Thoracic Transplantation (Heart, Lung, Heart/Lung)  
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Michael Petty MS, RN, CCNS, CNS; Cardiothoracic Clinical Nurse Specialist at Fairview-University Medical Center, Minneapolis, Minnesota presented the following information at United Resource Network's, A Course In Transplantation For Case Managers, Newport, RI, October 2003.

Absolute Contraindications to Thoracic Transplantation
* Positive prospective cross match with donor.  
* Bone marrow failure.  
* Malignancy precluding long-term survival.  
* Etiology likely to recur in transplanted organ(s).  
* Irreversible renal and/or hepatic dysfunction.  
* Diabetes with end organ damage.  
* Morbid obesity and sever cachexia.  
* Current cigarette/alcohol/drug use.  
* Fixed pulmonary hypertension in adult heart candidates.  
* History of noncompliance with medical regimens.  
* Inability to fully understand the procedure and its follow-up care (Petty, M., MS, RN 2003).

Relative Contraindications to Thoracic Transplantation
* Physiologic age  
* Heart - <= 65 years of age.  
* Single lung transplant <= 65 years of age.  
* Bilateral lung transplant <= 55 years of age.  
* Heart-lung transplant <= 50 years of age.  
* Weight outside acceptable range.  
* Prednisone dose > 20 mg per day or 40 mg per day for lung recipients.  
* Tobacco use within 6 months.  
* Mechanical ventilation in lung transplant candidates.  
* Intrinsic renal disease (Petty, M., MS, RN 2003).

Temporary Contraindications to Thoracic Transplantation
* Inadequate insurance coverage - related to costs of the surgery, related to costs of immunosuppressive mediations, related to costs of follow-up visits (Petty, M., MS, RN 2003).

Evaluation of Heart Candidates
* Laboratory panels including immunology evaluation.  
* Viral antibody status (CMV, HSV, HIV, HBV, HCV).  
* Cardiopulmonary exercise testing.  
* Right and left heart catheterization with coronary angiogram if none recently.  
* Echocardiogram.  
* Cardiac biopsy.
*Neurohormone levels.
*DEXA scan.
*Up-to-date primary care evaluation.
*Neuropsychological evaluation (Petty, M., MS, RN 2003).

Evaluation Heart-Lung Candidates
*Laboratory panels including immunology evaluation.
*Viral antibody status (CMV, HSV, HN, HBV, HCV).
*Right and left heart catheterization with coronary angiogram if none recently.
*Pulmonary function tests.
*X-ray, CAT scan.
*V/Q scan.
*DEXA scan.
*Up-to-date primary care evaluation.
*Neuropsychological evaluation as needed (Petty, M., MS, RN 2003).

Evaluation Single or Bilateral Lung Candidates
*Laboratory panels including immunology evaluation.
*Viral antibody status (CMV, HSV, HN, HBV, HCV).
*Coronary angiogram.
*Pulmonary function tests.
*X-ray, CAT scan.
*V/Q scan.
*DEXA scan.
*Up-to-date primary care evaluation.
*Neuropsychological evaluation as needed (Petty, M., MS, RN 2003).

Care During Waiting Period
*Flolan (Epoprostenol) for Pulmonary Hypertension administered as a continuous infusion.
Needs dedicated intravenous line.
Cannot be stopped for more than 3-5 minutes.
Prolonged cessation can lead to rebound pulmonary hypertension and death (Petty, M., MS, RN 2003).

Pulmonary Problems following Lung transplantation
*Acute lung injury.
*Pneumothorax, hemothorax.
*Bacterial pneumonia.
*Acute rejection.
*Anastomotic problems.
*CMV Pneumonia.
*Non-CMV Viral Pneumonia.
*Obliterative bronchiolitis.
*Infection due to immunocompromised state.
Evaluation - Chest x-ray, bronchoscopy, brochoalvelar lavage, culture (blood,
urine, sputum).
Treatment - Antibiotics, reduction in immunosuppression.
*Decreased gas exchange due to airway narrowing.
Evaluation - Chest x-ray, bronchoscopy, spiral chest CT scan.
Treatment - Balloon dilation, stenting, laser therapy (Petty, M., MS, RN 2003).

