Adult Heart Transplantation

Nader Moazami, M.D.
Staff Surgeon, Heart and Vascular Institute and the
Department of Biomedical Engineering, Cleveland
Clinic; Surgical Director of Kaufman Center for Heart
Transplantation and Mechanical Circulatory Support
## The Epidemiology of Heart Failure

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence</td>
<td>5 Million Americans</td>
</tr>
</tbody>
</table>
| Incidence     | 550,000 new cases/year
6-10% of people >65 years have heart failure                                  |
| Morbidity     | 1.1 million hospitalizations for HF as 1º diagnosis
5%-10% of all admissions
Most frequent cause of hospitalization in the elderly                          |
| Mortality     | Causes or contributes to 290,000 deaths/year
40% sudden cardiac death                                                       |
| Cost          | $29.6 billion (hospitalization accounts for 60% of cost)                    |
Heart Failure Severity in the United States

Class I
No limitations of physical activity

Class II
Slight limitations of physical activity

Class III
Marked limitations of physical activity

Class IV
Inability to carry out physical activities without discomfort and/or symptoms at rest

Class III
1.20 M (25%)

Class IV
240 K (5%)

Class I
1.68 M (35%)

Class II
1.68 M (35%)
Prognosis After **First** Symptoms of Heart Failure

**ONE YEAR**
Mortality of Hospitalized Patients:
- Mild to Moderate Symptoms: 10-20%
- Severe Symptoms: 40-60%

*Ho, K. Circulation 1993; 88:107-115*
*AHA, 1998 Heart and Statistical Update. NCHS, National Center for Health Statistics*
Continuous Inotropic Infusion
(n=36)

Mean age 55 years
NYHA Class IV heart failure
Maximum medical therapy
Failure to wean inotropes
Transplant not option

Heart Failure

Heart Failure Therapy
Tailored Medical Therapy
  85 - 90% do well

10 - 15% do poorly

Heart Transplantation

Mechanical Ventricular Assistance

Alternative Surgical Therapy
Heart Transplantation is the GOLD Standard for End-Stage, Refractory Heart Failure
Who Requires Cardiac Transplantation?

- Patients with an unacceptably limited prognosis
- Patients with an unacceptable quality of life secondary to congestive heart failure symptoms

All other appropriate medical and surgical options have been exhausted
LIFE

A new report on an era of medical failure

The Tragic Record of Heart Transplants

Six recipients of transplants, shown here against a picture of the heart, were all dead within eight months of being photographed together.
Adult and Pediatric Heart Transplants
Number of Transplants by Year and Location
Clinically Successful Transplant

Surveillance for Rejection and Complications

Understanding Immune Response and Tailored Therapy

Candidate Selection

Immunosuppression

Organ Allocation

Surgical Technique Post-op management

Definition of Appropriate Donor

Recipient Management

Organ Preservation

Donor Management
Adult and Pediatric Heart Transplants
Kaplan-Meier Survival
(Transplants: January 1982 – June 2012)

Median survival = 11 years
Median survival conditional on surviving 1st year= 14 years

N = 108,343
N at risk at 27 years = 108
Candidate Selection:
Contraindications to Cardiac Transplantation

- Coexistent illness with poor prognosis
- Irreversible pulmonary or hepatic disease
- Irreversible renal dysfunction (Cr > 2 mg/dl or Cl<sub>cr</sub> < 50 ml/min)
- IDDM with end-organ damage
- Cerebrovascular disease/peripheral vascular disease
- Active infection
- Coexisting neoplasm
- **Irreversible pulmonary hypertension**
- Severe obesity (BMI > 30-35)
- Severe osteoporosis
- Psychosocial instability, substance abuse, documented noncompliance
The Effect of PVR on 1-Year Mortality

J Heart Lung Transplant 19:909
UNOS Heart Allocation Criteria

**Status 1A***
- Mechanical circulatory support for acute decompensation
  - Left and/or right ventricular assist device*  Total artificial heart (30 days)
  - Intra-aortic balloon pump
  - Extracorporeal membrane oxygenator (ECMO)
- Mechanical circulatory support with device related complication
- Mechanical ventilation
- Continuous infusion of inotropic support (high dose single agent or 2 agents) with concomitant hemodynamic monitoring
- Life expectancy less than 7 days (Prospective Regional Review Board approval required)

