Biventricular Failure – Total Artificial Heart

Francisco A. Arabía, MD
Director, CHSI Center for Surgical Device Management
Cedars-Sinai Heart Institute
Los Angeles, CA
Disclosures

- Surgical Proctor for Syncardia System
- Place more LVADs than TAHs
TAH-t

CARDIOWest C-70 TAH Placement in the Chest

CAUTION — The Freedom® driver system is an
Not *Everyone* in Heart Failure needs a TAH

But YOU need to know when your patient needs one.

The Total Artificial Heart is **NOT** a Ventricular Assist Device.

The TAH is a **Heart REPLACEMENT** Device
Newer Indications

• Biventricular Failure: Intermacs 1 & 2
• Thrombosed Venticles
• Failing Heart Transplant Graft
• Congenital Abnormalities
• Intractable Arrhythmias
• Progressive RVF in patient with LVAD
• Previous Multiple Cardiac Surgeries?
• Post Infarction VSD’s in BTT candidates
• Hypertrophic & Restrictive CM
• Cardiac Malignancies
CS experience with TAH

- 45 patients, 22% females
- Average age 53 (25 – 68)
- UNOS Status 1 A – 95%
- ECMO – 27%
# Etiology

<table>
<thead>
<tr>
<th>Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>NICM</td>
<td>13</td>
</tr>
<tr>
<td>ICM (VSD)</td>
<td>10 (1)</td>
</tr>
<tr>
<td>Familial</td>
<td>3</td>
</tr>
<tr>
<td>Valvular</td>
<td>3</td>
</tr>
<tr>
<td>Viral</td>
<td>1</td>
</tr>
<tr>
<td>Restrictive CM</td>
<td>4</td>
</tr>
<tr>
<td>PGD</td>
<td>3</td>
</tr>
<tr>
<td>Amyloid</td>
<td>3</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>3</td>
</tr>
<tr>
<td>Chagas’</td>
<td>1</td>
</tr>
<tr>
<td>Congenital</td>
<td>1</td>
</tr>
</tbody>
</table>
# Risk - Intermacs Profiles

<table>
<thead>
<tr>
<th>Profile</th>
<th>% of Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38%</td>
</tr>
<tr>
<td>1 TCS</td>
<td>11%</td>
</tr>
<tr>
<td></td>
<td>27%</td>
</tr>
<tr>
<td>2</td>
<td>40%</td>
</tr>
<tr>
<td>2A</td>
<td>32%</td>
</tr>
<tr>
<td></td>
<td>8%</td>
</tr>
<tr>
<td>3</td>
<td>11%</td>
</tr>
<tr>
<td>3A</td>
<td>3%</td>
</tr>
<tr>
<td>4</td>
<td>5%</td>
</tr>
<tr>
<td>4A</td>
<td>3%</td>
</tr>
</tbody>
</table>
Implantation Technique

- Remove Ventricle about 1 cm distal to AV
- Atrial quick connect with 1 suture line + repair
- Place prosthetic ventricles
- Measure & cut arterial conduits
- Anastomose arterial conduits
- Pressure Test
- Connect TAH, Off CPB
Implantation Technique

- To Close or not to Closed?
- ECMO, Redo, Difficult – leave Sternum open
- First Sternotomy – Close?
- Bring back next Day
- Close if stable
- Prepare for transplant sternotomy!!!
Goals to Facilitate Explantation

1. Be able to perform Sternotomy with minimal risk

2. Obtain control of vascular structures

3. Remove device

4. True for all MCS patients undergoing Tx
Blue Bands

Jaroszewski DE, Lackey JJ, Lanza LA, DeValeria PA, Arabia FA.

Use of an inexpensive blue band during ventricular assist device and total artificial heart placement facilitates and expedites explantation during heart transplant.

PTFE Cover
Silastic Membrane

Surgical grade silicone membrane (0.060 Inches) Bentec Medical, Woodland CA
Silastic Membrane
Silastic Membrane Strip
Management
Avoid Tamponade

- If chest closed at time of first operation:
  - Start anticoagulation 24 to 48 hours later if flows good.

- If chest open, hold anticoagulation for first few days.

- Greatest risk of bleeding in the first 2 WEEKS
Management

Anticoagulation

• Usually start ASA 81 mg in the first 24 to 48 hours after chest closed.
• Start Heparin around 48 after chest closed.
• Start Coumadin

Ambulation, Training and Discharge

• Start ASAP
• Transition to Freedom Driver
• Discharge Home
• Educate, Educate
Length of Stay

- Average LOS: 58 days
- Average LOS post Tx – LVAD: 17 days
- Average LOS post TX – TAH: 18 days

Length of Support

- Average LOS (expired): 36.4 days
- Average LOS (Transplanted): 129 days
- Ongoing: 365+ days
Adverse Events

- ADVERSE EVENTS
  - Hepatic Dysfx 3
  - Major Bleeding 40
  - Major Infection 52
  - Neuro Events (TIA) 7
  - Renal Dysfx 11
  - Stroke 11 (4 transplanted, 1 listed)
  - Cancer 1
  - Psych 1
  - Resp Failure 18
  - DVT 1
Competing Outcomes at Cedars-Sinai

Graph showing competing outcomes over time with different lines representing various outcomes:

- Alive
- On going
- Tx
- Deceased

Percentage distributions across different months.
Post Implant Survival - Primary TAHs
Primary Prospective Implants: June 23, 2006 to June 30, 2014

Shaded areas indicate 70% confidence limits
p (log-rank) = 0.6241
Event: Death (censored at transplant or recovery)
Conclusions

• TAH concept is for a very specific group of patients

• It is a for very ill population (Intermacs 1 & 2)

• Implementation has to be early,
  – BEFORE Multiple Organ Failure

• It is essential in the armamentarium for the management of end stage heart disease

• Future: Do re-TAH, use newer technology as it evolves. Easier than doing a re-Tx.
Coming Up

• DT Trial to start next month

• 50 cc TAH-t Trial to start in the next few months

• 5 Companies working in TAH technology, all pulsatile