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Functional Mobility For A Patient With Myelodysplastic Syndrome, Chronic GVHD, And Corticosteroid Use: A Case Report

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The patient signed an informed consent form allowing the use of medical information for this case report. The patient was educated on the Health Insurance Portability and Accountability Act (HIPPA) and received formal paperwork outlining the definition of HIPPA and appropriate disclosure of personal health information.

Key Words: Myelodysplastic Syndrome, GVHD, Physical Therapy, Corticosteroids

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ABSTRACT

Background: The use of corticosteroids to treat chronic graft-versus-host-disease (cGVHD) is common in oncological treatment. However, the long-term complications of cGVHD and prolonged use of corticosteroids have not been reported in terms of the benefits of physical therapy (PT) interventions. The purpose of this case report was to report the impact of PT interventions for an individual with a cancer diagnosis having received an allogenic-stem cell transplant (allo-SCT) with the long-term complications associated with cGVHD, long-term corticosteroid use, and cancer survivorship.

Case Description: The patient was a 73-year-old male diagnosed with Myelodysplastic Syndrome and received an allo-SCT two years prior to initial evaluation. After a multitude of tests, his primary diagnosis was *paraplegia with unclear etiology*. The patient had weakness in his bilateral lower extremity's proximal musculature (right lower extremity greater impaired than left) and loss of bowel/bladder function. The proposed plan of care included therapeutic exercise, neuromuscular re-education, self-care/home management, and gait training.

Outcomes: After receiving both corticosteroid and PT interventions, the patient increased strength and mobility as shown by his improvement with transfers (Functional Independence Measure score from 4 to 6), gait (distance from 2 feet to 850 feet), and ability to complete balance and strength exercises consecutively and independently. He was discharged with the ability to walk with an assistive device and navigate his home and community environments safely.

Discussion: Despite the lack of evidence for therapeutic interventions in patients with chronic corticosteroid use, cGVHD, and allo-SCT patients, this specific example shows the progress and accomplishments one can make with PT to optimize functional independence. Future research requires a greater focus on long-term complications and management of allo-SCTs including

rehabilitation.

INTRODUCTION/BACKGROUND and PURPOSE

Myelodysplastic Syndromes (MDS) are a type of cancer in which blood-producing cells in the bone marrow function abnormally, causing normal blood cells to die earlier.[1] The most prevalent type of MDS, MDS with multilineage dysplasia, causes two of the three blood cell types (white blood cells, red blood cells, or platelets) to be low; however, there are several types of MDS.[1] Approximately one in three individuals with MDS will develop Acute Myeloid Leukemia (AML), which is why MDS is often called *pre-leukemia*.[1] It has been estimated that approximately 10,000 cases of MDS are diagnosed each year in the United States.[2] The treatment for MDS can include chemotherapy, supportive therapy, a stem cell transplant (SCT), and/or clinical trials.[3]

A SCT can serve as the only potential curative treatment for individuals with MDS.[3] Types of SCTs include *allogenic* and *autologous*. See Table 1 for SCT information. An allogenic stem cell transplant (allo-SCT) involves collecting a matched donor's stem cells and introducing them to the patient to produce a *graft-versus-tumor-effect*, in which the donor's immune system combats the patient's cancer.[4] However, patients receiving an allo-SCT are at risk for complications both during the acute stages, and long after, their SCT.[5]

Long-term complications after an allo-SCT span all body systems and are commonly due to *graft-versus-host-disease* (GVHD).[5] GVHD causes the donor's cells to attack both the malignancy and the patient's healthy cells.[4] There is both acute and chronic GVHD.[5,6] A systematic review found that chronic GVHD (cGVHD) developed in approximately 70% of patients following an allo-SCT.[5]

Once acquired, the treatment for acute and chronic GVHD is often steroids such as glucocorticoids (GC), which can have a detrimental effect on muscle strength, immune function,

weight, and mood.[5] Recent research indicates that greater than 90% of patients who underwent an allo-SCT have at least one chronic health impairment.[5] Ultimately, due to the risk for musculoskeletal and neurological impairments from the SCT process, there is a necessity for skilled rehabilitation intervention.

A retrospective study included patients receiving GC for GVHD and reported on their adherence to a rehabilitation program in a sub-acute rehabilitation setting.[6] Of those who completed their full plan of care (POC) (56%), there were improvements in the functional measures; however, the improvements were not statistically significant and some even declined in function.[6] Ultimately, the findings report SCT patients, especially those receiving GC treatment, are likely to participate in exercise interventions granted that their condition did not worsen.[6] Overall, these programs are necessary for patients post allo-SCT also taking GC due to the potential negative side effects on muscle strength such as the patient described in this case report. However, current research revolves primarily around the acute and sub-acute stages of patients post allo-SCT and does not consider long-term treatment needs.

Furthermore, Morishita et al[7] conducted a study including patients post allo-SCT who were prescribed corticosteroids. Results indicated that increased corticosteroid dose was associated with decreased grip and knee extensor strength.[7] This study also considered the impact of physical therapy (PT) frequency on the above measures. Low physical function was correlated to high corticosteroid dose, low frequency of PT, and increased fatigue.[7] Current research has not considered the effect of increased frequency of PT in patients with chronic GC usage, cGVHD, and additional comorbidities associated with a cancer diagnosis such as low blood counts and fatigue.