**Long Term Complications**
*Transplant Vasculopathy (Chronic Rejection).
Evaluation - endomyocardial biopsy, cardiac catheterization, echocardiogram, EKG.
*Obliterative Bronchiolitis, Chronic Rejection, Bronchiolitis Obliterans Syndrome.

**Thoracic Transplantation in the future** - Xenotransplantation, Artificial lung (Petty, M., MS, RN 2003).

**Future state of the Art Cardiac Assist Programs**
*Abiomed BVS 5000 Left/Right/Bi- Ventricular Assist device.
*Thoratec Left/Right/Bi- Ventricular Assist System.
HeartMate XVE Vented Electric Left Ventricular Assist System. (Petty, M., MS, RN 2003).

Immunosuppression remains vital for patient/graft survival in thoracic transplants, as with all other transplants. The 2003 OPTN/SRTR Annual Report noted that in 2001, the most common maintenance therapy combination for heart transplant recipients within the first year after transplantation consisted of corticosteroids, cyclosporine or tacrolimus, and mycophenolate mofetil.

**Calcineurin inhibitors:** Therapy with cyclosporine or tacrolimus remains the cornerstone of maintenance immunosuppression in heart transplant recipients. Over the past 10 years, there has been a trend toward less use of cyclosporine and more use of tacrolimus. Cyclosporine use has decreased from 99% in 1992 to 65% in 2001, with Neoral® being the most frequent formulation. The use of tacrolimus has greatly increased from 1% to 43% during the same time interval. (2003 OPTN/SRTR Annual Report).

**Antimetabolites and rapamycin:** Although antimetabolites are still frequently used within the first year after heart transplantation, there has been a shift in practice over the last 10 years. The use of mycophenolate mofetil now appears to be standard practice (81% in 2001) in heart transplantation. Overall, there appears to be a slight decline in the use of the standard antimetabolites as a class. In 1992, approximately 97% of heart transplant recipients received either azathioprine or mycophenolate mofetil. In 2001, the use of either azathioprine or mycophenolate mofetil fell to 95%. Concurrent with this trend, there was an increase in use of other novel immunosuppressant agents. In 2001,
approximately 8% of heart transplant recipients received rapamycin within the first year after transplantation. (2003 OPTN/SRTR Annual Report).

**Corticosteroids:** The vast majority of heart transplant recipients are treated with corticosteroids as part of maintenance therapy during the first year after transplantation. Over the last 10 years, there has been no clear trend in the use of corticosteroids. In 2001, 91% of heart transplant recipients received either prednisone or methylprednisolone. (2003 OPTN/SRTR Annual Report).

The 2003 OPTN/SRTR Annual Report noted that in 2001, the most common maintenance therapy combination for lung transplant recipients within the first year after transplantation consisted of corticosteroids, tacrolimus, and either azathioprine or mycophenolate mofetil.

**Calcineurin inhibitors:** As in heart transplantation, cyclosporine or tacrolimus remain the primary calcineurin inhibitors used for immunosuppression in lung transplant recipients. Tacrolimus now appears to be the agent of choice. Cyclosporine use has decreased from 93% in 1992 to 46% in 2001, with NeoralB being the most frequent formulation. The use of tacrolimus has increased from 7% to 69% during the same time interval. (2003 OPTN/SRTR Annual Report).

**Antimetabolites and rapamycin:** Although antimetabolites are still used frequently, the use of azathioprine declined from 97% in 1992 to 49% in 2001. The use of mycophenolate mofetil concurrently increased from 0% to 52% over the same time period. Overall, there appeared to be a slight decline in the use of standard antimetabolites as a class. In 1992, approximately 97% of lung transplant recipients received azathioprine. In 2001, the use of either azathioprine or mycophenolate mofetil fell to 91%. Concurrent with this trend, there was an increase in use of other novel immunosuppressant agents. In 2001, approximately 11% of lung transplant recipients received rapamycin within the first year after transplantation. However, the recent trend shows a decrease in use, perhaps related to the observation that airway anastomotic dehiscence is associated with the use of rapamycin immediately after lung transplantation. (2003 OPTN/SRTR Annual Report).

