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High Intensity Intervals And Gait Training For A Patient With Heart Failure And Parkinson Disease In A Skilled Nursing Facility: A Case Report

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The patient signed an informed consent allowing the use of medical information and video footage 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: Congestive Heart Failure is one of the most expensive conditions to manage medically and close to 20% of patients hospitalized for congestive heart failure are readmitted within 30 days. Fifty to seventy percent of people with Parkinson disease experience one or more falls in a 12- month period. The purpose of this case report is to describe the physical therapy management for a patient with acute congestive heart failure and Parkinson disease. **Case description:** The patient was an 85 year-old male with acute congestive heart failure and Parkinson disease. He received physical therapy at a skilled nursing facility six days per week for 13 total sessions. The plan of care included functional mobility training, stretching, balance training, gait training, and high intensity interval training. **Outcomes:** The 10- meter walk test improved (0.34 meters per second to 0.47 meters per second), the six-minute walk test improved (107.3 meters to 139.7 meters) and the timed up and go score improved (26 seconds to 25 seconds.) The Tinetti falls efficacy scale was 19/28 at evaluation and discharge. The observed gait assessment and functional mobility improved from evaluation to discharge. **Discussion:** This patient appears to have benefited from physical therapy in the skilled nursing facility for acute congestive heart failure and Parkinson disease. Research suggests exercise training, stretching, balance and gait training as physical therapy intervention for congestive heart failure and Parkinson disease separately. Further research is required to understand physical therapy management of both congestive heart failure and Parkinson disease together, as well as the effectiveness of high intensity interval training for Parkinson disease.

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BACKGROUND and PURPOSE

Congestive heart failure (CHF) is one of the most expensive conditions to manage medically, and close to 20% of patients hospitalized for CHF are readmitted within 30 days.[1] Signs and symptoms of CHF include decreased exercise tolerance, dyspnea and fatigue. According to the guideline for the management of heart failure from the American College of Cardiology Foundation/American Heart Association, exercise is a safe and effective intervention for patient's with CHF and decreases mortality.[2]

Parkinson disease (PD) is a neurological disorder that affects one million people in the United States; it is the second most common neurodegenerative disorder, and it is expected to increase due to the aging population. Cardinal signs include rigidity, tremor, bradykinesia and postural instability.[3] Fifty to seventy percent of people with PD experience one or more falls in a 12- month period.[4]

High-intensity interval training (HIIT) has been shown to be more effective than moderate intensity continuous exercise in cardiovascular adaptations among patients with CHF.[5] Short intervals of 30 seconds of high intensity followed by 30 seconds of passive rest were optimal to improve peak oxygen uptake, ventricular function and endothelial function. Dyspnea is an exercise-limiting factor in patients with CHF, but HIIT with a passive rest interval has been shown to improve adherence to exercise and time spent exercising.[5] Patients' with mild to moderate PD can tolerate high intensity training and it has been shown to improve motor performance, increase quality of life, and slow the progression of the disease, [3,6] however, no studies have looked at the effects of HIIT on PD.

This case report documents the PT management of a patient with CHF and PD and the outcomes of cardiovascular endurance training, gait training, therapeutic exercise, and balance

training for a patient with acute CHF and PD. The plan of care was created using current literature, clinical expertise and patient preferences. The primary impairments of CHF and PD may interact and present a unique challenge to rehabilitation. There is limited evidence on the PT management of both CHF and PD in the literature.

CASE DESCRIPTION

Patient History and Systems Review

The patient was an 85 year-old male admitted to a skilled nursing facility (SNF) with a diagnosis of acute CHF with an ejection fraction of 25%, dysphagia with signs of aspiration, and a diagnosis of PD. His chief complaints were shortness of breath (SOB), general weakness, stiffness, poor balance and decreased appetite. Prior to admission, he lived with his wife in a two-story home with twelve stairs and a railing to the bedroom. The patient and his wife worked together on instrumental activities of daily living including cooking, cleaning and managing the household. The patient was independent in all activities of daily living and functional mobility. He walked independently using a single point cane and was a limited community ambulator. During his stay in the SNF he was seen by occupational therapy (OT) and speech and language pathology (SLP) in addition to PT. His past medical history was significant for PD, CHF, deep vein thrombosis, peripheral vascular disease and hypertension. Table 1 presents a complete systems review, and Appendix 1 presents his current medication list. At the time of initial evaluation, the patients' goal for PT was to return home.