This case report is necessary due to the lack of published literature regarding the PT management for individuals with cGVHD and the long-term effects of allo-SCTs. Specifically,

there is a lack of literature discussing how PT impacts patients with steroid myopathy caused by high dose steroid therapy for treatment of GVHD. Lee et al[8] studied patients with MDS/AML who had an allo-SCT and were diagnosed with acute GVHD. Of 70 patients identified, 29 (41%) had steroid myopathy.[8] However, no literature reported on the effects of PT intervention for patients with cGVHD who continue to take GC for maintenance. Additionally, no current literature has identified a successful therapeutic approach for the treatment of patients with functional and strength deficits due to allo-SCTs. Therefore, the purpose of this case report is to describe PT interventions for an individual with a cancer diagnosis who received an allo-SCT and subsequently had long-term complications associated with cGVHD, long-term GC use, and cancer survivorship.

Patient History and Systems Review

The following patient consented to participate in this case study. A 73-year-old male was diagnosed with MDS six years before his IE. Prior to an allo-SCT, he had multiple rounds of Decitabine, a form of chemotherapy specific to treatment of MDS. He underwent an allo-SCT two years prior to IE and was diagnosed with GVHD of the skin shortly after. His skin GVHD responded well to steroids, specifically Prednisone; however, once he started tapering the steroids, the rash reoccurred. Therefore, he was on Prednisone for an extended period of time, ending one year prior to IE. After discontinuing Prednisone, he was readmitted to the hospital with Respiratory Syncytial Virus. He was tested for GVHD of the gastrointestinal tract and the results revealed grade 1 GVHD of the duodenum, antrum, and right and left colon. Therefore, he was given high dose steroids to alleviate his GVHD and Sirolimus as an immunosuppressant.

His past medical history included: diverticulitis; subclinical hypothyroidism; anemia; immunodeficiency disorder; electrolyte and fluid disorders; drug/chemical induced diabetes

mellitus with hyperglycemia; deep vein thromboses; and long-term use of insulin and systemic steroids. His pertinent familial history included a brother with MDS and a sister with lung cancer. See Appendix 1 for his medication list.

The patient was admitted to an acute care cancer center (ACCC) days before his IE with reported progressive weakness in his bilateral lower extremities (BLE) for the previous six weeks. He was on vacation when he first noticed his symptoms, and subsequently required a rolling walker (RW) for ambulation. At that point, he sought care and received steroid treatment which alleviated his symptoms allowing him to ambulate with a cane. After he returned from vacation, he continued to lose strength and sensation of his BLE causing him to resort back to using a RW for household ambulation. Ultimately, he went to the emergency center (EC) after losing function of his BLE and bladder/bowel control. His initial diagnosis was paraplegia with loss of bladder/bowel function and Brown Sequard Syndrome. However, after multiple tests, Brown Sequard Syndrome was ruled out as well as viral meningitis, influenza, E. coli, Listeria, Neisseria, Streptococcal pharyngitis, Cytomegalovirus, Epstein-Barr virus, and cryptococcal antigen. A magnetic resonance imaging (MRI) of the spine showed no cord compression however, it showed moderate to severe stenosis at the C5-6 level and mild degenerative joint disease. A computed tomography (CT) scan of the head was negative. The patient had multiple lumbar punctures, all of which were negative. An electromyography revealed moderate generalized axonal sensorimotor polyneuropathy with chronic changes and chronic myopathy. However, this was not the root cause of his progressive functional decline, and his primary diagnosis remained *paraplegia with unclear etiology*. The patient was frustrated with the uncertainty of the cause of his weakness; however, he maintained a positive attitude and was motivated to improve his strength and ambulation abilities in order to return to his prior level of function (PLOF). See Appendix 2 for systems review results.

Prior to his admission, he was a retired chemical engineer who enjoyed spending time with his family and tending to his yard. He had a strong support system including his wife and children which were positive factors in his recovery. He lived in a two-story home with his bedroom/bathroom on the main level and no stairs to enter. He had a walk-in-shower and shower chair. He also noted he owned a RW and cane.

Examination – Tests and Measures

Upon IE, the patient's BLE strength was evaluated using manual muscle testing (MMT) in a seated position. See Table 2 for MMT scores. Light touch sensation was assessed and was within normal limits (WNL), however, the patient noted chemotherapy induced peripheral neuropathy (CIPN) in his bilateral feet. The patient reported painful paresthesias over his right rib cage and BLE induced by quick movements or pressure over the areas; he rated this pain as an 8/10 on the Numeric Pain Rating Scale (NPRS).

The Activity Measure for Post-Acute Care (AM-PAC), a 6-click short-form assessment, was developed by physical and occupational therapists at the Cleveland Clinic Health System based on the initial assessment created by researchers at Boston University.[11] The scoring of the AM-PAC is a scale from 1 (patient required total assistance for the task) to 4 (patient required no assistance). The patient scored an 18/24 on the AM-PAC at the IE. See Appendix 3 for test descriptions and psychometric properties.

