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Role of Occupational Therapy Before and After Heart Transplant: A Case Study

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Abstract

Background

Mechanical circulatory support devices have been increasingly used as a bridge to sustain organ function and stabilize hemodynamics while patients remain on the heart transplant waiting list. The medical intervention, intra-aortic balloon pumps (IABPs), may be placed via transfemoral artery, which may limit out of bed daily occupational engagement and participation.

Methodology

This case study is of a 68-year-old female, who was admitted to the intensive care unit with decompensated heart failure. Due to progressive hemodynamic instability, an IABP was placed while the patient was awaiting heart transplant. Occupational therapy was continued post-heart transplant until time of patient's discharge.

Results

Prior to heart transplant, occupational therapy provided skilled interventions to address activities of daily living (ADLs) performance, cognitive function, coordination and strength, activity tolerance, while the patient was unable to mobilize due to institutional restrictions and medical precautions with an IABP implanted pre-transplant. Rehabilitation services were re-initiated post heart transplantation, with the aim of returning the patient to their prior level of function. A variety of assessments were used pre-transplant and post-transplant to measure change in function. The patient's total length of hospital stay was 18 days. Post heart transplant, the patient was discharged home with home health services and support from their spouse.

Discussion

This case study provides an example of an evaluative and intervention approach for delivering occupational therapy services with a patient awaiting heart transplant with medical intervention specific to a transfemoral IABP. There were no adverse medical events pre and post heart transplant with occupational therapy services.

Keywords: heart transplant, occupational therapy, transformal intra-aortic balloon pump

Introduction and Background

Mechanical circulatory support devices, such as the intra-aortic balloon pump (IABP) have been increasingly used as a 'bridge' to sustain organ function and stabilize hemodynamics while patients remain on the transplant waiting list (Naqvi et al., 2018). Depending on the patient's medical needs, a femoral insertion is a common approach due to the large size of the femoral artery. However, an IABP placed via transfemoral artery typically limits the ability for the patient to engage in out of bed activities and ambulation to prevent device dislodgement. The sequelae from extended immobility while awaiting a heart transplant can include increased risk of muscle atrophy, deconditioning, pulmonary complications, decreased metabolism, deep vein thrombosis and pulmonary embolisms (Brower, 2009). Research suggests immobility can affect a patient's physical and brain function, including executive functioning skills needed to complete activities of daily living (ADLs) and may lead to increased risk of falls and healthcare expenses (Lipnicki et al., 2009; Musich et al., 2017). Immobility in the intensive care unit (ICU) can increase a patient's risk for developing delirium, which can also lead to long term-cognitive impairments (Salluh et al., 2015). Furthermore, patients with cardiovascular disease are already at an increased risk of developing mild cognitive impairments which impact their ability to complete their ADLs and instrumental activities of daily living (IADLs) (Norris, 2018).

In this medical institution, patients with transfemoral placed IABP are limited to zero degrees of hip flexion which prohibit out of bed out of bed occupations and ambulation activities. This is a current policy established by the institution and supported by the active medical team. To offset anticipated deconditioning, upright

activity via a tilt bed is routinely implemented twice per day by nursing staff for as long as the patient can tolerate the upright position. The nurse must record the patient's vitals throughout the session, the length of the session, the height of tilt in degrees, the correlating trunk offloading, and weight bearing. The patient tilted with nursing staff a total of 15 times outside of therapy sessions for an average of: 59 minutes, with a verticalization of 48 degrees, trunk offloading of 34.7%, and weight bearing of 49.2 kg. The maximum verticalization achieved in this case study was 50 degrees due to the patient's discomfort with a higher position. No adverse events were noted throughout the duration of the patient's hospitalization.

In this case, occupational therapy (OT) was added to the patient health care team to promote participation in functional activities and to facilitate upper extremity strengthening with overall conditioning due to the potential of an extended time with the immobility in bed due to IABP implantation. The maximum verticalization achieved in this case study was 50 degrees due to the patient's discomfort with a higher position. OT sessions occurred with nursing staff monitoring the position and parameters of the IABP and were terminated if warning alarms sounded, or if patient's vitals changed outside of accepted ranges (e.g., heart rate below 60 or above 140 bpm, oxygen saturation less than 88%, and mean arterial pressure less than 60 or greater than 100 mmHg).

