FIVE CONSECUTIVE CASES OF PATIENTS OVER SIXTY-EIGHT YEARS OLD WHO UNDERWENT LUNG TRANSPLANTATION

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Associate Professor of Surgery
Emory University
AGE DISTRIBUTION OF LUNG TRANSPLANT RECIPIENTS (1/1985-6/2011)

% of Transplants

Recipient Age

0-11, 12-17, 18-29, 30-39, 40-49, 50-59, 60-65, >65

ISHLT

LUNG TRANSPLANTS
Transplant Recipient Age by Year of Transplant
(Transplants: January 1, 1987 – June 30, 2011)

Median recipient age (years)

% of Transplants

Year of Transplant

0-11 12-17 18-34 35-49 50-59 60-65 >65 Median Age

ISHLT

ADULT LUNG TRANSPLANTS
Kaplan-Meier Survival by Age Group
(Transplants: January 1990 - June 2010)

All pair-wise comparisons are significant at p < 0.05

Survival (%)

Years

ISHLT

Risk Factors For 1 Year Mortality with 95% Confidence Limits
Recipient Age

Relative Risk of 1 Year Mortality

p < 0.0001

ISHLT 2012
Risk Factors For 5 Year Mortality with 95% Confidence Limits
Recipient Age

p < 0.0001

ISHLT
Risk Factors For 5 Year Mortality with 95% Confidence Limits
Conditional on Survival to 1 Year
Recipient Age

Relative Risk of 5 Year Mortality

p < 0.0001

Recipient Age

ISHLT

Patient 1

- 69 year old male
- History of left lower lobectomy in 1975 for lung cancer
- Disease free for 25 years
- Developed significant bullous emphysema
Patient 1: PreTxp PFTS/Imaging

- **PFTs**
  - TLC 11.24 (148% of predicted)
  - FVC 3.03 liters (60% predicted)
  - FEV-1 .81 (20% of predicted)
  - FEV to FVC ratio 27%. DLCO/VA 1.23 (32% of predicted)
- **Arterial blood gas** = pH 7.39, pCO2 40, pO2 61 on 3L NC
- **Chest x-ray** = hyperinflation with scarring in the left costophrenic angle
- **Chest CT**
  - Severe bullous disease, greater on the right than the left with evidence of previous pleural scarring on the left.
- **Evaluated for LVRS and felt not to be a candidate**
Patient 1: PreTxp Cardiac Catheterization

- Left ventricular pressure = 104/8
- RA pressure = 6
- Right ventricular pressure = 36/4
- Mean wedge pressure = 6
- Pulmonary artery pressure = 36/20 with a mean of 28
- CO 4.62 liters/min by Fick
- Coronary Arteries:
  - Diffuse luminal irregularity
  - The proximal left circumflex is calcified.
  - The right coronary artery is normal.
- Ventriculogram:
  - Systolic function is normal
  - No mitral regurgitation is noted
  - The ejection fraction is estimated at 60%.
Patient 1: Quantitative Perfusion Scan

- Lt. lung: 29%
- Rt. Lung: 71%
- Lt upper: 35%
- Lt lower: 65%
- Rt upper: 28%
- Rt lower: 72%
Patient 1: Clinical Course

- Redo Left thoracotomoy for left single lung transplant
- Extubated on first postoperative day
- Discharged on room air on ninth postoperative day, no complications
Patient 1: Clinical Course

- By third post transplant year developed CRI, early OB, DVT, drug induced hepatitis, tremor
- Admitted to hospital three years after transplant
  - Bilateral Pneumonia
  - Coumadin for LE DVT, INR of 9
  - Developed subscapular hematoma
  - Worsening pneumonia
  - Rhabdomyolysis
  - Renal Failure
  - Made DNR by family and died after one month in the hospital
Patient 2

- 70-year-old gentleman with bullous emphysema, A1AT Deficiency
- Originally been COPD1950 at the age of 23
- Right upper lobectomy in 1960
Patient 2: PFTs/Imaging

- FEV1 of 1.17 liters
- FEV1:FVC ratio of 31%.
- Diffusion capacity is 25% of predicted
- Walking pulse oximetry on 2 L NC
  - 91% saturated at rest
  - 86% using 3 liters after three minutes of walking
  - 83% using 4 liters of oxygen at six minutes
  - total walk distance is 1183 feet (lowest SaO2=79%)
- Chest CT severe bullous lung
Patient 2: Echo

