Successful Heart-Lung Transplantation for Cystic Fibrosis

Kevin Jones, M.D.; Tim Higenbottam, F.C.C.P., and John Wallwork, M.D.*

Sixteen months after heart-lung transplantation, the FEV₁ of a young woman, who had been in the terminal stages of cystic fibrosis, has risen from 16 percent (0.6 L) to 77 percent of her predicted value. Concomitant with the changes in pulmonary function, her ventilatory response to rebreathing carbon dioxide has improved, and so has her exercise tolerance. She has returned to work.

Despite recent advances in treatment, most patients with cystic fibrosis die in early adult life as a consequence of lung disease. Since 1984, our institute has undertaken 22 combined heart-lung transplant operations, eight of which were for lung disease. We report a patient in whom the pathologic pulmonary physiology of cystic fibrosis has been corrected by heart-lung transplantation.

Case Report

A 20-year-old woman was first seen at the age of five months because of steatorrhea. Two separate sweat tests revealed a sodium concentration of >70 mmol/L. She received oral antibacterial therapy from the age of five years for repeated chest infections. Intravenous antibiotics were first required in 1981. Three prolonged hospital admissions followed, and by 1984, she had developed peripheral edema and needed therapy with diuretics. Finally, during 1985, she required admission to the hospital for a total of five months. At best, she was able to walk only 30 yards at her own pace because of breathlessness. She was thin (wt = 39 kg; ht = 1.62m) with central cyanosis, finger clubbing and a hyperinflated chest with coarse crackles on auscultation. The jugular venous pressure was raised 4 cm. Her hemoglobin concentration was 14.7 g/dl and her white blood cell count was 12.8 x 10⁹/L. Her heart was seen to be enlarged on chest radiograph and there were multiple ring shadows throughout the lung fields. The electrocardiogram showed right axis deviation and right ventricular hypertrophy. Sputum culture grew Staphylococcus aureus and Pseudomonas maltophilia. Six months before the operation (Table 1) she was hypercapnic and her ventilatory response to carbon dioxide during hyperoxic rebreathing was 0.2 L/min/mm Hg (normal range for our laboratory is 1.1–3.5 L/min/mm Hg).

*Blood gas analysis performed while patient received O₂ via nasal tube at 2 L/min. H+ = hydrogen ion concentration; PaO₂ = partial pressure of arterial oxygen; PaCO₂ = partial pressure of arterial carbon dioxide; Std HCO₃⁻ = standard bicarbonate

Combined heart and lung transplantation was performed in October, 1985. The graft was preserved for 70 minutes before reimplantation. The patient was weaned from assisted ventilation 12 hours after the operation and was breathing air spontaneously after 36 hours. The arterial blood gas tension improved progressively over a period of six weeks. Her ventilatory response to rebreathing CO₂ returned to within our laboratory normal range at 1.6 L/min/mm Hg by six weeks. Her lung fields remained clear on the chest radiographs until her discharge from the hospital after six weeks.

After 16 weeks, she experienced an episode of increased breathlessness associated with a fall in FEV₁. At this time she had a productive cough and purulent sputum. Cultures grew Hemophilus influenzae. She was treated with amoxicillin 500 mg tds and recovered.

**Table 1—Results of Arterial Blood Gas Analyses before and after Operation**

<table>
<thead>
<tr>
<th>Time</th>
<th>H+</th>
<th>PaO₂</th>
<th>PaCO₂</th>
<th>Std HCO₃⁻</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mmol/L</td>
<td>mm Hg</td>
<td>mm Hg</td>
<td>mmol/L</td>
</tr>
<tr>
<td>six months</td>
<td>36</td>
<td>42</td>
<td>50</td>
<td>33</td>
</tr>
<tr>
<td>preoperation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>two hours</td>
<td>37*</td>
<td>76*</td>
<td>55*</td>
<td>34</td>
</tr>
<tr>
<td>preoperation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>two weeks</td>
<td>38</td>
<td>80</td>
<td>49</td>
<td>30</td>
</tr>
<tr>
<td>postoperation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>six weeks</td>
<td>39</td>
<td>94</td>
<td>41</td>
<td>25</td>
</tr>
<tr>
<td>postoperation</td>
<td></td>
<td></td>
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</tbody>
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Successful Heart-Lung Transplantation for CF (Jones, Higenbottam, Wallwork)

