Donation after Circulatory Death (DCD) Lung Donation for Transplantation

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Lung Transplant Service
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Australian DCD LTx experience & potential for growth
Original Categories of DCD Donors

1 - Dead on arrival to ED
2 - Unsuccessful resuscitation
3 - Awaiting cardiac arrest post-planned WLST
4 - Spontaneous cardiac arrest in planned DBD donor

Kootstra 1995
Australian DCD experience

- DCD 3 LTx in Australia has added 29% more lung LTx with excellent clinical results since 2006
- ~330 cases in Australia, 195 cases at Alfred
- This is ~25% of the worlds DCD LTx activity

- Aided by creation of Australian DCD LTx Collaborative

Levvey AJT 2012
Australian DCD LTx

- National DCD LTx Collaborative
  - Standardized LTx protocols, definitions
  - New program support
  - Support for National Donation processes & evolution
  - Databasing, Audit, Reporting
  - Presentations at ISHLT
  - Involvement, benchmarking with ISHLT DCD Registry

- National DCD HTx protocol
  - Support for National Donation processes, dovetails with DCD LTx
Australian DCD LTx per DCD donor

DCD donor & DCD LTx

% LTx per DCD Donor

Mean = 36%

DCD donor
DCD Lung donor


donors

0 20 40 60 80 100 120 140
Australian DCD LTx Survival 2006-2016

% Survival

Years post LTx

DCD n=255
DBD n=1126

p = ns

DCD
DBD

ANZCOTR 2016
Australian DCD LTx Outcomes

- PGD grade @ 24hrs
  - Grade 0-1 76%
  - Grade 2 12%
  - Grade 3 12%

- Total ECMO use: n=23 (10%),
  - 7 PAH (elective), 4 CF, 6 IPF, 6 COPD

- 80% extubated by 24hrs

- ICU LOS Med (range) : 5 days (1-124)
- Total LOS Med (range) : 20 days (3-180)
• 75 Australian Hospitals
• 30 month audit 2012-4
• 16,500 deaths
Australian DCD LTx potential

Effect of waiting longer

Effect of increasing age limit

Rakhra, 2016
Australian DCD LTx: conclusions

- National donation & ICU protocols have facilitated appropriate DCD donor referrals, where 67% die < 90mins
- Extended DCD lungs (older, lobar/cut-down, low PO$_2$) in sicker recipients (PAH, Re-LTx) still have excellent results
- Ischaemic time limits haven’t been reached
- Many more potential ‘standard’ DCD 3 lung donors are out there
- DCD 3 LTx overall produces QUALITY outcomes
Alfred Hospital DCD LTx experience & future directions
DBD & DCD LTx PMP comparison

- Alfred
- Australia
- USA OPTN
- Eurotransplant UK Transplant

<table>
<thead>
<tr>
<th></th>
<th>DCD Lung Transplants</th>
<th>DBD Lung Transplants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfred</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Australia</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>USA OPTN</td>
<td>4</td>
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<tr>
<td>Eurotransplant UK Transplant</td>
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### PGD and Length of Stay

<table>
<thead>
<tr>
<th>Variable</th>
<th>DCD (n= 150)</th>
<th>DBD (n=546)</th>
<th>p Value</th>
</tr>
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<tbody>
<tr>
<td>PGD Grade @ 24hrs (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PGD 0-1</td>
<td>80</td>
<td>77</td>
<td>ns</td>
</tr>
<tr>
<td>PGD 2</td>
<td>8.3</td>
<td>7.9</td>
<td></td>
</tr>
<tr>
<td>PGD 3</td>
<td>11.7</td>
<td>15.1</td>
<td></td>
</tr>
<tr>
<td>Median ICU Stay (days) (range)</td>
<td>5 (2-124)</td>
<td>4 (2-51)</td>
<td>ns</td>
</tr>
<tr>
<td>Median Hospital LOS (days) (range)</td>
<td>21 (8-127)</td>
<td>20 (2-163)</td>
<td>ns</td>
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</tbody>
</table>
Alfred LTx waiting list days

ITT mortality
29%

ITT mortality
4%
Alfred LTx PAH since 2006-15: DCD=tough!

<table>
<thead>
<tr>
<th></th>
<th>DCD</th>
<th>DBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>11/100 (11%)</td>
<td>20/412 (5%)</td>
</tr>
<tr>
<td>IV PGI</td>
<td>56%</td>
<td>66%</td>
</tr>
<tr>
<td>6mw</td>
<td>190</td>
<td>271</td>
</tr>
<tr>
<td>PGD 3</td>
<td>44%</td>
<td>40%</td>
</tr>
<tr>
<td>Total LOS</td>
<td>34 d</td>
<td>34 d</td>
</tr>
<tr>
<td>Survival</td>
<td>96m 80%</td>
<td></td>
</tr>
</tbody>
</table>

