The patient exhibited severely impaired cognition and motor control. The patient was difficult to arouse, inattentive, confused, inappropriate, and nonverbal, although he nodded appropriately at times and became more alert with upright activity. He presented to physical therapy with severely impaired balance, decreased activity tolerance, and required consistent cueing and maximal to total assist from two to three people with all functional motor activity. The patient required 24-hour intensive care and was unable to perform ADLs.

Diagnostic Impression

The patient presented with an evident mechanism of injury, altered consciousness, and abnormalities on CT imaging. The patient's neurological deficits resulted in impaired cognition, consciousness, attention, and motor control, and his presentation was consistent with the medical diagnosis of TBI.[8,9] The patient's impairments contributed to limitations in mobility and impaired safety awareness. His diminished safety awareness and severely limited mobility resulted in restrictions in social functioning and an inability to perform ADLs.

G-Codes

Current G-code with modifier: G8978CM. Mobility: walking and moving around; functional limitation. CM = at least 80% but less than 100% impaired, limited, or restricted. Based on the standardized AMPAC score.

Goal G-code with modifier: G8979CJ. CJ = at least 20% but less than 40% impaired, limited, or restricted. Based on the standardized AMPAC score.

Prognostic Statement

The patient's positive prognostic factors were young age, early rehab intervention, and improving medical status. Negative prognostic factors included male sex, injury severity based on initial GCS score, duration of altered consciousness, abnormal pupillary responses, effaced basal cisterns and subarachnoid hemorrhage findings on CT, musculoskeletal injuries due to a MVA, and poor social support.[11,25-30] The patient's initial basic mobility AMPAC standardized score of 28.58 was below the prognostic cut-off of 42.9 and indicated probable discharge to an inpatient facility (versus going home). The natural course of healing and therapeutic intervention were expected to improve the patient's cognition and mobility, however, the patient's rehabilitation prognosis was guarded due to his prolonged intensive care unit stay, his limited arousal, and his limited attention during the evaluation.

Discharge Plan

The patient was expected to be discharged from the ICU to acute care, and later to an inpatient rehabilitation hospital with eventual discharge to his home if assistance was available.

Chapter 5

Plan of Care – Goals and Interventions

Table 3 - Plan of Care – Goals and Interventions

PROBLEM	PLAN OF CARE		
	Short Term Goals (Anticipated Goals) (2 days)	**Long Term Goals (Expected Outcomes) (10 days)**	**Planned Interventions Direct or Procedural unless marked: (C) = Coordination of care (E) = Educational**
BODY FUNCTION OR STRUCTURE IMPAIRMENTS			
Impaired attention	Patient will increase MARS score from 40/110 to ≥ 46/110	Patient will increase MARS score to ≥ 52/110 MDC_{95} = 5.7 points	Verbal and tactile cueing to support attention to tasks throughout duration of treatment Goal-directed tasks that encouraged attentiveness throughout duration of treatment
Impaired arousal, cognition	Patient will progress from LOCF Level IV to Level V	Patient will progress to LOCF Level VI	(C) Communicated with patient's care providers regarding appropriate environment during rest and rehabilitation (C) Coordinated timing of physical therapy interventions with nursing and other providers to ensure appropriate medication level and sufficient energy for patient engagement in treatment Postural facilitation to encourage attentiveness to stimulation throughout duration of treatment Encouraged initiation of tasks using simple one-step commands and progressed complexity as appropriate throughout duration of treatment Progressed task difficulty and environmental complexity as cognition improved throughout duration of treatment Introduced dual-task training at third treatment session as patient demonstrated ability to perform motor and cognitive tasks simultaneously