- The left ventricle is normal in size, shape, and function, EF = 60 to 65 %, Diastolic dysfunction
- The mitral valve is normal
- The aortic valve is normal
- The right ventricle is mildly-to-moderately dilated
- There is no evidence of shunting on bubble study
- Borderline elevation of right-sided pressures. Pulmonary acceleration time, however, is normal.
Patient 2: Cardiac Catheterization

- The left ventricular pressures 124/16
- The mean RA pressure = 3
- The right ventricular pressure = 37/5, mean wedge pressure = 7
- The pulmonary pressure = 34/11 (mean = 19)
- The cardiac output was 5.28 liters/min by Fick.
- Left Coronary Arteries:
  - The left coronary artery has diffuse luminal irregularity.
- Right Coronary Arteries:
  - The right coronary artery has diffuse luminal irregularity. The right coronary artery is dominant. There is an ulcerated plaque in the distal RCA of mild severity.
- Ventriculogram:
  - Systolic function is normal.
  - No mitral regurgitation is noted.
  - The ejection fraction is estimated at 65%.
Patient 2: Quantitative Perfusion Scan

• Left Lung 52 % Right Lung 47 %
• Left Upper 37 % Left Lower 63 %
• Right Upper 52 % Right Lower 48 %
Patient 2 Clinical Course

- Left single lung transplant
- Extubated on first post-operative day
- Discharged three weeks later, 99% on RA
- Immediate post-transplant course complicated by
  - Atrial fibrillation, placed on coumadin
  - Acute renal insufficiency, creatinine = 1.4
  - Acute rejection, treated with i.v. steroids
  - Confusion, dysphagia
Post-Transplant CXR
Patient 2: Current Condition

- Currently alive 9 years after transplant, 99% SaO2 on RA with stable PFTs
- CRI with baseline creatinine = 2.5
- Developed symptomatic CAD, required coronary stenting x 2
- Recurrent prostate cancer treated with XRT
- Developed DM
- Recurrent basal cell skin cancer
CXR/Chest CT Nine Years Post-Transplant
Patient 3

- 71-year-old white man
- 20-pack year history of smoking, quit in 1986.
- 2000- developed pneumonia and was on a ventilator for two
- Right lung biopsy, tick-borne, rickettsial dz (ehrlichiosis)
- Treated with doxycycline with complete resolution
- 2007 developed shortness of breath + a normal chest x-ray
- Worsening dyspnea
- Developed atrial fibrillation/flutter treated with diltiazem.
CXR/CT:
Inferstital Infiltrates/Fibrosis
Patient 3

- Left VATS lung biopsy in Michigan
  - Reviewed by the Mayo Clinic
  - UIP/IPF
- Progressive hypoxemia from oxygen at night only to now being on 4 L of oxygen at rest, and up to 6
Patient 3 PMHx

- 1. Rheumatoid arthritis, with no obvious joint deformities
- 2. Ulcerative colitis, mild and has been quiescent for many years.
- 3. Hypertension
- 4. Hyperlipidemia
- 5. Benign prostatic hypertrophy.
- 6. Distant history of rickettsia infection.
- 7. Depression, treated
- 8. GERD
Patient 3: PFTs

### Spirometry (NHANES/Crapo/P&P)

<table>
<thead>
<tr>
<th>Test</th>
<th>Pred</th>
<th>2SD</th>
<th>Meas</th>
<th>%Pred</th>
<th>Post BD</th>
<th>Meas</th>
<th>%Pred</th>
<th>%Chg</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLC</td>
<td>6.49</td>
<td>(4.88-8.10)</td>
<td>6.24</td>
<td>96</td>
<td></td>
<td></td>
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<tr>
<td>VC</td>
<td>3.95</td>
<td>(&gt; 3.09)</td>
<td>4.44</td>
<td>112</td>
<td>4.49</td>
<td>114</td>
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<tr>
<td>ERV</td>
<td>1.30</td>
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<td>2.03</td>
<td>156</td>
<td>2.04</td>
<td>156</td>
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<td>FRC N2</td>
<td>3.42</td>
<td>(1.96-4.88)</td>
<td>3.76</td>
<td>110</td>
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<tr>
<td>FRC PL</td>
<td>3.42</td>
<td>(1.96-4.88)</td>
<td>3.76</td>
<td>110</td>
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<tr>
<td>RV</td>
<td>2.32</td>
<td>(1.56-3.08)</td>
<td>1.80</td>
<td>77</td>
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<tr>
<td>FVC</td>
<td>3.95</td>
<td>(&gt; 3.09)</td>
<td>4.44</td>
<td>112</td>
<td>4.49</td>
<td>114</td>
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<tr>
<td>FEF25-75%</td>
<td>2.18</td>
<td>(&gt; 0.70)</td>
<td>1.79</td>
<td>82</td>
<td>1.62</td>
<td>74</td>
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<tr>
<td>FEV1</td>
<td>2.88</td>
<td>(&gt; 2.16)</td>
<td>3.06</td>
<td>106</td>
<td>3.02</td>
<td>105</td>
<td>-1</td>
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<tr>
<td>FEV1/FVC</td>
<td>73</td>
<td>(&gt; 64)</td>
<td>69</td>
<td>67</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Fev1/Svc</td>
<td>82</td>
<td></td>
<td>69</td>
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</tr>
<tr>
<td>IC</td>
<td>2.70</td>
<td>(&gt; 0.86)</td>
<td>2.48</td>
<td>92</td>
<td>2.24</td>
<td>83</td>
<td>-9</td>
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<tr>
<td>FET</td>
<td>11.69</td>
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<td>10.82</td>
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### Mechanics

