

## The Transplant Patient

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### HISTORY

- The ability to transplant an organ from one individual to another is a relatively new phenomenon. Early attempts at transplant were barely successful. New advances in surgical techniques and immunosuppressive drugs, however, have made transplantation of solid organs a viable treatment option.
- The increased life expectancy of transplant patients means that physical therapists have many opportunities to treat patients after transplant in various settings.

### HISTORY

- Trends in patient demographics indicate that a physical therapist may see a transplant patient not only in a regional medical center setting but also in outpatient and rural clinics.

### BACKGROUND

Early transplant experiments were carried out on animals in the early 1900s, with success at maintaining life for 90 minutes to 8 days . Medical advances in cardiopulmonary bypass and immunosuppressive medications provided the opportunity for successful transplants. After many trials and failures, the first successful heart transplant was performed in 1967 by Barnard; the first successful lung transplant was performed in 1963 by Hardy and Webb.

## Purpose of Transplants

Although transplants are considered an acceptable treatment option, a solid organ transplant is usually considered a last-resort therapeutic intervention.

Medical intervention for diseases, such as cardiomyopathy and interstitial pulmonary fibrosis, is limited.

When conventional medical therapy has failed, a transplant may be considered. Although a transplant offers a patient a second chance at life, the medical management of a transplant causes a patient to require medical intervention on a long-term basis.

## Availability of Transplants

The number of medical centers who perform transplants has grown to approximately 175 worldwide in 1989. Because of the success rates, many types of transplants are no longer considered experimental but are considered appropriate treatment for organ failure. In 1994 approximately 10,000 kidney transplants were performed and 2500 heart transplants were completed.

## Rejection Issues

Although transplants are successful, some health professionals believe that patients are merely exchanging one set of problems for another. For a transplant to be successful, a patient must remain on powerful immunosuppressive drugs for the remainder of his or her life.

- Some of these medications have crippling side effects.
- The effects of long-term prednisone usage are osteoporosis, muscle weakness, and glucose intolerance,
- long-term effects of cyclosporine and azathioprine impact on the patient's ability to fight infection.
- Patients also need to manage medication side effects on a day to day basis. It is these medications, however, that make for impressive survival rates.

### 1-year survival rates are as follows:\*

- Kidney 93.8%
- Liver 76.7%
- Heart 82.6%
- Heart-lung 57%
- Lung 68%

### Organ Donation

- The major limitation of organ transplantation is a
- supply and demand issue. The number of patients who could benefit from transplant significantly exceeds the number of organs available.
- Self decision
- Family consent

### CURRENT TRANSPLANT ISSUES

- Organ management
- Ethical issues
- Waiting Time

#### *Criteria for Transplant Waiting List*

Age: under 65 (60 in some centers)

Terminal illness (expected life span less than 1 year)

Nonsmoker

Adequate social support system

Disease free in other systems

## Patient Education

- The waiting period time provides an ideal opportunity for patient education. Nursing generally provides much of the education regarding preoperative procedures,
- Postoperative course, and medication. Rehabilitation teaching includes breathing training, airway clearance techniques, and activity progression

## SURGICAL PROCEDURES

Heart transplants are usually performed through a median sternotomy incision and cardiopulmonary bypass is used

- A midline incision from sternal notch distally allows the sternum to be accessed and split. Although the native heart is excised, a portion of the right atrium and the SA node is preserved.
- The donor heart is sutured to the atrial cuff and the major vessels reattached. After surgery, the two halves of the sternum are wired together, the new heart defibrillated, bypass reversed, and the patient awakened.

## Lung transplant

- Single lung transplants are performed through a posterolateral thoracotomy incision, with the patient side lying on the opposite side. To allow visual access for the surgeon, the latissimus dorsi and lower trapezius muscles are cut.
- The incision through the fourth or fifth intercostal space also means the intercostal muscles at this level may be incised.

- Double-lung transplants are performed through an anterior incision sometimes described as a clamshell approach. A horizontal incision above the level of the diaphragm is performed, but the distance needed for adequate visualization means that the pectoralis major and minor may be incised bilaterally.

## PHYSICAL THERAPY CONSIDERATIONS

Physical therapists need an understanding of the physiological components of both the

1. Pre transplant disease
2. Post transplant state,
3. the influence of surgery or physiology on musculoskeletal structure and function,
4. Medical management

## Pre transplant

- The cardiovascular and respiratory systems
- Adequate oxygenation and circulation are needed to provide fuel to perform daily activities.
- Pulmonary rehabilitation has been beneficial in improving daily function
- The waiting period before transplant is an ideal time to optimize muscle function and flexibility.
- Musculoskeletal Considerations

## PHYSICAL THERAPY ASSESSMENT

- The purpose of physical therapy before transplant is .To identify baseline function and to screen for impairments that may limit rehabilitation goals. Physical therapists will provide treatment in the pre transplant period.
- In other cases, the information gained from early assessment allows the therapist to identify areas needing attention or modification after transplant.
- Physical therapy assessment in the postoperative period addresses specific impairments and functional limitations of the individual.

