Ex Vivo Lung Perfusion for Lung Transplantation
Andres Pelaez, MD

How can we impact this patient outcome?

Using ECMO to support patients while waiting for lungs

Expanding the Donor Pool in Lung Transplantation
Ex Vivo Lung Perfusion (EVLP)
Andres Pelaez, MD
Medical Director University of Florida Lung Transplant Program

Disclosure

• Nothing to disclose
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The Problem: A Gap Exists Between Available Lungs and Waiting Recipients in the US

<table>
<thead>
<tr>
<th>Removal Reason</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transplant</td>
<td>194</td>
<td>331</td>
<td>245</td>
</tr>
<tr>
<td>Improved, Transplant not needed</td>
<td>49</td>
<td>38</td>
<td>42</td>
</tr>
<tr>
<td>Patient refused transplant</td>
<td>13</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>Patient died</td>
<td>236</td>
<td>271</td>
<td>243</td>
</tr>
<tr>
<td>Patient too sick for transplant</td>
<td>135</td>
<td>133</td>
<td>148</td>
</tr>
<tr>
<td>Total with Poor Outcome</td>
<td>351</td>
<td>403</td>
<td>391</td>
</tr>
</tbody>
</table>

OPTN/SRTR 2015 Annual Data Report: Lung. AJT 2018

CURRENT PRACTICE IN ORGAN SELECTION AND MANAGEMENT

Prior to the insult of ischemia-reperfusion, the lung may be injured by a number of events in the donor before lung retrieval

Leading to "silent" injury, but enough to change the threshold for subsequent acute lung injury when another insult comes

As an example, this donor chest radiograph at the time of procurement seems to be normal

However, when the lung transplant team arrived for their consultation the donor lung looked abnormal

CURRENT PRACTICE IN ORGAN SELECTION AND MANAGEMENT

Donor Management
Organ Procurement
Cold Static Preservation
Transplantation

Decision

Slows down death
Unable to assess function (Questionable organs are declined at procurement)
Of all potential donors, lungs are procured from 16% of donors. So is the limitation to transplantation lack of donors or lack of optimization of lung donors?

UNOS-www.optn.org

Concept of Ex Vivo Evaluation

- Focus has been on slowing cell death, rather than on facilitating recovery / regeneration
- Static cold preservation hinders the possibility of active metabolic processes / repair
- Find out how the organ works AFTER we implant it
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Toronto Ex Vivo Lung Perfusion (EVLP) System

Perfusion: 40% CO
Ventilation: 7 cc/kg, 7 BPM, PEEP 5, FiO2 = 21%


Ex Vivo Lung Perfusion Assessment

Hemodynamics
Compliance

Peak Airway Pressure
Delta PO2

Formal Indications for EVLP

Box 1: Current indications for EVLP for both brain death donors and donors after cardiac death
1. Body R, PaO2 less than 60 mmHg
2. Signs of pulmonary edema either on chest radiograph or physical examination of the donor site
3. Hypo Lung Compliance
4. Risk factors such as more than 18 units of blood transfusion or questionable history of aspiration
5. Hx with more than 30 minute interval from withdrawal life support to cardiac arrest


Normothermic Ex Vivo Lung Perfusion in Clinical Lung Transplantation

Machulla Cypel, M.D., Jonathan B. Young, M.D., Myung-Goo Kim, M.D., Masoud Anvari, M.D., Fong-Chuen Chen, M.M., Katarina Kardel, M.D., Masato Sato, M.D., Ph.D., Jian Liu, R.N., Lisanth Kuch, C.R.N.A., Amy Maloney, C.R.N.P., Cheng-Po Chen, M.D., Cecilia Chapman, M.D., Michael Hackman, M.D., Gary C. Singer, M.D., Arthur S. Bickel, M.D., Kazuyoshi Kasaibara, M.D., Ph.D., Bala V. Medhi, M.D., Andrew R. Nier, M.D., Thomas K. Woodwell, M.D., Ph.D., and Staff Kesknu, M.D.

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Experience with the first 50 ex vivo lung perfusions in clinical transplantation

Functional outcomes and quality of life after normothermic ex vivo lung perfusion lung transplantation

Survival Curves

Donor Assessment

- Female, 49-yrs old, 187cm, 98kg
- Former-smoker, 10 pack-years, quit 10 years
- Lower limb pain (DVT) and shortness of breath 2 days before admission
- Admission – right side paralysis – stroke
- Intracranial bleed
- Brain Death

- History
  - Thromboembolic disease
  - ABG – P/F: 266 mmHg
  - Chest X-ray: No infiltrates
  - Transthoracic ECHO RVSP: 52 mmHg + RV dysfunction, consistent with massive PE
  - Bronchoscopy: Clear bilaterally
  - Intra-operative PAP: 41/30 mmHg
  - Antegrade and Retrograde Flush: Macroscopic clots extracted bilaterally

Concern: Thrombotic/embolic history, Elevated RVSP, RV dysfunction, Heart turned down, PAH acute or chronic?
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Significant improvement of Pulmonary Hemodynamics after treatment

Donor vs. Recipient post-reperfusion

Recipient pre and post-transplant

Improving outcomes in transplantation: Organ resuscitation and repair

The Future of Organ Preservation

What about Donation After Circulatory Death (DCD) Lungs?

19 DCD lungs

351 deaths on the lung transplant waitlist
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**Similar Survival Curves ALL DCD vs. ALL NDD**

- DCD EVLP 1y-survival 92%
- DCD no EVLP 1y-survival 77%

**The UF Ex Vivo Lung Perfusion Program Experience**

- UNOS database 2005 to 2011
- <162 cm
  - 34% lower lung transplant rate
  - 62% higher waitlist mortality
  - 42% higher rate of respiratory failure
Conclusions

1. DCD donors represent a valuable source of lungs
2. Provide similar outcomes to NDD lungs
3. EVLP is an important technique to assess and increase the utilization of extended criteria DCDs
4. Outcomes of DCD EVLP are very encouraging
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