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A routine transbronchial biopsy a year later showed normal bronchial mucosa and only one site of perivascular inflammation. Immunosuppressive therapy with cyclosporine (900 mg per day) and azathioprine (85 mg per day) was left unchanged. Sixteen months postoperatively she remains well. She no longer has a cough, is able to run, and has returned to work. There is no cyanosis, the finger clubbing has regressed and she has gained 13 lb in weight. Her maximum rate of oxygen consumption while walking on a treadmill has doubled from 10 ml/kg/min to 24 ml/kg/min.

**Discussion**

This patient was a chronic invalid in respiratory failure requiring prolonged hospital admissions and was clearly in the terminal stages of her disease. Initial post-transplant lung function was excellent despite a 70 minute ischemic time. This was achieved using a single flush preservation system, which had enabled organ procurement from a distant hospital. She now has a near normal lifestyle and her maximum exercise capacity is strikingly improved.

The ventilatory response to CO₂ rebreathing is now normal. The initial blunted response was probably the result of mechanical impairment rather than loss of neural drive. Her arterial Pco₂ did not return to normal level until two weeks after the operation. This probably reflects the time needed to eliminate the increased extracellular bicarbonate (which had been generated when she was in chronic respiratory failure) to act as a buffer for chronic respiratory acidosis.

She experienced one episode of acute bronchitis which was associated with a fall in FEV₁ (Fig 1), but this responded to treatment with broad spectrum antibiotics. She has not developed any symptom or physiologic change to suggest obliterative bronchiolitis, a not uncommon complication of heart-lung transplantation. Indeed, a transbronchial biopsy at 52 weeks showed normal mucosa and only one focus of perivascular infiltration. In our experience, the perivascular infiltration on transbronchial biopsies is much greater in rejection than seen in her biopsies. Heart and lung transplantation is successful in the treatment of pulmonary vascular disease. While it is impossible to predict the future for our patient, heart-lung transplantation appears to offer a step forward in the treatment of the terminal stages of cystic fibrosis.

**References**

2 Jones NL, Campbell EJM. Clinical exercise testing. London: WB Saunders, 1982

**Bilateral Pyopneumothorax Secondary to Intravenous Drug Abuse**

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An intravenous drug abuser presented with bilateral pyopneumothoraces and bacteremia which is a previously unreported complication of jugular vein self-injection. The patient sustained direct pleural trauma and resultant infection by injecting herself with contaminated needles.

**Case Report**

A 28-year-old white woman, a heroin addict, came to the D.C. General Hospital Emergency Room with progressive dyspnea, right-sided chest pain, and fever for four days.

The patient reported injecting heroin into the right and left supraclavicular sites on the evening prior to presentation. She noted no air in the syringe or pain on injection. She often shared needles, and regularly placed the needles in her mouth prior to injection.

On physical examination, the patient was restless and tachypneic. She had dry mucous membranes and appeared to be dehydrated. Her temperature was 37.7°C with a respiratory rate of 27/min. There were multiple fresh and old needle marks in both supraclavicular areas (Fig 1). Breath sounds were decreased at both bases. White blood cell count on admission was 18,100/ml with 77 percent neutrophils and 14 percent bands. Chest roentgenogram demonstrated bilateral pneumothoraces, a prominent right pleural effusion, and blunting of the left costophrenic angle (Fig 2).

Right thoracotomy and tube insertion yielded 1 L of purulent fluid and resulted in immediate re-expansion of the lung. The patient

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**Figure 1. Needle marks in skin adjacent to tips of arrows are visible in both supraclavicular areas.**