Levvey
AJT 2015
# Alfred Pediatric LTx recipients

<table>
<thead>
<tr>
<th></th>
<th>DBD 2012-18 (n=13)</th>
<th>DCD 2012-18 (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age mean Median, Range</strong></td>
<td>14.0±1.6 14.5, 5-17</td>
<td>15.2±2 15, 11-17</td>
</tr>
<tr>
<td><strong>Gender %female</strong></td>
<td>54%</td>
<td>56%</td>
</tr>
<tr>
<td><strong>CF/Pul Ht/ILD/other</strong></td>
<td>3/5/4/1</td>
<td>5/3/0/1</td>
</tr>
<tr>
<td><strong>Wait list days mean Median</strong></td>
<td>200±102 85</td>
<td>78±116 37</td>
</tr>
<tr>
<td><strong>PreLTx ECMO</strong></td>
<td>14%</td>
<td>28%</td>
</tr>
<tr>
<td><strong>Lobar LTx</strong></td>
<td>15%</td>
<td>22%</td>
</tr>
<tr>
<td><strong>ICU days mean Ward days</strong></td>
<td>16 28</td>
<td>15 27</td>
</tr>
<tr>
<td><strong>Currently alive</strong></td>
<td>77% Aspergillus d29, CLAD d797,907</td>
<td>80% CLAD d531, ESRF d1813</td>
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</table>
## Alfred Pediatric LTx donors

<table>
<thead>
<tr>
<th></th>
<th>DBD 2006-18 (n=62)</th>
<th>DCD 2006-18 (n=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Donor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age yrs mean</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Median</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Range</td>
<td>5-17</td>
<td>3-17</td>
</tr>
<tr>
<td>Gender %female</td>
<td>39%</td>
<td>44%</td>
</tr>
<tr>
<td><strong>Recipient</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age yrs mean</td>
<td>31</td>
<td>37</td>
</tr>
<tr>
<td>Median</td>
<td>32</td>
<td>44</td>
</tr>
<tr>
<td>Range</td>
<td>6-68</td>
<td>6-64</td>
</tr>
<tr>
<td>Gender %female</td>
<td>56%</td>
<td>44%</td>
</tr>
<tr>
<td>Waitlist d mean</td>
<td>282</td>
<td>173</td>
</tr>
<tr>
<td>Median</td>
<td>156</td>
<td>66</td>
</tr>
<tr>
<td>Followup d mean</td>
<td>1676</td>
<td>1751</td>
</tr>
<tr>
<td>1 yr survival</td>
<td>91%</td>
<td>100%</td>
</tr>
<tr>
<td>10 yr survival</td>
<td>45%</td>
<td>93%</td>
</tr>
<tr>
<td>Currently alive</td>
<td>61%</td>
<td>93%</td>
</tr>
</tbody>
</table>
Alfred DCD LTx innovations

- Extending DCD 3 age criteria to 75yrs ✔

- Extend DCD 3 waiting time to 240mins ? X

- Additional sources of DCD donors
  - DCD 3 ECMO, VADs, AICD/pacemaker ✔
  - ‘Late DCD 3’ ie arresting 90min-24hrs, then topical cooling ✔
  - Extending to other/new Cat 3, Cat 1 & 2 DCD ? ✔
‘New category’ DCD LTx innovation

1. (a) Death outside hospital, no witness
   (b) Death outside hospital, witnessed and attempted resuscitation

2. (a) Unsuccessful resuscitation in ICU, ER or OR
   (b) Unsuccessful resuscitation in ward

3. (a) Awaiting cardiac arrest after planned WLST in ICU, ER or OR
   (b) Awaiting cardiac arrest after planned WLST in ward
   (c) Spontaneous cardiac arrest occurring before planned WLST

4. (a) Spontaneous cardiac arrest in planned DBD donor
   (b) Awaiting cardiac arrest in known DBD donor

5. Medically assisted death (ie. Euthanasia)
Emergency Room

Confirmation of futility of further resuscitation

Cessation of CPR

Confirmation of diagnosis of death

Standoff 5 min

Possible organ donor

**DCD 2b**
Ward
Unsuccessful Resuscitation at 30’

**DCD 1 or 2a**
Ambulance
Unsuccessful Resuscitation at 30’

**DCD 3b or 5**
Ward
Expected death
No resuscitation
Premortem donation directive
Assisted Dying
Possible organ donor

Consent & baseline bloods/Xray

Organ preservation

30 min post-CPR PEEP 5-7mmHg

±

120 min ventilation 8 x 6ml/kg/min

Topical lung cooling via 4 x ICC

EVLP machine assessment

Lung retrieval
DCD LTx: conclusions

- Currently DCD 3 produces significant numbers of quality LTx- without EVLP

- Potential simple modifications to existing practices can further increase DCD 3 numbers ± EVLP

- Evolution to other redefined ‘new’ DCD categories (1&2, late 3) with EVLP could dramatically increase DCD LTx activity