The Functional Independence Measure (FIM) was utilized to measure the amount of independence and/or assistance required for specific tasks. See Appendix 4 for scoring. His initial FIM scores were as follows: bed mobility 5 (stand-by assistance), transfers 4 (contact guard assist (CGA)), gait 2 (total assistance), and stairs 0 (unable to assess/perform).

Despite the lack of information regarding validity and reliability for oncologic populations specifically, the FIM and the AM-PAC were utilized with every patient at this

ACCC for a comprehensive understanding of patient mobility and assistance/independence. Ultimately, due to the patient's functional ability and increased fatigue at the time of the IE, there was a lack of functional outcome measures performed. See Table 3 for results of test and measures.

Clinical Impression: Evaluation, Diagnosis, Prognosis

After reviewing the patient's chart, he was previously independent and experienced severe decline in function and progressive weakness including bowel/bladder incontinence due to an unknown etiology. However, at his IE, he presented with greater functional ability than expected for his age, diagnosis, and initial chart review. Despite the notable weakness in his BLE, specifically the right lower extremity, his ability to activate his BLE muscles and the necessity for functional training in daily activities prompted continuation of care and appropriateness for PT intervention.

The proposed POC included: therapeutic exercise to improve strength deficits; neuromuscular re-education to improve balance; self-care/home management to ensure safe and efficient navigation of his home and environment; gait training to allow for functional mobility; and therapeutic activities to target common activities this patient participated in prior to admission to the ACCC. The patient's medical diagnosis, although truly unknown, was deemed as paraplegia with neurogenic bladder. His medical diagnosis was consistently changed due to the plethora of tests the patient underwent in the attempt to determine the root of his progressive impairments. The patient's PT diagnoses were generalized weakness, gait abnormalities, and fatigue. See Appendix 5 for ICD-10 codes.

The prognosis for this patient was initially unclear due to the unknown etiology, his

primary diagnosis of MDS, and the known complications of allo-SCTs. However, the patient's ability at IE compared to his EC evaluation already showed promise towards recovery with medication and additional assistance from PT. Morishita et al[7] determined the use of high dose corticosteroids was related to decreased strength which was more pronounced in those patients who did not receive PT services or received them at a lower frequency. Due to the research stated above, clinical judgment from the patient's IE, and the patient's PLOF his PT prognosis had positive influences. However, due to the uncertainty of the root causation of his progressive weakness, there were also barriers to understanding his potential from a PT standpoint.

Upon IE a consult with occupational therapy (OT) and physiatry were requested. A multitude of tests were conducted to determine the root cause of his progressive weakness and included: blood screens, lumbar punctures, bronchoscopies, MRIs and CT scans. Re-evaluations at the ACCC were performed at the tenth visit which included strength and sensation testing, gait distance, and any additional measures deemed necessary.

The POC included targeting his functional decline through improvement in his strength, balance, endurance, and gait efficiency. Due to the patient's weakness and quick fatigability, interventions had to be planned appropriately to ensure the best outcomes and ability of the patient. For example, PT sessions were scheduled for the morning and ambulation was done first to ensure the patient was at his full capacity to participate. The PT goals for the patient were written at IE and were to be completed within four weeks and reassessed with each treatment session. At the ACCC, the goals were all short-term goals (STG) with the long-term goal of discharge home at the patient's PLOF. See Appendix 6 for STG.

Intervention and Plan of Care

The patient's POC and progress were coordinated with and communicated to the OT,

nurses, and physiatry doctors. Each treatment session was documented through an electronic medical record database. The patient was educated and cued using his preferred learning style of demonstration, verbal and tactile cueing.

At IE, the patient was educated on the importance of out of bed (OOB) activities and was recommended to be OOB for 6-8 hours daily to improve cardiopulmonary function. He was instructed to complete his home exercise program (HEP) to improve his BLE strength and ambulation three times daily to improve his mobility. His wife was present for all treatment sessions and agreed with the POC. The interventions were based on impairments noted during his IE including strength deficits, balance impairments, gait abnormalities, and overall decreased functional independence.

After the patient's IE, the patient was scheduled for PT five times weekly with additional weekend PT if requested. During every session, the patient completed seated and/or standing exercises to improve BLE muscular strength, endurance, balance, and mobility. See Table 4 for descriptions of seated and standing exercises. Initially, the patient did not have the strength to complete all of the seated exercises independently and required active assisted range of motion (AAROM). When the patient completed ten repetitions of his seated and standing exercises without rest breaks, his exercises were progressed by increasing repetitions or focusing on functional activities.

Lee et al[8] noted that use of high dose steroid therapy, such as in this patient's case, led to steroid myopathy which affects proximal lower muscles greater, with the quadriceps muscle affected the most. This patient showed this trend with proximal weakness and specifically he showed quadricep weakness during gait with episodes of knee buckling (KB). Therefore, the PT focused on strengthening proximal musculature while maintaining strength in distal musculature. At each session, transfers and gait training were assessed using FIM scores and distance of

