Standard of Care: Inpatient Physical Therapy Management of the Patient s/p Cardiac Transplantation

ICD9 Codes:
428.0 Heart failure
425.0 Cardiomyopathy
996.83 Complications of transplanted organ/heart

Case Type / Diagnosis:

This standard of care applies to patients who are status post a primary orthotopic cardiac transplantation. An orthotopic heart transplant is a procedure in which the person’s native heart is removed and replaced with a donor/allograft heart. A technique less commonly used is the heterotopic procedure, where the donor heart is placed in the chest along with the patient’s native heart to assist the native heart’s function. This standard of care also includes information for patients who have previously undergone cardiac transplantation and are readmitted to the hospital for complications directly related to their transplant, or for unrelated conditions. It is a supplement to the cardiac standard of care and should be used in conjunction with the procedures and precautions outlined in that document.

Heart transplants are typically performed on patients who have end-stage heart disease or heart failure, but are otherwise healthy enough to undergo this surgery. The diseases for which cardiac transplant is indicated can be divided as follow: idiopathic cardiomyopathy (54%), ischemic cardiomyopathy (45%), congenital heart disease and other diseases (1%). Patients will specifically have a left ventricular ejection fraction of less than 25% and New York Heart Association (NYHA) class III or IV symptoms in order to be a candidate for heart transplant.

American Heart Association Statistics:
- There were 2,192 heart transplants performed in the United States in 2006 and 2,125 in 2005.
- Each year thousands more adults would benefit from a heart transplant if more donated hearts were available.
- In the United States, 74.2 percent of heart transplant patients are male; 68.4 percent are white; 20.0 percent are between the ages of 35-49 and 55.3 percent are between the ages of 50-64.
- As of June 15, 2007, the one year survival rate was 87.4 percent for males and 85.5 percent for females; the three-year survival rate was about 78.7 percent for males and 75.9 percent for females. The five-year survival rate was 72.3 percent for males and 67.6 percent for females.

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Indications for Treatment:

There are several important reasons for physical therapy following heart transplant. “Cardiac transplant patients continue to experience exercise intolerance due to extended inactivity and convalescence, associated skeletal muscle derangements, loss of muscle mass and strength, and the absence of autonomic cardiac innervation.” In addition, medical treatment with steroids postoperatively often leads to or worsens already existing muscular weakness. The patients who are able to stay active prior to heart transplantation, such as those on ventricular assist devices (VADs), may experience some of this to a lesser extent.

The APTA preferred practice patterns that apply to this population include:
- Impaired aerobic capacity/endurance associated with deconditioning.
- Impaired aerobic capacity/endurance associated with cardiovascular pump dysfunction or failure.
- Impaired muscle performance.

Contraindications / Precautions for Treatment:

Postoperative Complications

The heart transplant patient may experience postoperative complications including: right heart failure, persistent pulmonary hypertension, renal dysfunction, arrhythmias, bleeding, acute rejection, infection (examples include cytomegalovirus (CMV), pneumocystis carinii (PCP), herpes virus), or psychological disturbances related to steroid therapy. Initiation of physical therapy is delayed in the ICU until the patient is hemodynamically stable, the patient’s chest is closed, bleeding is controlled, and any other immediate postoperative medical complications have resolved.

Rejection

About two-thirds of patients experience at least one rejection episode in the first post-transplant year, with the greatest risk occurring in the early post-transplant months. Endomyocardial biopsies are performed routinely to screen for rejection. The biopsies are performed more frequently immediately postoperatively (weekly), and less frequently as time passes, eventually progressing to once a year.

Signs and symptoms of rejection may include symptoms similar to heart failure (fatigue, dyspnea, decreased exercise tolerance, hypotension, pericardial friction rub, ventricular S3 gallop, decreased cardiac output, peripheral edema, pulmonary crackles, jugular vein distension, increased temperature, arrhythmias, and/or decreased urinary output). However, the patient often does not have any symptoms.