<table>
<thead>
<tr>
<th>Test</th>
<th>Pred</th>
<th>2SD</th>
<th>Meas (post-BD) (Black &amp; Hyatt) Meas</th>
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<tbody>
<tr>
<td>sGaw L/s/cmH20/L (Ruppell)</td>
<td>&gt;0.15</td>
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<tr>
<td>PEF L/sec (NHANES)</td>
<td>10.74</td>
<td>7.67</td>
<td>9.34</td>
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### Blood Gases: 02 L Flow: Room air

<table>
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<tr>
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<th>Value</th>
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<td>FIO2</td>
<td>21.00</td>
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<tr>
<td>THb</td>
<td>13.9</td>
</tr>
<tr>
<td>%O2Sat</td>
<td>87.0</td>
</tr>
<tr>
<td>%COHb</td>
<td>1.5</td>
</tr>
<tr>
<td>%MethHb</td>
<td>0.3</td>
</tr>
<tr>
<td>O2Ct</td>
<td>17.80</td>
</tr>
<tr>
<td>pH</td>
<td>7.46</td>
</tr>
<tr>
<td>PCO2</td>
<td>28.9</td>
</tr>
<tr>
<td>PO2</td>
<td>56.1</td>
</tr>
<tr>
<td>BE</td>
<td>-2.5</td>
</tr>
<tr>
<td>HCO3</td>
<td>20.1</td>
</tr>
<tr>
<td>A-aO2</td>
<td>54.2</td>
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</table>

### Single Breath DLCO: (pre/post-BD)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Meas</th>
<th>Pred</th>
<th>2SD</th>
<th>% Pred</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLCO pre/post</td>
<td>5.9</td>
<td>24.8</td>
<td>(16.8-32.8)</td>
<td>24</td>
</tr>
<tr>
<td>DL Adj pre/post</td>
<td>6.1</td>
<td>25</td>
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</tr>
<tr>
<td>DLCO/VA pre/post</td>
<td>1.06</td>
<td>4.06</td>
<td>(2.86-5.26)</td>
<td>26</td>
</tr>
<tr>
<td>DL/VA Adj pre/post</td>
<td>1.10</td>
<td>27</td>
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<tr>
<td>VA pre/post</td>
<td>5.56</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Patient 3: Echocardiogram

- Left ventricular ejection fraction is 55%.
- Mildly enlarged right ventricular cavity size.
- Trace aortic valve insufficiency.
- Mildly to moderately reduced right ventricular systolic function.
- Trivial pericardial effusion as described below.
- Severely elevated pulmonary artery systolic pressure.
Patient 3: Cardiac Catheterization

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>AO</td>
<td>145/71</td>
<td>mmHg</td>
</tr>
<tr>
<td>RA</td>
<td>7/5 (4)</td>
<td>mmHg</td>
</tr>
<tr>
<td>RV</td>
<td>54/7</td>
<td>mmHg</td>
</tr>
<tr>
<td>PA</td>
<td>53/20 (33)</td>
<td>mmHg</td>
</tr>
<tr>
<td>PCW</td>
<td>7/7 (5)</td>
<td>mmHg</td>
</tr>
<tr>
<td>Fick CO</td>
<td>6</td>
<td>L/min</td>
</tr>
<tr>
<td>Fick CI</td>
<td>3</td>
<td>L/min/m2</td>
</tr>
<tr>
<td>No CAD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Patient 3: Perfusion Scan**