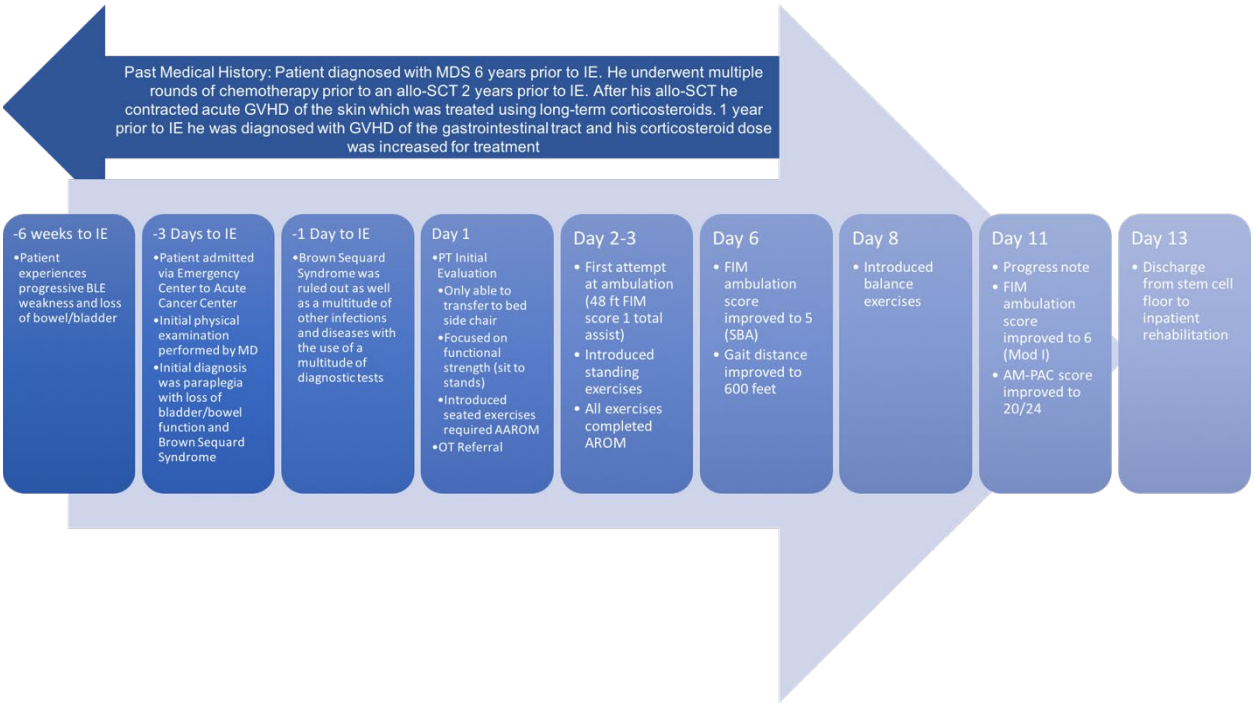
ambulation. See Table 5 for FIM scores and ambulation distances. Gait training over even surfaces with non-skid socks was utilized to help improve functional mobility and BLE strengthening. Initially the patient required the use of a RW (Drive Medical, Port Washington, NY) and CGA from the PT. He initially showed increased episodes of BLE KB, approximately seven episodes, with turning, longer ambulation distances, and increased fatigue. Therefore, the patient ambulated first during a treatment session to maximize available strength. As he progressed, his KB decreased by approximately 75% and the patient recovered from KB episodes independently. By treatment five he ambulated after he completed his exercises, which showed an improvement in endurance. Based on clinical judgement, the patient required more assistance from the PT without a RW. Therefore, it was determined he would benefit from using a RW to be more independent. The distance of ambulation per day was determined via patient tolerance and frequency of KB as a sign of fatigue. His endurance was also assessed through the number of patient requested rest breaks during ambulation. The patient's anemia was also considered as a factor leading to fatigue, as anemia has shown an association with decreased 6MWT distances.[7]

Balance was also targeted because allo-SCT patients have demonstrated decreased dynamic and static balance and strength after SCT.[14] Therefore, both strength and balance were interventions to ensure his safety with functional mobility. Balance interventions included narrow base of support stance, tandem stance, and single leg stance. The patient was instructed to hold the positions for as long as possible or a maximum of 30 seconds. Initially, the patient was allowed to use his RW for support with his upper extremities. Once he was able to maintain a position for 30 seconds, the intervention progressed to no support then further progressed to maintain a position with eyes closed. See Table 6 for balance exercises.

At each treatment session, the patient's goals, FIM scores, and AM-PAC scores were

assessed and documented. Therefore, the PT understood the patient's short-term progress and determined if the patient was compliant with his HEP.

TIMELINE



OUTCOMES

At IE, the patient had decreased strength, FIM scores, AM-PAC scores, and ambulation distance. At the final visit in acute care, the patient had improved in all categories. He was transferred to the inpatient rehabilitation floor within the hospital where he showed further improvements prior to his discharge home. See Tables 2 and 3 for final examination scores. Although difficult to assess, through the measurement of breaks required, total distance ambulated, and instances of KB, the patient made marked gains at final discharge from the acute floor.

Despite making vast improvements in functioning, his diagnosis still remained *paraplegia with unclear etiology*. He continued to have tests done including daily blood counts, bronchoscopies, MRI scans, and x-rays as symptoms required.