Clinical Impression 1

The patients' primary concerns are SOB and weakness from acute CHF that is limiting activity tolerance as well as decreased range of motion (ROM) and decreased balance from PD that is limiting his functional mobility. Differential diagnoses include worsening PD or side

effects of immobility from hospitalization. Based on the history and systems review, it was hypothesized the patient would present with decreased activity tolerance, decreased cardiovascular endurance, shuffling gait, festinating gait, weakness, and ROM deficits. Tests and measures were used to assess pain, balance, submaximal exercise capacity, fall risk and functional mobility.

This patient is a good candidate for a case report because there is limited evidence on the PT management of CHF and PD. The patient is highly motivated to return to his prior level of function, agreeable and cognitively able to participate in PT, and has excellent family support.

Examination – Tests and Measures

Gait was assessed while the patient was observed using a single point cane and required contact guard. The 6-minute walk test (6MWT) was used to assess cardiopulmonary function as described by the American Thoracic Society.[7] The 6MWT is a valid measure to assess functional exercise capacity because it correlates with VO2 max and has excellent test-retest and intrarater reliability as well as good clinical reliability.[8] Gait speed was measured at the patients' self-selected velocity using the 10-meter walk test which has excellent test-retest reliability in patients with PD.[8] The timed up and go and the tinetti falls efficacy scale were both used to assess fall risk. The tinetti falls efficacy scale is recommended for assessing fall risk in patients with Parkinson disease because it correlates with unified Parkinson's disease rating scale motor scores as well as gait speed; the sensitivity and specificity in identifying fallers is 76% and 66%, respectively.[9]

Clinical Impression 2

Following examination, the initial clinical impression was confirmed and the patient was determined to be a good candidate for PT. Based on the medical history and results of test and

measures, the primary medical ICD-10 code was 150.31 *acute diastolic (congestive) heart failure* and the primary physical therapy ICD-10 codes were R06.02, *shortness of breath* and R26.9, *unspecified abnormalities of gait and mobility*.[10] The patient continued to be a good candidate for this case report due to his need for PT to address his impairments and to increase his functional mobility, independence, and submaximal exercise capacity. The patient's motivation to participate, high prior level of function and strong family support were considered positive prognostic factors. Negative prognostic factors included the patient's concurrent diagnosis of PD as well as his decreased ejection fraction of 25%. [11]

The patient continued to receive OT services to address impairments in activities of daily living, energy conservation techniques, self-care and upper extremity ROM and strength. He also received SLP services to address impairments of dysphagia. The plan of care included coordination and communication with OT, SLP, nursing, certified nursing assistants, general practitioners and care coordinators. The PT interventions addressed decreased cardiopulmonary endurance and SOB, impaired ROM, impaired balance, impaired gait and decreased activity tolerance and were progressed as tolerated by the patient. Follow up and re-evaluation of outcomes and goals was completed on day seven. Education was provided to the patient and family, detailing the course of the patients' disease, safety concerns, home safety modifications, therapy interventions and progress in therapy. Short-term and long-term goals were discussed and formulated with the patient and caregiver (Table 2). Upon discharge, the patient was referred for home health services to continue to address impairments of functional mobility and increase safety in the home.

INTERVENTION

Coordination

The patient's care was coordinated with PT, OT, SLP and nursing. Each therapy saw the patient six days per week, and nursing saw the patient every day. OT, PT and SLP worked together to coordinate the patient's schedule so that he had adequate rest between sessions.

Communication

Information was shared between disciplines via the patient's paper chart, on patient information sheets for the certified nursing assistants, and in weekly rounds meetings with the care coordinator. The patient's wife was updated on his progress multiple times per week and often accompanied him to therapies to observe the POC. The patient was compliant and attended all scheduled sessions and outside appointments. Prior to discharge, the patient and caregivers were provided written and verbal education on a home safety checklist as well as information on home health therapies.

Procedural Interventions

Interventions aimed to improve functional mobility, gait, balance, ROM and cardiovascular endurance. Procedural interventions included functional mobility training, gait training, therapeutic exercise and balance training. Interventions were adjusted as needed based on the patient's response in order to facilitate full participation in therapy. The patient was seen 45-65 minutes per session six days per week with 13 total PT sessions.

