

Risk of Major Hemorrhage in Bilateral Lung Transplantation for Chronic Thromboembolic Pulmonary Hypertension: A Case Report*

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ABSTRACT

Chronic thromboembolic pulmonary hypertension (CTEPH) is one of the indications for lung transplantation. When patients with CTEPH undergo transplantation, massive bleeding can occur because of severe pleural adhesions and collateral vessels that develop from the thoracic wall to the lungs. However, there has been no previous case report that has discussed the bleeding risk in detail. We report the case of a patient having CTEPH who underwent bilateral lung transplantation with massive blood loss (11,730 mL) in the first operation and required repeat operations for hemostasis. The patient underwent left upper lobectomy because compromised blood flew to the left upper lobe. He recovered from the operations by postoperative day 9; however, he died from pyothorax from an intractable air leak 56 days after transplantation.

Keywords: Lung Transplantation; Chronic Thromboembolic Pulmonary Hypertension; Massive Bleeding; Control

1. Introduction

End-stage peripheral chronic thromboembolic pulmonary hypertension (CTEPH) is a disease for which lung transplantation is indicated. [1] In patients with CTEPH who undergo lung transplantation, thoracic cavity adhesions and collateral angiogenesis from the thoracic wall to the recipient lungs are expected because of the characteristics of the disease. [2] These situations can cause massive bleeding during the lung transplantation procedure. However, there have not yet been any case reports in the literature discussing the volume of bleeding that can occur and the details of how such bleeding can be controlled. A transplant procedure in a patient with CTEPH who underwent bilateral lung transplantation with massive bleeding and needed several additional operations for hemostasis is reported.

2. Case Report

A 28-year-old man was admitted to our hospital for lung

transplantation. He had a history of right pneumothorax beginning at age 21 years, and he was diagnosed with pulmonary hypertension. He received home oxygen therapy and the oral agents beraprost sodium, sildenafil citrate, and warfarin. At age 27 years, his pulmonary hypertension and right heart failure deteriorated, and he began to receive continuous intravenous prostacyclin infusion. He was finally diagnosed with the peripheral type of CTEPH by lung computed tomography (CT, **Figure 1**) and perfusion scintigraphy. After 5 months on the lung waitlist, he underwent bilateral lung transplantation with lungs from a cadaveric donor.

Under general anesthesia, a clamshell incision was made, and bilateral thoracotomy was performed through the 4th intercostal space with transection of the sternum. There were severe adhesions bilaterally. There was also pleural neovascularization at the dorsal parts of the thoracic cavity from the apex of the lungs to the dorsal side of the diaphragm. Dissections of the adhesions, except the dorsal parts, were performed with an ultrasonically activated scalpel. Because of circulatory instability that occurred at mobilization of the lungs, cardiopulmonary bypass (CPB)

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Figure 1. Computed tomography of the patient showing the development of bronchial arteries arising from the aorta (A, arrow) and aberrant arteries from intercostal arteries to the lung (B-D, arrows).

was instituted with a cell saver system. The hilum of the right lung was exposed and divided. Then, the remaining adhesion, the dorsal part, was dissected. Many small arterial and venous bleeding points were observed. Considerable difficulty was encountered with hemostasis. The same procedure was performed on the left side. Bleeding was also severe on the left side, and difficult hemostasis was again encountered. While astriction with a towel was performed for left thoracic wall bleeding, lung implantation was performed in the order of right and left. Although the effort to achieve hemostasis was continued with suture, fibrin glue, Tachocomb® (CSL Behring K.K., Japan), and using argon beam coagulation, it was difficult to obtain complete hemostasis, and the volume of blood loss reached 11,730 mL. Consequently, the patient was transfused with 11,850 mL including 1050 mL of platelet concentrate (PC). To decrease the use of heparin, extracorporeal circulation was changed from CPB to extracorporeal membrane oxygenation (ECMO). It was decided to delay closure of the thoracotomy until after adjustment of the activated coagulation time.