The patient's adherence and tolerability to each session were determined through ability to perform familiar and new exercises, ambulation distance, and pain and fatigue levels. His blood counts often correlated with his fatigue levels and ambulation distance. See Appendix 7 for lab values. His wife stayed at the hospital every night and was adamant about him performing his exercises and staying OOB. The patient had a strong motivation to participate in PT as his goal was to return home with the same PLOF.

The only unanticipated event was the patient contracted pneumonia and clostridium difficile while in the hospital. He subsequently required contact isolation, but the infections were successfully treated prior to discharge.

DISCUSSION

This case report described the PT interventions for an individual who underwent an allo-SCT and consequently had a multitude of long-term complications. His complications caused progressive weakness, sensory impairments, and decreased functional mobility. PT services were

provided to address these impairments with the patient's goal of being discharged home at the same PLOF. Specifically, this patient wanted to walk again without an assistive device.

The long-term systemic complications due to GVHD after an allo-SCT were evident with this patient. Similar to the results by Morris et al,[6] this patient was adherent with PT interventions except for when his condition worsened (during low hemoglobin levels and other contracted illnesses). Also, consistent with the research, he consequently had proximal weakness due to long-term corticosteroid use. His weakness was a barrier to ambulation and performing activities of daily living (ADLs) independently.

Strengths of the approach to this case were the clinician's knowledge of allo-SCTs, cGVHD, and MDS, the support of other health care clinicians, and the determination of the patient. Additionally, having inpatient rehabilitation within the hospital allowed this patient to transfer internally and receive the care he required. Limitations of this case report include lack of outcome measures utilized and unclear etiology of the patient's diagnosis.

The outcomes revealed improvements in ambulation distance with decreased KB, independence with ADLs such as transfers, and improved strength. The primary take away lessons from this case report is the benefit of PT for individuals with cancer who undergo allo-SCTs and acquire GVHD. Also, it is important to understand lab values, patients' fatigue, and pain levels to determine activity tolerance. Potential implications for clinical practice stemming from this case report include a focus for clinicians on strength and ADL function in oncology rehabilitation, as well as the importance of additional research on long-term complications from allo-SCTs and GVHD.

With the increase in prevalence of allo-SCTs, it is estimated approximately 500,000 long term survivors of allo-SCTs by 2020.[15] Many research articles depict the long-term complications of allo-SCTs which can cause severe impairments and even mortality.[15] Due to

these complications, patients require a team of health professionals and greater surveillance to manage the long-term effects of allo-SCTs. Additionally, any individual receiving an allo-SCT is estimated to have at least a 30% lower life expectancy than the general population.[16] Further research is required in areas of prevention and management of long-term complications of allo-SCTs to optimize treatment. Currently, research on the effects of exercise on GVHD being performed in animal models and has proven mice with cGVHD had less deterioration of physical capacity with increased physical activity.[17] Research needs to continue on allo-SCTs in humans due to the increased prevalence and common complications that result in decreased function and mortality.

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TABLES and FIGURES (Max of six total)

Table 1: Stem Cell Transplant Information

Type of Stem Cell Transplant	Mechanism of Treatment	Common Complications
Autologous	-Patient undergoes chemotherapy to destroy cancerous cells and decrease the production of blood cells[4] -Patient's own stem cells are reintroduced[4] -Stem cells differentiate into new healthy blood cells[4]	-Anemia and thrombocytopenia[4] -Deconditioning[4] -Chemotherapy induced peripheral neuropathy (CIPN)[5] -Cancer related fatigue[4] -Decreased immune function[4]

Allogenic	-Matched donors stem cells are collected[4] -Patient undergoes chemotherapy to destroy cancerous cells[4] -Patient takes immunosuppressants to weaken immune system and attempt to prevent graft-versus-host-disease (GVHD)[4] -Patient also takes prophylactic antimicrobial agents to decrease the risk of infection from the immunosuppressants[4] -Stem cells differentiate into new healthy cells[4]	-Anemia and thrombocytopenia[4] -Deconditioning (muscle weakness and loss of muscle mass)[5] -Steroid myopathy (proximal muscle weakness) due to glucocorticoid treatment for GVHD[5] -CIPN[5] -Cancer related fatigue[4] -GVHD and associated side effects due to both the disease and treatment for GVHD[4] -Decreased immune function -Increased risk for long term complications such as: osteopenia/osteoporosis, osteonecrosis, fasciitis, polymyositis, polyneuropathy, fatigue[5]

402

Table 2: Manual Muscle Testing for Bilateral Lower Extremities

	IE Acute		Progress Note Acute		Inpatient Rehab IE		Inpatient Rehab Discharge	
Muscle Action	**RLE**	**LLE**	**RLE**	**LLE**	**RLE**	**LLE**	**RLE**	**LLE**
Hip Flexion	3-/5	3+/5	3+/5	4/5	4-/5	4/5	4-/5	4/5
Hip Abduction	2/5	4/5	4-/5	4/5	3-/5	3-/5		
Hip adduction	2/5	4/5	4-/5	4+/5	4-/5	4+/5		
Knee flexion	3+/5	4/5	4-/5	4+/5	4/5	4+/5		
Knee extension	3-/5	4/5	4-/5	4+/5	4/5	4+/5	4/5	4+/5
Ankle dorsiflexion	4/5	5/5	4/5	5/5	4+/5	5/5	4+/5	5/5
Ankle plantarflexion	4/5	5/5	4/5	5/5	4+/5	5/5	4+/5	5/5

