Pulmonary arterial stent for pulmonary trunk stenosis after size-mismatched lung transplantation

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To the Editor: Appropriate donor-to-recipient size matching is of crucial importance in lung transplantation. Although tailoring of the lung has been described as a successful means of overcoming size disparities, its merits and demerits remain unclear. Here, we present a case of recurrent hypoxemia after unmatched single lung transplantation. The causes of the hypoxemia were right middle lobe resection and the consequential pulmonary trunk stenosis that lead to unbalanced ventilation–blood flow ratio, which was diagnosed by pulmonary angiography and properly treated by the implantation of stents. The diagnostic protocol and treatment experience may have value for future clinical lung transplantations.

We report a case of a 57-year-old male (height, 172 cm; weight, 72 kg) with a 4-year history of pulmonary fibrosis. He received an allocation lung by donation from a brain-dead donor (height, 175 cm; weight, 80 kg) through the China Organ Transplant Response System and underwent a right single lung transplant under extracorporeal membrane oxygenation (ECMO) assistance in March 2018. ECMO and tracheal intubation were successively discontinued on postoperative days 2 and 3, respectively. Nevertheless, 2 weeks after the transplantation, he started to complain of progressive dyspnea. After infectious factors were excluded by chest computed tomography (CT) scanning, bronchoscopy, and laboratory test results, vascular factors were highly suspected. Echocardiography revealed moderate pulmonary hypertension of 52 mmHg. Pulmonary artery CT angiography showed stenosis at the level of the right lower pulmonary trunk [Figure 1A], and a tiny left lower pulmonary artery thrombus. After 2 weeks of adequate anticoagulant therapy (Enoxaparin, 6000 IU, every 12 h), the patient evolved with dyspnea on exertion.

As the symptoms were worsening, the patient underwent further right cardiac catheterization examination and pulmonary angiography, which demonstrated an open anastomosis with severe stenosis of the distal right pulmonary trunk. The right middle lobe and lower lobe pulmonary artery were not clearly shown, whereas there were no other obvious stenoses, occlusions, or filling defects in other branches of the pulmonary artery. Serial balloon dilation was performed first; however, elastic retraction occurred and oxygen saturation could not be maintained above 90%. Stent implantation was postponed, and the patient was reintubated, sent to the intensive care unit, and placed under ECMO for a second time. Three days later, he underwent another pulmonary angiography, which revealed a 90% stenosis of the right pulmonary trunk. Balloon dilation (Aviator 6.0 mm × 20.0 mm, 14 atm) was performed, and two stents (Palmaz Blue 7.0 mm × 18.0 mm, 18 atm; Palmaz Genesis 8.0 mm × 24.0 mm, 20 atm; Johnson&Johnson Interventional Systems, Warren, NJ, USA) were implanted sequentially, one in the pulmonary trunk and the other stretched across the stenotic section. Once again, pulmonary angiography demonstrated residual stenosis of less than 25% of the lumen. The right pulmonary arterial pressure decreased from 70/24 to 35/16 mmHg and then stabilized at approximately 55/20 mmHg. The stents were fixed, and no displacement was observed. Immediately after the procedure, the oxygen saturation of the patient substantially improved; he was extubated in the operation room, and ECMO was removed on postoperative day 3. A follow-up pulmonary artery CT angiography showed two stents in the proper position without an apparent narrowing of the pulmonary trunk [Figure 1B–D]. The patient recovered well and is living a normal life. He is currently under continuous follow-up monitoring at the clinic.

Size-matching between donors and recipients represents one of the organ distribution criteria that is widely