**Status 1B** (Patient must have at least one of the following therapies in place)
- Left and/or right ventricular assist device support
- Continuous infusion of inotropic support

**Status 2**
- All other patients not meeting Status IA or IB criteria.

**Status 7**
- Patient is temporarily unsuitable to receive a cardiac transplant

*Patients must be admitted to the listing transplant center hospital and have at least one of the following therapies in place*
Effect of New Heart Allocation Model

- Transplant sickest patients first
- Decrease deaths on waiting list
- Status IA and IB transplanted sooner
- “Average” status II patients will wait longer
  Up to 30% either are upgraded; 10% die
Centers within a 500 mile radius
For a sample of transplant programs

Depending on the geographic location of the center, the 500 mile radius for each program includes from 4 to 67 other
Number of Candidates Ever Actively Waiting (2010-2012)

Each symbol represents one transplant center, with the size of the symbol proportional to the number of centers within 500 miles.
CC Heart Transplant Trends

Median Wait Months

<table>
<thead>
<tr>
<th>Year</th>
<th>Median Wait Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>5.4</td>
</tr>
<tr>
<td>2008</td>
<td>1.8</td>
</tr>
<tr>
<td>2011</td>
<td>7.5</td>
</tr>
<tr>
<td>2012</td>
<td>8.6</td>
</tr>
<tr>
<td>2013</td>
<td>9.7</td>
</tr>
</tbody>
</table>
Adult Heart Transplants

% of Patients Bridged with Mechanical Circulatory Support*
(Transplants: January 2000 – December 2012)
Factors Influencing the Decision to Utilize Donor Hearts

- Donor Age
- Donor-recipient size mismatch
- LV function
- Inotropic support
- The presence of coronary disease
- The presence of LVH
- Ischemic time
- Infections
- “Adverse” social history
HEART TRANSPLANTS:
Donor Age by Year of Transplant

J Heart Lung Transplant 2005;24: 945-982
Bicaval Technique

Diagram showing the bicaval technique with labels for Ao, SVC, PA, LA, and IVC.
Endomyocardial Biopsy
Adult Heart Transplants
Employment Status of Surviving Recipients
(Follow-ups: January 2000 – June 2013)

![Bar chart showing employment status of heart transplant recipients at 1, 3, and 5 years post-transplantation. The chart indicates the percentage distribution of recipients in categories such as retired, not working, working part-time, working full-time, and working with unknown FT/PT status.]
Adult Heart Transplants
Number and % of Combined Organ Transplants Reported by Year and Type of Transplant

JHLT. 2014 Oct; 33(10): 996-1008
Cardiac Hepatic Relationships

Heart Failure

- Left Heart Failure:
  - decreased hepatic blood flow,
  - increased hepatic venous pressure, and
  - decreased arterial oxygen saturation

- Abnormal liver function:
  - bilirubin, INR
  - Increased fibrosis
  - cirrhosis

Heart Fail Rev (2012) 17:355–366
European Heart Jour 2013; 34, 2804–2811
World J Hepatol 2014 January 27; 6(1): 41-54
Circ Res. 2014;115:176-188
## ADULT HEART TRANSPLANTS (2006-6/2011)

### Risk Factors For 1 Year Mortality

<table>
<thead>
<tr>
<th>Continuous Factors (see figures)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Recipient age</td>
<td></td>
</tr>
<tr>
<td>Recipient height</td>
<td>Ischemia time</td>
</tr>
<tr>
<td>BMI ratio</td>
<td><strong>Recipient pre-transplant bilirubin</strong></td>
</tr>
<tr>
<td>Donor age</td>
<td>Recipient pre-transplant creatinine</td>
</tr>
<tr>
<td>Transplant center volume</td>
<td>PRA Class II</td>
</tr>
<tr>
<td></td>
<td>Recipient pulmonary artery systolic pressure</td>
</tr>
</tbody>
</table>
ADULT HEART TRANSPLANTS (2006-6/2011)
Risk Factors For 1 Year Mortality with 95% Confidence Limits
Recipient Pre-Transplant Bilirubin

p < 0.0001

(N = 10,473)