IE = initial evaluation, RLE = Right lower extremity, LLE = left lower extremity
2/5 = part moves through complete ROM with gravity decreased, 3-/5 = part moves through incomplete (>50%) against gravity, 3+/5 = part moves through compete ROM gravity/slight resistance, 4/5 = part moves through complete ROM against gravity/moderate resistance, 5/5 = part moves through complete ROM against gravity/full resistance

403

404

Table 3: Tests & Measures	
Tests & Measures	**Initial Evaluation Results**
Light Touch Sensation	WNL
Manual Muscle Testing	Decreased strength R > L
5 Times Sit to Stand	Unable to asses due to safety concerns, inability to perform correctly, and continuous education required during task
FIM Bed Mobility Score	5 (SBA)
FIM Transfer Score	4 (CGA/Minimal assistance)
Ambulation Distance	2 feet
FIM Ambulation Score	2 (Total Assist)

FIM Stairs	0 (Unable to assess/perform)
AM-PAC Basic Mobility (6-Click)	18
WNL = within normal limits, R = right, L = left, SBA = stand by assistance, CGA = contact guard assist, FIM (Functional Independence Measure)	

405

Table 4: Seated and Standing Exercises

	Exercise	Rx 1	Rx 2	Rx 3*	Rx 4	Rx 5	Rx 6	Rx 7	Rx 8	Rx 9	Rx 10	Rx 11	Rx 12	Rx 13
SEATED EXERCISES	Marches (hip flexion)	1x5 AROM 1x5 AAROM	1x7 AROM 1x3 AAROM	2x5	1x10	1x15		1x15	1x15	1x15		1x15	1x15	1x15
	Long arc quads (knee extension)	1x5 AROM 1x5 AAROM	1x7 AROM 1x3 AAROM	2x5	1x10	1x15		1x15	1x15	1x15		1x15	1x15	1x15
	Ankle dorsiflexion/plantarflexion	1x5 AROM 1x5 AAROM	1x10 AROM	2x5	1x10	1x15		1x15	1x15	1x15		1x15	1x15	1x15
	Hip abduction with knee extension		1x5 AAROM 1x5 AROM	2x5	1x10	1x15		1x15	1x15	1x15		1x15	1x15	1x15
	Hip adduction	1x5 AROM 1x5 AAROM	1x10 AROM	2x5	1x10	1x15		1x15	1x15	1x15		1x15	1x15	1x15
STANDING EXERCISES	Marches (hip flexion)		1x5 AROM	1x10	1x10		1x15					1x15	1x15	1x15
	Heel raises (ankle plantarflexion)		1x5 AROM	1x10	1x10		1x15					1x15	1x15	1x15
	Knee flexion		1x5 AROM	1x10	1x10		1x15					1x15	1x15	1x15
	Hip abduction			1x10	1x10		1x15					1x15	1x15	1x15
	Hip extension			1x10	1x10		1x15					1x15	1x15	1x15
	Mini squats				1x5		1x10				1x5	1x10	1x5	1x10

Rx = treatment session, AROM = active range of motion, AAROM = active assisted range of motion
*By Rx 3 all exercises were completed with AROM

406

Table 5: Functional Measures

		Rx 1	Rx 2	Rx 3	Rx 4	Rx 5	Rx 6	Rx 7	Rx 8	Rx 9	Rx 10	Rx 11	Rx 12	Rx 13
Functional Measures	Sit to Stand	10					10				5 (16.3 sec)		5 (12.1 sec)	
	Transfers FIM	4	4	4	4	4	5	5	5	5	5	6	6	6
	Gait Distance (ft)	2 ft	48 ft	100, 200 ft	150 x3 ft	400 x3 ft	600 x2 ft	300 x2, 600 x1 ft	600 x2 ft	500 x2 ft	500 x2 ft	200 x1, 150 x2 ft	650 ft	850 ft
	Gait FIM	1	1	1	1	1	4	4	4	4	4	1	4	4
	AD	RW	RW, WCF	RW	RW	RW	RW	RW	RW	IV, WCF	IV, WCF	RW	RW	RW
	AM-PAC	18	17	18	18	17	17	17	17	17	17	20	20	20

Rx: treatment, FIM = Functional Independence Measure, ft = feet, sec = seconds, AD = assistive device, RW = rolling walker, WCF = wheel chair follow

407

Table 6: Balance Exercises								
		Rx 1-7	**Rx 8**	**Rx 9**	**Rx 10**	**Rx 11**	**Rx 12**	**Rx 13**
Balance Exercises	Narrow BOS with BUE support RW with EO		30 sec					
	Narrow BOS 1 UE on RW EO		30 sec					
	Narrow BOS no AD EO		30 sec					30 sec
	Narrow BOS BUE support on RW EC		21 sec					
	Narrow BOS no AD EC						30 sec	7 sec
	Tandem stance BUE support on RW EO		30 sec					
	Tandem stance 1 UE support on RW EO		30 sec					
	Tandem Stance L in front of R EO						30 sec	30 sec
	Tandem Stance R in front of L EO						30 sec	30 sec
	Tandem stance R in front of L EC							Unable
	Tandem stance L in front of R EC							Unable
	SLS EO L						7 sec	1 sec
	SLS EO R						3 sec	1 sec
Rx: treatment, sec = seconds, AD = assistive device, BOS = base of support, BUE = bilateral upper extremity, UE = upper extremity, EO = eyes open, EC = eyes closed, L = left, R = right, SLS = single leg stance								