Occupational therapists are healthcare professionals that treat patients with cardiovascular conditions to address their physical, cognitive, and emotional capacity to promote engagement in ADLs and IADLs (Norris, 2018). Occupational therapists also specialize in delirium prevention and can assist patients and family members on

management of stress and anxiety caused by hospitalizations, especially in the ICU (Costigan et al, 2019). Unfortunately, limited information is available on the role of occupational therapists working with patients with transfemoral IABP; therefore, it has not been documented until this case study, making it a novel intervention.

The overall aim of this case study was to describe occupational therapy role and responsibilities in delivering occupational therapy services when working with a patient pre-heart transplant with a transfemoral IABP and post-heart transplant until the patient was discharged from the hospital. A written consent form was obtained from the patient for participating in sharing the medical and rehabilitation outcomes noted as a case study. The researcher's medical institution's review board did not require additional approval for case studies with a sample size less than three patients.

Methodology

The patient was a 68-year-old female with cardiac diagnoses including heart failure with reduced ejection fraction (HFrEF), acute on chronic systolic heart failure (*NYHA IIIB, ACC/AHA Stage D)*, ischemic cardiomyopathy, coronary artery disease, and hypertension. Prior to hospital admission the patient was listed for heart transplant at a status of six. Per the United Network for Organ Sharing (UNOS) rating scale, a six indicates the patient met the medical stability criteria to remain at home while they waited for a heart transplant (Liu et al., 2020). The patient attended annual wellness visits with their primary care physician and cardiologist. The patient reported knowing their medications well and taking them as prescribed, including atorvastatin and metoprolol. At baseline, the patient was independent with all ADLs, an active driver, ambulated community-based distances without gait assistive devices. She was employed part-time at a local community college and lived with their husband in a one-

story condominium. The patient was admitted to the cardiac ICU through the emergency department with complaints of progressive weakness and dyspnea on exertion for approximately one month due to HFrEF symptoms. On admission day one the medical team began the medication, Milrinone, for inotropic support. By hospital day two, the hemodynamic data showed profoundly low cardiac output despite the use of Milrinone, which led to the primary service team to proceed with an IABP placement. According to UNOS, a patient who is hospitalized with severe ventricular arrhythmias and/or requiring mechanical support is classified as a status two on the heart transplant list (Liu et al., 2020), therefore this patient's status was escalated accordingly.

Occupational therapy was consulted on day three of admission with evaluation being completed same day to assess the patient's prior level of function and support system and to develop a plan of care that promotes engagement in meaningful daily activities prior to heart transplant. Physical therapy was consulted, however, did not complete the evaluation prior to heart transplantation due to out of bed activities being contraindicated. Speech therapy was not consulted as the patient did not have swallowing deficits.

Outcome Tools

The Activity Measure for Post-Acute Care (AM-PAC) "6 Clicks" Daily Activity Inpatient Short Form and grip strength using a digital dynamometer were assessed during each OT session to measure progress with daily activity performance and general strength. The AM-PAC "6 Clicks" is a standardized and simple assessment of a patient's functional abilities in self-care performance, which includes feeding, toileting, grooming, upper body dressing, lower body dressing, and bathing (Jette et al., 2014).

This self-care focused outcome tool uses a rating scale of 1 to 6 to indicate level of independence which includes: 1- total assist, 2- maximum to moderate assist, 3- minimum to supervision, 4- modified independent to completely independent. On the initial OT evaluation, the patient scored a 15/24 on the AM-PAC (Table 1), indicating need for assistance with ADLs.