<table>
<thead>
<tr>
<th>Lung Zone</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Lung</td>
<td>52.4 %</td>
</tr>
<tr>
<td>Right Lung</td>
<td>47.6 %</td>
</tr>
<tr>
<td>Left Upper</td>
<td>10.1 %</td>
</tr>
<tr>
<td>Right Upper</td>
<td>8.4 %</td>
</tr>
<tr>
<td>Left Middle</td>
<td>26.1 %</td>
</tr>
<tr>
<td>Right Middle</td>
<td>24.0 %</td>
</tr>
<tr>
<td>Left Lower</td>
<td>16.2 %</td>
</tr>
<tr>
<td>Right Lower</td>
<td>15.2 %</td>
</tr>
</tbody>
</table>

Lung zones are reported as a percentage of the contribution to the overall lung function.
Patient 3: Clinical Course

- Bilateral Lung Transplant
- Extubated post op day 1
- Discharged on RA on post op day 11
- DISCHARGE DIAGNOSES:
  - Multibacterial pneumonias (Enterobacter, Klebsiella, MRSA)
  - Recurrent atrial fibrillation
  - Non-ST-elevation myocardial infarction
  - Acute kidney injury (resolved)
Patient 3: Discharge Medications

- 1. Lortab 5/500 one to two tabs q.4 hours p.r.n. for pain.
- 2. Albuterol two puffs q.4 hours p.r.n.
- 3. Amphotericin B inhaled 4 mL q.12 hours.
- 4. Aspirin 325 mg p.o. daily.
- 5. Bupropion 300 mg q.24 hours.
- 6. Calcium carbonate 1250 mg twice a day.
- 7. Dornase alfa 2.5 mL twice a day.
- 8. Lovenox 100 mg daily.
- 9. Nexium 40 mg b.i.d.
- 10. Fexofenadine 180 mg daily.
- 11. Folic acid 1 mg daily.
- 12. NovoLog sliding scale subcu.
- 13. Magnesium oxide 400 mg twice a day.
- 14. Multivitamins one tablet daily.
- 15. CellCept 1000 mg q.12 hours.
- 16. Posaconazole 200 mg three times a day.
- 17. Pravachol 20 mg daily at bedtime.
- 18. Prednisone 27.5 mg on 08/30/2011, then decrease by 2.5 mg daily until reaching 20 mg and then continue with 20 mg daily.
- 19. Sotalol 80 mg twice a day.
- 20. Bactrim double-strength one tab q.8 hours until 09/03/2011, then one tablet Monday, Wednesday, Friday.
- 21. Tacrolimus 4.5 mg q.12 hours.
- 22. Cialis 20 mg one tablet p.r.n.
- 23. Valcyte 900 mg q.12 hours.
Patient 3: Post Transplant Course

• Readmitted after 1 month
  – Acquired anaphylaxis from donor (peanut allergy) and intubated, extubated next day
  – Hemothorax requiring vats
  – DVT w IVC filter placed
  – Discharged after four days

• Recurrent arrhythmias recalcitrant to sotalol and flecainide

• AV node ablation and biventricular pm placement 7 months after transplant

• Currently Doing well on RA

• Moved to Michigan returns to Emory for follow up
Patient 3: One Year PFTs, CXR, CT
Patient 4

- 69-year-old man requiring 8L O2
- Imaging suggesting both pulmonary fibrosis and emphysema
Patient 4: Past Medical History

- GERD.
- Allergic rhinitis.
- Basal cell carcinoma6
- Hypoxia on home oxygen therapy.
- Squamous cell CA of the nose
- Hiatal hernia.
Patient 4: PFTs

**6-minute Walk**

372 feet in 7 minutes with desaturation down to 87% on 4 L.