APPENDICES (Supplemental tables and figures beyond max of six)

Appendix 1: Medication List	
Inpatient Medications	**Outpatient Medications**
Amlodipine (NORVASC)	Vitamin D3
Cefepime (MAXIPIME)	Contour test strips
Cholecalciferol (vitamin D3)	Lomotil
Dexamesthosone (DECADRON)	Tricor
Fenofibrate nanocrystalized (TRICOR)	Neurontin
Folic acid (Vitamin B-9)	Glucotrol
Gabapentin (NEURONTIN)	Levaquin
Insulin glargine (LANTUS)	Magnesium oxide
Insulin lispro (HumaLOG)	Metformin (Glucophage XR)
Linezolid (ZYVOX)	Zofran-ODT
Neomycin-bacitracin-polymyxin B (NEOSPORIN)	Protonix
Pantoprazole (PROTONIX)	Pentamidine inhalation
Potassium chloride	Miralax
Prednisone (DELATSONE)	Deltasone
Psyllium husk (METAMUCIL)	Senokot-S
Rosuvastatin (CRESTOR)	Rapamune
Sirolimus (RAPAMUNE)	Valtrex
Sucralfate (CARAFATE)	VFEND
Thiamine (Vitamin B-1)	
ValACYclovir (VALTREX)	
Voriconazole (VFEND)	

414
415

Appendix 2: Systems Review Results	
Cardiovascular/Pulmonary	BP 121/74 HR 97 O2 97% BMI: 22.31 kg/m^2
Musculoskeletal	Decreased gross strength in BLE, R>L Atrophy in bilateral thighs
Neuromuscular	AxO x 3 Decreased DTRs patella and Achilles R> L Sensation to touch decreased R>L up to upper ¼ of R thigh
Integumentary	WNL
Communication	WNL
Affect, Cognition, Language, Learning Style	Mood and affect appropriate Cognition normal English language Responded well to multiple learning styles including auditory and visual
BP = blood pressure, HR = heart rate, O2 = oxygen saturation, BMI = body mass index, BLE = bilateral lower extremities, R = right, L = left, AxO = alert and oriented, DTRs = deep tendon reflexes, WNL = within normal limits,	

416
417

Appendix 3: Tests & Psychometric Properties		
Test	**Description of Test**	**Psychometric Properties**
Manual Muscle Testing (MMT)	-Patient is asked to maintain a muscle contraction with resistance provided by the physical therapist	-Controversial in the literature -Good concurrent validity compared to handheld dynamometers[9]
Numeric Pain Rating Scale (NPRS)	-Patient subjectively rates pain from 0-10 with 10/10 meaning the patient is in severe pain	-Excellent interrater reliability, internal consistency, concurrent, and convergent validity[10]
AM-PAC Basic Mobility	-Determines the amount of assistance necessary for the patient to complete turning over in bed; sitting down on and standing up from a chair with arms; moving from lying on back to sitting on the side of the bed; moving to and from a bed to a chair; walking in a hospital room; and climbing 3-5 stairs with a railing	-Excellent interrater reliability (0.849) amongst physical therapists[11] -Internal consistency reliability for the basic mobility scale was 0.96[12] -Validity determined to be strong based on correlation to FIM scores at discharge[12]
Functional Independence Measure (FIM)	-Measures amount of independence the patient has, or the assistance required from the physical therapist to complete the task	-Reliability for older adult and geriatric population was excellent (test-retest reliability 0.98) [13] -Interrater reliability (0.95) for patients with different diagnoses and impairments[13]