Once the patient returned to the intensive care unit with towel packing, he underwent further transfusion. After rewarming, the patient went back to the operating room; the first re-thoracotomy was performed to control the pleural bleeding on the next day. No bleeding was recognized from the anastomoses. Considerable difficulty

was again encountered in achieving hemostasis of the oozing at the dissection area. The volume of the bleeding reached 11,900 mL, and an immense transfusion volume was needed (total 10,400 mL). Subsequently, the patient was transfused further with recombinant FVIIa (5 mg, 90 µg/kg). Hemostasis with re-thoracotomy was performed twice, including a left upper lobectomy because of ischemia of the lobe with kinking of the pulmonary arteries to the lobe. The volume of bleeding reached 4850 mL in the second re-thoracotomy and 3250 mL in the third re-thoracotomy, and the total transfusion volumes were 4290 mL and 2880 mL, respectively. In addition, recombinant FVIIa was used before and after each re-thoracotomy (5 mg each).

The patient subsequently recovered sufficiently that he could be weaned from ECMO. Dialysis and tracheotomy were required, but he recovered consciousness. Recovery continued such that the patient could start rehabilitation of his extremities at postoperative day (POD) 9. However, late-onset air leakage appeared from a pulmonary fistula of the left lung, because of the marginal donor lung with severe emphysema. Although closure of the air leak was performed on POD 30, the condition deteriorated to pyothorax. The patient underwent fenestration of the left thoracic cavity. However, the infection did not subside, and on POD 56, the patient died of massive hemorrhage from the pyothorax cavity.

3. Discussion

Lung and heart-lung transplantation procedures or patients with CTEPH are often associated with severe bleeding due to the multiple neovascularized pleural adhesions and the development of significant bronchial arterial circulation from the intercostal and bronchial arteries. [3] Neovascularized pleural adhesions are caused by the development of precapillary bronchial-to-pulmonary vascular anastomoses, pulmonary arterial remodeling, and abnormal pulmonary artery vascular reactivity with dysfunction of the pulmonary endothelium [4].

Neovascularity is associated with markers of vascular injury (circulating endothelial cells, soluble E-selectin, and soluble vascular cell adhesion molecules), but not with markers of remodeling (endothelial progenitor cells or vascular endothelial growth factor) [5] with these factors, innumerable neovascular and collateral vessels from bronchial arteries bridge from the thoracic wall to the lungs. During surgery, these abnormal vessels cause extensive bleeding because the vessels become torn off and drawn into the thoracic wall. However, coagulation of these vessels is difficult, for example, with an ultrasonically activated scalpel, during dissection of the adhesions to the dorsal part of the thoracic wall and to the costophrenic angle, because the ultrasonic scalpel cannot reach the vessels at these structures.

Despite the use of CPB, the bleeding could not be controlled. To reduce the bleeding, CPB was started after dissection of the recipient lungs. However, this did not reduce the bleeding, and circulatory instability occurred. In addition, to control the hemostasis, the extracorporeal circulation support was changed from CPB to ECMO. A previous study reported that intraoperative ECMO allows for better periprocedural management, reduces postoperative complications, and confers a survival benefit compared with CPB. [6] When the patient's circulatory condition precludes the use of CPB but not ECMO, one alternative is to use ECMO as the first choice for extracorporeal circulation support to reduce the bleeding volume. In addition, use of a different anticoagulant may be another alternative to reduce the volume of bleeding. A previous case report suggested that, for massive pulmonary hemorrhage, ECMO administration with nafamostat mesilate rather than heparin could reduce the risk of bleeding after lung transplantation [7].

It is important to anticipate and have ready a large

transfusion volume for transplantation in patients with CTEPH. However, it is also important to perform CT before the operation to evaluate the presence of aberrant blood vessels. In addition, it is necessary to carefully consider the indication for transplantation and to prepare for a challenging situation, as in the present case.

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