When rejection is suspected, the patient’s immunosuppressive medications may be increased and biopsies may be performed more frequently. Patients who have had an increase in their glucocorticoid dosage have an increased possibility of a coronary event.
Sternal Precautions
For all patients s/p sternotomy with a stable sternum for 6 weeks, or until surgeon clearance:

- Avoid simultaneous bilateral shoulder flexion, abduction greater than 90 degrees.
- Log rolling for bed mobility to avoid strong contraction of the abdominal muscles.
- Avoid activities that may cause Valsalva maneuver.15
- Encourage chest splinting with pillow when coughing.
- Upper extremity (UE) strength & range of motion (ROM) testing greater than functional should be performed only if neurological changes are suspected to have occurred.
- Avoid full weight bearing through upper extremities (e.g., gait training must be at least partial weight bearing for ambulation)
- Avoid lifting, pushing, and pulling greater than 10 lbs. for 3 months (no use of bed ladder or trapeze).
- No driving and no sitting in passenger seat behind an airbag for 4 weeks.
  - Clarify specific orders with MD for patients who have an unstable sternum or who have developed pain, drainage, click, infection, necrosis or need for additional sternal surgery (e.g., rewiring or muscle flaps).
  - Encourage unilateral UE active ROM as tolerated to facilitate functional mobility gains and reduce the risk of shoulder ROM impairments and muscle performance changes.9,10,20
    - Discourage movements that cause bidirectional sternal stresses including bilateral shoulder extension and shoulder abduction.10,15
  - Consider patients who may be at high risk for sternal dehiscence12,16
    - Internal mammary artery use in bypass graft
    - Females with pendulous breasts
    - Morbid obesity
    - Barrel chest
    - History of diabetes mellitus
    - Osteoporosis

Infection Control Precautions
In order to protect the heart transplant patient from communicable illness, the following precautions are recommended by the Brigham and Women’s Infection Control Department:

- Anyone with a fever or upper respiratory infection may not enter the room (if it is essential for staff to enter the room to provide care for these patients, the staff member should wear a surgical mask)
- Gowns and gloves are needed to enter the room
- Anyone entering the room must disinfect their hands with an alcohol-based waterless agent or antimicrobial soap
- Use only the stethoscope in the patient’s room
- Communal patient care equipment is disinfected prior to bringing it into the patient’s room
- Patients are assigned to a single room
- Keep the number of visitors to a minimum
**Denervated heart**

Normally the heart is innervated via the vagus nerve, however during an orthotopic heart transplant procedure the heart becomes denervated and vagal input is lost. This alters the resting heart rate and also changes the heart rate responses during activity and exercise.

In a normally innervated heart, the vagus nerve at rest works by depressing the intrinsic rate of the heart set by the SA (sinoatrial) node. In the transplanted heart however, the SA node paces the allograft heart resulting in a higher resting heart rate. The resting rate elevates to approximately 90-110 beats per minute.

During exercise and activity, the transplanted heart is regulated by the humoral system instead of the neural system. The humoral system relies on circulating catecholamines to elevate the heart rate in response to the higher demands of activity, which lengthens the time between the onset of activity and the increase in heart rate. There is also a prolonged heart rate recovery after exercise. Therefore, there is a greater need for warm-up and cool-down periods during activity to allow for an appropriate heart rate response. Patients should gradually increase and decrease demands on the transplanted heart by extending their warm-up and cool-down periods to 5-10 minutes.

**Effects of use of steroids/immunosuppressive medications**

The heart transplant recipient will always be on immunosuppressive medications to prevent rejection of the donor heart. There are potential side effects of these medications which may include:

- Systolic and diastolic hypertension may be due to elevated catecholamine levels, the effects of immunosuppressive medications, altered baroreceptor sensitivity, or combinations thereof.
- There is a potential for decreased bone density and associated comorbidities. “Significant reduction in bone mineral density (BMD) occurs postoperatively in nearly 100% of heart transplant recipients immunosuppressed with glucocorticoids.”
- Potential for the development of diabetes: 15-20% of adult patients will develop diabetes after cardiac transplant.
- Steroid myopathies with proximal muscle weakness
- Increased risk for infections
- Increased tendency to develop lymphoproliferative malignancies

**Orthostatic hypotension**

Orthostatic hypotension is common in the early postoperative phase due to the absence of compensatory reflex tachycardia. Position changes should be performed slowly to allow the patient to slowly adapt to the new position.
Evaluation:

Medical History:
- Patient’s preoperative diagnosis including stage of heart failure if applicable
- Onset and duration of symptoms
- Primary admission for initial heart transplant vs. readmission for other medical reasons.
- Later complications that may result in repeat hospitalizations include, but are not limited to: rejection, infection, development of secondary malignancies, and coronary vasculopathy.
- The two most common malignancies to develop in this population of patients are post-transplant lymphoproliferative disorder (PTLD), and skin cancers. ⁸
- Primary surgery for heart failure vs. previous VAD.
- If patient used a VAD, note length of time spent on the device and type of device.