ACTIVITY LIMITATIONS			
Impaired functional mobility	Patient will increase functional mobility with an improved AMPAC raw score from 8/24 to ≥ 13/24, standardized score from 28.58/61.14 to ≥ 36.74/61.14	Patient will increase functional mobility with an improved AMPAC raw score of ≥ 18/24, standardized score of ≥ 43.63/61.14 standardized score MDC_{90} = 4.72	See specific interventions for bed mobility, transfers, balance, and ambulation Progressed task difficulty and environmental complexity as patient demonstrated mastery of tasks throughout duration of treatment
Impaired bed mobility	Patient will be able to move supine to and from sitting on EOB with maximal assist of one (Patient will increase AMPAC item 3 score from 1/4 to ≥ 2/4)	Patient will be able to initiate movement and move supine to and from sitting on EOB with CGA and use of bed features (Patient will increase AMPAC item 3 score to ≥ 3/4)	Facilitated use of adaptive hospital bed until patient demonstrated ability to perform task without bed features Verbal and tactile cueing, sequencing, and postural support as needed to facilitate repetitive practice of bed mobility tasks
Impaired transfers	Patient will be able to move sitting to and from standing with maximal assist of one (Patient will increase AMPAC item 2 score from 1/4 to ≥ 2/4)	Patient will be able to initiate movement and move sitting to and from standing with CGA (Patient will increase AMPAC item 2 score to ≥ 3/4)	Facilitated use of adaptive equipment and used verbal and tactile cueing, sequencing, and postural support as needed to facilitate repetitive practice of transfers
Impaired balance	Patient will be able to sit on EOB with moderate assist	Patient will be able to sit on EOB with CGA	Facilitated use of adaptive hospital bed in sitting on EOB until patient demonstrated ability to maintain sitting balance without bed features Verbal and tactile cueing and postural support as needed to encourage patient to maintain sitting and standing balance

Impaired ambulation	Patient will increase ambulation from 6 feet to ≥ 25 feet with CAM boot and platform walker with maximal assist of one (Patient will increase AMPAC item 5 score from 2/4 to ≥ 3/4)	Patient will be able to ambulate 50 feet with CAM boot and platform walker with CGA (Patient will increase AMPAC item 5 score to 4/4)	Over ground gait training with CAM boot and platform walker; increased distance, repetitions, and total time ambulating, decreased assistance level according to patient's attention to task and fatigue Verbal and tactile cueing, sequencing, and postural support as needed to maintain attention to task and safety to facilitate repetitive practice of ambulation
PARTICIPATION RESTRICTIONS			
Unable to perform ADLs without assistance	Patient will decrease level of assistance required from total assist x2 to maximal assist of one or less for out of bed activity	Patient will decrease level of assistance required to moderate assist x1 or less for out of bed activity	Participation goals addressed through improvement of body structure and function impairments and activity limitations (C) Consulted with nursing regarding discharge destination and social work coordination
MARS = Moss Attention Rating Scale; LOCF = Rancho Los Amigos Level of Cognitive Functioning; AMPAC = Activity Measure for Post-Acute Care "6-Clicks" Basic Mobility Inpatient Short Form; MDC = minimal detectable change; EOB = edge of bed; CGA = contact guard assist; CAM = controlled ankle motion			

Overall Approach

The guiding treatment philosophy utilized during this course of physical therapy was a restorative, task-oriented approach. In this approach to rehabilitation, the focus was on improvement of functional capacity through activity-based and repetitive task-specific interventions.[7] Difficulty of tasks, duration, and complexity of the environment were increased as simple tasks were mastered. Clear, immediate feedback was provided following tasks.

The principle of specificity was used to narrow the focus of the task-oriented approach. Initial interventions emphasized activities such as getting out of bed, standing, and ambulating that would enable the patient to improve his functional mobility and participate meaningfully in further inpatient rehabilitation. As the patient progressed, dual-task training was explored to facilitate improved cognitive and motor performance and recovery of basic task automaticity.

The patient received three physical therapy sessions over a one-week period with each session lasting approximately 40 minutes. The patient was then moved from the ICU to an acute neurological care unit, and physical therapy was transferred to another physical therapist.

PICO question

For a young man with cognitive and motor deficits resulting from moderate to severe TBI (P), is dual-task training (I) more beneficial than a conventional task-oriented approach (C) in the acute care setting for improving functional mobility (O)?

There is limited data for physical therapy interventions appropriate to the acute stage in the TBI population.[31] Thus, the three articles that were appraised for this PICO question included evidence for treatment of post-acute TBI and other neurological injuries.