## Cardiac Patients

- Pre transplant assessment of the cardiac patient includes
- functional ambulation (6-minute walk)
- screening for deficits in muscle strength or range of motion.
- Exercise training is not generally recommended pre transplant.
- Range of motion may be increased or specific muscle strengthening may be accomplished.  
All patients will be limited in functional endurance, therefore the results of the 6-minute walk is compared with post transplant functional status.

## Pulmonary Patients

Because rehabilitation in the pre transplant period is often indicated in patients waiting for lung transplant, the physical therapy assessment information may be used to design a more effective rehabilitation program.

1. Upper and lower extremity muscle strength
2. Range of motion is assessed, as well as posture, shoulder and trunk mobility
3. Breathing pattern, breath sounds, and functional mobility.

## Post transplant Assessment (Heart and Lung)

- After transplant, physical therapy assessment addresses all areas of functional limitations and the corresponding impairments. Patients should be evaluated in the immediate postoperative phase, and re evaluated on admission to the outpatient treatment phase.
- Bed mobility
- Ventilation
- Secretion management
- Range of motion, Pain control are important areas to address.

## REHABILITATION OF THE TRANSPLANT PATIENT

To assist in treatment planning, rehabilitation is categorized into the four phases

- Pre transplant
- Postoperative acute phase
- Postoperative outpatient phase
- Community- or home-based phase.

## PRETRANSPLANT REHABILITATION

- Heart Transplant
- Because the patient awaiting heart transplant has significantly compromised cardiac output and may be hemodynamically unstable preoperative rehabilitation is generally not recommended. Some patients may need musculoskeletal intervention for decreased range of motion, muscle weakness, or general discomfort. If physical intervention is needed, heart rate, blood pressure, and ECG monitoring is used to guide treatment. If heart rate or blood pressure decreases during exercise, exercise should be stopped.

## PRETRANSPLANT REHABILITATION

- Lung Transplant
- Pre transplant rehabilitation resembles pulmonary rehabilitation programs in existence for patients with COPD, CF, and restrictive diseases

Oxygen needs are essential to monitor. A pulse oximeter with finger or ear probe is mandatory in a pre transplant pulmonary rehabilitation program.

Oxygen saturation should be maintained above 88% at all times.

**TABLE 38-1**  
Recommended Monitoring  
√ = heart      x = lung

	BLOOD PRESSURE	HEART RATE	Sat <sub>o</sub>	RATING OF PERCEIVED EXERTION
Before exercise	x √	x √	x	
During exercise	√	x √	x	x √
After exercise	√	x √	x	



## Goals

- The overall goal of pre transplant pulmonary rehabilitation is to maximize function and reduce all musculoskeletal impairments to function.
- Using the waiting time to maximize muscle strength and range of motion means that less time is needed post transplant to return to functional activities.

Preoperative Pulmonary Rehabilitation		
<b>Warm-up (group)</b>		<b>15 minutes</b>
Active range of motion		
Upper body		
Lower body		
Trunk		
Light resistance (5 to 10 rep)		
<b>Individualized Endurance Program</b>		
Bike (Aerobic)	25 to 30 mins	60 to 20 minutes intervals
Treadmill	0.8 to 1.3 mph	60 to 20 minutes
	0% to 5% grade	60 to 15 minutes forward and backward
Arm ergometer	0 to 25 wats	
<b>Individualized Strength Program</b>		<b>15 to 20 minutes</b>
<b>Palms</b>		
Latissimus pull-downs		
Dips on arms		
Prone pull		
Latissimus		
Triceps		
Shoulders		
Lower Extremity		
Quadriceps		
Hip extension		
Hip abductors		
<b>Cool-down (group)</b>		<b>10 minutes</b>
Stretching (full-body)		
Breathing		
Relaxation		

## ACUTE PHASE REHABILITATION

- The acute phase of rehabilitation begins in the intensive care unit and continues throughout the patient's hospital stay.

### Goals

- Goals of the acute phase of rehabilitation
  - regain normal postural cardiovascular responses (no postural hypotension)
  - increase functional activities.
- The former is primarily focused on the patient being able to tolerate changes in position, increase time in upright sitting, and transfer independently.
- Upper and lower extremity range of motion and strength need to be adequate to perform activities of daily living.

## Exercise Guidelines

- Deconditioning and lack of sympathetic input to increase heart rate response contribute to the possibility of hypotension. Because of the high incidence of postural hypotension, patients need to change positions slowly and be given time to adapt to the new position.
- Exercise may be continued during mild-to-moderate rejection episodes but is not performed during periods of severe rejection.
- The main consideration for exercise in patients with heart transplants is that the heart is denervated. Because of the lack of sympathetic input, heart rate cannot increase quickly and contractility is not under sympathetic control. The only mechanism by which heart rate can be increased is by circulating catecholamines, which take 10 to 15 minutes to influence a response. Therapists working with heart transplant patients should allow time for patients to adapt to changes in position and may want to use light active bed exercises as a warm-up activity.