Hospital Course:
- Note any preoperative or postoperative evaluation studies, including but not limited to: results of heart catheterizations, echocardiograms, stress tests, electrocardiograms, endomyocardial biopsies.
- Date of surgery
- Postoperative course including length of time on pressors, length of time intubated, any postoperative complications

Social History:
- Prior functional level including remote vs. recent activity tolerance, types of activities the patient enjoys, and the typical frequency and duration of prior activities.
- Available home exercise equipment with early discussion regarding the patient’s preferences for mode(s) of exercise once they are home.
- Available home supports
- Home or community environmental barriers
- Family roles, professional roles and roles within the community

Medications:
- Note the patient’s current list of medications, including medications related to anti-rejection (i.e.: Cyclosporin, Cellcept, Prednisone) and hemodynamic control. If the patient is in the ICU, pay most attention to intravenous (IV) medications. Physical therapy may be delayed in some cases due to the use of certain IV medications. Refer to the cardiac standard of care for further details.

Examination (Physical / Cognitive / applicable tests and measures / other)

Observation:
- Make note of the equipment being used in the patient’s room including: intravenous lines/medications running, catheters, chest tubes (to suction vs. waterseal; mediastinal vs. pleural), pulmonary artery lines, method of oxygen delivery if being used, vital sign monitoring equipment.

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- Appearance of the patient including body type, cushinoid features or cachexia, areas of atrophy, skin integrity (presence of edema, any areas or potential areas of skin breakdown), tone/tremors, respiratory pattern
- Observe the sternal wound and make note of any areas of redness or swelling, and note the type of closure method and/or dressings being used.

**Mental Status:**
Evaluate patient’s level of alertness, ability to follow motor commands, and level of safety awareness. Also note any personality changes, such as being emotionally labile or euphoric, which may be occurring as a result of the use of steroid treatment.

**Pain:**
Assess pain related to the sternotomy and/or any other area of pain. Use verbal analog (VAS) rating scale for pain assessment. Note that cardiac denervation often prohibits the patient from feeling the sensation of angina.

**ROM:**
Assess gross range of motion of all extremities; shoulder flexion and abduction should be looked at unilaterally per sternal precautions. Note any limitations in spine mobility related to abnormal postures.

**Strength:**
Assess gross strength of the patient’s trunk and extremities, and consider the potential development of any proximal muscle weaknesses that may have occurred due to bedrest and/or the effects of anti-rejection steroids

**Sensation:**
Gross assessment of the integrity of patient’s sensory system is sufficient via light touch testing; more detailed sensory testing may be indicated if the gross assessment test is abnormal, or if the patient has any history that may warrant further testing (e.g., Diabetes, h/o CVA or any other neurologic problems).

**Posture/alignment:**
Note the presence of any postural abnormalities that the patient may have developed through the course of their illness.

**Function:**
Ongoing assessment of the patient’s ability to perform bed mobility, transfers, ambulation level surfaces, ambulation on stairs. Be aware that proximal muscle weakness may influence the patient’s ability to perform sit to stand transfers and stair training.

**Hemodynamic Monitoring:**
- All activity is monitored by measuring the patient’s heart rate (HR), blood pressure (BP), oxygen saturation (O2 sat), respiratory rate (RR), and rate of perceived exertion (RPE).
- Baseline values are documented, and taken again routinely throughout the patient’s activity program as the activity is advanced. Any abnormal results should be highlighted, and the patient’s activity may need to be stopped or modified.
- Be aware that the patient’s heart rate response to activity will be blunted, and an increase in heart rate should not be relied on as a limiting factor to the heart transplant recipient’s activity.
- In addition, cardiac denervation often prevents the patient from feeling the symptom of chest pain, as noted above.
- Abnormal responses to activity include: decreasing systolic blood pressure or the failure of the patient’s BP to elevate in response to activity, development of arrhythmias, patient reporting excessive fatigue with activity, lightheadedness/faintness or any other subjective complaint such as leg cramping.
Assessment:

**Problem List**

Potential impairments include but are not limited to:
- Pain
- Decreased muscular strength
- Decreased ROM
- Impaired skin integrity
- Decreased balance
- Decreased aerobic capacity/endurance
- Decreased patient knowledge regarding postoperative cardiac transplant precautions and activity/exercise progression

Potential functional limitations include:
- Bed mobility
- Transfers
- Ambulation level surfaces
- Ambulation stairs
- Ambulation distances

**Prognosis:**
The patient should be independent with all of their basic functional mobility at home and in the community immediately upon discharge from the hospital, or soon thereafter. The patient is encouraged to participate in a strengthening and endurance program, independently or monitored in an outpatient cardiac rehabilitation setting if needed, once their sternum has adequately healed. Most patients will achieve their maximal level of endurance within months of discharge. This will vary depending on the patient’s adherence to their exercise program and/or any complications.