<table>
<thead>
<tr>
<th>SPHROMETRY (NHANES/Crapo/F&amp;P)</th>
<th>Meas</th>
<th>%Pred</th>
<th>Post BD</th>
<th>Meas %Pred</th>
<th>%Chg</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLC (Liters)</td>
<td>6.72 (5.11-8.33)</td>
<td>4.70</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VC (Liters)</td>
<td>4.21 ( &gt; 3.32)</td>
<td>3.35</td>
<td>80</td>
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<td></td>
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<tr>
<td>ERV (Liters)</td>
<td>1.39</td>
<td>1.43</td>
<td>103</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FRC N2 (Liters)</td>
<td>3.54 (2.08-5.00)</td>
<td>3.55</td>
<td>10</td>
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<td></td>
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<tr>
<td>FRC PL (Liters)</td>
<td>3.64 (2.08-5.00)</td>
<td>2.78</td>
<td>79</td>
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<tr>
<td>RV (Liters)</td>
<td>2.35 (1.59-3.11)</td>
<td>1.35</td>
<td>58</td>
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<td></td>
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<tr>
<td>FVC (Liters)</td>
<td>4.21 ( &gt; 3.32)</td>
<td>3.35</td>
<td>80</td>
<td></td>
<td></td>
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<tr>
<td>FEF25-75% L/sec</td>
<td>2.39 ( &gt; 0.86)</td>
<td>1.36</td>
<td>57</td>
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<td></td>
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<tr>
<td>FEV1 (Liters)</td>
<td>3.10 ( &gt; 2.35)</td>
<td>2.37</td>
<td>76</td>
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<td></td>
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<tr>
<td>FEV1/FVC %</td>
<td>74 ( &gt; 64)</td>
<td>71</td>
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<tr>
<td>FIV1/FVC %</td>
<td>82</td>
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<tr>
<td>IC (Liters)</td>
<td>2.85 ( &gt; 0.89)</td>
<td>1.85</td>
<td>65</td>
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<tr>
<td>FET (sec)</td>
<td>12.07</td>
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</tbody>
</table>

BLOOD GASES: O2 L Flow: Room Air

- FIO2: 21.00
- THb: 17.2
- %O2SAT: 87.1
- %COHb: 1.7
- %MetHb: 0.0
- O2Ct: 21.60
- pH: 7.45
- PCO2: 34.0
- PO2: 53.4
- BE: 0.1
- HCO3: 23.2
- A-aO2: 50.2

SINGLE BREATH DLCO (pre/post-BD) (Miller/Foglar)

- DLCO: 6.4
- DL Adj: 6.1
- DLCO/VA: 1.38
- DL/VA Adj: 1.32
- VA: 4.60
- IVC: 3.15

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*Note: The table includes various lung function and blood gas measurements, with abbreviations and units, providing a comprehensive assessment of the patient's respiratory status.*
## Patient 4: Cardiac Catheterization

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>AO</td>
<td>139/85 (110)</td>
<td>mmHg</td>
</tr>
<tr>
<td>RA</td>
<td>23/19 (9)</td>
<td>mmHg</td>
</tr>
<tr>
<td>RV</td>
<td>71/11</td>
<td>mmHg</td>
</tr>
<tr>
<td>PA</td>
<td>73/28 (46)</td>
<td>mmHg</td>
</tr>
<tr>
<td>PCW</td>
<td>8/8 (6)</td>
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<tr>
<td>Fick CO</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Fick CI</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

No CAD
Patient 4: Perfusion Scan

Left Lung  44.1 %  
Right Lung  55.9 %

Lung zones are reported as a percentage of the contribution to the overall lung function.

Left Upper   9.2 %  
Left Middle  22.4 %  
Left Lower   12.5 %  
Right Upper  7.8 %  
Right Middle 28.7 %  
Right Lower  19.4 %
Patient 4: Clinical Course

• Bilateral lung transplant with CPB
• Extubated on postop day 3, initially requiring BiPAP
• Developed visual hallucinations with voriconazole
• Subacute cerebellar stroke with expressive aphasia, recovered
• Discharged on 16th POD, 97% SaO2 on RA
Patient 4: Post-Op CXR
Patient 4: CXR/CT 6 Months After Transplant
Patient 4: PFTs 1 Year After Transplant

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pred</th>
<th>2SD</th>
<th>Meas</th>
<th>%Pred</th>
<th>%Chg</th>
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</thead>
<tbody>
<tr>
<td>TLC (Liters)</td>
<td>6.72</td>
<td>5.12</td>
<td>8.33</td>
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<tr>
<td>VC (Liters)</td>
<td>4.18</td>
<td>&gt; 3.29</td>
<td>4.21</td>
<td>101</td>
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<tr>
<td>ERV (Liters)</td>
<td>1.38</td>
<td>0.19</td>
<td>13</td>
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<tr>
<td>FRC N2 (Liters)</td>
<td>3.55</td>
<td>2.09</td>
<td>5.01</td>
<td>3.55</td>
<td></td>
</tr>
<tr>
<td>FRC PL (Liters)</td>
<td>3.55</td>
<td>2.09</td>
<td>5.01</td>
<td>3.55</td>
<td></td>
</tr>
<tr>
<td>RV (Liters)</td>
<td>2.37</td>
<td>1.61</td>
<td>3.13</td>
<td>2.37</td>
<td></td>
</tr>
<tr>
<td>FVC (Liters)</td>
<td>4.18</td>
<td>&gt; 3.29</td>
<td>4.04</td>
<td>97</td>
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<tr>
<td>FEF25-75% L/sec</td>
<td>2.34</td>
<td>&gt; 0.81</td>
<td>3.67</td>
<td>157</td>
<td></td>
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<tr>
<td>FEV1 (Liters)</td>
<td>3.07</td>
<td>&gt; 2.31</td>
<td>3.37</td>
<td>110</td>
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<tr>
<td>FEF1/FVC %</td>
<td>74</td>
<td>64</td>
<td>84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fev1/Svc %</td>
<td>82</td>
<td>80</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC (Liters)</td>
<td>2.83</td>
<td>&gt; 0.89</td>
<td>3.61</td>
<td>127</td>
<td></td>
</tr>
<tr>
<td>PET (scc)</td>
<td>7.60</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Mechanics:**
- sGaw L/s/cmH2O/L (Rupell)
- PEF L/sec (Nhanes)
- FeNO ppb
- Pre RX
- FVL ECode: 000000
- FEF/FIF50: 0.69