Balance training was performed to increase static and dynamic standing balance and to facilitate balance reactions. At the start of treatment, balance training was performed in the parallel bars with upper extremity support. Starting at week two, balance activities were progressed as described by Kisner and Colby[12] by creating an unstable surface with the BOSU Pro Balance Trainer (BOSU, Ashland, OH) and Thera-band Stability trainer blue soft (Thera-band, Akron, OH). By week three, balance activities were progressed to stable surfaces without

upper extremity support, and with one upper extremity on unstable surfaces.

Gait training was performed to increase the patient's stride length, gait speed, toe clearance, and safety with turning and changing directions. A step over exercise with visual cues was utilized to increase stride length and toe clearance. Two rows of three, 2.75" high cups were placed 12 inches apart and the patient was instructed to step over each cup and land in a heel-to-toe pattern (See Figure). Intervals of fast and normal walking speeds down a straight hallway were used to increase gait speed. External cues have been shown to improve movement in individuals with mild to moderate PD.[3]

Functional mobility included transfer training on a variety of surfaces and stairs. Transfer training was discontinued at the end of week one because the patient was safe and independent. Stair training was performed prior to discharge to ensure the patient was safe to return home.

Therapeutic exercise included HIIT to increase cardiopulmonary endurance and stretching to improve trunk ROM. HIIT was performed on the SciFit StepOne Recumbent Stepper (Model number: RST7000, SciFit Systems Inc., Tulsa, OK). According to Guiraud et al, [5] using a short interval of 30 seconds of work with 30 seconds passive recovery is optimal for patients with CHF. The patient maintained an eight out of ten on the Borg scale of perceived exertion and progressed the work period from three to five minutes over the course of the POC. According to Kisner and Colby[13] 3-5 minutes of daily HIIT is effective for patients with deconditioning. ROM exercise included contract-relax and hold-relax stretching of the shoulder and trunk performed as described by Kisner and Colby, [14] as well as standing snow angel.

OUTCOME

Outcomes were reassessed on day seven and at discharge on day 13. The 10-meter walk test, 6MWT and TUG scores improved, while the Tinetti falls efficacy scale showed no change. The 10- meter walk test showed substantial change with an increase in gait speed by 0.13 meters

per second from initial evaluation to discharge, which is the minimally clinically important difference (MCID) for the 10-meter walk.[15] The 6MWT improved 32.4 meters from initial evaluation to discharge, which is less than the MCID.[8] The timed up and go does not have established MCID values, but the patient's time improved by one second from evaluation to discharge. The observed gait assessment improved from evaluation to discharge with increased stride length and increased toe clearance being the most notable changes. See table 3 for a summary of outcomes. The patient met two STGs and one LTG and failed to meet one STG and two LTGs (Table 2).

DISCUSSION

The purpose of this case report was to document the outcomes of the PT management for a patient with acute CHF and PD. The plan of care was developed to create patient centered and disease specific PT management to reduce impairments. The patient appeared to have benefited from functional mobility training, gait training, therapeutic exercise and balance training.

Minimally clinically important differences were seen in gait assessment and the 10-meter walk test, while changes in the TUG and 6MWT were also seen. The patient met his goal of returning home with independent functional mobility and, subjectively, the patient reported feeling "stronger and healthier" at the end of the 13 sessions of PT. But, it is important to note the patient remained below the age-matched norms for the 6MWT distance and 10-meter walk speed, and his time on the TUG and score on the Tinetti categorized him as being at risk for falls.

Currently, the evidence supports gait training, balance training, and ROM exercises for patients with PD.[3] HIIT is supported for patients with CHF[5], but more information about the PT management of CHF should be documented. General exercise guidelines in patients with CHF are established, and the literature demonstrates a multi-disciplinary plan of care, including PT, is

necessary to reduce readmissions and health care costs associated with the disease.[1]

This case report suggests that using HIIT with usual PT management of CHF and PD in a SNF may improve outcomes. Future research on HIIT training in patients with PD and its benefits in the form of a randomized control trial is recommended. Further research on the PT management of the combination of CHF and PD is also warranted.

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297 **TABLES and FIGURES**

298 **Table 1. Systems review**

Cardiovascular/Pulmonary	Impaired; decreased endurance, SOB with activity.
Musculoskeletal	Impaired; decreased trunk and cervical ROM, strength within functional limits.
Neuromuscular	Impaired balance.
Integumentary	Impaired; bilateral edema.
Communication	Intact.
Affect, Cognition, Language, Learning Style	Flat affect, English, Cognition intact, learns best by demonstration.

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Table 2. Short term and long term goals.