418
419
420
421

422
423
424
425

Appendix 4: Functional Independence Measure (FIM) Scoring			
	Transfer: Bed, Chair, Wheelchair	**Locomotion: Walk/Wheelchair**	**Stairs**
0	Activity did not occur due to safety/medical limitation or refusal	Activity did not occur due to safety/medical limitation or refusal	Activity did not occur due to safety, medical condition, refusal
1: Total Assist	Patient performs less than 25% of transfers on and off a bed to a wheelchair (WC) or chair or requires two helpers (includes setup) or mechanical lift, or 1 helper transfers patient lift and lower while 1 helper supervises	Patient moves less than 50 feet or requires 2 helpers (helper assists with managing IV pole, O2 tank, or WC)	Less than 4 stairs or 2 helpers, tried by unable or unsafe
2: Max Assist	Patient transfers self on and off a bed to a WC or chair and requires lifting and lowering assistance or performs 25-49% of effort required	Patient moves greater than or equal to 150 feet and requires steadying or touching assist	4-6 stairs with 1 helpful
3: Moderate Assist	Patient transfers self on and off a bed to a WC or chair and requires lifting or lowering assistance or moving 2 limbs or performs 50% to 74% of the effort required	Patient moves greater than or equal to 150 feet and requires lifting assistance	Full flight with lifting assist
4: Minimum Assist/Contact Guard Assist	Patient transfers self on and off a bed to a WC or chair and requires touching or steadying assistance or lifting one limb or 75% or greater of the effort required	Patient moves greater than or equal to 150 feet and requires steadying or touching assist	Full flight with steady or touching assist
5(Supervision, Stand-By Assist)	Patient transfers self on and off a bed to a WC or chair and requires supervision, or setup (includes positioning chair, locking wheelchair, applying/removing/adjusting leg rests) or verbal cues	Patient moves greater than or equal to 150 feet and requires cueing supervision, standby assist	Full flight with supervision, cueing, stand-by assist
5 (Household Exception)		Patient walks short distance (50+ feet) with or without device, or takes more time and requires no helper	4-6 stairs with or without device and no helper
6 (Modified Independent)	Patient transfers self and off a bed to a WC or chair and uses and assistive device handrail, armrest, slide board, walker etc.) or slower pace (3x slower) or safety concerns	Patient moves greater than or equal to 150 feet, uses device, takes 3x longer, if WC is being scored, patient also turns, maneuvers to table, bed and toilet, maneuvers over a door sill, and negotiates a 3% grade	Full flight with device or handrail and no helper
7	Patient transfers self on and off a bed to a WC or chair at a usual	Patient moves greater than or rqual to 150 feet without	Full flight without device or handrail at

(Independent)	pace (no devices without use of handrails, armrests, or devices, includes managements of WC parts)	device (walkers or WC) safe, timely, this score is not to be used when patient uses WC for locomotion	usual time with no helper

426
427

Appendix 5: ICD-10 Codes	
ICD-10 Code	**Code Meaning**
R53	Malaise and fatigue
R26	Abnormalities of gait and mobility
R26.2	Difficulty in walking, not elsewhere classified
R29.3	Abnormal posture
M62.81	Muscle weakness (generalized)
M62.5	Muscle wasting and atrophy, not elsewhere classified
R26.81	Unsteadiness on feet
G89.3	Neoplasm related pain (acute) (chronic)

428

Appendix 6: Short-Term Goals (4 weeks)	
1	Patient will be compliant with out of bed (OOB) recommendations for 6-8 hours per day in order to improve cardiopulmonary functioning.
2	Patient will be independent with HEP to improve strength/conditioning.
3	Patient will be independent with all bed mobility to improve functional independence.
4	Patient will be independent with all transfers in order to improve functional independence.
5	Patient will ambulate over an even surface at modified independent for 150 feet in order increase functional mobility.

429

Appendix 7: Complete Blood Count Trends			
Visit Number	**White Blood Cells**	**Hemoglobin**	**Platelets**
1	2.4	9.3	452
2	4.4	9.5	507
3	4.4	9.1	396
4	4.6	10.8	426
5	4.3	9.2	268
6	5.4	8.9	269
7	6.4	8.6	255
8	10.3	10.1	241
9	10.9	9.8	241
10	16.2	11.4	281
11	13.2	9.6	249
12	14.3	8.2	220
13	13.3	10.1	217
Normal values for white blood cells: 4.0-11.0K/uL Normal values for hemoglobin: Male: 14.0-18.0 g/dL, Female: 12.0-16.0 g/dL Normal values for platelets: 140 – 440 k/uL			

430
431
432

433

434

435

436

437 **CARE Checklist**

CARE Content Area	Page
1. **Title** – The area of focus and "case report" should appear in the title	1
2. **Key Words** – Two to five key words that identify topics in this case report	1
3. **Abstract** – (structure or unstructured) a. Introduction – What is unique and why is it important? b. The patient's main concerns and important clinical findings. c. The main diagnoses, interventions, and outcomes. d. Conclusion—What are one or more "take-away" lessons?	2
4. **Introduction** – Briefly summarize why this case is unique with medical literature references.	3-5
5. **Patient Information** a. De-identified demographic and other patient information. b. Main concerns and symptoms of the patient. c. Medical, family, and psychosocial history including genetic information. d. Relevant past interventions and their outcomes.	5-6
6. **Clinical Findings** – Relevant physical examination (PE) and other clinical findings	7
7. **Timeline** – Relevant data from this episode of care organized as a timeline (figure or table).	12
8. **Diagnostic Assessment** a. Diagnostic methods (PE, laboratory testing, imaging, surveys). b. Diagnostic challenges. c. Diagnostic reasoning including differential diagnosis. d. Prognostic characteristics when applicable.	8-9
9. **Therapeutic Intervention** a. Types of intervention (pharmacologic, surgical, preventive). b. Administration of intervention (dosage, strength, duration). c. Changes in the interventions with explanations.	9-11
10. **Follow-up and Outcomes** a. Clinician and patient-assessed outcomes when appropriate. b. Important follow-up diagnostic and other test results. c. Intervention adherence and tolerability (how was this assessed)? d. Adverse and unanticipated events.	12-13
11. **Discussion** a. Strengths and limitations in your approach to this case. b. Discussion of the relevant medical literature. c. The rationale for your conclusions.	13-14

d. The primary "take-away" lessons from this case report.	
12. **Patient Perspective** – The patient can share their perspective on their case.	N/A
13. **Informed Consent** – The patient should give informed consent.	1,5

438