**Post TX**
- FVL ECode
- FEF/FIF50

**Trend Report**

<table>
<thead>
<tr>
<th>Date</th>
<th>FVC (pre/post)</th>
<th>FEV1 (pre/post)</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/16/13</td>
<td>3.81</td>
<td>3.20</td>
</tr>
<tr>
<td>05/15/13</td>
<td>4.98</td>
<td>4.20</td>
</tr>
<tr>
<td>06/18/13</td>
<td>3.90</td>
<td>3.26</td>
</tr>
<tr>
<td>07/15/13</td>
<td>4.04</td>
<td>3.37</td>
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</tbody>
</table>

**Blood Gases:**
- O2L Flow:
  - FIO2
  - T/Hb
  - % O2Sat
  - % COHb
  - % MethHb
  - O2Ct
  - pH
  - PCO2
  - PO2
  - BE
  - HCO3
  - A-aO2

**Single Breath DLCO:**
- (pre/post-BD)
  - DLCO pre/post
  - DL Adj pre/post
  - DLCO/Va pre/post
  - DL CO Adj pre/post
  - VA pre/post
  - IPC pre/post

**Flow Volume:**

---

Note: The table and graphs provide detailed pulmonary function test (PFT) results for Patient 4, one year after transplant surgery.
Patient 4: 1 Year Follow-up

• One episode of mild rejection.
• Chronic kidney injury-ckd stage II
• Left popliteal and calf dvt
• HTN
• Weight gain
Patient 5

- 69-year-old female with idiopathic pulmonary fibrosis
- On 2 L of oxygen at rest, 5 L with ambulation.
- New York Heart Association Class III functional symptoms.
- Enrolled in a pulmonary rehab
Patient 5: Past Medical History

- Idiopathic pulmonary fibrosis/UIP
- Hypertension, diagnosed at age 40
- DJD
- Right VATS wedge
- Cervical fusion
- Lower back fusion
- Ankle fracture
- Bilateral carpal tunnel release
- Cholecystectomy
Patient 5: PFTs