Short term goals – 1 week	Goal met	Long term goals – 3 weeks	Goal met
Safely perform functional transfers and ascend/descend 3 stairs with SPC[a] without LOB[b] in order to safely return to private residence with reduced risk for falls.	Yes	Ambulate on level surfaces with using SPC with functional speed and proper heel strike without LOB to increase functional ambulation.	Yes
Increase walking speed to 0.5 m/s.	No	Increase walking speed to 1.0 m/s.	No
The patient will ambulate 350' without RPE[c] > 4-6/10 in order to improve walking distance and cardiovascular endurance.	Yes	Increase distance ambulated during 6MWT[d] by 50 m in order to achieve MCID[e].	No

a= single point cane; b= loss of balance; c=rate of perceived exertion; d= six minute walk test

Table 3. **Results of Tests and Measures at Initial evaluation, Re-evaluation and Discharge**

Measure	**Evaluation Day 1**	**Day 7**	**Discharge Day 13**
6 MWT[a]	107.3 m[b]	128.3 m	139.7 m
10 m walk	0.34 m/s[c]	0.36 m/s	0.47 m/s
TUG[d]	26 s[e]	22 s	25 s
Tinetti falls efficacy scale	19/28	Not tested	19/28
Pain – verbal	0/10	0/10	0/10
Functional gait	Forward lean of the trunk, inadequate hip extension, absent push-off, decreased cadence, decreased rotation of the hips and shoulders, decreased speed and amplitude, decreased step length, decreased stride length, deficits during turning, flat foot during weight acceptance and shuffling gait.	Not tested	Forward lean of the trunk, inadequate hip extension, decreased rotation of the hips and shoulder, increased stride length, increased step length, increased clearance of foot during swing through.
Functional mobility assessment 1. Bed mobility 2. Transfers 3. Stairs	1. Independent. 2. Supervision. 3. Did not test.	Not tested	1. Independent. 2. Independent. 3. 10; independent

a: minute walk test; b: meters; c: meters per second; d: timed up and go; e: seconds

Table 4. Physical therapy interventions

Gait training	Therapeutic exercise	Neuromuscular re-education
Stride length • Cup step overs (Figure 1) 6 steps of 4 repetitions	ROM[a] • Contract-relax and hold-relax stretching. • Snow angels (Figure 2) 2 minutes in each position	Static standing balance • Tandem stance. • Single limb stance. 20-30 seconds x 4 trials
Gait speed • Verbalized "walk as fast as possible", "walk at your normal pace" alternating every 10 steps for 100' x 4 times.	HIIT[b] • 5 minute warm up @ 2.5 resistance • 30 seconds working at 8/10 on Borg scale at 10.5 resistance. • 30 seconds passive recovery. • 5 minute cool down @ 2.5 resistance. 3-5 minutes of intervals	Dynamic standing balance • BOSU ball toe taps. • Tandem stance with UE[c] flexion. 2-3 sets of 10-15 repetitions Unstable surfaces • Tandem stance on Thera-band foam

A= range of motion; b= high intensity interval training; c= upper extremity

Figure. Exercises to improve gait and trunk mobility. Left: The patient was instructed to step over each cup and land in a heel-to-toe pattern to increase stride length and toe clearance. Cups were placed 12 inches apart. Right: Standing snow angel stretches were performed to help increase trunk mobility.

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APPENDICES

Appendix 1: Current Medications

Medication	Dosage	Indication
Amitriptyline	5 mg bedtime	For mood disorder
Aspirin	81 mg[a] daily	For preventing blood clots
Carbidopa-levodopa	25mg-100mg 3x/day	For Parkinson disease
Carvedilol	3.125 mg 2x/day	For CHF[c]
Cholecalciferol (Vitamin D)	1,000 IU[b] daily	For calcium absorption
Docusate-senna	50 mg-8.6 mg 2x/day	For stool
Furosemide	40 mg daily	For CHF
Glyoopyrrolate	1 mg 2x/day	For peptic ulcer
Levothyroxine	0.1 mg daily	For hypothyroidism
Lisinopril	2.5 mg daily	For CHF
Pantoprazole	40 mg daily	For GERD[d]
Pravastatin	20 mg bedtime	For high cholesterol
Tamsulosin	0.4 mg daily	For prostate
Warfarin	2.5 mg daily	For preventing blood clots

a: milligrams; b: international units; c: congestive heart failure; d: gastroesophageal reflux disease