Mechanical Support Options for PAH
Bridge to Lung Transplantation

Shaf Keshavjee MD MSc FRCSC FACS
Surgeon-in-Chief, University Health Network
James Wallace McCutcheon Chair in Surgery
Director, Toronto Lung Transplant Program
Professor, Division of Thoracic Surgery and
Institute of Biomaterials and Biomedical Engineering,
Vice Chair, Innovation, Department of Surgery
University of Toronto
Disclosure

• Founding Partner:
  • Perfusix Canada Inc. (CSO)
  • Perfusix USA Inc. (Lung Bioengineering /UT)
  • XOR Labs Toronto Inc. (CSO)

• XVIVO Perfusion – Research support and clinical trial
• United Therapeutics – Research support and clinical trial
• Xenios/Fresenius – Research support and investor in XOR
Outcomes ECLS Bridge to LTx are Dependent on:

1) Patient Selection
2) Time of Initiation
3) Program Experience with ECLS
4) Program Experience with Lung Transplantation
5) Donor Pool Availability
Pulmonary Hypertension

• High wait list mortality
• Death: Severe Right Heart failure / arrhythmia
• Bridging options – limited efficacy
  • PG / vasodilators etc.
  • Atrial septostomy \(\rightarrow\) trade-off pressure decompression with systemic hypoxia
Current Algorithm

Hypercapnic failure

- Veno-Venous (low flow)

Hypoxemic failure

- Veno-Venous (high flow)

PAH (severe RV dysfunction)

- PA-LA iLA (pumpless)
- Veno-Arterial
- VV + Septostomy

(UHN Logo)
Bridge to Lung Transplant for PAH Patients
Simple Atrial Septostomy is Unsatisfactory

RV failure $2^o$ to Pulmonary Vascular Resistance
Atrial Septostomy: provides pressure decompression problem: R-L shunt, hypoxia
Novalung PA to LA
Bridge to Lung Transplant for PAH Patients
“The Oxygenating Septostomy”

1. Pumpless
2. Effectively: an oxygenating shunt → provides pressure decompression AND gas exchange

Devices: Novalung and Quadrox
Novalung PA to LA
Bridge to Lung Transplant
Pediatric Novalung Bridge to Lung Transplant PA -LA
Novalung PA-LA: Bridge to lung transplant
Brief Communication

Bridge to Thoracic Organ Transplantation in Patients with Pulmonary Arterial Hypertension Using a Pumpless Lung Assist Device


Department of Cardiothoracic, Transplant and Vascular Surgery, and Department of Respiratory Medicine, Hannover Medical School, Hannover, Germany
Toronto Lung Transplant Program, Toronto General Hospital, Toronto, Ontario, Canada

n = 5

As a bridge to transplantation. In such a situation the patient is eligible to be ranked up to the highest priority status.

For extracorporeal support, venoarterial pump-driven extracorporeal membrane oxygenation (ECMO) is routinely used completely bypassing the failing heart as well as providing gas exchange. The use of ECMO in adult patients however is generally limited to a run time of approximately 2 weeks. Thereafter, the incidence of clinically relevant complications associated with the use of ECMO
PA-LA ECLS decreases wait list mortality in PAH patients: Toronto experience

Wait list mortality: 22% → 0%

$p=0.03$

de Perrot et al J Heart Lung Transplant 2011
Central iLA Implantation Under Peripheral ECMO Protection

W Klepetko, Vienna
Central PA-LA liA cannulation
Sub-analysis: PAH patients

January 2006 - September 2016
71 patients bridged to LTx - 13 PPH patients

11/13 bridged successfully to LTx (85%)

ECLS devices:

- PA/LA Novalung  n=5
- PA/LA Novalung (+ VA ECMO)  n=5
- Femoral-femoral VA ECMO  n=3
## Pediatric PA-LA Novalung

<table>
<thead>
<tr>
<th>iLA Cohort</th>
<th>n=7</th>
</tr>
</thead>
<tbody>
<tr>
<td>iLA used as bridge to 1\textsuperscript{st} Tx</td>
<td>6/6</td>
</tr>
<tr>
<td>Sex ( female)</td>
<td>5/6 (83%)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>14.8 (10-16)</td>
</tr>
<tr>
<td>Duration of iLA support</td>
<td>57 (30-180) days</td>
</tr>
<tr>
<td>ECLS mode switch: VA ECMO ↔ iLA</td>
<td>4/6 (67%)</td>
</tr>
<tr>
<td>Post LTx ECLS</td>
<td>2/6 (33%)</td>
</tr>
<tr>
<td>Duration of all ECLS support</td>
<td>67 (31-214) days</td>
</tr>
<tr>
<td>Survival to transplant</td>
<td>6/6 (100%)</td>
</tr>
<tr>
<td>60 day Survival</td>
<td>5/6 (83%)</td>
</tr>
<tr>
<td>1 year Survival</td>
<td>4/6 (67%) **</td>
</tr>
<tr>
<td></td>
<td>2 deaths had post LTx ECLS</td>
</tr>
<tr>
<td>iLA used as bridge to 2\textsuperscript{nd} Tx</td>
<td>1/1</td>
</tr>
<tr>
<td>Duration of support</td>
<td>29 days</td>
</tr>
<tr>
<td>Died on waitlist</td>
<td>3. 8 years post 1\textsuperscript{st} LTx</td>
</tr>
</tbody>
</table>
PPH patient survival post-LTx
(2006 – 2016)
Bridge to Lung Transplant Survival

<table>
<thead>
<tr>
<th>Condition</th>
<th>1-year</th>
<th>5-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPF</td>
<td>2/26</td>
<td></td>
</tr>
<tr>
<td>CF</td>
<td></td>
<td>2/16</td>
</tr>
<tr>
<td>PPH</td>
<td></td>
<td>2/13</td>
</tr>
<tr>
<td>CLAD</td>
<td></td>
<td>2/11</td>
</tr>
</tbody>
</table>

Survival rates for different lung conditions following bridge to transplant.