

Bilateral pneumonectomy to treat uncontrolled sepsis in a patient awaiting lung transplantation

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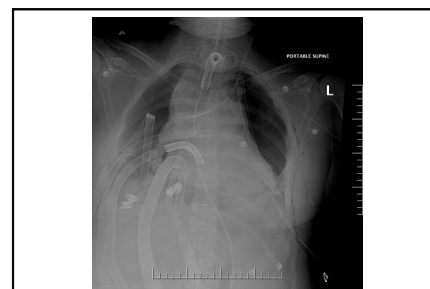
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A 32-year-old woman with advanced cystic fibrosis lung disease was relatively stable on the waiting list for lung transplantation, but contracted H1N1 influenza. She required intubation and mechanical ventilation, but her condition progressively worsened, ultimately necessitating bridging with veno-venous (VV) extracorporeal life support (ECLS). Unfortunately, no donor lungs were available for 10 days. During this time, septic shock developed from Gram-negative bacteremia (*Pseudomonas aeruginosa*) due to worsening lung infection (Figure 1, A).

Despite therapy with broad-spectrum antibiotics and appropriate fluid resuscitation, acute kidney injury developed, requiring high doses of inotropes and vasopressors (norepinephrine 0.5 μ g/kg/minute, vasopressin 6 U/hour, and epinephrine boluses). Maintaining oxygenation was difficult despite 7 L of VV ECLS flow (partial pressure of oxygen in arterial blood, 52 mmHg, partial pressure of carbon dioxide, 50 mmHg; pH 7.19; oxygen saturation, 82%).

The patient's condition continued to worsen, and her prognosis was grim, with survival believed to be measured in hours at this stage. After detailed discussion with the patient's family, and knowing her previously expressed wishes for the most aggressive therapy, we sought source control of her sepsis by performing bilateral pneumonectomy and mechanically bridged her to lung transplantation. To our knowledge, this had never been achieved before.

The operation began with a clamshell incision in the fourth intercostal space. The pericardium was opened and she was placed on central veno-arterial (VA; right atrium to aorta) ECLS at 5 L/minute. The VV ECLS was weaned, and the cannulas were removed. Bilateral pneumonectomy was performed. The main bronchi, pulmonary arteries, and veins were stapled closed, and the pleural spaces were irrigated with saline. The vascular stumps were left extra



A patient with cystic fibrosis after undergoing bilateral pneumonectomy to treat pulmonary septic shock.

Central Message

A patient with cystic fibrosis developed pulmonary-induced septic shock. Bilateral pneumonectomy was performed to remove the septic source. Six days later, a successful lung transplantation was performed.

long for subsequent transplantation. Via the right hilum, a pumpless Novalung device (Xenios, Heilbronn, Germany) was then placed from the right pulmonary artery (28 Fr single-stage venous cannula) to the left atrium via the right superior pulmonary vein (24 Fr right-angled cannula) to provide the “lung” for the remaining flow in the right ventricle to empty into and transfer oxygenated blood to the left atrium. The patient was transferred back to the intensive care unit in this state, with no lungs (Figure 1, B). A diagram of the mechanical support applied to the patient is shown in Figure 2.

Following this procedure, the patient showed almost immediate and dramatic improvement, and we were able to discontinue all vasoactive support before leaving the operating room. Extracorporeal membrane oxygenation flow was maintained at 2.5 to 3 L/minute, and Novalung flows ranged from 1.5 to 2.5 L/minute. ACT was maintained between 160 and 180 seconds.

The patient's condition improved progressively over the next few days. Six days later, we obtained suitable donor lungs and successfully performed the final step in this staged bilateral lung transplantation procedure. The transplantation procedure was uncomplicated. Left lung implantation was followed by decannulation of the Novalung, then right lung implantation. At the end of the procedure, the central VA ECLS was weaned, and patient demonstrated