The patient who has undergone a cardiac transplant should be able to attain a higher level of function and exercise tolerance than they had prior to surgery, although peak cardiorespiratory and cardiovascular responses to exercise in patients with orthotopic heart transplantation are blunted in comparison to normal age-matched norms. In a study by Badenhop, it was shown that physical work capacity is also significantly reduced to 46% of that achieved in normal subjects. Suggested reasons for persistently abnormal exercise capacity in the early posttransplant period include 1) Marked deconditioning prior to transplant due to heart failure; 2) Surgical denervation; 3) Corticosteroid therapy; 4) Peripheral vasoconstriction.

However, studies by studies demonstrate that exercise training provides positive results in the heart transplant recipient’s activity tolerance and muscular strength. Exercise training has been shown to be effective in improving exercise tolerance and aerobic capacity in patients who have undergone a heart transplant. It was shown that over time, patients can increase their average maximum MET level from approximately 5.0 to 6.0 METs with improvement in their physical work capacity on the average of 37% from early to late post-transplantation. In a study by Kobashigawa et al it was shown that exercise training initiated early after cardiac transplantation improved physical work capacity. It was also demonstrated in a study by Braith
et al.\textsuperscript{6} that a 6-month resistance exercise program is successful in preventing the effects of steroid-induced myopathy.

**Goals:**

Goals to be achieved in 1-2 weeks for discharge to home:

- Independent mobilization including bed mobility, transfers, ambulation level surfaces and stairs
- Good ambulation balance
- Patient will tolerate specified ambulation distances level surfaces and stairs with stable vital signs and rated perceived exertion of 4-6/10 (moderate) or less.
- Functional range of motion and strength of all extremities
- Patient will be independent in a home endurance exercise program
- Patient will be independent in a home strengthening exercise program
- Patient will demonstrate a good understanding of the following information: how to safely advance their exercise programs; sternal precautions; home safety; effects of denervation on the heart; methods for counteracting the effects of steroids.

**Treatment Planning / Interventions**

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<th>Established Pathway</th>
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<td>Established Protocol</td>
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**Interventions most commonly used for this case type/diagnosis**

Pacing and prolonged warm-up and cool-down periods of 5-10 minutes are encouraged with all activity in this population of patients.

Progression of therapeutic exercise program:

- Initial exercises may include supine active assisted range of motion (AAROM) exercises if the patient is significantly deconditioned.
- The patient is issued a cardiac therapeutic exercise program, and the patient is advanced from active supine exercises to seated exercises to standing exercises.
- Weights may be added to the program, adhering to the guidelines of 3 lbs or less for the proximal upper extremities (due to sternal precautions), and up to 5 lbs for the lower extremities and distal upper extremities (biceps and lower).
- Postural exercises are incorporated into the program.
- Proximal muscle strengthening is important to counteract the effects of steroids and generalized weakness (e.g., partial squats, partial sit to stand).
- It has been demonstrated that resistance exercise training can prevent myopathy that is associated with the use of corticosteroids post-transplant\textsuperscript{6}, and progression of the patient’s weight program should be encouraged once their sternum has healed.
Progression of functional mobility:

- Early intervention often consists of bed mobility via log rolling, transfers, and initial ambulation with the use of assistive devices.
- Use assistive devices initially that allow for the greatest endurance training, and wean from assistive devices as appropriate.
- Encourage an ambulation program of at least three times daily with the assistance of nursing staff or family if appropriate, and advance towards independent ambulation.
- The distance of ambulation will be determined by the patient’s hemodynamic and perceived responses to activity during their therapy sessions.
- The patient is advanced to stairs once they are ambulating functional distances and/or are nearing discharge home. The patient may require a shorter practice step in their room initially if proximal muscle weakness is present.
- Continuous patient education is needed to encourage self-monitoring.