Hellweg et al. performed a Cochrane Review (level of evidence: 1a) that evaluated efficacy of physical therapy intervention in post-acute inpatient rehabilitation following a TBI. The review examined fourteen studies and several intervention sub-groups, one of which was functional skill training. The review established strong evidence that task-oriented rehabilitation is an effective therapy for improving functional ability. The review did not address dual-task training, but did establish that partial body-weight support is not superior to conventional gait training for patients with TBI, and that aerobic training results in improved cardiovascular fitness and general health but that these improvements do not transfer to function. While the patient in this case study would have been excluded from the study because he was in the ICU, he met other inclusion criteria: his vital parameters and intracranial pressures were stable and his primary neurosurgical care had concluded. The results of this review supported the inclusion of task-oriented training for this patient.[32]

Vanderploeg et al. carried out a randomized controlled trial (level of evidence: 1b) that compared the relative effectiveness of cognitive didactic and functional-experiential rehabilitation in acute inpatient rehabilitation.[33] Participants were active duty military or veterans that had sustained moderate to severe nonpenetrating TBI injuries in the previous six months. They received 1.5 to 2.5 hours of protocol-specific therapy in addition to standard occupational and physical therapy. The cognitive approach emphasized explicit learning and awareness of errors; the functional approach emphasized implicit learning through errorless motor performance. Both resulted in similar functional outcome, but participants in the cognitive treatment group displayed improved cognitive performance. Limited communication of the patient in this case study precluded the initial use of cognitive didactic treatment, but elements of the functional-experiential treatment were integrated into the patient's plan of care.

Fritz et al. completed a case study (level of evidence: 5) that considered the value of incorporating dual-task training for a 26-year-old woman that sustained a severe TBI due to a MVA.[34] She presented to physical therapy 46 days following the accident at LOCF IV with impairments in attention, functional mobility, and balance. The patient was determined to be appropriate for dual-task training when she was able to perform motor tasks while answering questions. The study demonstrated clinically meaningful improvements in functional mobility with standard physical therapy plus motor and cognitive-motor dual-task interventions. Although case studies provide low-level evidence, and there was no way to verify the patient would have responded more favorably to dual-task training as compared to standard treatment, the similarities between the study patient and clinical patient warranted consideration of this case study. Dual-task training was introduced to the clinical patient as he was able to participate.

Chapter 6

Outcomes

Table 4 - Outcomes

OUTCOMES				
BODY FUNCTION OR STRUCTURE IMPAIRMENTS				
Outcome Measure	**Initial**	**Follow-up**	**Change**	**Goal Met? (Y/N)**
MARS (raw score)	40/110	48/110	+ 8 points MDC_{95} = 5.7	N*
*The patient surpassed the MDC at discharge but did not meet goals within the specified time frames.				
LOCF	IV, emerging V	VI	+ 2 levels	Y
ACTIVITY LIMITATIONS				
Outcome Measure	**Initial**	**Follow-up**	**Change**	**Goal Met? (Y/N)**
AMPAC	Raw score: 8/24 Standardized score: 28.58/61.14	Raw score: 13/24 Standardized score: 36.74/61.14	+ 5 points + 8.16 points MDC_{90} = 4.72	N*
*The patient surpassed the MDC at discharge but did not meet goals within the specified time frames.				
AMPAC item 3 (raw score)	1/4; required total assist x2 to move supine to and from sitting on EOB	3/4; required minimal assist to move supine to and from sitting on EOB	+ 2 points	Y
AMPAC item 2 (raw score)	1/4; required maximal assist x2 to move sitting on EOB to and from standing	3/4; required minimal assist to move sitting on EOB to and from standing	+ 2 points	Y
Assistance level of sitting balance	Trace+ sitting (static and dynamic) balance, poor weight shifting in sitting, required maximal assist to maintain balance though may have been capable if able to attend to task	Fair static sitting balance, fair- dynamic sitting balance, fair wait shifting in sitting, patient maintained upright sitting posture on EOB for 2 minutes	Static sitting improved from trace+ to fair; assist level for static sitting improved from maximal to SBA	Y
AMPAC item 5 (raw score)	2/4; required maximal assist x2 with stepping forward, maximal assist x3 with stepping backward	2/4; required moderate physical assist for ambulation, maximal assist for safety due to impaired balance and attention	0 points	N