Case Report

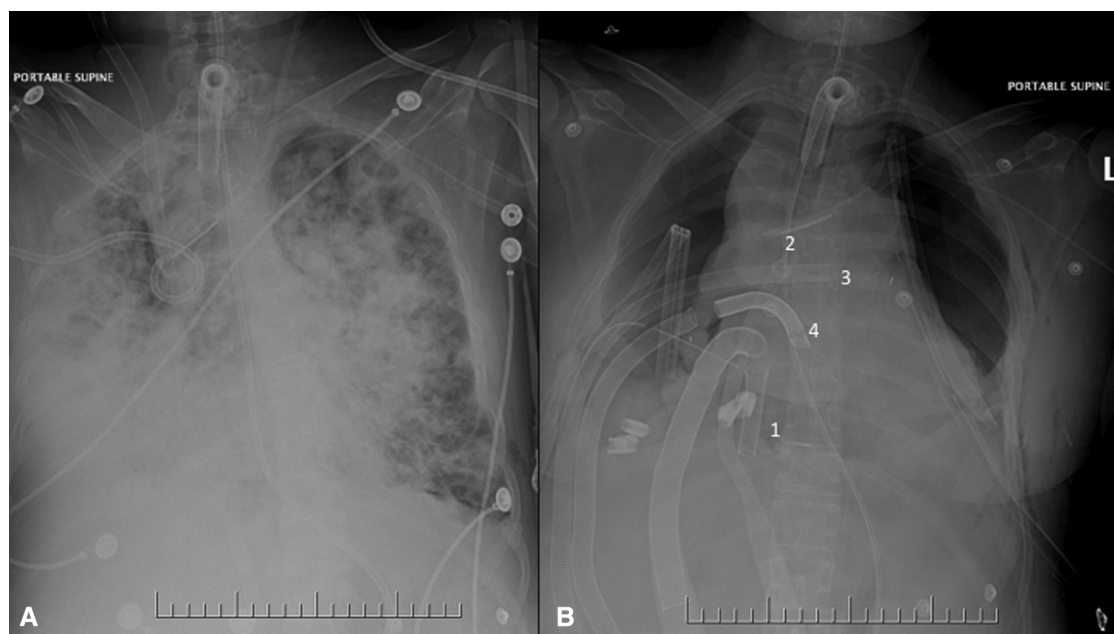


FIGURE 1. A, Severe pneumonia in the background of end-stage cystic fibrosis. B, Patient in the intensive care unit with no lungs for 6 days. 1, Right atrial venous drainage cannula; 2, aortic return cannula; 3, pulmonary arterial cannula; 4, pulmonary vein arterial cannula (left atrial).

excellent hemodynamics and International Society for Heart and Lung Transplantation primary graft dysfunction grade 1. Her chest imaging on ICU arrival is shown in

Figure 3. At 4 months after surgery, although still needing twice-weekly ambulatory dialysis, she was doing very well clinically, fully mobile and breathing normally on room air.

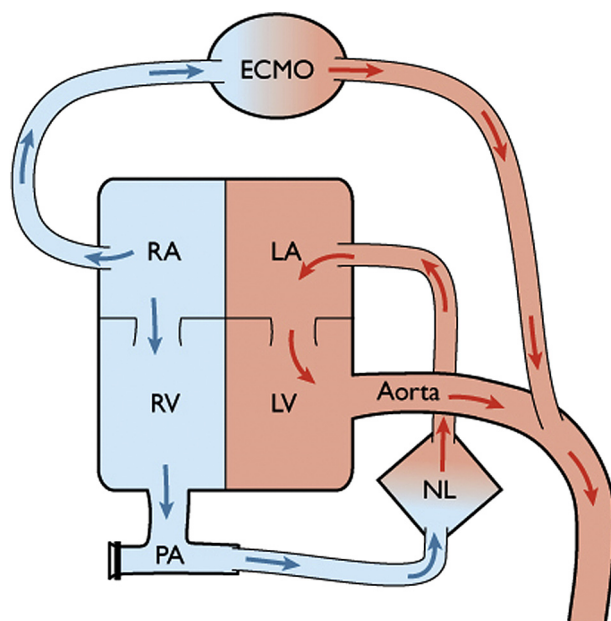


FIGURE 2. Diagram of mechanical support before transplantation in the absence of lungs. Flow is directed from the right ventricle to the aorta in a standard veno-arterial extracorporeal membrane oxygenation configuration. Residual flow passing from the right atrium to the pulmonary artery is then shunted and oxygenated via the Novalung to the left atrium, allowing the right ventricle to provide pulsatility against a low-resistance system. ECMO, Extracorporeal membrane oxygenation; RA, right atrium; LA, left atrium; RV, right ventricle; LV, left ventricle; PA, pulmonary artery; NL, Novalung.

DISCUSSION

Patients with cystic fibrosis are common candidates for ECLS as a bridge to lung transplantation; however, centers bridging these patients have often experienced situations in which pulmonary failure and sepsis eventually develop, precluding subsequent transplantation. With improvements

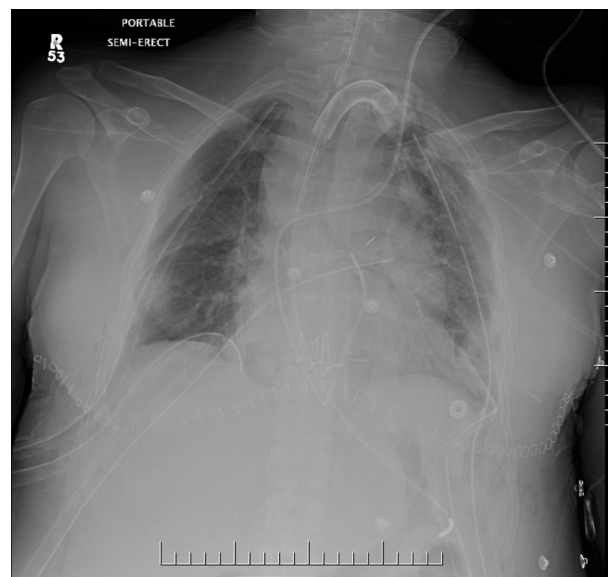


FIGURE 3. Immediate post-bilateral lung transplantation.

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