Table 1

Assessment Results Conducted by Occupational Therapy during Hospitalization

Assessment	AM-PAC ADLs	Grip Strength (pounds)		Box and Blocks (seconds)		LISAT-11 Score	Medi-Cog Score	9 Hole Peg Test (seconds)	
		Right Hand	Left Hand	Right Hand	Left Hand			Right Hand	Left Hand
Day 3	15	64.4	47.2						
Day 4	15	62.3	57.0						
Day 7	15	72.4	64.7						
Day 8	15	80.6	72.2	56	39	42/66	5/10	24.4	94.2
Day 9	15	75.8	65.5						
Day 13	12	42.8	42.6						
Day 14	12								
Day 15	14	62.9	54.8	50	40			27.2	125.1
Day 16	18	45.7	42.7			48/66	8/10		
Day 18	20	46.8	44.4						

Note. Day 3 indicates 3rd day of hospitalization, and the OT evaluation was completed on Day 3. The patient received a heart transplant on Day 11 and the OT re-evaluation was on Day 13. The patient was discharged on Day 18. A blank space indicates the assessment was not completed on that date. Abbreviations: AM-PAC, Activity Measure for Post-Acute Care; ADL, Activities of Daily Living; LISAT-11, Life Satisfaction Questionnaire 11; 9HPT, Nine Hole Peg Test.

The patient's grip strength measured 29.2 kilograms (kg) on the right hand and 21.4 kg on the left hand (132% and 97% respectively of predicted normal value, PNV) (Abizanda et al, 2012). The patient demonstrated an increase in grip strength to 34.8 kg (157% PNV) (right) and 29.7 kg (134% PNV) (left) after 4 treatment sessions (hospital day 8) with no decline in the functional ADLs according to AM-PAC scores (15/24).

The patient demonstrated gross motor upper extremity impairments as measured by the Block and Box Test (BBT), a standardized assessment, on hospital day nine pre-heart transplant (Mathiowetz et al., 1985). The patient scored 56 (right arm) and 39 blocks (left arm), where normative values are 72 and 71 blocks, for the right and left arm, respectively. The patient also demonstrated fine motor coordination difficulties as indicated by the Nine Hole Peg test (9HPT), a standardized assessment measuring fine motor coordination (Oxford, 2003). The patient scored 24.42 (right hand) and 34.15 seconds (left hand), where normative values for the right and left hand are 19.9 and 24.4 seconds, respectively.

On hospital day eight the Medi-Cog was administered to further assess the patient's cognition function. The Medi-Cog is a combination of the Mini-Cog and Medication Transfer tools. This tool was selected because it is a screening tool and can indicate difficulties with short term memory and ability to complete medication management (Anderson et al., 2014). The patient scored a 5 out of 10 on the Medi-Cog, which is below the cutoff score of 8 out of 10 depicting a patient's ability to perform medication management independently. From this result, occupational therapy facilitated cognitive intervention regarding medication re-training strategies with the patient's post-transplant medication regimen.

In addition to further cognitive evaluation pre-transplant (hospital day eight), occupational therapy also administered the Life Satisfaction Questionnaire (LISAT-11) to assess the patient's interpretation of their own quality of life. This assessment measures satisfaction of life in the domains of vocation, leisure, finance, sexual, social, physical, and psychological health (Fugl-Meyer et al, 2003). The scores are determined by taking the mean of the patient's answers with a score of 1-4 indicating overall

Table 2

Occupational Therapy Interventions throughout Hospital Stay

Day of Admission	OT Interventions
3	UE HEP with light-medium resistance bands. Unable to tilt due to hypotension.
4	HEP with light-medium resistance bands, therapeutic activity to promote core strengthening and UE overhead movements. Tilted 15-50 degrees for 30 minutes.
7	HEP with light-medium resistance bands, reaching, crossing midline, core strengthening and trunk control. Tilted 50 degrees for 30 minutes.
8	HEP with resistance bands, hand strengthening, FMC with medium Theraputty, and small object manipulation. Tilted 51-53 degrees for 60 minutes.
9	HEP with 1.36-kilogram dumbbells. Activity graded down to active ROM when fatigued. Therapeutic activity of stacking blocks to promote fine and gross motor control, sequencing, problem solving, and sustained attention. Tilted 50 degrees for 56 minutes
13	Sitting tolerance at edge of bed, grooming tasks, breathing exercises, sternal precaution, and post-operative education.
14	Sternal precaution education, standing tolerance, grooming tasks and fine motor tasks with graded assistance, fall prevention and energy conservation education.
15	Functional transfers, sternal precautions education, finger ROM HEP for edema management.
16	Grooming, upper body and lower body dressing, bathing, toileting, functional transfers, standing tolerance, and finger ROM HEP review.
18	Full bathing task in shower, sternal precautions education, surgical incision hygiene education, grooming, dressing, and functional transfers.