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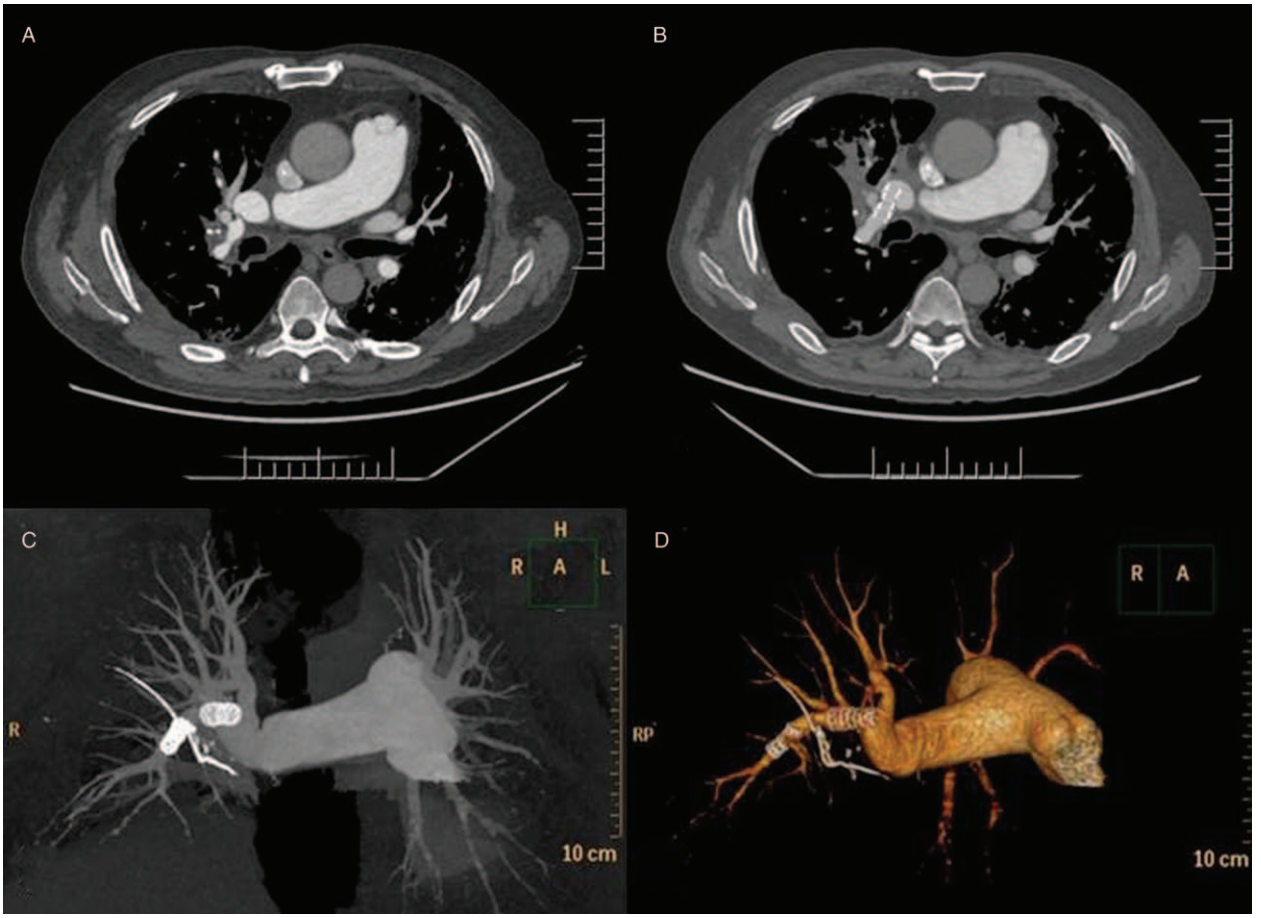

Figure 1: Pulmonary artery computed tomography angiography imaging and three-dimensional reconstruction results. (A) Computed tomography angiography imaging of the recipient showed stenosis at the right lower pulmonary trunk. (B) Computed tomography angiography imaging showed no apparent narrowing after the stents implantation. (C and D) Three-dimensional reconstruction results of the pulmonary artery after the stents implantation (stents and stapled line are highlighted).

accepted by lung transplant teams.[1] It is widely agreed that a lung size-based allocation mechanism, which could be estimated by the predicted total lung capacity, can help reduce the disparities.[2] Nevertheless, "matched" lungs from the donors are sometimes too large for the recipients with end-stage restrictive pulmonary diseases, due to their pathological narrowing of the chest cavity. Surgical procedures such as pulmonary tailoring and lobar transplantation have been advocated to avoid possible complications and improve outcomes.[3] Although indicated to be safe and reliable, with no additional morbidity to those in standard lung transplants, lung volume reduction surgery itself may occasionally lead to serious complications.

Pulmonary trunk stenosis is a rare complication caused by right middle lobe or left lingual segment resection, both of which are common methods for lung volume reduction. In our case, we first ruled out the possibility of infection causing postoperative dyspnea. Echocardiography revealed moderate pulmonary hypertension, which provided a critical diagnostic clue. After excluding the cause of left lower pulmonary artery thrombus by experimental anticoagulation therapy, the main reason for the progressive dyspnea was confirmed by CT and angiography to be pulmonary trunk stenosis. This outcome may have been caused by the following reasons: First, the donor was relatively obese, and the anteroposterior diameter of the donor's lung was longer than average. When the donor lung was implanted into the relatively smaller recipient thoracic cavity and underwent a right middle lobe resection for more proper size-matching, the pulmonary trunk could have been twisted into angles that led to stenosis; second, the bronchial stump of the right middle lobe might have a compression effect on the pulmonary trunk and thereby cause stenosis; finally, the fissure of the donor's lung was insufficient and applying linear-cut stapler devices may lead to curling and angling of the lung tissue, thus aggravating the distortion of the pulmonary trunk.

The treatment strategy is relatively simple. Balloon dilatation and stent implantation are effective methods to resolve the problem herein. One should pay attention to elastic retraction during the procedure. Improper treatment may aggravate the symptoms in a short period of time. In severe cases, such as this one, it is necessary to reintubate the patient, or even to place the patient under ECMO. It should be emphasized that ECMO is playing a much more important role in lung transplantation perioperatively.[4,5] It is also important to design a reasonable mode of stent implantation, including both

number and location. After implantation, it should be observed for a period of time to ensure a fixed position. If the pathogenesis is clear, then oxygen saturation and symptoms should immediately improve.

In conclusion, for pulmonary trunk stenosis caused by right middle lobe resection during donor-lung volume reduction, pulmonary angiography and stent implantation could be reasonable diagnostic and therapeutic methods.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initials will not be published and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflicts of interest

None.

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