Progression of patient’s endurance training program:

- According to American College of Sports Medicine (ACSM) guidelines, the heart transplant patient should perform aerobic exercise 4 to 6 days/week while progressively increasing the duration of training from 15 to 60 min/session.4
- Warm-up and cool-down periods of 5-10 minutes are always incorporated into the patient’s training program, as previously stated.
- The endurance program is initially addressed along with the patient’s function. A walking program is established as soon as possible postoperatively. The distance encouraged is based on the patient’s tolerance to activity during physical therapy sessions and advanced as the patient is able to tolerate.
- Other options for endurance training while the patient is an inpatient at Brigham and Women’s Hospital include use of a restorator or stationary bike. When starting any endurance training, the patient’s HR, BP, RR, SpO2 and RPE are monitored prior to activity, and in regular intervals during the activity (every 5 minutes), and in regular intervals following cessation of the activity.
- Regardless of the mode of exercise, their program is progressed in terms of frequency, duration and intensity, as the patient is able to tolerate. Interval training is often used to advance their program.
- In preparation for discharge home, the patient’s home endurance exercise program is established. The therapist should discuss early in the patient’s course their available resources for exercise equipment at home. The patient is encouraged to choose types of exercises that they will enjoy. Any exercise equipment that requires use of the upper extremities (e.g., elliptical or row machine) needs to be avoided until their sternum is completely healed. Recommendations are provided in terms of mode, frequency, duration and intensity for each individual patient.
According to the American Physical Therapy Association’s (APTA) guidelines for monitoring of cardiovascular patients, the following are indications for discontinuing or modifying activity:

- Pallor, peripheral cyanosis; cold, moist skin
- Staggering gait, ataxia
- Confusion or blank stare in response to inquiries
- Resting heart rate > 130 bpm, < 40 bpm
- More than 6 arrhythmias (irregular heart beats) per hour
- Uncontrolled diabetes mellitus (BS > 250 mg/dL)
- Oxygen sat < 85%
- Acute infection or fever > 100 degrees F
- Inability to converse during activity
- Fall in SBP with increased activity (10 mmHg or more)
- Rise in SBP > 250 mmHg or diastolic pressure > 120 mmHg
- Patient’s request

A six-minute walk test is performed prior to discharge from the hospital. The results of the test should aid the therapist in developing an appropriate home exercise program.

**Frequency & Duration:**
Frequency and duration of treatment will vary depending on the patient’s needs. The patient immediately post-op heart transplant may only tolerate brief sessions of therapy while they are in the ICU, and the frequency and duration of treatment will often increase as their tolerance to activity increases. The patient may require 5-7 day/week frequency as they approach discharge from the hospital.

**Patient / family education:**
Topics of education that are addressed with the patient and family include: 1) Recommendations for the patient’s home exercise program including a strength training program and endurance training program, 2) Importance of warm-up and cool-down periods of activity during exercise with a denervated heart, 3) Self-monitoring during exercise including the probability of the absence of chest pain as an indicator of excessive workload, 4) sternal precautions, 5) handling times of rejection in terms of their mobility and exercise, and 6) importance of adherence to a strengthening program to counteract the effect of steroids in terms of muscle weakness and bone quality.

Available handouts include: Guidelines after Heart Surgery, Sternal Precautions, Log rolling instructions, cardiac therapeutic exercise program, Beginner Aerobic Home Exercise Program.
Recommendations and referrals to other providers.

- Referral to social work or psychiatry is warranted if the patient is experiencing difficulty coping with the issues surrounding heart transplantation.
- Refer the patient to occupational therapy if the patient is demonstrating difficulties with their activities of daily living (ADLs).
- Care coordination may need to be involved if there are any issues regarding the patient’s discharge plans.

Re-evaluation / assessment

The patient will be reassessed every 7-10 days while they are an inpatient as per department guidelines. Other circumstances that warrant reassessment include: a significant change in the patient’s medical status, the patient is ready to advance beyond the original goals, or the patient is being discharged from the facility.

Discharge Planning

**Commonly expected outcomes at discharge:**
Independent mobilization with the least amount of assistive devices and an independent strengthening and endurance program are the optimal goals for discharge.

**Transfer of Care**
The heart transplant patient is typically discharged to home with an independent home program. Patients who have not reached a level of being able to go home may be discharged to an extended care facility, however a home plan is encouraged if possible due to the higher risk of infection in this patient population. Home VNA physical therapy is also an option. Patients are often referred to outpatient cardiac rehabilitation by their cardiologists once their sternum has healed.

**Patient’s discharge instructions**
The patient will be discharged to home with an individualized strengthening program to be performed 2-3 days/week, and an individualized endurance program to be performed 4-6 days/week. Specific recommendations are provided to each patient in terms of mode, frequency, intensity and duration of the exercise upon discharge. They are also instructed how to safely advance their home program.

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References