Note. Abbreviations: FMC = fine motor coordination; HEP = home exercise program; OT= occupational therapy; ROM = range of motion; UE = upper extremity

dissatisfaction and a score of 5-6 indicating overall satisfaction (Table 2).

The patient scored 42 out of 66 (mean of 3.81) thereby indicated dissatisfaction in the following domains: their overall physical health and ability to perform ADLs. The LISAT-11 has been proven to be valid and reliable within stroke populations (Anke et al., 2003), however, it has not been validated within the pre or post heart transplantation population. Three occupational therapists worked with this patient during this hospitalization for a total of 10 sessions with an average time of 49.7 minutes.

Treatment Considerations

Three occupational therapists worked with the patient during the hospitalization for a total of 10 sessions with an average session time of 49.7 minutes. Fifty percent of the treatments were provided with IABP and use of tilt bed pre-heart transplant. These therapeutic activities facilitated fine and gross motor coordination, lower extremity weight bearing via tilt bed, and cognition to optimize patient outcomes including medication management tasks with pseudo pill box, incorporating grooming ADLs, provided exercises, and TheraPutty to promote grip strengthening.

The patient experienced the following benefits from treatment including the tilt bed, including improved positioning for increased alertness and environmental awareness, lower extremity weight bearing, and trunk offloading without breaking movement restrictions at the hip due to the IABP insertion. The remaining five sessions were post-heart transplant and focused on standard acute care practice for cardiopulmonary patients, including sternal precautions education, functional transfers, edema management, functional mobility, and engagement in ADLs.

The patient received a heart transplant eleven days after admission to the ICU which subsequently allowed for the removal of the IABP. An OT re-evaluation was warranted to update the patient's plan of care due to the patient's change in medical status after heart transplantation. The remaining five sessions were delivered post-heart transplant and focused on standard acute practice for cardiopulmonary patients, including education on sternal precautions, retraining of daily functional mobility and self-care occupations, edema management, and activity tolerance building. Research has shown there is a positive correlation between the time in minutes of OT services and change in function at discharge for patients with solid organ transplantation who received OT intervention (Hastings et al., 2004). Additional data in a Medicare report showed that higher hospital spending on occupational therapy services led to decreased hospital readmission for patients with heart failure, pneumonia, and myocardial infarction (Rogers et al., 2017).