**SPIROMETRY (NHANES/CDC/FLUIDS)**

<table>
<thead>
<tr>
<th></th>
<th>Pred</th>
<th>2SD</th>
<th>Meas %Pred</th>
<th>Post BD Meas %Pred %Chg</th>
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<tbody>
<tr>
<td>TLC</td>
<td>4.84</td>
<td>(3.77-5.92) 1.86</td>
<td>41</td>
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</tr>
<tr>
<td>VC</td>
<td>2.86</td>
<td>(&gt; 2.20) 0.94</td>
<td>33</td>
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</tr>
<tr>
<td>ERV</td>
<td>0.94</td>
<td>0.24</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>FRC N2</td>
<td>2.76</td>
<td>(1.69-3.82) 1.29</td>
<td>47</td>
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</tr>
<tr>
<td>FRC PL</td>
<td>2.76</td>
<td>(1.69-3.82) 1.03</td>
<td>49</td>
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<tr>
<td>RV</td>
<td>2.10</td>
<td>(1.32-2.87) 1.03</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>FVC</td>
<td>2.86</td>
<td>(&gt; 2.20) 0.94</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>FEF25-75%</td>
<td>1.87</td>
<td>(&gt; 0.68) 2.51</td>
<td>134</td>
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</tr>
<tr>
<td>FEV1</td>
<td>2.17</td>
<td>(&gt; 1.61) 0.91</td>
<td>42</td>
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<tr>
<td>FEV1/FVC</td>
<td>75</td>
<td>(&gt; 66) 96</td>
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<tr>
<td>Fev1/Svc</td>
<td>62</td>
<td>96</td>
<td></td>
<td></td>
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<tr>
<td>IC</td>
<td>1.80</td>
<td>(&gt; 0.66) 0.68</td>
<td>38</td>
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<tr>
<td>FET</td>
<td>1.40</td>
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**BLOOD GASES:**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>FIO2</td>
<td>21.00</td>
<td>PRED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THb</td>
<td>14.9</td>
<td></td>
<td>12.0-18.0</td>
<td></td>
</tr>
<tr>
<td>% O2Sat</td>
<td>84.7</td>
<td>94-100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% COHb</td>
<td>1.0</td>
<td>&lt; 1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% MetHb</td>
<td>0.3</td>
<td>0.4-1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O2Ct</td>
<td>18.20</td>
<td>15.0-23.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7.43</td>
<td>7.35-7.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCO2</td>
<td>31.2</td>
<td>35-45</td>
<td></td>
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</tr>
<tr>
<td>PO2</td>
<td>50.1</td>
<td>60-100 (RA)</td>
<td></td>
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</tr>
<tr>
<td>BE</td>
<td>-2.6</td>
<td>-2.0-2.0</td>
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</tr>
<tr>
<td>HCO3</td>
<td>20.5</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-aO2</td>
<td>58.3</td>
<td>30.7</td>
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</table>

Pt desat to 78% (PR 120) when she walked to the starting point of test. O2 increased to 4 L/min, SpO2 was 83% so increased to 6 L/min, SpO2 now=89%. Pt started walk test on 6 L/min. Pt desat to 84% (PR 130) about 1 minute 45 seconds into 6 MWT and stopped to rest at 2 minutes. O2 increased to 8 L/min but sats did not improve while she rested so increased to 10 L/min. Pt c/o headache and requested to stop testing at 4 minutes into test. Pt monitored for additional 15 minutes. Pt states headache has resolved but c/o fatigue, SpO2= 87-88% (PR 113)on 6 L/min.

**INTERPRETATION:**

FEV1 and FVC are reduced suggesting a restrictive defect. Since 3.4.13, lung function has improved. Flow volume loops show a restrictive pattern. Severely reduced exercise capacity with hypoxemia on 8 liters of oxygen.
Patient 5: Echocardiogram

- Left ventricular ejection fraction is 60%
- Moderate concentric left ventricular hypertrophy
- Mild-moderate diastolic dysfunction and elevated left atrial pressure
- Mild tricuspid regurgitation.
- Bubble study positive, small PFO probably present
- Mildly to moderately reduced right ventricular systolic function
- Moderately enlarged right ventricular cavity size.
- There is mildly elevated right ventricular systolic pressure.
Patient 5: Cardiac Catheterization

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
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<tr>
<td>AO</td>
<td>96/64 (73)</td>
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</tr>
<tr>
<td>LV</td>
<td>103/2</td>
<td>mmHg</td>
</tr>
<tr>
<td>RA</td>
<td>null/null (5)</td>
<td></td>
</tr>
<tr>
<td>RV</td>
<td>18/null</td>
<td>mmHg</td>
</tr>
<tr>
<td>PA</td>
<td>16/6 (11)</td>
<td>mmHg</td>
</tr>
<tr>
<td>PCW</td>
<td>null/null (2)</td>
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</tr>
<tr>
<td>Fick CO</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Fick CI</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

80 % stenosis in the second diagonal branch, no other CAD
Patient 5: Perfusion Scan

Left lung 45 %; Right lung 55 %

Left upper 11.5 %
Left middle 24.1 %
Left lower 9.0 %

Right upper 10.4 %
Right middle 32.2 %
Right lower 12.9 %
Patient 5: Clinical Course

- RSLTx
- PGD grade 3
- Recovered
- HIT +, placed on argatroban
Patient 5: CXR Progression

POD 1

POD 2

POD 7
Patient 5: Clinical Course

- Not awakening
- CT showed large CVA
- PEG/Trach
- Currently on floor on trach collar
- Some minimal neurologic improvement
Lung Transplant and Age: Clinical Studies

- Weiss et al, *JACS 2009*
- UNOS database, > 8000 patients
- Age stratified, 18-45, 46-55, 56-60, 61-79
- Age > 60 assoc with 37% increase risk of death
- 30 day mortality not increased for patients over 60
- 30 day and 1 year mortality significantly worse for patients > 70

---

Impact of Advanced Age in Lung Transplantation: An Analysis of United Network for Organ Sharing Data