PARTICIPATION RESTRICTIONS				
Outcome Measure	**Initial**	**Follow-up**	**Change**	**Goal Met? (Y/N)**
Level of assistance required for ADLs, assessment of activity level function	Patient required total assist x2 for bed mobility, maximal assist x3 for functional activities	Patient required minimal assist x1 for bed mobility, maximal assist x1 for functional activities	Bed mobility: total x2 to minimal x1 Functional activities: maximal x3 to maximal x1	N
MARS=Moss Attention Rating Scale; LOCF=Rancho Los Amigos Level of Cognitive Functioning; AMPAC=Activity Measure for Post-Acute Care "6-Clicks" Basic Mobility Inpatient Short Form; MDC = minimal detectable change SBA = stand-by assist				

Discharge Statement

The patient received three sessions of acute inpatient physical therapy for treatment over a seven-day period for deficits from a moderate to severe TBI. Upon initial evaluation, the patient exhibited impaired arousal, attention, and cognition, limited functional mobility, and decreased independence. Physical therapy interventions focused on activity-based task-specific training. Over the course of treatment, the patient displayed improvements in all capacities. The patient's improved attention was apparent through his improved communication and ability to attend to functional tasks; the patient was visibly more alert and engaged in therapy. His improvement as measured by the MARS surpassed the MDC which indicated a true change occurred. His arousal and cognition improved and he progressed from LOCF IV to VI. This change indicated that the patient was progressing to a functional level appropriate for discharge to an inpatient rehabilitation facility. The patient's functional mobility improved as measured by a change of 8.16 points on the standardized score of the AMPAC. Although the patient did not reach the established goals for every functional mobility domain, he met goals for bed mobility, transfers, and balance, and demonstrated measurable change in overall functional mobility. At the end of this course of treatment, the patient was discharged from the ICU to the acute neurological unit, required decreased assistance for functional activities, and appeared motivated to continue working toward functional independence.

G-Codes

Discharge G-Code with modifier: G8980CL. CL = at least 60% but less than 80% impaired, limited, or restricted. Based on the standardized AMPAC score.

Chapter 7

Discussion

There were several components to this patient's case that complicated his rehabilitation progress. In addition to his brain injury, the patient had several traumatic orthopedic injuries and was required to maintain weight bearing restrictions and wear a left wrist splint and CAM boot. The combination of cognitive impairments and specialized orthotics and adaptive equipment made it especially challenging to work on bed mobility and functional ambulation. Additionally, at the time of care, the patient did not have any apparent social support. This resulted in significant gaps in the patient's social and medical history, and was an indication that discharge planning might be challenging.

The severity of the patient's impairments and fragile medical condition at the time of initial examination limited the extent of the assessment. Incorporating outcome measures proved to be a difficult task: there were very few outcome measures actively used in the facility, and of the limited outcome measures that are suitable for patients in an intensive care setting, many of them have poor or no psychometrics.[35] I utilized measures that were appropriate to my patient's abilities and helped identify markers of progress and potential discharge disposition.

There is also limited research evidence for effective physical therapy interventions during rehabilitation of patients with moderate to severe TBI. This made it difficult to formulate an evidence based plan of care for the patient. I chose to apply task-oriented training and the principles of neuroplasticity because these approaches have been demonstrated to be useful in patients with neurological injuries and seemed most likely to help progress the patient to be eligible for inpatient rehabilitation.

The patient responded appropriately to the provided care and showed signs of accelerated progress toward the end of the course of treatment. The progression of his function could have been attributed to the patient's natural recovery and facilitation of rehabilitation from his health care team. Although the patient did not meet all of the set physical therapy goals, the patient's arousal, attention, cognition, and functional mobility were expected to continue to improve with further task-oriented training and utilization of the neuroplasticity principles during care.

To apply this treatment approach to similar patients in the future, I will consider the heterogeneity of the presentation of the condition and consider each individual's impairments, limitations, prior lifestyle, environment, available social support, and pathoanatomical progression. The literature has established the importance of early rehabilitation intervention and a multi-disciplinary approach, so I will make every effort to include those elements for the care of future patients. I will not hesitate to utilize task-specific training and the principles of neuroplasticity for future patients with TBI.

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