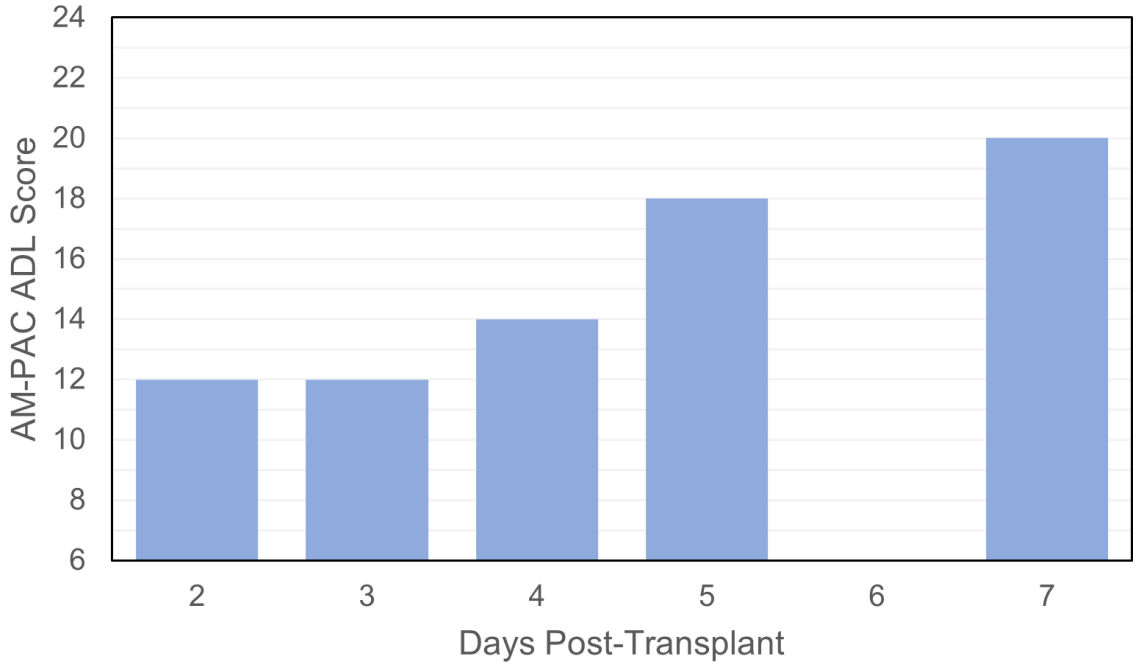
Results

After transplantation, the patient demonstrated an initial functional decline in ADLs, grip strength, and activity tolerance when contracted with the initial OT evaluation. Across subsequent sessions, the occupational therapist provided interventions to increase strength, activity tolerance, and activity adaptations to support overall improved ADLs performance and quality of life, as defined within OT's role with this patient population (Norris, 2018). The patient scored a 12 out of 24 on the AM-PAC "6 Clicks" immediately after transplant, but the patient's independence in ADLs continued to increase across sessions as evidenced by the increasing AM-PAC "6 Clicks" scores. On the day of discharge (day 18) the patient scored 20/24 due to

requiring minimum assistance with bathin, and upper and lower body dressing and

Figure 1

Progression of AM-PAC ADL Score after Lung Transplant until Day of Discharge



contact guard assist with toileting (Figure 1). The patient required additional assistance due to lower body weakness, decreased balance and endurance, requiring physical assistance to stand, secondary to their extended length of stay and overall deconditioning post-operatively.

The patient demonstrated improved cognition after transplant as indicated by re-assessment with the Medi-Cog, where the patient scored 8 of 10. The patient's grip strength on the date of re-evaluation was 19.4 kg (right) and 19.3 kg (left), indicating a decline in hand strength. The patient's grip strength fluctuated across subsequent sessions, and the patient scored 21.2 kg (right) and 20.1 kg (left) on the day of

discharge. The patient also demonstrated fine motor coordination difficulties after transplant where the patient scored 27.22 seconds (right) and 35.06 seconds (left) on the 9HPT.

The patient completed the BBT test again and demonstrated 50 (right) and 40 (left), which is still below average. The scores for the dynamometer, 9 HPT, and BBT assisted in quantifying weakness as increased difficulty was observed during fine motor tasks (e.g., opening toothpaste). Post-transplant (hospital day 15), a re-assessment of quality of life using the LISAT-11 was completed. The patient demonstrated improvements in perceived quality of life with a score of 48 out of 66, with a mean of 4.36. There was still some noted dissatisfaction in quality life aspects specific overall physical and psychological health. The patient was discharged home with their husband on the hospital day 18.

Discussion

This case study is a description of the occupational therapy services, outcome measures used to measure functional progress, and the treatment approach with a patient awaiting a heart transplantation while implanted with a femoral IABP as well as at post-transplant. The patient's progress was evidenced by improved mobility, self-care independence, cognition function, and self-reported quality of life from time of evaluation to discharge from the hospital. OT interventions were focused on promotion of strength conditioning prior to transplant to assist in return to prior level of function post-operatively after heart transplant.