Eric S Weiss, MD, Christian A Merlo, MD, MPH, Ashish S Shah, MD, FACS

**BACKGROUND:** Elderly patients are increasingly referred for lung transplantation (LTx) evaluation. Earlier outcomes studies in this cohort are limited by small size. The United Network for Organ Sharing (UNOS) database provides an opportunity to examine survival in a large cohort of elderly patients. We retrospectively reviewed UNOS data to identify 8,363 adult patients who underwent LTx between 1999 and 2006. Patients were stratified into quinaries of age. The primary end point was short-term mortality (30-day, 90-day, and 1-year). Posttransplant survival was compared using Cox proportional hazards regression.

**STUDY DESIGN:** Mean age was 51 ± 12 years (SD) (range 18 to 79 years, median 55 years). Age stratification by quintile (Q) was Q1, 18 to 45 years (n = 2,192); Q2, 46 to 55 years (n = 2,160); Q3, 56 to 60 years (n = 2,080); Q4, 61 to 75 years (n = 2,011). The two most common indications for transplantation, chronic obstructive pulmonary disease (40%) and idiopathic pulmonary fibrosis (22%), varied substantially by age, and younger transplantation patients more often had additional indications (i.e., cystic fibrosis). Age greater than 60 years (Q5, reference, Q1) was associated with a 37% increase in the risk of death (hazards ratio [HR], 1.37; 95% Cl, 1.16 to 1.62; p < 0.001 after risk adjustment). Thirty-day mortality was not statistically different (HR, 1.22; 95% Cl, 0.82 to 1.80; p = 0.33) for patients older than age 60. Patients 70 years and older had substantially increased risk of 30-day (HR, 2.9; 95% Cl, 1.2 to 7.1; p = 0.02), 90-day (HR, 3.0; 95% Cl, 1.5 to 5.6; p < 0.001), and 1-year mortality (HR, 2.2; 95% Cl, 1.2 to 3.9; p = 0.008) when compared with the reference of those less than 70 years.

**RESULTS:**

**CONCLUSIONS:** Lung transplantation may be used with caution in older patients (> 60 years) but should not be used for patients older than age 70. (J Am Coll Surg 2009;208:400-409. © 2009 by the American College of Surgeons)
Lung Transplant and Age: Clinical Studies

- Gutierrez et al: AJT 2007
- Matched 42 recipients > 60 to younger recipients
  - 1-year survival worse for older patients
    - 60% v. 86% p = .005
- 5-year survival worse for older patients
  - 37% v. 57% p = .005
- More infection, malignancy in older patients

The Effect of Recipient's Age on Lung Transplant Outcome

Gutierrez et al, AJT 2007

Matched 42 recipients > 60 to younger recipients

1-year survival worse for older patients
- 60% v. 86% p = .005

5-year survival worse for older patients
- 37% v. 57% p = .005

More infection, malignancy in older patients
Lung Transplant and Age: Clinical Studies

- Smith et al, *ATS 2006*
- 1995 to 2005 UVa
- 182 patients
- No difference in survival (30d, 1 year, 3 year, 5 year) for patients > 60
Lung Transplant and Age: Clinical Studies

- Mahidhara et al, *JTCVS 2008*
- 2000 to 2006 at UCLA
- Matched study, 50 patients > 65
- More SLT in older patients
  - 76% v. 16% *p* < .05
- No diff in AR or BOS
- No diff in 1 month, 1 year or 3 year survival
Lung Transplant and Age: Clinical Studies

- Vadnerkar et al, *JHLT 2011*
- U. Pittsburg retrospective study
- 2006 to 2008
- 268 txp, 128 > 60 y.o. (64% > 65)
- No survival difference by age
- Older patient complications
  - More AR
  - More drug toxicity
  - More malignancies

*Age-specific complications among lung transplant recipients 60 years and older*

Aniket Vadnerkar, MD, a Yoshiya Toyoda, MD, PhD, b Maria Crespo, MD, a Joseph Pilewski, MD, a Dimitria Mitsani, MD, a Eun J. Kwak, MD, a Fernanda P. Silveira, MD, a Jay Bham, MD, b,c Ryan Shields, PharmD, a Christian Bermudez, MD, a,b Cornelius J. Clancy, MD, a,b,c, and M. Hong Nguyen, MD a

From the "Departments of Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania, and Cardiothoracic Surgery, University of Pittsburgh Medical Center, and the "Department of Medicine, Pittsburgh VA Healthcare System, Pittsburgh, Pennsylvania."