**Corticosteroids:** The vast majority of lung transplant recipients are treated with corticosteroids as part of maintenance therapy during the first year after transplantation. Within the last decade, there has been no clear trend in the use of corticosteroids. In 2001, nearly 100% of lung transplant recipients received either prednisone or methylprednisolone. (2003 OPTN/SRTR Annual Report).

The 2003 OPTN/SRTR Annual Report noted that in 2001, the most common maintenance therapy combination for the small numbers of heart/lung transplant recipients within the first year after transplantation consisted of corticosteroids, tacrolimus, and mycophenolate mofetil.
**Calcineurin inhibitors:** Cyclosporine or tacrolimus remain the cornerstone of maintenance immunosuppression in heart-lung transplant recipients. Over the past 10 years, there has been a trend toward less use of cyclosporine and more use of tacrolimus. Cyclosporine use has decreased from 81% in 1992 to 50% in 2001, with Neoral B being the most frequent formulation. During the same time interval, the use of tacrolimus has increased greatly, from 19% to 75%. (2003 OPTN/SRTR Annual Report).

**Antimetabolites and rapamycin:** Although antimetabolites are still used frequently within the first year after heart-lung transplantation, there was a shift in practice over the last decade. The use of azathioprine declined from 97% in 1992 to 50% in 2001. Concurrently, the use of mycophenolate mofetil rose to 60%. The use of rapamycin increased to 10% in 2000; however, no first year heart-lung patients received rapamycin in 2001. (2003 OPTN SRTR Annual Report).

**Corticosteroids:** The vast majority of heart-lung transplant recipients were treated with corticosteroids as part of maintenance therapy during the first year after transplantation. In 2001, 95% of heart lung transplant recipients received either prednisone or methylprednisolone. (2003 OPTN/SRTR Annual Report).

The Milliman USA Research Report 2002 noted the median waiting time for heart transplants was 206 days, Lung transplants 704 days and heart lung transplants 889 days. In 1999, there were 7,546 patients waiting for heart transplants, of those 712 died while waiting. There were 5,074 lung transplant patients listed and 591 died while waiting. There were 353 patients waiting for heart-lung transplants and of those 53 died while waiting. Survival rates for heart transplant patients in 2000 are 86% at one year, 77% at three years and 70% at five years. Lung transplant recipients survival rates were 77% at one year, 58% at three years and 44% at five years. Heart-lung recipient survival rates were 60% at one year; 51% at three years and 42% at five years. (2002 Milliman USA). The Milliman Research Report 2002 outlines the cost of thoracic transplants through the first year of follow-up as follows:

**Heart:** Evaluation - $16,800; Procurement - $57,000; Hospital - $210,400; Physician - $29,300; Follow-up - $68,100; Immunosuppressants - $10,200.

**Lung:** Evaluation - $17,400; Procurement - $58,200; Hospital - $170,400; Physician - $27,100; Follow-Up - $57,00; Immunosuppressants - $12,800.

**Heart-Lung:** Evaluation - $17,100; Procurement - $115,200; Hospital $253,800; Physician - $37,400; Follow-up - $68,100; immunosuppressants $12,800.

**Works Cited:**

OPTN/SRTR (US Organ Procurement and Transplant Network and Scientific

Petty, Michael MS, RN, CCNS, CNS; Cardiothoracic Clinical Nurse Specialist at Fairview-University Medical Center, Minneapolis, Minnesota. Thoracic Transplantation: Hospitalization to Discharge Care Issues. Presented at United Resource Network’s, A Course In Transplantation For Case Managers, Newport, Rhode Island, October 7-10, 2003.