Immobility due to a transfemoral IABP increases the risk of the patient developing muscle atrophy, generalized weakness, and cognitive dysfunction which

leads to decreased functional activity tolerance and independence in ADLs (Brower, 2009). OT has the unique opportunity to provide a holistic and patient-centered approach for improving functional outcomes by utilizing therapeutic interventions simultaneously with a tilt bed to promote lower extremity weight bearing to offset the ramifications of immobility (Chen et al., 2021). Research has demonstrated that pre-operative exercise therapy decreased length of stay for cardiac surgery patients (Valkenet et al., 2010). Prior to transplant, upper extremity strength exercises, including shoulder flexion, shoulder abduction, horizontal shoulder abduction, scapular range of motion, elbow flexion and extension with a TheraBand during tilt sessions, prescribed by the occupational therapist demonstrate improvement in the outcomes measured, based on this study.

Occupational therapy has a unique role in addressing a wide scope of the patient's abilities to promote optimal recovering and improved participation in daily activities for patients with cardiovascular disease (Norris, 2018). Leading up to surgery, the patient demonstrated an increase in grip strength across subsequent OT sessions, signifying benefits from the interventions provided which facilitated independence to manipulate objects during ADLs related tasks. Despite post-surgical interventions, the patient continued to show deficits in fine and gross motor coordination and did not demonstrate a return in grip strength from the initial OT evaluation. The patient experienced significant hand edema after surgery which may have contributed to lack of improvement in fine and gross motor coordination, and grip strength, which did not extend their length of stay due to support from their husband.

Life saving devices such as the IABP are being used to keep patients alive longer while they are awaiting transplant, but at the cost of potential physical deconditioning and need for rehabilitation after receiving a heart transplant. Due to the evolving new medical and surgical advancements for cardiac populations, occupational therapy practitioners in acute care need to be aware of theses advancements and consider how they can change their approach to facilitate occupational engagement in conjunction with the medical intervention process. Currently, there are not well-defined professional documents or processes that define the role of occupational therapists working with patients implanted with medical devices such as IABPs. Occupational therapy practitioners are well positioned to address a patient's unique medical and functional needs through adaptive interventions to their specific situation, such as the patient in this case study, who is required use of a tilt-based hospital bed due to an IABP. This case study demonstrated a positive example of OTs role and value on a patient's occupational engagement pre-and post-transplant that supported discharge home from the hospital.

There were several limitations noted by the researchers of this case study. First, being that this is a single-patient case report limits the amount of data and generalization to all patient awaiting heart transplant. The second limitation is confounding factors such as additional disciplines (e.g., physical therapy, cardiopulmonary rehab, nursing staff) that may have contributed to functional mobility (e.g., ambulation, transfers, adherence to sternal precautions), thus also impacting overall patient related outcomes and independence in ADLs. A third limitation is the use of a non-standardized assessment for cognitive evaluation (i.e., Medi-Cog). It is

possible the patient's cognition improved due to learning the assessment instead of a true improvement, or that their cognition improved due medication or procedural side effects. Lastly, another limitation may be the scarcity of evidence-based practice to support out of bed activities with an IABP placed in the femoral artery.

Future research is needed to examine outcomes associated with acute care focused occupational therapy interventions in the cardiopulmonary patient population, especially with patients receiving critical care services using mechanical circulatory support like IABPs, ventricular assist devices (VAD), and extracorporeal membrane oxygenation (ECMO). More descriptive and comparison focused research that includes a larger sample size would provide a generalized and more diverse understanding of the impact that occupational therapy may on the functional performance of patient's pre and post heart transplant. Additionally, more long-term focused research on patient's functional performance with return to community-based occupations post-transplant needs to be further examined.

Conclusion

Occupational therapy has a unique role within the intensive care unit interdisciplinary team and should be consulted for evaluation and treatment with patients implanted with a transfemoral IABP awaiting a heart transplant. This case study provided a description of the occupational therapy process and performance outcomes from a single-case patient implanted with a femoral IABP pre-heart transplant and post-heart transplant. This patient case study provides an example of occupational therapy services being successfully delivered with no adverse medical events pre and post heart transplant. Furthermore, this case study provided a description of the function,

cognitive, and quality of life outcomes to consider for comprehensively measuring a patient's functional performance and perceived wellness pre and post heart transplant. For this case, occupational therapy facilitated holistic interventions that addressed fine motor skills, activity tolerance building, retraining and sustaining self-care performance, and cognition retraining and monitoring throughout the pre and post heart transplant.

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