## Heart Transplant (Acute) Considerations

- Transplanted heart is stiff for several days, and the sympathetic nervous system input to the heart is destroyed in the transplant process. To maintain cardiac output (HR x SV) in a heart with decreased stroke volume a fixed rate pace maker is used at a rate of approximately 120 beats/minute for several days. The therapist working with heart transplant patients in the ICU should be aware that heart rate cannot increase significantly, therefore blood pressure and patient response should be monitored.
- Treatment, with increases of 0.5 to 1 metabolic equivalent (MET) per day
- Acute rejection episodes are characterized by flu-like symptoms



## Lung Transplant Considerations

- After lung transplantation, patients are generally mechanically ventilated for 24 to 72 hours. Often, paralytic agents are used in this period so that ventilation can be optimized.
- Patients who received double-lung transplants may be more hemodynamically compromised
- Chest tubes are likely in place, and patients are medicated for pain.
- Infection control is imperative; isolation rooms with negative-pressure ventilation are used
- medical personnel at minimum are required to wash their hands and wear masks when in the patient's room. Isolation or reverse-isolation procedures are followed
- The primary monitoring is oxygen saturation, followed by heart rate and blood pressure.
- A common complication in the immediate postoperative period is pneumothorax.

PROBLEM	GOAL
<b>Decreased secretion clearance</b> Because the lungs are deservant, there is decreased sensation of secretions	Independent secretion management
<b>Incisional pain</b> Postoperative pain is related to the surgical incision and decreased movement of muscles.	Pain management Pain medication
<b>Abnormal postural hemodynamic responses</b> (i.e., postural hypotension and fatigue)	Normalized hemodynamic response (i.e., no postural hypotension, normal heart rate, respiratory rate, and blood pressure response to exercise)
<b>Increased oxygen/ventilatory requirements</b>	Adequate oxygenation without supplemental (SaO <sub>2</sub> 90% to 96% on room air) Diaphragmatic breathing Normal vital capacity
<b>Decreased functional mobility</b> Decreased shoulder range of motion	Independent activities of daily living (dressing, hygiene, shower, toilet) Need adequate shoulder range of motion to perform these activities
<b>Decreased exercise tolerance</b>	Independent transfers Out of bed most of day Independent ambulation 500 ft Bicycle 10 minutes, no resistance
<b>Compromised nutrition</b>	No supplemental feedings (IV)

Acute Rehabilitation Interventions	
GOALS	INTERVENTIONS
Independent secretion management	Incentive spirometer Secretion removal (positioning, percussion, and vibration) Assisted cough or instruction
Pain management Pain medication	Active range of motion shoulder girdle Positioning Mild heat Massage/soft tissue techniques
Normalize hemodynamic response (i.e., no postural hypotension, normal heart rate, respiratory rate, or blood pressure response to exercise)	Sitting on edge of bed Out of bed to chair day 1 or 2 Ambulation to bathroom day 2 or 3
Adequate oxygenation without supplemental oxygen Diaphragmatic breathing with activity Normal vital capacity	Instruction of diaphragmatic breathing Facilitation of diaphragmatic breathing Lateral costal expansion techniques (surgery side) Incentive spirometry

Independent activities of daily living (dressing, hygiene, shower, toilet) Need adequate shoulder range of motion to perform these activities	Encourage and assist with activities of daily living Active and active-assisted stage of motion All motion shoulder girdle Wall exercises Side lying shoulder abductors
Independent transfers Out of bed most of day Independent ambulation 500 ft Bicycle 10 minutes, no resistance	Daily schedule Assisted ambulation in room initially, to hallway within 2 to 3 days Bicycle in room, 2 minutes initially, progress to 10 minutes
No supplemental feedings (IV)	Schedule rehabilitation around meals Medical management of nausea

## POSTOPERATIVE OUTPATIENT REHABILITATION Heart Transplant

### *Summary Cardiac Guidelines*

Cardiac phase II protocols  
 Heart rate is not intensity regulator  
 Increase warm-up and cool-down to 10 to 15 minutes  
 RPE 11 to 13 (20-point Borg scale)  
 No exercise in severe rejection (biopsy)  
 Continue exercise in mild rejection

## POSTOPERATIVE OUTPATIENT REHABILITATION

### *Lung Transplant Guidelines*

Keep  $SpO_2$  above 90%  
 Add supplemental oxygen if necessary during  
 treated acute rejection episodes  
 Patient should wear mask when with people  
 Increase strength program during prednisone bursts

## COMMUNITY OR HOME-BASED REHABILITATION

### **Heart Transplant**

- The medications used to prevent rejection in transplant patients may increase the incidence of coronary artery disease. It is recommended that patients participate in a regular exercise program to manage the effects of the medications and to prevent coronary artery disease complications.

## COMMUNITY OR HOME-BASED REHABILITATION

- If the patient is medically stable but has rehabilitation needs, the patient may be referred for physical therapy in his or her home town, patients may have multiple episodes of rejection, which are treated with high-dose steroids, and develop steroid myopathy, requiring intensive and progressive strength training.

*Side Effects of Immunosuppressive Medications*

<b>Prednisone</b>	<b>Cyclosporine</b>
Hypertension	Tremors
Glucose intolerance	Hypertension
Osteoporosis	Increased cholesterol
Muscle weakness	Nephrotoxicity
Delayed wound healing	

